Reviewer Report to the Center for Independent Experts on the Red Snapper Review Workshop (SEDAR 31) held April 29-May 3, 2013 in Gulfport, Mississippi

Prepared for:

Center for Independent Experts

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Executive Summary

This document contains my independent reviewer report of review activities and findings for the 31st Southeast Data, Assessment and Review (SEDAR 31) Review Workshop, held April 29 – May 3, 2013 in Gulfport, Mississippi. An assessment for red snapper in USA waters in the Gulf of Mexico, including the results of the data and assessment workshops, were reviewed at the meeting.

There is a very large amount of information available for red snapper, including landings for several directed commercial and recreational fisheries, bycatch estimates for other fisheries, several abundance indices covering different parts of their range for varying periods of time, age and length composition data for most fisheries and indices, and information from which life history parameter estimates, such as age-specific natural mortality, fecundity and growth, can be derived. The data used in the assessment and decisions made about life history were generally sound, although there is evidence indicative of potentially important population structuring that is not really captured in a model with a single stock-recruitment relationship and two sub-stocks (the East and West areas).

The analytical team chose to use Stock Synthesis 3 for this assessment, a decision that seems appropriate given the complexity of the assessment. However, the assessment was not completed prior to the Review Workshop and the Assessment Workshop report provided by for review was not complete or accurate, and the assessment could not be accepted or rejected for these reasons. The analytical team presented work as it was completed at the Review Workshop, and undertook many sensitivity analyses to help with the review of the available results. Based on what would have to be considered a hurried review, although I cannot accept or reject the model, I did not find evidence sufficient to reject the base model results as they pertain to the point estimates of abundance and exploitation. However, I do have concerns about 1) whether the stock-recruitment relationship is representative given the information about population structuring and mixing; 2) whether the methods being used to characterize uncertainty (which were not complete at the end of the Review Workshop) do fully characterize uncertainty both with respect to within the base model run, the uncertainty in the data, and with respect to other possible models; and 3) that the projections (which were also not completed by the end of the workshop) may not fully capture the uncertainty associated the retrospective analysis, potential alternate states of nature and implementation uncertainty. However, the approaches being proposed for the projections and characterization of uncertainty are not inconsistent with standard practices.

This report is one of three Center for Independent Experts (CIE) reviewer reports that are best read together with the Review Workshop Report to get a complete summary of the Review Workshop.

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1.0. Background

This document contains my independent reviewer report of review activities and findings for the 31st Southeast Data, Assessment and Review (SEDAR 31) Review Workshop, held April 29-May 3, 2013 in Gulfport, Mississippi. An assessment for red snapper, including the findings of the data and assessment workshops were reviewed at the meeting. Prior to the meeting, the review committee (Appendix 1) was provided with a Statement of Work (Appendix 2), including the Terms of Reference (TOR) for the assessment as well as for the review panel (RP). Assessment documents and background material (Appendix 3) were provided via a website and/or by email during the three weeks prior to the meeting, although not in accordance with the Schedule of Milestones and Deliverables in the Statement of Work. During the meeting there was a general consensus among the RP regarding most of the main discussion points and findings of the panel as outlined in the Review Workshop Report. This document contains a summary of those findings as well as my own opinions about this assessment.

2.0. Individual Reviewer Activities

Prior to the meeting I reviewed the assessment and background documents provided for the workshop. I participated in the Review Workshop in Gulfport, Mississippi, April 29 – May 3, 2013. This workshop benefited from the participation of fisheries representatives who were able to provide both background and personal experience with respect to red snapper. The analytical team (AT) from the Assessment Workshop presented the assessment results. The structure was fairly informal with discussion during each presentation. During the meeting, I actively participated as member of the meeting review panel and questioned several aspects of the assessment. These issues are expanded upon in the next section.

After the Review Workshop, I prepared this individual, independent report and assisted in writing the Review Workshop Report. As outlined in Appendix 3, this independent report is intended to summarize review activities completed during the panel review meeting, including providing a detailed summary of findings, conclusions, and recommendations for each TOR. The following sections in this document contain my personal perspectives about this assessment and its results.

It should be noted that, although the Data Workshop Report, workshop working papers and background material were provided to the assessment panel in accordance with the Schedule of Milestones and Deliverables in the Statement of Work, the Assessment Workshop Report was provided on Friday, April 26th for review beginning Monday, April 29th. This Assessment Workshop Report had not been reviewed by the Assessment Panel, and did not contain a sufficient description of the model to allow for a thorough review. Sections pertaining to the sensitivity analyses, evaluation of uncertainty, benchmarks and reference points, and projections were missing from the report. On the first day of the Review Workshop, the RP was informed of an error in the implementation of the productivity component of the model, as well a change to the way selectivity had been modeled from that described in the Assessment Workshop Report. The RP was presented with a new base model run via PowerPoint. Descriptions of the model changes, as well as some of the details of the model configuration were provided to the RP verbally during the meeting.

At the end of the Review Workshop, the RP had not seen a complete report documenting the methods and results of the assessment, an issue that significantly hindered both the RP's and my own ability to critically review the assessment. For these reasons, I agree with the RP consensus that the timing with which the Assessment Workshop Report was provided, the adequacy of the documentation, and the completeness of the assessment at the end of the Review Workshop significantly hindered the review process. As a result of these issues, the RP was unable to either accept or reject the assessment, and similarly, although I can provide a perspective about the assessment, I cannot presently endorse the assessment or provide statements about stock status based on the material available at the time of writing this report. My findings are also subject to uncertainty as a result. However, based on what would have to be considered a hurried review, although I cannot accept or reject the model, I did not find evidence sufficient to reject the base model results as they pertain to the point estimates of abundance.

3.0. Summary of Findings, Conclusions and Recommendations in Accordance with the TOR's

3.1. Evaluate the data used in the assessment, addressing the following:

- Are data decisions made by the Data and Assessment Workshops sound and robust?

The data workshop report and supporting working papers thoroughly documented the very large amount of information available for assessing red snapper. The data used in the assessment were divided into life history information, commercial landings, recreational fisheries statistics, measures of population abundance, and discard mortality. In general, I think the data decisions made by the Workshops are sound and robust.

With respect to the life history information, I have some concerns with the conclusions about stock structure, and minor suggestions with respect to the estimation of age-specific natural mortality and the calculation of age-specific fecundity (specifically increased spawning frequency with age).

The Life History Working Group supported the two stock model, and I don't think this is unreasonable given the current state of knowledge. However, given the growing body of evidence, including recent genetic, otolith chemistry and oceanographic results, that indicates that red snapper have a metapopulation structure and exhibit demographic structuring on small spatial scales, I am not convinced that the current model, which may be also viewed as a one stock model with two sub-stocks (East and West) can capture the dynamics sufficiently to ensure that long-term maximum sustainable yield is met, particularly given that some areas are unlikely to be re-colonized by larval drift if depleted and variation in local productivity is unknown. These potential issues are expanded on in the sections on the stock-recruitment relationship, the projections and research recommendations, and are an area for future research.

The Data Workshop considered a few options for deriving age-specific natural mortality (M) estimates, settling on using Hoenig's method to derive a single value of M over the lifespan of the fish, and then re-scaling the Lorenzen relationship such that the average natural mortality rate for the exploited age classes was equal to the lifespan M. Although this approach is not uncommon in stock assessments, as pointed out by one of the other reviewers, the CV for Hoenig

(1983) method estimates of M is 0.54. Also, there are species and population assemblages for which mortality is higher for older/larger animals than for younger/smaller animals, such as Atlantic salmon, (e.g. Gibson et al. 2008) and Scotian Shelf Atlantic cod (Fu et al. 2001). Although I do not have a specific recommendation for an alternate approach, sensitivity analyses that include different functional forms for the age-mortality relationship could be considered in addition to simply higher or lower lifespan values.

Fecundity-at-age for this assessment was estimated using a model that included age-specific number of spawnings per year and batch fecundities (Porch et al. 2013). I think this approach is very reasonable, although it has been demonstrated that increases in fecundity and spawning frequency do not always result in proportionately greater numbers of offspring due to differences in egg size and egg survival, at least in Atlantic salmon (Reid and Chaput 2012). This is also a topic for future research if these relationships are to be further refined.

Commercial and recreational landings were well characterized by the Data Workshop and, with the exception of discards, were unchanged for the Assessment Workshop Report. Historical landings are subject to greater uncertainty, particularly with respect to size and age composition. Discard rates and quantities are also not well known, and the decision to assign higher variances to these data in the model seems appropriate. Bycatch in the shrimp fisheries are not well quantified, and the decision to use the shrimp fishing effort series as an index of the annual bycatch rates in this fishery also seems appropriate, particularly because red snapper are not being targeted. The overall assessment is quite complex, and this is an example of the ingenuity displayed by the workshop participants in finding ways to best quantify the effects of the many activities that affect the stock. Mortality associated with oil rig removal was described in the Data Workshop Report, and was also included in a sensitivity run showing little effect on the overall dynamics of the red snapper stock. As a very minor point, I would have liked to have seen oil rig removals included in the base model, if only to show its effect, although at present levels it doesn't appear that it would alter the conclusions of the assessment.

The Data Workshop Report contains a thorough review of the many fishery dependent and independent indices available for the stock. I did not find evidence that the decisions about which indices to include or the way they were incorporated into the model was inappropriate.

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

Data uncertainties are reasonably described in the Data Workshop Report and supporting working papers. Although personally I would have liked to have seen more detail about the accuracy and precision of the landings data, treating these data as well known is common in stock assessments.

- Are data applied properly within the assessment model?

For the most part, I believe the data are applied reasonably within the assessment model, although there were a few data decisions that would affect the model results. For example, with the exception of the discards, small variances were assigned to the landings forcing the model to fit these data very closely. This is the equivalent of assuming the landings are very well known, despite there being an error in the estimation of the landings (e.g. the recreational landings).

Additionally, initial attempts to fit the model to length composition data were not successful, so the analytical team converted the length composition data to age composition data using age-length keys. While both of these approaches are common in stock assessments, they do have the effect of removing some of the uncertainty from the assessment results. In the case of the length frequency data, some of the sample sizes were small, and the number of animals in each length category was small. As an alternative to converting length composition data to age composition data externally to the model, in my work, I've had some success fitting models by reducing the number of length categories (by using larger length increments), although it's unlikely that this would work in all cases, and I don't know what the effect of this data manipulation would be on the associated uncertainty.

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

Overall, I believe the input data series are reliable and sufficient to support the assessment approach (findings were incomplete at the Review Workshop).

3.2. Evaluate the methods used to assess the stock, accounting for only the available data:

- Are the methods scientifically sound, robust, and appropriate for the available data?

This assessment was carried out using Stock Synthesis 3 (Methot and Service 2011, NOAA Fisheries Toolbox 2011), an assessment package that provides a statistical framework for fitting population dynamics models to fishery and survey data. SS3 is designed to accommodate a wide variety of fishery data types, including length and age compositions, as well as multiple stock sub-areas (two were used in this assessment) and time periods. This assessment software is very flexible with many options for modeling processes such as growth, stock-recruitment, and the selectivity of fisheries and indices. It can also incorporate data uncertainty such as aging error. It is an appropriate tool for this assessment given the complex nature of the fisheries and indices available for this stock.

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

As configured, this is a very complex assessment model. Although many aspects of the assessment model configuration, such as the stock-recruitment relationship, the use of historical data, the incorporation of the length and age composition data, the use of the shrimp effort time series and the random walk for the selectivity parameters, were very well described in the Assessment Workshop Report, other aspects were not. For example, readers of the report were directed to the Stock Synthesis 3 (SS3) manual for descriptions of algorithms and options, but in some cases the selection of these options was not described. For example, I would have liked to have seen a more complete description of the likelihoods used for fitting the model.

Although the stock-recruitment component of the model did appear to be set up consistently with previous assessments and the current management of the stock, as an alternative to the single stock-recruitment relationship for the entire stock, I would have liked to have also seen model configurations that more closely match the newer information about population structuring. As

described by the AT during the Review Workshop, this could be difficult given the current configuration of SS3, particularly with respect to mixing between the two areas. One approach that would work with this configuration would be to run separate models for the east and west areas without mixing. Additionally, if the population structuring is such that re-colonization of depleted areas may be slow, inclusion of a time varying virgin recruitment parameter (for each area and allowing for more than one change through time) might help characterize changes in carrying capacity if some areas are not contributing to production at various points in time for this reason.

Although some aspects of the model configuration were not described in the workshop report, the analytical team provided clear descriptions of many details during the Review Workshop. Although it is difficult to be sure the model was properly configured given the issues described in Section 2 (for example, the analytical team identified an error in the model configuration after providing the Assessment Workshop Report that was not evident when reviewing the Assessment Workshop Report), I did not find evidence during the review that the model configuration was improper or inconsistent with standard practices.

3.3. Evaluate the assessment findings with respect to the following:

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

For the reasons described in Section 2, I agree with the RP consensus that, due to the nature of the review process, it cannot accept or reject the finding of the assessment. However, despite my having some concerns with the assessment, I do concur with the review panel that during the review activities, evidence was not found to reject the assessment or to recommend changes to the corrected base model run with respect to its [point] estimates of abundance and exploitation. However, given the issues with the review process, I cannot fully endorse the results of this assessment. My primary concerns with the assessment relate to: 1) recruitment dynamics and the stock-recruitment relationship, 2) the estimation of the life history parameters, 3) the retrospective analysis, and 4) variances (or relative weightings) used for various datasets. These issues were discussed and explored at the Review Workshop, although I do not believe, in the absence of documentation of the corrected assessment, that a thorough enough review was possible such that I would be willing to recommend that the estimates are reliable enough that they should be used as a basis for management decisions without completion of the assessment documentation, review and endorsement by the Assessment Panel, and possibly further independent review. More specifically, the scenarios explored at the Review Workshop indicated that the model results appeared relatively insensitive to different weightings of the index and age-composition data series, but that they were sensitive to assumptions about the steepness parameter and natural mortality. As a minimum, the effects of these assumed values would need to be carried forward through the assessment before the abundance estimates could be used for making statements of stock status.

During the review meeting, I questioned the extent to which assumptions about life history parameters were determining the results of the assessment. Nearly all of the life history parameters, including natural mortality, growth, weight-length relationships, fecundity, and the

steepness of the stock-recruitment relationship were constants in the model; only the virgin recruitment levels for two time periods were estimated. Because, with the exception of the discards, removals from the population were assumed to be well known (by using a low assumed variance forcing the model to fit the landings well), the model scales the overall abundance up or down using the virgin recruitment parameters, in order to match the indices with adjustments to the estimated selectivities for the various fleets and indices. The RP questioned the extent to which the model was being informed by the data inputs versus the assumptions made when setting up the model, and sensitivity analyses did indicate that the assessment results differed if different values for steepness or natural mortality were used. This is a result that is not uncommon in stock assessment modeling, nor is it necessarily bad if the uncertainties associated with the assumptions are carried forward throughout the remainder of the assessment. Given the time constraints at the RW, appropriate alternative values for steepness sensitivity runs were not discussed. Other issues with the stock-recruitment relationship are discussed under the stock-recruitment TOR.

A retrospective analysis for the corrected base model was provided by the AT during the Review Workshop. As noted in the Review Workshop Report, although the retrospective analysis did not show a systematic bias, it did appear to indicate that the model could provide different abundance estimates with the inclusion of data for additional years. These differences could be important or not, depending on the scale over which abundance changes are being evaluated. On longer time scales, the differences in these estimates are small and would not lead to large differences in conclusions about the depletion of the stock from virgin levels (Figure 1), whereas these differences may be more important on shorter more recent time scales (Figure 2). Also as noted in the RW report, the estimate of the spawning biomass in the west in 2008 in the retrospective analysis increased by more than 50% when estimated using data to 2010. The estimate of 2008 spawning biomass in the west then decreased by about 15% with the inclusion of the 2011 data. Because there is no systematic pattern, there is no simple correction that can be applied. This source of uncertainty could be carried through to the statements about stock status, projections and other management advice.

In summary, although the model estimates appear to be more or less consistent with the indices and data available for the stock based on the model fits, there may be other sets of estimates that would also appear consistent, potentially with different abundance and productivity estimates.

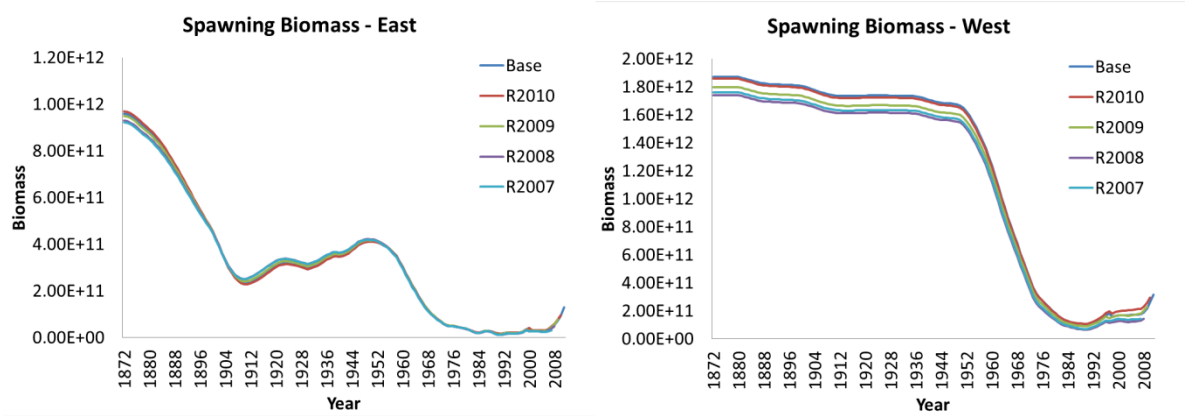

Figure 1. The retrospective analysis of the corrected base model from 1872 to 2011 (from SEDAR31_RW_Retrospectives.pptx – April 30, 2013).

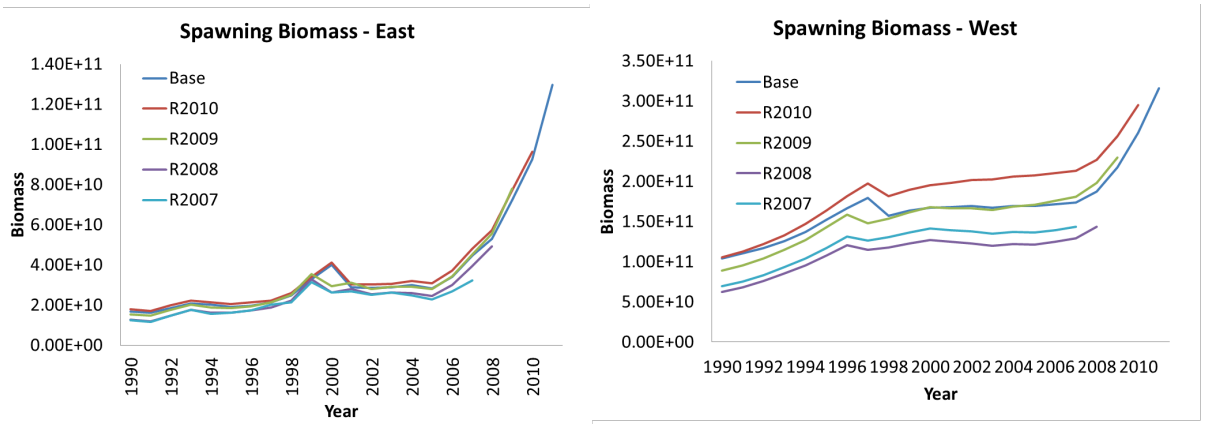

Figure 2. The retrospective analysis of the corrected base model showing the results from 1990 to 2011 (from SEDAR31_RW_Retrospectives.pptx – April 30, 2013).

With respect to the presentation of the fishing mortality rates, the AT presented time series of apical fishing mortality rates, as shown in Figure 3. Because the fleets have different selectivity patterns, these rates are not directly comparable. Additionally, because the selectivity patterns for each fleet are allowed to vary through time, the time series of fishing mortality rates are not really indicative of the overall impacts of the fishery on the stock. As an alternative, these results could be presented as the percent reduction in SPR associated with each fishery in each year. The results would then be presented in a common metric that would allow comparison of the effects both among fleets and through time.

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

Neither criteria for determining whether the stock is overfished or statements of stock status were provided in the Assessment Workshop Report, and although proxies for MSY were discussed at

the Review Workshop, no decisions were reached about the appropriateness of these proxies (comments are provided below under status determination criteria). A comparison of the corrected base model and several sensitivity runs (SensitivitySummaryTable_FINAL.xlsx – May 3, 2013) is indicative that $SSB_{2011}<SSB_{reference}$, based on SPR26% as a proxy for MSY.

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

Neither criteria for determining whether the stock is undergoing overfishing or statements of stock status were provided in the Assessment Workshop report, and although proxies for MSY were discussed at the Review Workshop, no decisions were reached about the appropriateness of these proxies. A comparison of the corrected base model and several sensitivity runs (SensitivitySummaryTable_FINAL.xlsx – May 3, 2013) is indicative that $F_{current}<F_{reference}$, when $F_{current}$ is the 2009-2011 average, based on SPR26% as a proxy for MSY.

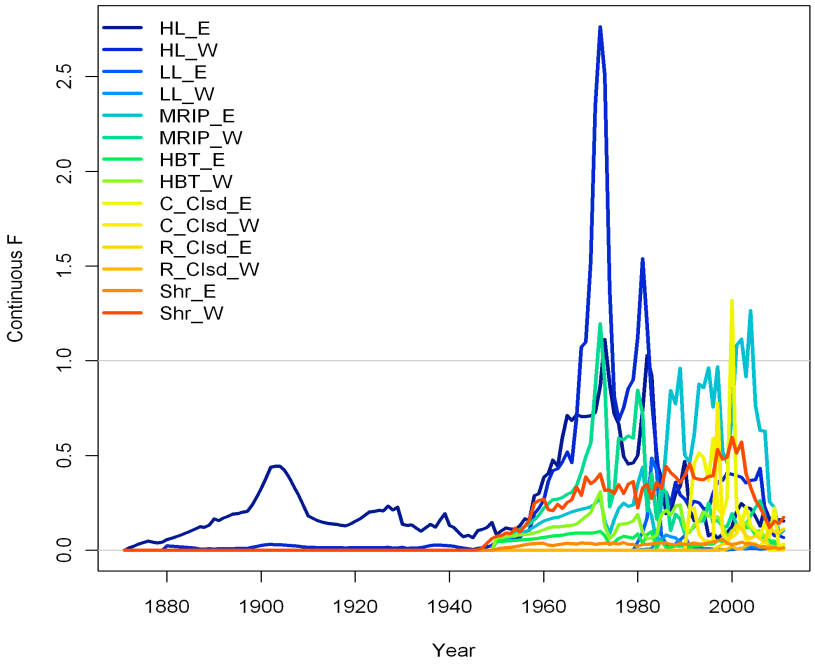

Figure 3. Time series of instantaneous fishing mortality rates for red snapper for the fleets included in the corrected base model (from SEDAR31_RW_BaseResults_4_29_13.ppt).

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

During the review workshop, I questioned whether the stock-recruitment relationship was informative, particularly for the evaluation of productivity in the context of deriving fishery reference points and for projecting future stock conditions outside the range of spawner abundances estimated for the more recent, data-rich time period. My primary concerns relate to the stock's meta-population structure, the extent to which the model may be able to accurately fit a stock-recruitment model given this structure, potential non-stationarity in the relationship, and the spawner abundance range available for estimating the stock-recruitment parameters.

The recruitment dynamic and meta-population structure described in Section 3.1 would be extremely difficult to model and the AT made some simplifying assumptions as a result. The stock-recruitment relationship used in the model was a single stock-recruitment relationship, that included annual deviates in the more recent, data-rich, time period, and that also included a time-varying parameter that distributed the recruits between the East and West areas. The decision to model recruitment in this way was made, at least in part, to match the configuration of SS3, which did not have the capacity to model the stock-recruitment dynamics independently with a low level of mixing between two areas except under a specific set of conditions. With a steepness parameter near one, this model has the capability to model the recruitment of the two stocks as if they were independent demographic units, but at lower steepness values, or if the values differed between the two areas, recruitment to the two stocks would not be independent and potentially this formulation would not work well if a single stock was depleted. Although likelihood profiling of the steepness parameter indicated a steepness value near one (this parameter was fixed at 0.99 for this reason), it was not clear to me that the model would be able to accurately estimate the recruitment dynamics for the two stocks particularly if their respective steepness values differed. I would have preferred to see a stock-recruitment model that better matched the description of the stock structure, or else simulation testing to demonstrate that the model can estimate the dynamics of red snapper in the two areas. As shown via sensitivity analyses at the Assessment Workshop, the assessment results are sensitive to the assumed steepness value.

The stock-recruitment relationship for the more recent time period is shown in Figure 4. As shown in the top panel, the first five years of data are not well fit by this model. I questioned if this was a data issue because the stock-recruitment relationship appears to shift beginning in 1989, one year before the beginning of the commercial discard time series in 1990. The AT explained that a similar pattern was evident in SEDAR 7, which didn't include the discard time series, and that the cause for this apparent shift in recruitment was more likely a signal in the age-frequency data. Additionally, although spawner biomass is highest during 2010 and 2011, these years have lower recruitments relative to other recent years. While there is comparatively little data for estimating recruitment in these two years, together with the earlier shift in the relationship, it is not known whether these represent non-stationarity in the spawner-recruitment relationship due to environmental changes within the Gulf or whether recruitment was lower in these years for some other reason.

As shown in Figure 4 (bottom panel), the range of spawner biomasses available in the recent, data-rich time period is very small relative to the range of spawner biomasses from zero to the

virgin spawner biomass (SSB_0). The estimated SSB_0 from the corrected base model is 4.71e+12 eggs, whereas the model estimated spawner biomasses during this time period range from about 1.21e+11 to about 4.45e+11 eggs. As such, the range of spawner biomasses available to estimate the virgin recruitment spans about 7% of the range from 0 to SSB_0, and all values are towards the lower end of the range (although as shown in the top panel, there are no data below 1.21e+11 eggs either). The AT attempted to address this issue by using historical data to extrapolate back to the inception of the fishery, but this method is also subject to uncertainty (a selectivity pattern is assumed and not all removals from the population are readily accounted for).

For these reasons, I am unconvinced that the stock-recruitment curve is reliable enough to be used for evaluation of productivity and future stock conditions outside the observed spawner biomass range in the more recent, data-rich time period. However, given the use of both recruitment deviates and a time varying parameter to assign recruitment to the two areas, I'm more comfortable that it might be sufficient to characterize recruitment in the more recent time period, in the sense that it might be flexible enough to estimate recent recruitment around a mean value (because the spawner biomass range is so narrow) rather than around a fitted relationship. Therefore, the formulation used may be less of an issue when estimating recent stock size than when projecting outside the range of available data, or when being used as a basis for estimating fishery benchmarks or reference points.

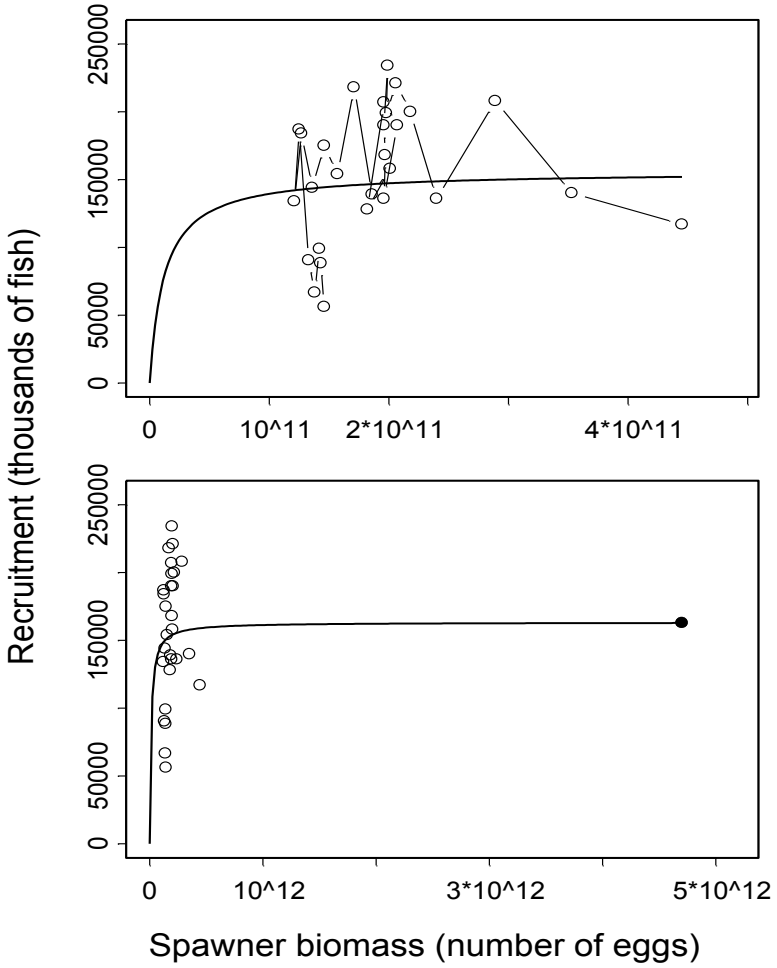

Figure 4. The stock-recruitment relationship for the 1984-2011 time period for the corrected base model presented at the review workshop. The upper panel shows the annual spawner-recruit estimates (points) and fitted relationship (heavy line) on the scale of the biomass estimates. The light line indicates the time series with the 2011 estimates the furthest to the right. The lower panel is similar, but plotted a biomass scale from zero to the virgin spawner biomass (black point). Data are from the model output file SS3-OUTPUT-BaseRun.xlsm provided at the Review Workshop, dated May 2, 2013.

- Are quantitative estimates of 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 status determination criteria were not provided in the Assessment Workshop Report and were not determined during the Review Workshop, although the analytical team did provide information about proxies for MSY midway through the Review Workshop

that were discussed in general terms. As noted in the Review Workshop Report, two topics were discussed: the use of a marginal F when calculating a proxy for MSY and whether a %SPR proxy for MSY should be based on the assumed steepness in the assessment model, or whether some other value should be used.

In general, I agree with the comments in the Review Workshop Report that the use of a marginal F to account for the reality that fishing effort for red snapper for all fleets (e.g. the shrimp fishery effort and closed season effort) is not under direct control, and that proportionally scaling up the fishing mortality for the other fisheries to find the F corresponding to the appropriate %SPR appears reasonable. I also agree with the comments in the Review Workshop Report that, with respect to the suggestion that the percent reduction in SPR should be based on the steepness assumed in the model (thereby using an MSY proxy consistent with the model used to derive the abundance time series, in this case F_{max}), there is not sufficient certainty in the spawner-recruitment relationship to warrant a change from the %SPR values currently being used or from the default value. As discussed, the uncertainty arises from at least four sources: 1) the steepness value is assumed, 2) there is limited contrast in spawner biomass time series for estimating the spawner-recruit parameters, 3) recruitment for the entire stock has decreased during the last 2 years even though spawner abundance has been increasing, and 4) there is evidence of a more complex population structure than is being modeled.

With respect to the question of whether there are other indicators that may be used to inform managers about stock conditions, although I do not have a specific recommendation for a different indicator, I do wonder if using a single indicator of stock conditions for red snapper in the Gulf of Mexico may preclude the rebuilding of depleted portions of the stock if other portions are not in a depleted state, or conversely, may preclude harvesting healthier portions of the stock if other portions are in a depleted state. As discussed in Section 3.1, there are recent genetic otolith chemistry and oceanographic results that show that red snapper have a metapopulation structure and exhibit independent demographic structuring on small spatial scales. Development of indicators of stock conditions on smaller spatial scales that account for this structuring may provide a better guidance about overall production potentially leading to higher long-term yields. Although presently speculative, this type of approach could be tested via simulation prior to being implemented.

3.4. Evaluate the stock projections, addressing the following:

Stock projections were not provided in the Assessment Workshop Report, and only deterministic projections were presented at the Review Workshop.

- Are the methods consistent with accepted practices and available data?

As described at the Review Workshop, the deterministic projections were done using SS3 and therefore would be consistent with the model, its structure, and the most recent abundance estimates. Fishing mortality was changed for the directed fleet only, consistent with the use of marginal F's as status determination criteria. However, because the projections are deterministic they do not reflect the uncertainty associated with the projections and therefore are not (presently) consistent with accepted practices. Stochastic projections were planned but were not completed in time for the Review Workshop.

- Are the methods appropriate for the assessment model and outputs?

As described above, the preliminary results provided at the Review Workshop are appropriate for the assessment model, but they do not incorporate uncertainty in the model output. These results cannot be considered appropriate for the model output for this reason. Again, stochastic projections were planned but were not completed in time for the Review Workshop.

- Are results informative and robust, and useful to support inferences of probable future conditions?

Because the projections are deterministic, they are only informative about the expected outcome in the absence of random variability, errors in the implementation, changes in life history parameters or changes in environmental conditions, a scenario which is unlikely. In order to be useful to support inferences about probable future conditions, I think the projections should incorporate, or minimally be accompanied by a description of the effects of: i) uncertainty in the life history parameters, ii) uncertainty in abundance-at-age in 2011, iii) covariance in model parameters, iv) potential productivity changes or alternate scenarios, and v) implementation uncertainty or alternate scenarios. Productivity changes are included because a single change in virgin recruitment levels is included in the assessment model and the recent recruitment estimates are low (although there are relatively few data contributing to these estimates). Implementation uncertainty is included because the fishing mortality for the six bycatch fleets is set at the 2011 exploitation rates, but is not directly controlled for red snapper. Uncertainty in the 2011 abundance-at-age could include the uncertainty shown in the retrospective analysis described in Section 3.3.

Irrespective of how the projections are carried out, rebuilding timelines will be highly uncertain. Projection results are known to be sensitive to assumed parameter variances and autocorrelations, which are very difficult to estimate. The use of these kinds of projections has been debated in the population viability analysis (PVA) literature. Although some authors have cautioned against the use of PVAs because the predictions, typically time to extinction or recovery, are almost always quite uncertain (e.g. Taylor 1995; McCarthy et al. 1996; Ludwig 1999), many authors believe that PVA's can be used to assess relative risk (e.g. Akçakaya & Raphael 1998; Beissinger & Westphal 1998; McCarthy et al. 2001).

With respect to selecting recovery strategies, McCarthy et al. (2003) used a simulation study and found that they were able to identify the better of two management strategies 67–74% of the time using 10 years of data, and 92–93% of the time with 100 years of data. Reed et al. (2002), argue that these relative evaluations are the most appropriate use of PVAs and can be used as a basis for choosing the most effective management strategy from a given set of possibilities (Lindenmayer & Possingham 1996). Because the projections used in this assessment for red snapper are analogous to PVA's, this is likely the best use of the projections in this assessment and the rebuilding timelines should be considered uncertain.

- Are key uncertainties acknowledged, discussed, and reflected in the projection results?

The projections were not completed in time to be included in the Assessment Workshop Report or to be fully presented and discussed at the Review Workshop. My comments with respect to the key uncertainties are provided above.

3.5. 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

Although the sections of the Assessment Workshop Report pertaining to uncertainty were not completed, the analytical team did provide presentations on the evaluation of uncertainty, including: 1) uncertainty within the base model run (via model parameter standard errors and a parametric bootstrap procedure); 2) uncertainty relating to alternative assumption about life history parameters (specifically natural mortality), 3) uncertainty relating the influence of various data inputs (via different weightings of data), and 4) uncertainty relating to the effects of adding new data on the model results (via the retrospective analysis previously described).

With respect to the uncertainty in the base model run, I agree with the RP comments that: 1) despite having relatively large variances for many of the annual index values, the model was constrained to fit some of the point estimates relatively well, and therefore did not fully capture the uncertainty in these indices; 2) that in this assessment, several of the variance parameters were fixed to values that were assigned subjectively, and 3) these uncertainties would be propagated through the model such that the variances of the estimated parameters would also be subjective. Although this approach is not ideal, it is also not uncommon in stock assessments. Although the AT did evaluate the effect of various data weighting schemes (combinations of variance parameters) on parameter estimates and model output, this approach does not address the effects on estimates of uncertainty associated with these estimates.

The AT presented an example of a Hessian-based, parametric bootstrap based on the original model run provided in the Assessment Workshop Report as conducted in SS3. In carrying out the bootstrap, the original data are not re-sampled, rather a new data set is created with the same variance properties that were assumed when analyzing the original data (Methot and Wetzell *in press*). To ensure that the simulated data sets reasonably approximate the original data, the assigned variance for the input data need to be approximately the same as the variability between the observed and expected values before creating bootstrap data sets (Methot and Wetzell *in press*), although it is unclear that this was undertaken in this example, or that given the small variances assigned to some data series, despite having relatively large standard errors associated with the data, that this approach would appropriately characterize the uncertainty in the model output. A non-parametric bootstrap in which new data sets are generated for the existing data would be expected to better carry forward the uncertainty associated with the data inputs.

The AT did evaluate uncertainty relating to alternative assumptions about natural mortality by running the model with both lower and higher fixed values for age-specific natural mortality, and at my request, did a sensitivity run with a low value of steepness. Biomass estimates appeared more sensitive to changes in these assumed values than they did to changing the relative weighting of various data sets, although these sensitivities were generally done in groups (e.g. the age composition data weighted more heavily than the indices, or vice versa). While it would have been nice to see the effects of individual data sets by fitting to them individually (where possible), I think this model is complex enough that a full exploration of the inputs and

assumptions would be time consuming to the point of being impractical. Additionally, based on discussion at the workshop, SS3 is not currently configured in a way that allows the uncertainty in the assumptions about stock structure and recruitment dynamics to be easily explored, although as described above, I believe this is a potentially important source of uncertainty in this assessment.

- Ensure that the implications of uncertainty in technical conclusions are clearly stated.

This section of the Assessment Workshop Report was not completed for review at the Review Workshop, and technical conclusions from the assessment were not available for review. From my perspective, the implications of uncertainty relating to the states of nature (productivity changes), population structuring, the retrospective analysis and the stock-recruitment relationship are sources of uncertainty that would not be directly captured in bootstrap simulations, status criteria determination, or projections from the base model run.

3.6. Consider the research recommendations provided by the Data and Assessment workshops and make any additional recommendations or prioritizations warranted.

- Clearly denote research and monitoring that could improve the reliability of, and information provided by, future assessments with particular emphasis on the Deepwater Horizon Oil Spill.

As discussed throughout this document, in my opinion a key uncertainty in this assessment is the recruitment dynamics of stock, and more specifically whether considering the stock to be comprised to two or possibly several populations would lead to a better assessment and potentially a higher long-term yield. A second key uncertainty relates to time varying productivity as potentially indicated via the change in the virgin recruitment parameter between the two time periods, in the residual pattern in the recruitment in the recent time period, and the lower recruitments estimated for the last two years. Particularly if some areas can become depleted with slow re-colonization, the virgin recruitment parameter and the recruitment dynamics may be quite variable, and avoiding localized depletion may lead to higher long-term yields. The effects of both population structure and episodic productivity changes on long-term yield could be evaluated via simulation and could help determine whether modifications to the model to include greater degrees population structuring and reproductive isolation, and finer scale regulation based on localized stock status, would improve the assessment.

With respect to research recommendations from the workshops, recommendations were not provided in the Assessment Workshop Report, but several were provided in the Data Workshop Report. I believe the recommendations that include site- and habitat-specific regional comparisons are those that will be most informative about the potential effects of the Deepwater Horizon Oil Spill on status and the assessment, and will also help to inform the modeling recommended above. These specific recommendations are listed below (numbers are from the Data Workshop report). Most the other recommendations are expected to lead to better data and therefore also a better assessment. I also consider discard mortality a research priority.

> 2. Site and habitat specific comparisons from more regions of the Gulf are needed for estimation of age-0 and age-1 mortality, accounting for

shelf characteristics (e.g., width, slope, depth) in tests of density-dependent variation in M and emigration.

3.Broader understanding of habitat value and areal estimates of habitat (distribution—areas of trawlable vs. untrawlable bottom; more refined maps Gulf-wide etc) are needed to further inform the habitat limitation hypothesis for density dependence.

5. Evaluate the potential for sea-bottom restoration or other means to expand habitat and increase survival for post-settlement red snapper.

9. A general recommendation of the LHW is to expand design-based fishery-independent sampling to elucidate regional (i.e., eastern and western GOM) and sub-regional differences in the demographics of red snapper.

13.Additional research is necessary to further clarify regional reproductive and demographic differences.

14. More information is needed to understand movement of young and older adult red snapper across along shore barriers. In particular the LHW recommends a large scale tagging study focused west and east of the Mississippi River.

15. Telemetry versus tagging approaches need to be expanded and evaluated according to shelf characteristics; e.g. cross compared in areas with little natural hard bottom habitat (yet high artificial reefs) versus areas with relatively high areal coverage of hard bottom and with more dispersed artificial reefs.

16. The LHW recommends a workshop or research symposia be convened to synthesize results and assess methodology for estimating red snapper movements and home range.

4. Produce a SEAMAP larval index based on the abundance of red snapper larvae captured during SEAMAP summer shrimp/groundfish surveys (past and present). This survey has for a number of years now been expanded to include the entire northern Gulf of Mexico shelf. I don't need to remind you that the data from summer months (i.e. during peak red snapper spawning months) could be a far better indication of spawning production than data from the end of season from which the current SEAMAP larval index is derived.

5. Explore the utility of a larval red snapper index based on a comprehensive modeling approach that includes all SEAMAP stations (regardless of how many times they have been sampled over the time series) and both sampling gears, i.e. neuston and bongo samples. There are other likely explanatory variables (one for sure is salinity) that could ultimately improve the index.

- Provide recommendations on possible ways to improve the SEDAR process

Overall, based on my experience with this and other SEDAR reviews, I think that the SEDAR process does provide for a thorough review and evaluation of the available data, does provide for thorough consideration and review of analytical approaches and modeling results, does provide very good guidance on the information expected to result from the process (the TOR's are clear, particularly with respect to evaluation of stock status and projections) and does provide very good documentation of the process including decisions made throughout the assessment (for

example, the background documents are an excellent resource and provide information about analyses and data decisions that are sometimes not described in other processes).

At some point, this process fell behind schedule resulting in the analytical team working under a very tight deadline; in their still learning about the model when writing the Assessment Workshop Report (changes to the model were made after the production of the report); and in the production of a report and analytical results that were not complete at the end of the Review Workshop. Even with these issues, although the Review Panel was not able to endorse the results of the assessment due to the uncertainties resulting from the process, it was still able to provide comments on the data and analytical methods and they did not find evidence that the abundance point estimates they had seen should be rejected. That any review was possible speaks to the strength of the SEDAR process (and also to the knowledge, skill and hard work of the analytical team as demonstrated at the Review Workshop). My one recommendation is that in circumstances such as these, the flexibility is built into the process to allow for changes to timelines on relatively short time scales to allow for completion of the work prior to the review. Although I'm sure there are many scheduling considerations of which I'm not aware, my personal preference would have been to see the review meeting postponed until after Assessment Workshop Report was thoroughly completed and reviewed by the Assessment Panel, thereby allowing the Review Workshop to focus on the review rather than the initial presentation of results and descriptions of methods. Had this occurred, I think this assessment had the potential to be excellent.

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

I think a simulation study to evaluate the effects of population structure and mixing would be beneficial prior to the next assessment, particularly in the context of the projections. This is discussed at the start of Section 3.6.

3.8. Prepare a Peer Review Summary Report summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Develop a list of tasks to be completed following the workshop. Complete and submit the Peer Review Summary Report in accordance with the project guidelines.

This TOR is ongoing at the time of writing of this independent reviewer report. Writing tasks for the Peer Review Summary were assigned to the RP members at the meeting and a draft Review Workshop Summary Report has been completed.

4.0. Acknowledgments

Thanks go to Luiz Barbieri for an excellent job in chairing the meeting, particularly for helping the review panel to understand how to deal with the issues arising from the timing with which review materials were provided as well as the completeness of this material. Brian Linton (assessment team lead), Clay Porch, Jakob Tetzlaff and Nancie Cummings presented the assessment and carried out further analysis at the request of the review panel while at the same time that they were working to complete parts of the assessment. It was very clear that they understood the data inputs and the model very well. I also wish to thank the other panel

members, Ben Blount, Jean-Jacques Maguire, Anders Nielsen and Will Patterson for stimulating discussions about the assessment, and Roberto Koeneke for coordinating the review on behalf of CIE and his assistance with travel arrangements. Ryan Rindone provided coordination around the meeting and guidance about the overall SEDAR process.

5.0. References

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6.0. Appendices

Appendix 1: Panel Membership
Appendix 2: CIE Statement of Work
Appendix 3: Bibliography of Materials Provided for Review

Appendix 1: Review Panel Membership.

Review Panel Membership

Luiz Barbieri	Chair	Gulf SSC
Will Patterson	Reviewer	Gulf SSC
Ben Blount	Reviewer	Gulf SSC
Jean-Jacques Maguire	Reviewer	CIE
Jamie Gibson	Reviewer	CIE
Anders Nielsen	Reviewer	CIE

Appendix 2: CIE Statement of Work.

Attachment A: Statement of Work for Dr. Jamie Gibson

SEDAR 31 Gulf of Mexico Red Snapper Review Workshop

BACKGROUND

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 Representative (COR), 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.

SCOPE

Project Description: SEDAR 31 will be a compilation of data, a benchmark assessment of the stock, and an assessment review conducted for Gulf of Mexico red snapper. 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 workshop panel. The review panel is ultimately responsible for ensuring that the best possible assessment is provided through the SEDAR process. The stock assessed through SEDAR 31 is within the jurisdiction of the Gulf of Mexico Fishery Management Council and the state waters of Texas, Louisiana, Mississippi, Alabama, and Florida.

OBJECTIVES

Requirements for the reviewers: Three reviewers shall conduct an impartial and independent peer review of the stock assessments in accordance with the tasks, milestones, and terms of reference (ToRs) of this SoW. The reviewers shall have 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.

Appendix 2: CIE Statement of Work.

PERIOD OF PERFORMANCE

The reviewers shall conduct the tasks according to the schedule of milestones and deliverables as specified in this statement of work (SoW). Each reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein. The tentative schedule of milestones and deliverables is provided herein.

PLACE OF PERFORMANCE AND TRAVEL

Each reviewer shall conduct an independent peer review during a five day panel review meeting scheduled in Gulfport, Mississippi during April 29 through May 3, 2013.

STATEMENT OF TASKS

Each reviewer shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Tasks prior to the meeting: The contractor shall independently select qualified reviewers that do not have conflicts of interest to conduct an independent scientific peer review in accordance with the tasks and ToRs within the SoW. Upon completion of the independent reviewer selection by the contractor's technical team, the contractor shall provide the reviewer information (full name, title, affiliation, country, address, email, and FAX number) to the contractor officer's representative (COR), who will forward this information to the NMFS Project Contact no later than the date specified in the Schedule of Milestones and Deliverables. The contractor shall be responsible for providing the SoW and stock assessment ToRs to each reviewer. The NMFS Project Contact will be responsible for providing the reviewers with the background documents, reports, foreign national security clearance, and other information concerning pertinent meeting arrangements. The NMFS Project Contact will also be 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 COR prior to the commencement of the peer review.

<u>Foreign National Security Clearance</u>: The reviewers shall participate during a panel review meeting at a government facility, and the NMFS Project Contact will be responsible for obtaining the Foreign National Security Clearance approval for the reviewers who are non-US citizens. For this reason, the reviewers shall provide by FAX (not by email) the 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/.

<u>Pre-review Background Documents</u>: Approximately two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the COR the necessary background information and reports (i.e., working papers) for the reviewers

to conduct the peer review, and the COR will forward these to the contractor. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the COR on where to send documents. The reviewers are responsible only for the pre-review documents that are delivered to the contractor in accordance to the SoW scheduled deadlines specified herein. The reviewers shall read all documents deemed as necessary in preparation for the peer review.

Tasks during the panel review meeting: Each reviewer shall conduct the independent peer review in accordance with the SoW and stock assessment ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs shall not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COR and contractor.** Each 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 stock assessment ToRs as specified herein. The NMFS Project Contact will be responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact will also be responsible for ensuring that the Chair understands the contractual role of the reviewers as specified herein. The contractor can contact the COR and NMFS Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

Tasks after the panel review meeting: Each reviewer shall prepare an independent peer review report, and the report shall be formatted as described in **Annex 1**. This report should explain whether each stock assessment ToR was or was not completed successfully during the SEDAR meeting. If any existing BRP or their proxies are considered inappropriate, each independent report shall include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report shall indicate that the existing BRPs are the best available at this time. Additional questions and pertinent information related to the assessment review addressed during the meetings that were not in the ToRs may be included in a separate section at the end of an independent peer review report.

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 at the Gulfport, Mississippi during April 29 – May 3, 2013.
3) Conduct an independent peer review in accordance with the ToRs (**Annex 2**).
4) No later than May 17, 2013, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, 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**.

Appendix 2: CIE Statement of Work.

DELIVERY

Each reviewer shall complete an independent peer review report in accordance with the SoW. Each reviewer shall complete the independent peer review according to required format and content as described in **Annex 1**. Each reviewer shall complete the independent peer review addressing each stock assessment ToR listed in **Annex 2**.

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

March 24, 2013	Contractor sends reviewer contact information to the COR, who then sends this to the NMFS Project Contact
April 14, 2013	NMFS Project Contact provides reviewers the pre-review documents
April 29 – May 3, 2013	Each reviewer participates and conducts an independent peer review during the panel review meeting in Gulfport, Mississippi.
May 17, 2013	Reviewers submit draft independent peer review reports to the contractor's technical team for independent review
May 29, 2013	Contractor submits independent peer review reports to the COR who reviews for compliance with the contract requirements
June 5, 2013	The COR distributes the final reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COR within 10 working days after receipt of all required information of the decision on substitutions. The COR 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 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: The deliverables shall be the final peer review report from each reviewer that satisfies the requirements and terms of reference of this SoW. The contract shall be successfully completed upon the acceptance of the contract deliverables by the COR based on three performance standards:

(1) each report shall be completed with the format and content in accordance with **Annex 1**,
(2) each report shall address each stock assessment ToR listed in **Annex 2**,
(3) each report shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Appendix 2: CIE Statement of Work.

Upon the acceptance of each independent peer review report by the COR, the reports will be distributed to the NMFS Project Contact and pertinent NMFS science director, at which time the reports will be made publicly available through the government's website.

The contractor shall send the final reports in PDF format to the COR, designated to be William Michaels, via email William.Michaels@noaa.gov

Support Personnel:

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Key Personnel:

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Appendix 2: CIE Statement of Work.

Annex 1: Format and Contents of Independent Peer Review Report

1. The independent peer review report shall be prefaced with an Executive Summary providing a concise summary of whether they accept or reject the work that they reviewed, with an explanation of their decision (strengths, weaknesses of the analyses, etc.).

2. The main body of the report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Findings of whether they accept or reject the work that they reviewed, and an explanation of their decisions (strengths, weaknesses of the analyses, etc.) for each ToR, and Conclusions and Recommendations in accordance with the ToRs. For each assessment reviewed, the report should address whether each ToR of the Assessment Workshop was completed successfully. For each ToR, the Independent Review Report should state why that ToR was or was not completed successfully. To make this determination, the SEDAR chair and reviewers should consider whether the work provides a scientifically credible basis for developing fishery management advice.

   a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including a concise summary of whether they accept or reject the work that they reviewed, and explain their decisions (strengths, weaknesses of the analyses, etc.), 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 SEDAR 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 independent report shall be a stand-alone document for others to understand the proceedings and findings of the meeting, regardless of whether or not others read the SEDAR Summary Report. The independent report shall be an independent peer review of each ToR, 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 this Statement of Work
   Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

Appendix 2: CIE Statement of Work.

Annex 2: Terms of Reference

SEDAR 31 Gulf of Mexico Red Snapper Review Workshop

1. Evaluate the data used in the assessment, addressing the following:
   - Are data decisions made by the Data and Assessment Workshops sound and robust?
   - Are data uncertainties acknowledged, reported and within normal or expected levels?
   - Are data applied properly within the assessment model?
   - Are input data series reliable and sufficient to support the assessment approach and findings?
2. Evaluate the methods used to assess the stock, accounting for only the available data:
   - Are the methods scientifically sound, robust, and appropriate for the available data?
   - Are assessment models properly configured and used consistent with standard practices?
3. Evaluate the assessment findings with respect to the following:
   - Are abundance, exploitation, and biomass estimates reliable, consistent with input data and population biological characteristics, and useful to support inferences on stock status?
   - Is the stock overfished? What information helps you reach this conclusion?
   - Is the stock undergoing overfishing? What information helps you reach this conclusion?
   - Is there an informative stock-recruitment relationship? Is the stock-recruitment curve reliable and useful for evaluation of productivity and future stock conditions?
   - Are quantitative estimates of 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, addressing the following:
   - Are the methods consistent with accepted practices and available data?
   - Are the methods appropriate for the assessment model and outputs?
   - Are results informative and robust, and useful to support inferences of probable future conditions?
   - 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.

Appendix 2: CIE Statement of Work.

6. Consider the research recommendations provided by the Data and Assessment workshops and make any additional recommendations or prioritizations warranted.

- Clearly denote research and monitoring that could improve the reliability of, and information provided by, future assessments with particular emphasis on the Deepwater Horizon Oil Spill
- Provide recommendations on possible ways to improve the SEDAR process

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

8. Prepare a Peer Review Summary Report summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Develop a list of tasks to be completed following the workshop. Complete and submit the Peer Review Summary Report in accordance with the project guidelines.

The review panel may not request a new assessment. The review panel may request a limited number of additional sensitivity analyses and evaluations of alternative assumptions, and may correct errors identified in the assessment. Additional details regarding the latitude given to the review panel to deviate from assessments provided by the assessment workshop panel are provided in the SEDAR Guidelines and the SEDAR Review Panel Overview and Instructions.

** The panel shall ensure that corrected estimates are provided by addenda to the assessment report in the event corrections are made, alternate model configurations are recommended, or additional analyses are prepared as a result of review panel findings regarding the TORs above.**

Appendix 2: CIE Statement of Work.

Annex 3: Tentative Agenda

SEDAR 31 Gulf of Mexico Red Snapper Review Workshop

Gulfport, Mississippi during April 29 – May 3, 2013

Monday

1:00 p.m.	**Convene**	
1:00 – 1:30	**Introductions and Opening Remarks**	**Rindone**
	- Agenda Review, TOR, Task Assignments	
1:30 – 5:00	**Assessment Presentations and Discussions**	**Linton, Saul**
5:00 p.m. - 6:00 p.m.	**Panel Work Session**	**Barbieri**

Tuesday

8:00 a.m. – 11:30 a.m.	**Assessment Presentations**	**Linton, Saul**
11:30 a.m. – 1:00 p.m.	**Lunch Break**	
1:00 p.m. – 3:30 p.m.	**Panel Discussion**	**Barbieri**
	- Assessment Data & Methods	
	- Identify additional analyses, sensitivities, corrections	
3:30 p.m. – 3:45 p.m.	**Break**	
3:45 p.m. – 5:00 p.m.	**Panel Discussion**	**Barbieri**
	- Continue deliberations	
	- Review additional analyses	
5:00 p.m. - 6:00 p.m.	**Panel Work Session**	**Barbieri**

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

Wednesday

8:00 a.m. – 11:30 a.m.	**Panel Discussion**	**Barbieri**
	- Review additional analyses, sensitivities	
	- Consensus recommendations and comments	
11:30 a.m. – 1:00 p.m.	**Lunch Break**	
1:00 p.m. – 3:30 p.m.	**Panel Discussion**	**Barbieri**
	- Final sensitivities reviewed.	
	- Projections reviewed.	
3:30 p.m. – 3:45 p.m.	**Break**	
3:45 p.m. – 5:00 p.m.	**Panel Discussion**	**Barbieri**
	- Review Consensus Reports	
5:00 p.m. - 6:00 p.m.	**Panel Work Session**	**Barbieri**

Wednesday Goals: Final sensitivities identified, preferred models selected, projection approaches approved, final results made available. Summary report drafts begun.

Thursday

8:00 a.m. – 11:30 a.m.	**Panel Work Session**	**Barbieri**
11:30 a.m. – 1:00 p.m.	**Lunch Break**	
1:00 p.m. – 3:30 p.m.	**Panel Work Session**	**Barbieri**
3:30 p.m. - 3:45 p.m.	**Break**	
3:45 p.m. - 6:00 p.m.	**Panel Work Session**	**Barbieri**

Thursday Goals: Draft Summary Report reviewed.

Friday

8:00 a.m. – 1:00 p.m.	**Panel Work Session**	**Barbieri**
1:00 p.m.	**ADJOURN**	

Appendix 3: Bibliography of Materials Provided for Review

SEDAR 31- Gulf of Mexico Red Snapper Document List

Document Number	Title	Authors
Data Workshop Documents		
SEDAR31-DW01	Relative abundance of juvenile red snapper, *Lutjanus campechanus* in the northern Gulf of Mexico	Parsons
SEDAR31-DW02	Brief overview on Gulf of Mexico Red Snapper IFQ Program	Stephen
SEDAR31-DW03	Working Paper for Red Snapper Data Workshop (SEDAR 31)	Cowan, Boswell, Simonsen, Saari, and Kulaw
SEDAR31-DW04	Recreational Survey Data for Red snapper in the Gulf of Mexico	Matter
SEDAR31-DW05	Red snapper (*Lutjanus campechanus*) otolith ageing summary for collection years 2009-2011	Allman, Barnett, Trowbridge, Goetz, and Evou
SEDAR31-DW06	An Update to the Age Composition, Growth, and Density-Dependent Mortality in Juvenile Red Snapper Estimated from Observer Data from the Gulf of Mexico Penaeid Shrimp Fishery	Gazey, Gallaway, and Cole
SEDAR31-DW07	Expanded Annual Stock Assessment Survey 2011: Red Snapper Reproduction	Fitzhugh, Lang, and Lyon
SEDAR31-DW08	SEAMAP Reef Fish Video Survey: Relative Indices of Abundance of Red Snapper	Campbell, Rademacher, Felts, Noble, Felts, and Salisbury
SEDAR31-DW09	Index of Abundance for Pre-Fishery Recruit Red Snapper from Florida Headboat Observer Data	O'Hop and Sauls
SEDAR31-DW10	Length frequency distributions for red snappers in the Gulf of Mexico from 1984-2011	Chih
SEDAR31-DW11	A Summary of Data on the Size Distribution and Release Condition of Red Snapper Discards from Recreational Fishery Surveys in the Gulf of Mexico	Sauls
SEDAR31-DW12	A comparison of the size and age of red Snapper, *Lutjanus campechanu*s, to the age of artificial reefs in the northern Gulf of Mexico	Syc and Szedlmayer
SEDAR31-DW13	Use of Ultrasonic Telemetry to Estimate Natural and Fishing Mortality of Red Snapper	Topping and Szedlmayer
SEDAR31-DW14	Fine-scale Movements and Home Ranges of Red Snapper *Lutjanus campechanus* Around Artificial Reefs in the Northern Gulf of Mexico	Piraino and Szedlmayer
SEDAR31-DW15	Spatio-temporal dynamics in red snapper reproduction on the West Florida Shelf, 2008-2011	Lowerre-Barbieri, Crabtree, Switzer, and McMichael
SEDAR31-DW16	Spatial distribution and occurrence of red snapper, *Lutjanus campechanus*, sampled off the Louisiana coast during nearshore trawl sampling efforts	Adriance and Sweda
SEDAR31-DW17	Summary report of the red snapper (Lutjanus	Campbell, Pollack, Henwood,

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	campechanus) catch during the 2011 expanded annual stock assessment (EASA)	Provaznik, and Cook
SEDAR31-DW18	On the comparisons of regional differences in the growth of red snappers from the Gulf of Mexico	Chih
SEDAR31-DW19	Abundance Indices of Red Snapper Collected in NMFS Bottom Longline Surveys in the northern Gulf of Mexico	Ingram and Pollack
SEDAR31-DW20	Red Snapper Abundance Indices from SEAMAP Groundfish Surveys in the Northern Gulf of Mexico	Pollack, Ingram, and Foster
SEDAR31-DW21	Examining delayed mortality in barotrauma afflicted red snapper using acoustic telemetry and hyperbaric experimentation	Stunz and Curtis
SEDAR31-DW22	Release mortality in the red snapper fishery: a synopsis of three decades of research	Campbell, Driggers, and Sauls
SEDAR31-DW23	Release Mortality Estimates for Recreational Hook-and-Line Caught Red Snapper Derived from a Large-Scale Tag-Recapture Study in the Eastern Gulf of Mexico	Sauls
SEDAR31-DW24	Fisheries-independent data for red snapper from reef-fish surveys on the West Florida Shelf, 2008-2011	Switzer, Keenan, and McMichael
SEDAR31-DW25	Estimated Conversion Factors for Adjusting MRFSS Gulf of Mexico Red Snapper Catch Estimates and Variances in 1981-2003 to MRIP Estimates and Variances	Rios, Matter, Walter, Farmer, and Turner
SEDAR31-DW26	Developing a survey methodology for sampling red snapper, *Lutjanus campechanus*, at oil and gas platforms in the northern Gulf of Mexico	Moser, Pollack, Ingram, Gledhill, Henwood, and Driggers
SEDAR31-DW27	Red Snapper (*Lutjanus campechanus*) larval indices of relative abundance from SEAMAP fall plankton surveys, 1986 to 2010	Pollack, Hanisko, Lyczkowski-Shultz, Jones, and Ingram
SEDAR31-DW28	Red Snapper Findings from the NMFS Panama City Laboratory Trap & Camera Fishery-Independent Survey – 2004-2011	DeVries, Ingram, Gardner, and Raley
SEDAR31-DW29	Artificial Structure and Hard-Bottom Spatial Coverage in the Gulf of Mexico	Mueller
SEDAR31-DW30	Shrimp Fishery Bycatch Estimates for Gulf of Mexico Red Snapper, 1972-2011	Linton
SEDAR31-DW31	Calculated red snapper discards in the Gulf of Mexico commercial vertical line and bottom longline fisheries: preliminary results	McCarthy
SEDAR31-DW32	Observer reported size distribution of Gulf of Mexico red snapper from the commercial vertical line and bottom longline fisheries	McCarthy
SEDAR31-DW33	Using a Censored Regression Modeling	Saul and Walter

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	Approach to Standardize Red Snapper Catch per Unit Effort Using Recreational Fishery Data Affected by a Bag Limit	
Assessment Workshop Documents		
SEDAR31-Assessment Workshop01	Headboat Discards for Red Snapper in the Gulf of Mexico	Matter and Walter
SEDAR31-Assessment Workshop02	Accounting for changes in fishing mortality when comparing density-dependent to density-independent mortality in Gulf of Mexico red snapper	Vincent
SEDAR31-Assessment Workshop03	Modeling the dependence of batch fecundity and spawning frequency on size and age for use in stock assessments of red snapper in U.S. Gulf of Mexico waters	Porch, Fitzhugh, and Linton
SEDAR31-Assessment Workshop04	The Effect of Hook Type on Red Snapper Catch	Saul, Walter, Shipp, Powers, and Powers
SEDAR31-Assessment Workshop05	Age Composition of Red Snapper Bycatch in the Gulf of Mexico Shrimp Fishery, 1997-2011	Linton
SEDAR31-Assessment Workshop06	Shrimp trawl index of abundance for Gulf of Mexico red snapper, 1967-1989	Linton
SEDAR31-Assessment Workshop07	Red Snapper Abundance Indices from Combined Bottom Trawl Surveys in the Eastern Gulf of Mexico	Pollack, Ingram, and Henwood
SEDAR31-Assessment Workshop08	A proposed methodology to incorporate ROV length data into red snapper stock assessments	Walter, DeVries, Drymon, Patterson, Powers, and Williams
SEDAR31-Assessment Workshop09	Reconstructed time series of offshore shrimp trawl effort in the Gulf of Mexico from 1945 to 1972 for use in the SEDAR 31 Gulf of Mexico red snapper assessment	Porch
SEDAR31-Assessment Workshop10	Use of the Connectivity Modeling System to estimate movements of red snapper recruits in the northern Gulf of Mexico	Karnauskas, Walter, and Paris
SEDAR31-Assessment Workshop11	Estimating historical recreational angler effort in the Gulf of Mexico for the private, charter, and headboat fishing modes	Rios
SEDAR31-Assessment Workshop12	Estimation of hook selectivity on red snapper (*Lutjanus campechanus*) during a fishery independent survey of natural reefs in the Gulf of Mexico	Pollack, Campbell, and Driggers
SEDAR31-Assessment Workshop13	Dauphin Island Sea Lab Bottom Longline Survey incorporation into the NMFS Bottom Longline Survey	Ingram
SEDAR31-Assessment Workshop14	Combined Index for Florida Fish and Wildlife Research Institute and NMFS Panama City Video Surveys	Ingram

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SEDAR31-Assessment Workshop15	Age frequency distributions estimated with reweighting methods for red snappers in the Gulf of Mexico from 1991 to 2011	Chih
SEDAR31-Assessment Workshop16	Changes in lengths-at-age and size selectivity of red snappers in the Gulf of Mexico from 2002 to 2011	Chih
SEDAR31-Assessment Workshop17	Response to comments on: *Age Composition, Growth and Density-Dependent Mortality in Juvenile Red Snapper Estimated from Observer Data from the Gulf of Mexico Penaeid Shrimp Fishery*	Gazey, Gallaway, and Cole
Review Workshop Documents		
SEDAR31-RW01		
Reference Documents		
SEDAR31-RD01	SEDAR 7 Stock Assessment Report	SEDAR
SEDAR31-RD02	2009 SEDAR 7 Update Assessment Report	SEDAR
SEDAR31-RD03	Red Snapper 2011 Projections Update	SEFSC
SEDAR31-RD04	Estimation of Fisheries Impacts Due to Underwater Explosives Used to Sever and Salvage Oil and Gas Platforms in the U.S. Gulf of Mexico	Minerals Management Service
SEDAR31-RD05	Age Composition, Growth, and Density-Dependent Mortality in Juvenile Red Snapper Estimated from Observer Data from the Gulf of Mexico Penaeid Shrimp Fishery	Gazey, Gallaway, Cole, and Fournier
SEDAR31-RD06	A Life History Review for Red Snapper in the Gulf of Mexico with an Evaluation of the Importance of Offshore Petroleum Platforms and Other Artificial Reefs	Gallaway, Szedlmayer, and Gazey
SEDAR31-RD07	Addressing Time-Varying Catchability	SEDAR
SEDAR31-RD08	Fishery-Independent Catch of Young-of-the-Year Red Snapper in the Texas Territorial Sea, 1985–2007	Dorf and Fisher
SEDAR31-RD09	Red Snapper Management History	GMFMC
SEDAR31-RD10	Home range and movement patterns of red snapper (*Lutjanus campechanus*) on artificial reefs	Topping and Szedlmayer
SEDAR31-RD11	Genetic variation and spatial autocorrelation among young-of-the-year red snapper (*Lutjanus campechanus*) in the northern Gulf of Mexico	Saillant, Bradfield, and Gold

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SEDAR31-RD12	Determining policy-efficient management strategies in fisheries using data envelopment analysis (DEA)	Griffin and Woodward
SEDAR31-RD13	Red Snapper Larval Transport in the Northern Gulf of Mexico	Johnson, Perry, Lyczkowski-Shultz, and Hanisko
SEDAR31-RD14	Estimation of the Source of Red Snapper Recruits to West Florida and South Texas with Otolith Chemistry: Implications for Stock Structure and Management	Patterson, Cowan, Barnett, and Sluis
SEDAR31-RD15	Trends in Gulf of Mexico Red Snapper Population Dynamics, 1979-85	Parrack and McClellan
SEDAR31-RD16	Effects of habitat complexity and predator exclusion on the abundance of juvenile red snapper	Piko and Szedlmayer
SEDAR31-RD17	Survival and movement of hatchery-reared red snapper on artificial habitats in the northern Gulf of Mexico	Chapin, Szedlmayer, and Phelps
SEDAR31-RD18	A Life History Review for Red Snapper in the Gulf of Mexico with an Evaluation of the Importance of Offshore Petroleum Platforms and Other Artificial Reefs	Gallaway, Szedlmayer, and Gazey
SEDAR31-RD19	The use of otolith shape analysis for ageing juvenile red snapper, *Lutjanus campechanus*	Beyer and Szedlmayer
SEDAR31-RD20	Validation of annual periodicity in otoliths of red snapper, *Lutjanus campechanus*	Szedlmayer and Beyer
SEDAR31-RD21	The Artificial Habitat as an Accessory for Improving Estimates of Juvenile Reef Fish Abundance in Fishery Management	Szedlmayer
SEDAR31-RD22	Home range and movement patterns of red snapper (*Lutjanus campechanus*) on artificial reefs	Topping and Szedlmayer
SEDAR31-RD23	Site fidelity, residence time and movements of red snapper *Lutjanus campechanus* estimated with long-term acoustic monitoring	Topping and Szedlmayer
SEDAR31-RD24	Proximity Effects of Larger Resident Fishes on Recruitment of Age-0 Red Snapper in the Northern Gulf of Mexico	Mudrak and Szedlmayer
SEDAR31-RD25	Estimates of Historic Recreational Landings of Spanish Mackerel in the South Atlantic Using the FHWAR Census Method	Brennan and Fitzpatrick

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SEDAR31-RD26	Declining Size at Age Among Red Snapper in the Northern Gulf of Mexico off Louisiana, USA: Recovery or Collapse?	Nieland, Wilson, and Fischer
SEDAR31-RD27	Examination of Red Snapper Fisheries Ecology on the Northwest Florida Shelf (FWC-08304): Final Report	Patterson, Tarnecki, and Neese
SEDAR31-RD28	Site Fidelity, Movement, and Growth of Red Snapper: Implications for Artificial Reef Management	Strelcheck, Cowan, and Patterson
SEDAR31-RD29	Factors Affecting Catch and Release (CAR) Mortality in Fish: Insight into CAR Mortality in Red Snapper and the Influence of Catastrophic Decompression	Rummer
SEDAR31-RD30	Effect of Circle Hook Size on Reef Fish Catch Rates, Species Composition, and Selectivity in the Northern Gulf of Mexico Recreational Fishery	Patterson, Porch, Tarnecki, and Strelcheck
SEDAR31-RD31	Effect of trawling on juvenile red snapper (*Lutjanus campechanus*) habitat selection and life history parameters	Wells, Cowan, Patterson, and Walters
SEDAR31-RD32	Habitat use and the effect of shrimp trawling on fish and invertebrate communities over the northern Gulf of Mexico continental shelf	Wells, Cowan, and Patterson
SEDAR31-RD33	Site Fidelity and Movement of Reef Fishes Tagged at Unreported Artificial Reef Sites off NW Florida	Addis, Patterson, and Dance
SEDAR31-RD34	Fish Community and Trophic Structure at Artificial Reef Sites in the Northeastern Gulf of Mexico	Dance, Patterson, and Addis
SEDAR31-RD35	A Review of Movement in Gulf of Mexico Red Snapper: Implications for Population Structure	Patterson
SEDAR31-RD36	Size selectivity of sampling gears targeting red snapper in the northern Gulf of Mexico	Wells, Boswell, Cowan, and Patterson
SEDAR31-RD37	Delineating Juvenile Red Snapper Habitat on the Northern Gulf of Mexico Continental Shelf	Patterson, Wilson, Bentley, Cowan, Henwood, Allen, and Dufrene
SEDAR31-RD38	Habitat- and Region-Specific Reproductive Biology of Female Red Snapper (*Lutjanus campechanus*) in the Gulf of Mexico	Kulaw
SEDAR31-RD39	Comparison of the Age and Growth of Red Snapper (*Lutjanus campechanus*) Amongst Habitats and Regions in the Gulf of Mexico	Saari

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SEDAR31-RD40	Oil Platforms and Red Snapper Movement and Behavior	McDonough
SEDAR31-RD41	Reconstructed time series of shrimp trawl effort in the Gulf of Mexico and the associated bycatch of red snapper from 1948 to 1972	Porch and Turner
SEDAR31-RD42	Individual-based modeling of an artificial reef fish community: Effects of habitat quantity and degree of refuge	Campbell, Rose, Boswell, and Cowan
SEDAR31-RD43	Literature Search and Data Synthesis of Biological Information for Use in Management Decisions Concerning Decommissioning of Offshore Oil and Gas Structures in the Gulf of Mexico	Versar, Inc.
SEDAR31-RD44	The Environmental Effects of Underwater Explosions with Methods to Mitigate Impacts	Keevin and Hempen
SEDAR31-RD45	Connections between Campeche Bank and Red Snapper Populations in the Gulf of Mexico via modeled larval transport	Johnson, Perry, and Lyczkowski-Shultz
SEDAR31-RD46	The commercial landings of red snapper in the Gulf of Mexico from 1872 to 1962	Porch, Turner, and Schirripa
SEDAR31-RD47	Estimates of Historical Red Snapper Recreational Catch Levels Using US Census Data and Recreational Survey Information	Scott
SEDAR31-RD48	MRFSS/MRIP Calibration Workshop: Ad-hoc Working Group Report	Salz, Miller, Williams, Walter, Drew, and Bray
SEDAR31-RD49	Survival of Red Grouper (*Epinephelus morio*) and Red Snapper (*Lutjanus campechanus*) Caught on J-Hooks and Circle Hooks in the Florida Recreational and Recreational-for-Hire Fisheries	Burns and Froeschke
SEDAR31-RD50	Circle Hook Requirements in the Gulf of Mexico: Application in Recreational Fisheries and Effectiveness for Conservation of Reef Fishes	Sauls and Ayala