Center for Independent Experts Independent Peer Review of the Gulf of Mexico Red Snapper Assessment (SEDAR 74)

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Executive Summary

The Research Track Peer Review Workshop for Gulf of Mexico Red Snapper was held in Tampa during December 12th- 15th, 2023. The assessment model proposed by the Assessment Team was built using version 3 of Stock Synthesis, an age-structured model that was capable of utilizing length and age-based inputs, as well as handling some aspects of population dynamics in either age or length-based forms, such as selectivity, maturity, as well as others.

This was an overly complex model, with three areas, 18 fleets, 21 different indices, and over 2,000 parameters. Data inputs were equally complex, with multiple fishery-dependent and independent indices, retention functions, selectivity functions, and the Great Red Snapper Count.

Several issues with the proposed model were noted, including the use of a three-area model without adequate data support, use of raw/unscaled data, lack of age-based data, inclusion of the Great Red Snapper Count, lack of adequate diagnostics/sensitivities, and many others. Of these issues, the use of unscaled length and age frequencies, the exclusion of age composition data, and the absence of crucial diagnostics and sensitivity analyses suggest that the proposed model is not ready to move to the Operational Assessment phase or provide management advice without more work.

Because these issues were not able to be resolved in the limited time set aside for the Review Workshop, detailed and hopefully clear recommendations were made. Some of these recommendations not only focus on the current proposed assessment but can be taken more generally for the overall process.

Background

Introduction

The Research Track Peer Review Workshop was held in Tampa FL, from December 12th- 15th, 2023. This was an in-person meeting held at the Gulf of Mexico Fishery Management Council office. Reviewers included three external contractors from CIE and four members of the Gulf Council Science and Statistical Committee, including Chair Jim Nance.

Stock Structure and Life History

Red Snapper (*Lutjanus campechanus*) is a long-lived but highly fecund and productive species found from the Carolinas on the US east coast through the Gulf of Mexico and the Caribbean to South America. Red Snapper is generally found between 3 and 200 m, with juveniles shallower than older fish (Allen 1985).

As outlined in Figure 1, the proposed assessment utilized three separate areas Western, Central, and Eastern. The max age used in the assessment was 57 years population wide. There was only a small (0.6y) difference in mean age, but there were some differences in growth among areas, with faster growth in Eastern and Central areas when compared to the Western area. Little is known about the possible mixing with the adjacent population presumably in Mexican waters. Previous to this proposed assessment, Red Snapper in the Gulf of Mexico has been assessed using a two-area model, though all management has been on the assumed unit stock.

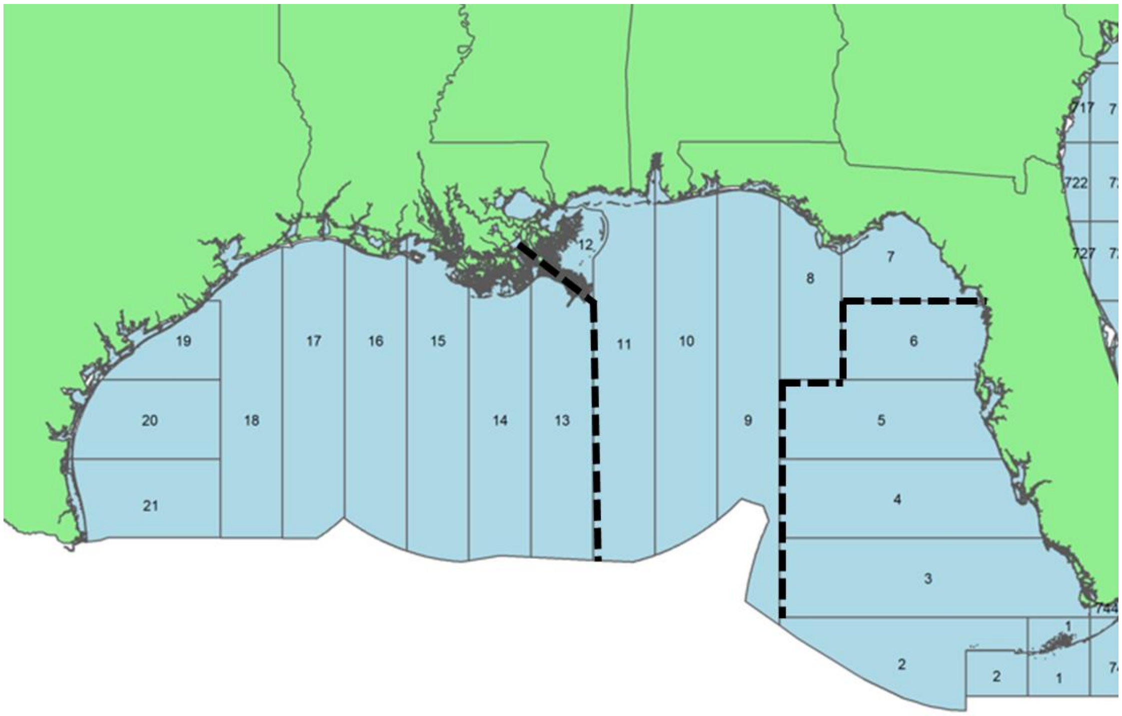

Figure 1: National Marine Fisheries Service (NMFS) fishing area in the Gulf of Mexico, divided into 23 statistical fishing zones. Thick black dashed lines indicate stock boundaries used for SEDAR 74: statistical zone 12/13- Mississippi River outflow, zone 9/10 - De Soto Canyon, zone 7/8 - Cape San Blas, and zone 7/6 - Big Bend. From Figure 2 of the assessment document.

Natural morality was estimated outside the model using a combination of different estimates (Then et al. 2015, Lorenzen 2000), producing natural mortality near 2.0 /yr at young ages, but then quickly reduced to > 0.2 /yr and finally declining to 0.1 /yr by age 12 (Figure 2). Maturity at age was similar in the Eastern and Central regions (M_{A50} = 1.95 yr) but was elevated in the Western area (M_{A50} = 2.47 yr)

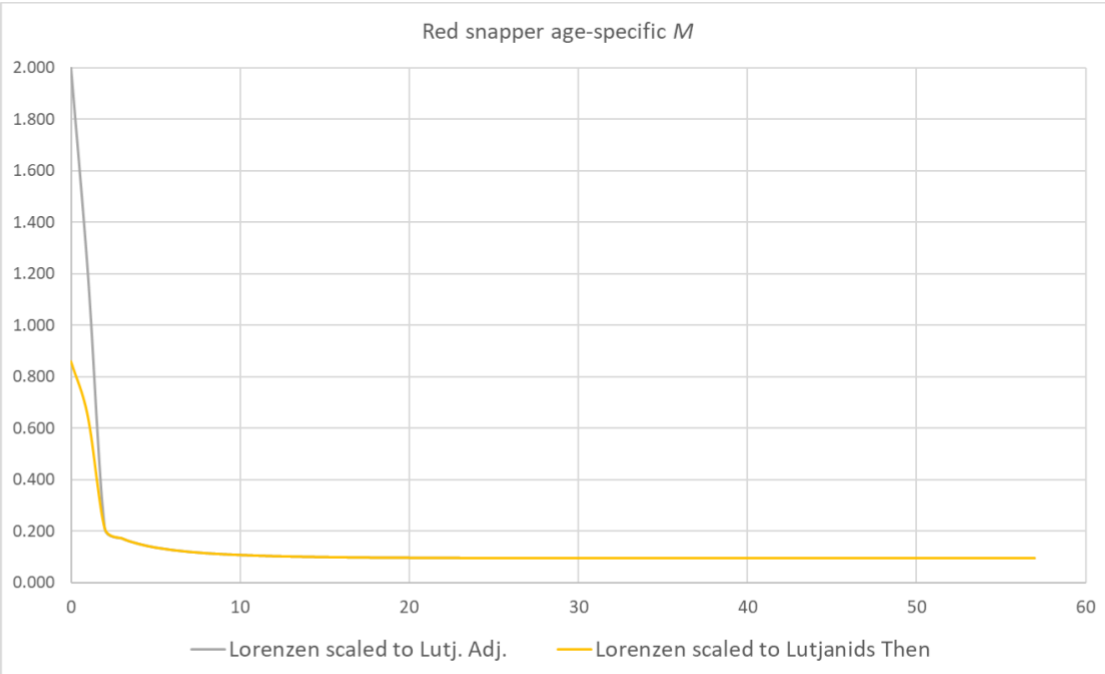

Figure 2: Natural mortality used in the proposed assessment. From Day 1 presentation at the Review Workshop.

Data

Data elements are shown in Figure 3 (some sources not shown). Overall, there were 21 different indices of abundance including, video surveys, longline surveys, the SEAMAP bottom trawl surveys, fishery-dependent indices via the shrimp bycatch trawl, fishery-dependent CPUE indices via at-sea observer data, and a single year of the Great Red Snapper Count (GRSC). GRSC states performed acoustic/video and other surveys to capture the true abundance of Red Snapper in absolute terms.

There were also 18 fleets within the proposed model (Figure 3) including fleets of commercial vessels fishing hand line and long line gear, recreational private, charter, and headboat fleets, and a series of discard fleets associated with the directed fleets. Each of these fleets often had complicated selectivity and retention functions.

Age data were rather sparse in the proposed assessment, with age compositions only being available from the Central longline survey and the SEAMAP Central and Western Fall Bottom trawl, post 2007. Such limited use of age data is curious in an age-based modeling approach. All of the other data included in the model were length-based, where composition data were available from multiple fleets and surveys (Figure 3).

Despite a rather old maximum age (57), a plus group was imposed on fish greater than 20 (i.e., there was a 20+ group). One oddity found in the documentation and discussed at the review was the decision to only present and model using the raw age and length compositions. This means that the length and age compositions were not scaled to the fleet or survey catches before input into the model.

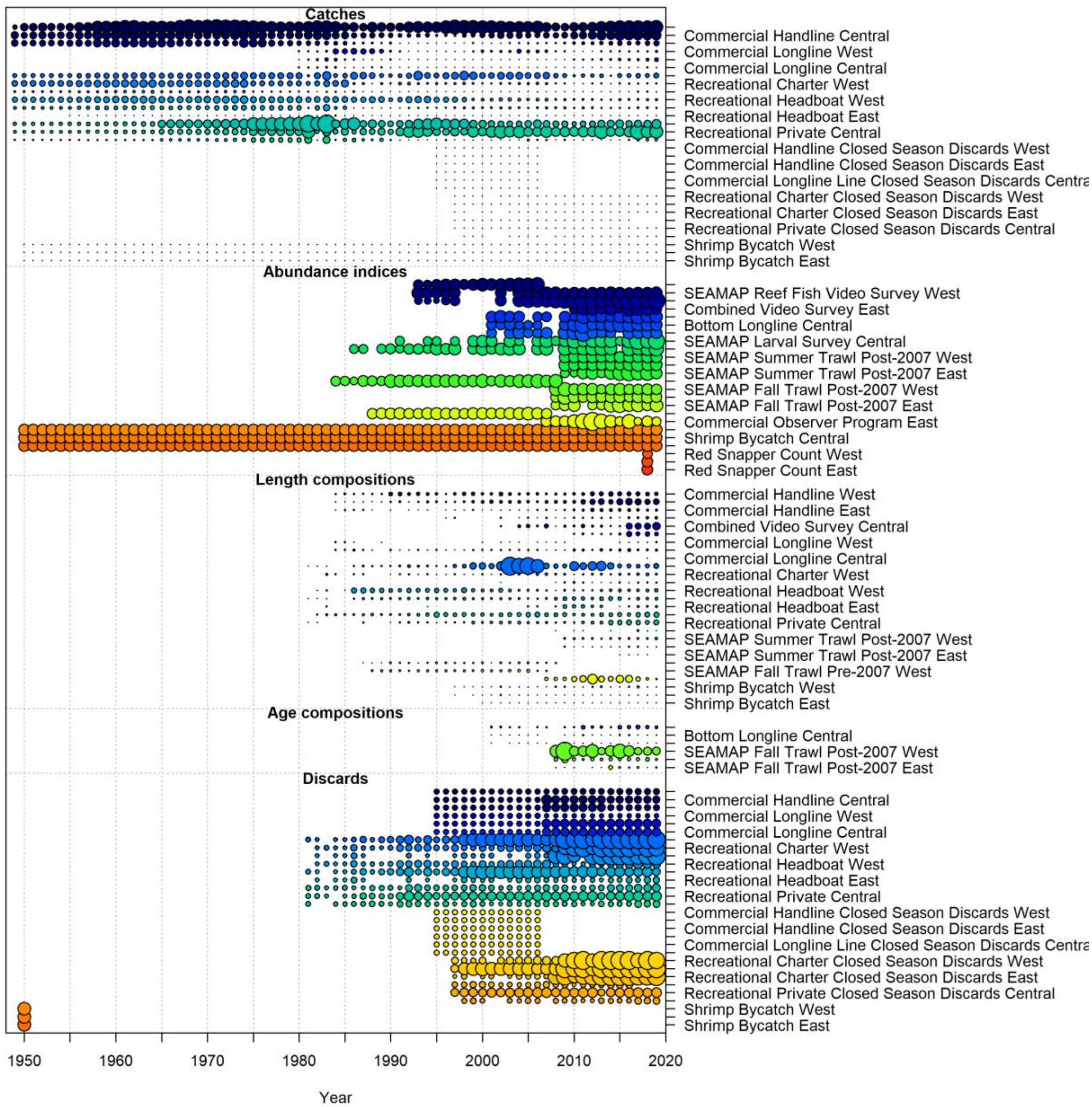

Figure 3: Data sources used in the Gulf of Mexico Red Snapper Stock Synthesis assessment model. Circle area is relative within a data type. Circles are proportional to total catch for catches; to precision for indices, discards, and mean body weight observations; and to total sample size for compositions and mean weight- or length-at-age observations. Note that since the circles are scaled relative to maximum within each type, the scaling between separate data types should not be compared. Due to the number of data sources used in this assessment, some labels may be missing. From Figure 1 of the assessment report.

Description of the model

Briefly, the proposed model was constructed using the age-based Stock Synthesis version 3.30.20, which uses maximum-likelihood estimation. The model was initialized in 1950 for Gulf Red Snapper through 2019 and consisted of three areas (discussed above). Growth in the model was fixed outside the model (rather than estimated within the model) by area. There were no sex-specific differences in maturity or growth factored in, but there were changes in maturity by area as noted above within the model.

Recruitment was modeled as one relationship across all the areas but then apportioned by area inside the model. Recruitment was modeled with a steepness fixed at 0.99 for the Beverton-Holt function, "out of convenience". A curious decision was made to not constrain the recruitment deviations to sum to zero, which resulted in increased deviations over time by the model, likely increasing convergence but effectively telling the model that a regime shift in productivity was underway (Figure 4).

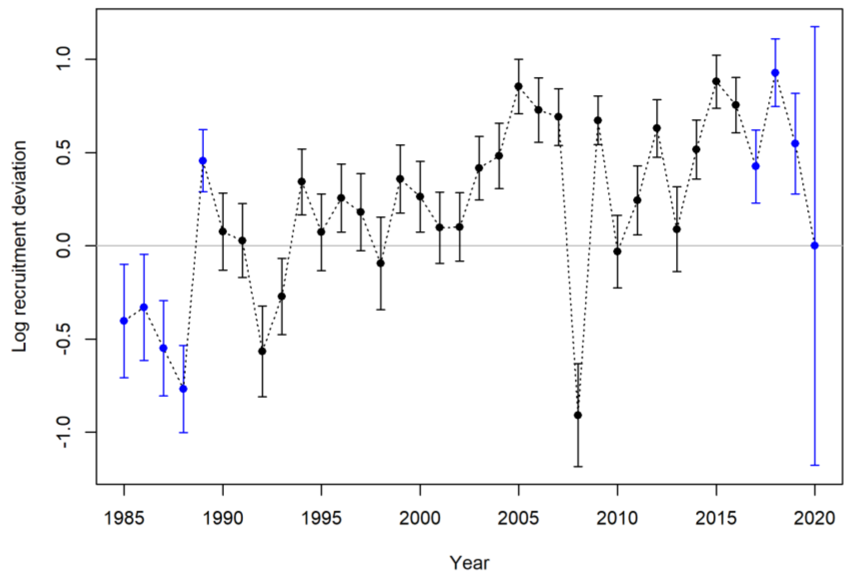

Figure 4: Estimated log recruitment deviations for Gulf of Mexico Red Snapper (steepness and SigmaR were fixed at 0.99 and 0.6, respectively). From Figure 126 of the assessment report.

The Team used time blocks for fleet selectivity rather than estimating time-varying selectivity that is fixed or that changes more than three times over the model period. The blocks consisted of

- Commercial: 1950-1992, 1993-2006 and 2007-2019
- Recreational: 1950-1994, 1995-2006 and 2007-2019

Selectivity blocks were based on a rather detailed examination of management given in the report. Selectivity by fleet was estimated within those blocks either using a logistic or double normal, based on the gear type used by the fleet.

Retention was modeled as a length function with blocks similar to selectivity.

- Commercial: 1950 - 1984, 1985 - 1994, 1995 - 2006, 2007 - 2019
- Recreational: 1950 - 1989, 1990 - 1994, 1995 - 1998, 1999 - 1999, 2000 – 2019

As noted earlier, a total of 21 indices were used. For all of these indices, the CV was scaled to a mean of 0.2 to equally weigh them within the model, despite their varying precision. The proposed model utilized the GRSC giving it a catchability of 1 (i.e., q =1.0) despite some evidence to the contrary.

Model results in terms of SSB and depletion are shown in Figure 5. Overall, the proposed model shows a decline in the SSB in the 1960s through the early 80s followed by rather stagnant or slow growth through the 2000s with an increase in SSB fairly rapidly from the late 2000s through 2020. However, it should be noted that there are several issues associated with the proposed model that render conclusions based on it suspect.

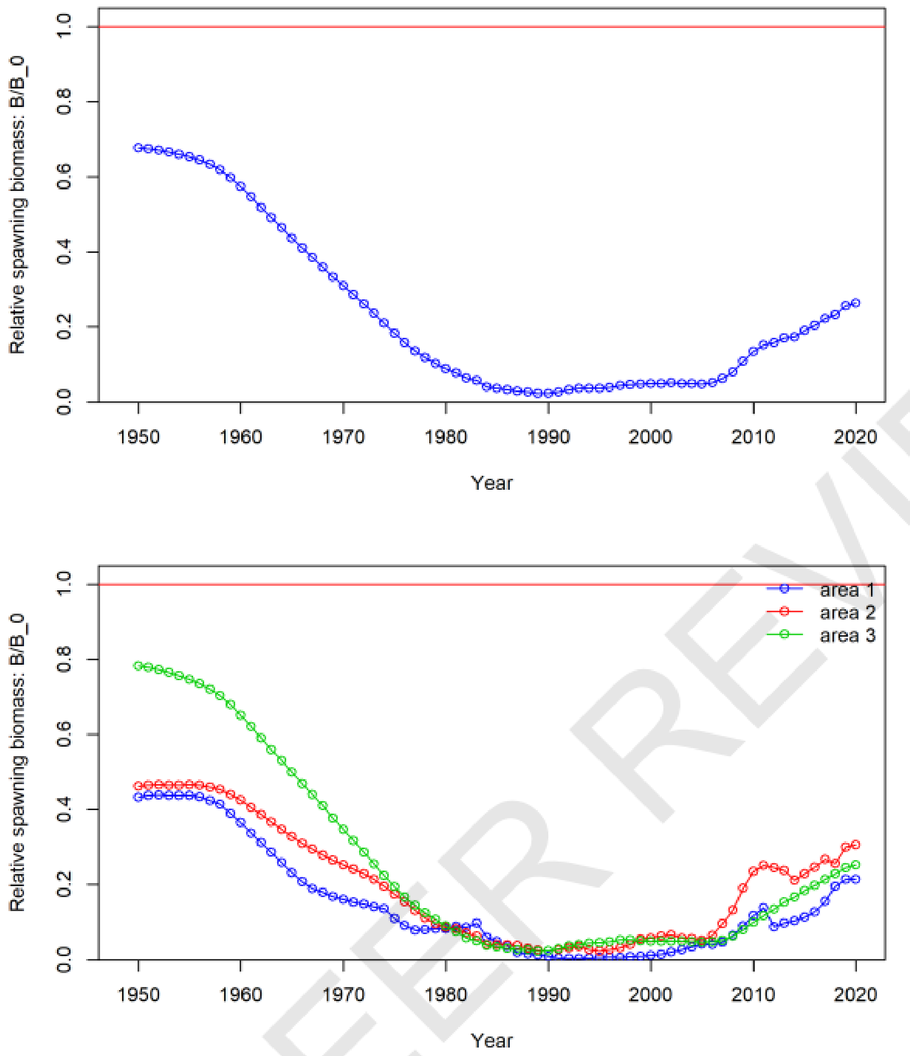

Figure 5: Estimates of the fraction of unfished SSB (SSB/SSB0) for Gulf of Mexico Red Snapper and by area with the blue, red, and green lines representing the east, central, and west areas respectively. From the assessment report Figure 132.

Parameter uncertainty was addressed through asymptotic SEs derived from the inverted Hessian matrix post-model fitting, a departure from regional approaches employing MCMC or Monte Carlo Bootstrapping (MCB). However, the error estimates derived from asymptotic SEs represent an underestimate of model uncertainty.

Although certain sensitivities were examined, such as those related to time- and spatially-varying maturity, the Great Red Snapper Count (GRSC) Estimate, and selectivity, a comprehensive suite of sensitivities was deferred to the Operational Assessment due to time and resource constraints. While this decision is understandable, it means that essential sensitivities were not analyzed, including those related to natural mortality, steepness, and index weight within the model. These sensitivities play a crucial role in understanding model behavior and mitigating the risk of misspecification.

Issues

Many issues, some of which were considered major problems, were uncovered both before and during the Review Workshop. These are discussed below.

Stock structure and identification

As mentioned earlier, the model under review utilized a three-area stock structure. Unfortunately, it was made clear in both the document and during the Review Workshop, that much of the data for the Eastern area was borrowed from the central region. Additionally, it was seen that the model for the Eastern area, of the three areas, had the most problematic fits to the surveys, odd selectivity patterns, and other issues. While it is certainly possible that there are, in fact, three loosely connected sub-stocks in this region, the data available simply didn't support the three-area modeling approach the Team took.

Data

Length and age observations were not properly scaled but rather used in raw form. This resulted in length and age compositions that were not representative of the fishery-dependent or independent data they were meant to represent. This is problematic when evaluating the assessment as those length and age frequencies are important for how the model tracks age classes. Moreover, any age-structured model relies on length and age composition data to reveal the population dynamics of the modeled population. Because such a critical data element was mishandled, requests for further work during the review by the Assessment Team (hereafter Team) were not made, as any results from additional runs would likely not be representative of runs conducted with appropriately scaled length or age compositions.

Removal (not utilizing) age-based information in the fishery-dependent data was also not appropriate. Stock Synthesis is, in essence, an age-structured model. While some internal calculations are or can be modified for length-based modeling, Stock Synthesis tracks the population internally as age classes. The argument provided by the Team was that the model's better fits to the indices were the result of using length compositions compared to age composition, which suggests model misspecification errors rather than the superiority of length compositions in tracking this vertebrate population. If most of the biology of this stock was in fact length-dependent, rather than age-controlled (as seen in some crustacean species) then a complete length-based modeling approach should have been applied instead of an inherently age-based approach.

The use of the GRSC as an index was premature given that the potential biases have not been fully investigated, as well as the reliance on the use of a catchability (or q) set at 1. Additionally, there was also no inclusion of the length frequency data from the GRSC which is needed to estimate selectivity for the GRSC.

It was noted that the plus-group used by the Team for Gulf Red Snapper was 20+ based on the externally derived growth curves and the appearance of few individuals in the fishery and surveys past that age. This contrasts with a maximum age in the model of 57. While it is understandable to limit the number of age classes in the model to reduce the number of parameters and computational overhead, the trade-off is that the bulk of the ages, and perhaps the bulk of the SSB, will reside in that plus group. This is not a favorable outcome in any age-structured model as year-class tracking will be limited to only the partially selected ages younger than the plus-group. Age-structured approaches such as Stock Synthesis function best with more ages. A recommendation to increase the plus-group to closer to the maximum age will be discussed later in this document.

Model

The model in its current form is overly complex, it includes three areas with 21 different indices of abundance, and 18 fleets distributed across those areas. There were a total of 2210 parameters, with 1828 active parameters, in the model. This resulted in a large amount of computational overhead which limited the number of sensitivity analyses, diagnostics, and other important exploratory analyses that could be performed. Additionally, such a model would be entirely unfeasible to update regularly with new data for management advice. Further, the complexity of the model was mostly unwarranted as often data and parameters were borrowed from one fleet for another, and from one area for another.

The lack of adequate diagnostics also hampered efforts to truly understand how the model was operating. Typical sensitivities around data elements, such as dropping various indices or changing either steepness or natural mortality, were not conducted. Moreover, the assessment document lacked a likelihood profile of the major data types and how they affected the likelihood. Such profiles are vital to understanding which data elements are pushing the model in likelihood space and allow for the graphical illustration of potential conflicts among data sources.

Additionally, the lack of any retrospective analysis was particularly troubling. Retrospective analysis is not only a tool to understand persistent biases in potential management advice and stock status but can also serve as a valuable diagnostic tool to understand how various data elements or selectivity block choices affect the output.

Even though this is a new modeling approach being built “from the ground up” during a Research Track Assessment, it is important to run both continuity and bridging analyses. A continuity analysis is when all (or most) of the old data elements and assumptions around parameters are maintained, but the assessment is transitioned from one model type to another. A bridging analysis is when new data elements and parameter assumptions are sequentially added until the final step results in the proposed base model. Providing these analyses is an important step as it allows analysts and reviewers to see how changes to the model type and data elements/parameter changes affect the outputs as well as other selective diagnostics.

Age-structured models often rely on either catch to be known well (low CVs) or exactly to help determine scale. The current assessment used CVs on the removals based on the recommendations of the data workshop. This resulted in an early version of the model not converging. Tightening of those CVs resulted in convergence but resulted in the model subsequently changing removal values to facilitate fitting other data elements. Because age-structured models generally need rather tight CVs (and thus fairly precise knowledge of removals), a better approach would be to test this uncertainty using sensitivity analysis rather than using wide CVs within the model.

During the assessment meeting, it was observed that the assessment team used the median CV across all indices, to give each index an equal weight within the model. This is not generally appropriate. Each index within the model has its own uncertainty and should have its own measure of precision to allow the model to weigh those surveys internally and allow them to have different effects on the outcomes. Less precise indices should have lower weight in a model allowing them to be fit more broadly versus a more precise index which should be fit more closely.

The proposed base model utilized a steepness (h) set at 0.99 externally. This is not only biologically implausible but leads to the population only producing median recruitment no matter the spawning stock size, which is nonsensical at low stock sizes and has management implications during rebuilding. In the best case, steepness should be estimated within the model. Given data constraints, however, it is usual for models to be unable to estimate steepness even with good priors. In such cases, life-history information should determine the base case steepness, while the exact value is explored using a combination of sensitivity analysis and likelihood profiling.

While examining the assessment document it was noticed that both natural mortality and steepness were fixed outside of the model. While this is a common practice when the estimation of those parameters is not possible, it has some important consequences. The most important of those is the fact that setting the natural mortality and the recruitment steepness effectively sets the productivity of the stock; essentially specifying MSY, but often causing issues with selectivity in some fleets. As outlined under recommendations, a better approach would be to allow the model to estimate either steepness or natural mortality while the other is fixed.

In examining the Stock Synthesis configuration presented by the assessment team, it was noticed that omitting the constraint for recruitment deviations to average to zero was inappropriate. Such an omission undermines the integrity and meaning of both the R_0 and B_0 parameters. The base model depicted a positive, upward trend in recruitment deviations over time, creating the impression of a regime shift.

<u>Conclusions</u>

Substantial time and effort were invested by the Assessment Team and all participants in the Data Workshop for the Gulf of Mexico Red Snapper assessment. Regrettably, the current model configuration put forth by the Team is not prepared for further advancement through the Operational Assessment process without significant additional work, likely requiring re-evaluation by external reviewers. The primary reasons behind this determination include:

- the utilization of unscaled length and age frequencies, hindering meaningful conclusions from the proposed base model;
- the exclusion of age composition data despite the proposed assessment being age-structured;
- and the absence of crucial diagnostics and sensitivity analyses preventing a comprehensive review of the model's behavior and usefulness.

As these deficiencies were inherent to the proposed assessment, addressing the issues during the Review Workshop proved unfeasible. Instead, the focus was directed at offering explicit recommendations in this report on how to rectify these issues not only for the Gulf of Mexico Red Snapper but also for other stocks in the SEDAR process. It should be noted that the proposed assessment is not, currently, fit for supporting management advice or management decisions. And no inferences should be drawn from it for management purposes.

Description of the reviewers' role

For this Review, the role of the reviewer was to read the materials provided, attend and participate in the Review Workshop, provide a review of the assessment for Red Snapper in the Gulf of Mexico, as well author a report following the TORs. This Review Report is the Review of that Review Workshop. This Review is independent of the other Review panel members and serves as a standalone document separate from any consensus document created during the process.

Summary of Findings

Evaluate the data used in the assessment, including a discussion of the strengths and weaknesses of data sources and decisions. Consider the following:

- *Are data decisions made by the Data and Assessment processes justified?*

Some of the decisions made by both the Assessment Team and the Data process seem reasonable on the surface. The length and thoroughness of the data process are impressive, with many reports, committee meetings, and views involved. Many of the decisions seemed properly vetted and would appear mostly reasonable. That said, when taken together with the current modeling approach, the results were less appropriate. For example, it would seem reasonable to want to capture as much uncertainty in the discard and removal data as possible and allow for a relatively large CV as a result. The reality is that within an integrated stock assessment modeling approach like Stock Synthesis, such a decision can result in model instability and an inability to converge.

Additionally, the decision to not include more aging data in the model would seem justified given the lack of fit when compared to the length data. This also however fails on the fact that Stock Synthesis is an age-based model that internally accounts for cohorts and thus is inherently age-, rather than length-based.

Of particular note is the decision to include the GRSC. While likely useful in other contexts, its inclusion within the proposed assessment was premature. As is, this single point estimate of abundance without associated length composition data or more attention to estimating q and capturing other sources of variability (e.g., uncertainty in habitat mapping) was not well fitted by the model without forcing. As such, its inclusion does not seem warranted.

Given this, the justification for the various data decisions seems less than appropriate, despite seeming soundness, once the data are incorporated as inputs within Stock Synthesis.

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

The Data group had suggested using coefficients of variation (CVs) for different periods to acknowledge the uncertain nature of estimates related to landings and discards. They also provided the estimated CVs derived from sampling designs (landings and indices) and CPUE analyses. A significant aspect of this assessment is the considerable uncertainty associated with total removals. This uncertainty primarily stems from the substantial contributions of recreational landings and discards to the overall removals from the population.

The primary challenge in the assessment lies in appropriately integrating the uncertainty surrounding total removals into the modeling framework. Recreational data relies on MRIP FES, the FCAL series, differing from the previous red snapper assessment that used the ACAL series. Given recent studies highlighting a significant telescoping error in the new FCAL series, it is crucial to thoroughly investigate the disparities in data input and CVs associated with these catches. This investigation becomes especially important in light of the model's requirement that catch information (catch + dead discards) be known with a high degree of certainty.

- *Is the appropriate model applied properly to the available data?*

The proposed assessment is a complex model. It includes three areas with 21 different indices of abundance, and 18 fleets distributed across those areas. A total of 2210 parameters, with 1828 active parameters, were used in the model. The version of Stock Synthesis used is quite capable of handling such a complex model if the required data are available and carefully prepared. In short, the correct model was chosen for the task, but the data preparation, treatment, and sources, were not appropriate.

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

The input data were not sufficient to support the assessment approach as prepared. One issue (outlined above) is that the use of a three-area model was not supported given the borrowing of data streams for the Eastern area from the Central. Because of this, it was recommended that the model be collapsed back to a two-area model until more data become available for the Eastern area. Additionally, the lack of proper scaling of the age/length data hampered the interpretation of the model output and the few diagnostics presented. Most important, however, was the uncertainty around the dead discards. These are a high fraction of the removals and by their very nature are uncertain. However, the incorporation of that uncertainty within the assessment is best depicted via a sensitivity analysis rather than increasing the input CVs. The unfortunate truth is that, given the high level of discards, there will always be a high level of uncertainty around removals for this stock.

<u>Evaluate and discuss the strengths and weaknesses of the methods used to assess the stock, taking into account the available data. Consider the following:</u>

- *Are methods scientifically sound and robust?*

Identification of more suitable modeling approaches has proven elusive, but the methods selected are sound on the surface. With exceptions explicitly addressed in this report and listed below, the methods used were aligned with currently recommended practices, though implementation was not. That said there were several issues raised earlier in this report including:

- The overall model complexity given the data.
- The lack of appropriate diagnostics and sensitivity analyses.
- The lack of continuity and bridging analyses.
- The use of high CVs rather than sensitivity analysis to explore uncertainty in the catch data.
- The equal weighting of indices using the median of the CVs.
- The fixing of steepness to 0.99.
- The lack of estimation of either Natural Mortality or steepness.
- Omitting the necessity for recruitment deviations to average to zero.
- And others that were related specifically to the data and data treatments within the model.

- *Are priority modeling issues clearly stated and addressed?*

The main modeling issues as expressed and addressed by the Team included the following:

- Deviations from data workshop recommendations are explicitly justified.
- The model incorporates absolute abundance estimates from "The Great Red Snapper Count" with detailed discussion.
- Selectivity and retention curves for all fleets are extensively modeled, with detailed formulation and parameterization.
- The Connectivity Modeling Simulation recruitment index is addressed but not included in the model due to scope considerations.
- Length composition data exploration was done for some fleets using age-length keys.
- Investigation into growth estimation within the model remains unclear and was not conducted.
- Stainability and model stability were assessed for recreational fleet selectivity functions.
- All prioritized stock population parameters were included, with some selectivities and stock-recruitment relationship parameters kept fixed for stability.
- Most relevant uncertainties in the input data were recognized, with many explicitly modeled and others identified for sensitivity analysis.
- Preliminary assessments of model performance, reliability, and goodness-of-fit are provided, but final diagnostics lack justification due to the preliminary condition of the composition data.

Although some priority modeling issues are identified and resolved, their comparative significance was not explicitly emphasized. The primary objective of a stock assessment model is to generate accurate estimates for effective management. Decisions regarding the inclusion of data sources and the model's structure should primarily align with supporting this overarching goal. However, this was not possible given the state of the proposed model at the Review Workshop.

- *Are the methods appropriate for the available data?*

Overall, Stock Synthesis is an appropriate method for the data types and overall assessment goals. Unfortunately, the team did not provide a good suite of diagnostics or sensitivity analyses to support conclusions about the proposed model at this time. To make such conclusions, the data must be handled correctly and the model must include appropriate sensitivity analyses and diagnostics to make that justification. Both conditions were absent from the proposed model.

- *Are assessment models configured properly and used in a manner consistent with standard practices?*

As stated earlier in this section several issues prevent the conclusion that the model was configured and used in a way that aligned with standard practices. Such a conclusion is prevented by:

- the use of high CVs rather than sensitivity analysis to explore uncertainty in the catch data;
- the equal weighting of indices using median CVs;
- the fixing of steepness to 0.99;
- the lack of estimation of either Natural Mortality or steepness;
- and allowing the recruitment deviations to sum to a non-zero number.

Having said all of that, it is important to understand that there were also some strengths in the proposed assessment. The Team, as well as the Data group, spent a lot of time and resources in developing robust surveys and other data streams that will be useful in understanding the dynamics of Red Snapper in the Gulf of Mexico. Should some of the recommendations from this, as well as the consensus reports be taken, then there is little doubt that a useful population model can be constructed in the near future.

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.*

Uncertainty in the proposed assessment and its outcomes were inadequately addressed. Although uncertainty associated with input data was acknowledged, there were instances where it was subjectively scaled to enhance model fitting. Furthermore, adjustments in lambdas were employed to both qualitatively reweight data sources to improve model fitting and to adjust the weighting of data sources. Unfortunately, this led to situations where lambdas were utilized to increase the weight of a data source within the model, despite that specific source having higher coefficient of variations (CVs), which should logically decrease its influence.

The estimation of uncertainty in parameters involved the utilization of asymptotic standard errors (SEs) derived from the inverted Hessian matrix post-model fitting. This approach differs from others in the region that opt for Markov chain Monte Carlo (MCMC) or Monte Carlo Bootstrapping (MCB). Consequently, the error estimates derived from asymptotic SEs represent conservative estimates of uncertainty in the model outputs. Due to the computational intensity associated with MCMC or MCB, it is suggested that such methods be considered only after a base model has been selected.

Some sensitivities were conducted, including those related to time- and spatially-varying maturity, the Great Red Snapper Count (GRSC) estimate, and selectivity. However, a comprehensive suite of sensitivities was deferred to the operational assessment phase. While this decision is understandable given time and resource constraints, it resulted in the omission of crucial standard sensitivities, such as for natural mortality, steepness, and index weight within the model. These sensitivities play a pivotal role in comprehending model behavior and their examination can serve as safeguards against misspecification.

- *Comment on the likely relationship of this variability with possible ecosystem or climate factors and possible mechanisms for encompassing this into management reference points.*

This proposed assessment did not delve into consideration of ecosystem and climatic factors due to the complexity of the analysis. The influence of these factors on estimations of natural mortality, growth, maturity, and recruitment is acknowledged as potentially important. Nevertheless, exploring these connections poses a challenge given the absence of demonstrated correlations during the assessment, or any analysis indicating how ecosystem and climatic factors impact these parameters. Instead of delving into this complexity, it is suggested that effort and resources instead be allocated toward constructing a more robust base model. The exploration of ecosystem and climatic factors can then be pursued through sensitivity analysis or another approach as warranted.

It should be noted that reference points and management advice were not encompassed within the scope of this Research Track assessment.

Provide, or comment on, recommendations to improve the assessment.

- *Consider the research recommendations provided by the Data and Assessment processes in the context of overall improvement to the assessment and make any additional research recommendations warranted.*

The research recommendations as found in the assessment report were as follows:

Recreational Landings and Discards data

- Further develop best practices for correcting for prominent peaks and troughs in the earlier part of the time series where uncertainty is high and catch/discard estimates are driven by few but influential intercept records.
- Investigate the influence of depredation as a contributor to discard mortality and its significance on observed discard data used in the assessment.

Composition Data Alternatives

- Incorporating age composition and length composition data for the directed fleets and estimating growth internally to the model to facilitate the fit of multiple simultaneous sources of composition data.
- Consider the application of conditional age-at-length data for use in red snapper stock assessment.

Alternate Start Years

- SEDAR 74 moved the model start year from 1872 to 1950, but other earlier years would have been considered if not for modeling limitations. The determining factor in selecting 1950 was the shrimp bycatch data and the lack of an ability to specify an initial F for a bycatch-only fleet. This issue should be further explored and possible modifications to SS should be considered to allow the consideration of earlier start years.

Additional Data Needs

- Currently the model includes length-converted age composition data for surveys, where possible. It would benefit the model to include real-age composition data for trawl surveys in the future.
- Incorporating recreational discard composition into the east assessment area.
- Investigate the impact of using state survey-derived landing statistics on the assessment model.

After examining these in the context of both the Assessment report as well as the Data Workshop report, these appeared to be appropriate. More important, however, is the continued exploration of the recommendations given in this and other reports from the Review Workshop. It is likely more efficient to first get a tractable working model to determine what data gaps or analyses should be pursued. Given the state of the proposed model, it was difficult to discern what direction future research should take, particularly given the lack of diagnostics and sensitivity analyses in the proposed model.

- *If applicable, provide recommendations for improvement or for addressing any inadequacies identified in the data or assessment modeling. These recommendations should be described in sufficient detail for application and should be practical for short-term implementation (e.g., achievable within ~6 months). Longer-term recommendations should instead be listed as research recommendations above.*

There are multiple recommendations that, if acted on, could improve the proposed model. For ease of reading these have been placed in bold both in this section and beyond this point in the report. There is some doubt, however, if these could all be completed within six months. Several issues need to be addressed before further review if the same outcome is to be avoided.

It was clear, from both the documentation as well as discussions during the Review Workshop, that there wasn't as much data support for a three-area model as opposed to a two-area model, despite some biological evidence to support a three-area model. Given this, **it is recommended that the Team structure the model as a two-area model in the short term**. As more data become available, a three-area model should be explored as a sensitivity in a future assessment.

The proper scaling of the length and age frequency data is a crucial component of any age- or length-based modeling approach. While a seemingly tedious and often arduous task, it is nonetheless important for proper model function. Unfortunately, the use of unscaled composition data makes it extremely difficult to draw conclusions from the proposed assessment. As such **it is recommended that all length and age frequency data be properly scaled to the data source or index they originated from**.

Stock Synthesis is, at its very heart, an age-structured model. Despite this, length, rather than age-based data, were used throughout the proposed model run. This was a curious decision given that if the age data were unreliable, a fully length-based approach should have been proposed instead. **It is recommended that age-based data be utilized wherever possible for fleets and indices.**

Additionally, it is important to carefully scrutinize the fishery-dependent CPUE indices. While fishery-dependent CPUE indices can sometimes be insightful, their standardization and their sensitivity to management changes and economic factors can reduce their effectiveness. The use of fishery-dependent CPUE indices needs to be balanced against these factors as well as the risk of hyperstability. Therefore, **it is recommended that the fishery-dependent indices used in the proposed assessment be carefully reconsidered**.

It was clear that there are many problems with the inclusion of the GRSC in the proposed model. Its current incorporation as a population scaling factor required the use of some extraordinary measures to force the fitting. Additionally, it seems rather implausible based on the documentation that the assumed catchability of 1.0 was correct, given the multitude of different measures used and other issues. Therefore, **the GRSC should be removed from the modeling of Red Snapper until further research on the potential biases can be conducted as well as further work on creating priors to inform the catchability of the survey**. **Additionally, length and age frequencies from the GRSC should be used when adding this data source to any model.**

The current plus-group in the proposed model was noted at 20+, despite the oldest age being 57. While there is some rationale given the slow growth of the stock past age 20, as well as the lack of fish older than age 20 in some indices, it is nonetheless difficult to understand why most of the mature fish capable of producing recruitment lay in the plus-group. **It is recommended that the plus-group for modeling purposes should be greater than 20+**. Preliminary sensitivities can be conducted to explore alternative plus-grouping. Additionally, a lower plus-group for input data can exist but it is important to allow the model to consider fits to year classes closer to the maximum age. However, runs should be examined to see if this increases the doming of some selectivity patterns in fleets and indices.

As discussed previously the model is currently more complex than the data currently supports. Where possible, **it is recommended that reducing model complexity should be a goal**. Some of the other recommendations in this report can help, such as dropping from a three-area to a two-area model. Additionally, the Team should explore modeling overall removals (dead catch) rather than trying to model landings, discards, and discard mortality separately by fleet, area, and time.

It is recommended that a suite of typical diagnostics and sensitivities be conducted. Further, sensitivity analyses should also be conducted, as warranted, depending on diagnostics and in an iterative fashion. This is important not only for understanding how the model is behaving but also in capturing the uncertainty as fully as possible. Such diagnostics should include a retrospective analysis where the terminal year is dropped sequentially to look for biases in the resulting stock status. Other diagnostics should include likelihood profiles and examination of standardized residuals Sensitivities could include, for example, different assumptions on natural mortality, steepness, start year, and the amounts of dead removals that result from discarding. One additional sensitivity that is suggested is the “leave one out” approach to indices, where indices are sequentially dropped (or added) to look at how they affect the model and results.

It is generally very important to understand how models and modeling approaches change over time. Even during a Research Track, or when a new model is built from scratch, it is important to take a methodical approach to try to explain, if possible, how model changes affect outcomes. As such **it is recommended that both continuity and bridging analyses be conducted as outlined under the Issues section**. It should be noted that while not all indices and new parameter assumptions need to be included in the bridging process, as this can be a large task given the model's complexity, it is important to at least capture the main features of the new base run. Likewise, there might be large differences in the continuity runs between new and old models. This is an expected result but important to illustrate and explain for transparency.

Age-based and even length-based models almost always rely on catches or landings being fairly well-known or very well-known. This is because if the model has high CVs for both catch and indices, it tends to function poorly given the wide range of possible stock trajectories. Therefore, **it is recommended that uncertainty in the catch data be examined using sensitivity analysis rather than by increasing or decreasing the CVs and that CVs should be set fairly low in the model**. For example, landings could be inputted with a fairly tight CV, while discard and discard mortality could be examined via sensitivity analyses.

It is inappropriate to simply give equal weight to all indices within a model. This is because each index has its own internal variability and how it contributes to the overall model fit should be based inversely on that variability. This prevents the model from trying to fit noisier indices as opposed to the overall trend when there is conflicting information. Given this, **it is recommended that survey information and other data sources be internally weighted**. Multiple forms exist in the platform including McAllister–Ianelli, Francis, and Dirichlet-multinomial as well as others.

While it is sometimes common (though less common than in years past) to find steepness values set at 0.99, this does not make it correct. It is rarely plausible that a stock such as Red Snapper has that sort of steepness given its life history. Additionally, setting the steepness parameter to such a value has important stock and management implications as discussed earlier. **It is recommended that a literature search on possible steepness values, for this or a similar species, be conducted to either inform**

possible alternative values for a sensitivity analysis or to act as priors when estimating steepness (see below). Such an analysis will mesh well with conducting proper diagnostics such as likelihood profiling.

It is recommended, if possible, that either steepness or natural mortality be allowed to vary rather than set outside the model. Models such as Stock Synthesis are best conducted with as few set parameters outside the model as possible. As mentioned earlier, setting steepness and natural mortality in effect sets the productivity of the stock, and thus MSY. Commonly, such attempts to estimate either steepness or natural mortality are not successful. Should this be the case, then the previous recommendation should be followed to at least understand the possible ranges of steepness and explore the consequences of the uncertainty using sensitivity analysis.

It was noted during the Review meeting that the recruitment deviations, while constrained in their variability, did not average to zero. This suggests to the model that those deviations should increase or decrease over time, creating the illusion of a regime shift in stock productivity that is not correct. As such **it is recommended that recruitment deviations should be constrained such that they average to zero to maintain the integrity of the R0 and B0 parameters**.

Provide recommendations on possible ways to improve the Research Track Assessment process.

The Review Workshop highlighted a consistent theme regarding the inflexibility of the data phase and the selection of data sources for integration into the model. It was evident that the Team had limited opportunities to eliminate or modify data streams that might not have been suitable for inclusion. Additionally, there seemed to be little flexibility in adjusting the coefficient of variations (CVs) unless the model failed to converge. Furthermore, the data process itself did not facilitate the exploration of multiple model configurations. Therefore, **it is recommended that the data process and workflow be examined to uncover areas where flexibility and efficiency can be inserted into that process**. As it stands the current workflow seems too cumbersome to adequately develop such a complex model and the needed sensitivities. Additionally, updating such a model for providing regular management advice will also prove very cumbersome.

It is recommended that more flexibility and autonomy be vested in the Assessment Teams to utilize, modify, or reject data streams as needed. Throughout the modeling process, the optimal parsing of various data streams often becomes apparent only when sensitivities are explored, and potential model configurations are either retained or discarded. Consequently, there is a need for greater flexibility in both the data and assessment processes to accommodate these uncertainties.

The Assessment Workshop TORs, in particular, were telling, in part, on how and why some aspects of the model we reviewed were experiencing issues. For example, TOR 2a stated "Consider and incorporate as appropriate the information derived from the "Great Red Snapper Count" and other independent studies". TOR 2d stated, "Investigate fitting length composition data directly within the SS3 model as opposed to developing age-length keys and converting length frequency to age composition external to the modeling process." These are rather proscriptive TORs and can easily be misinterpreted to mean specifying that the GRSC be included and that only (or mostly) length compositions be used. As such, **it is recommended that TORs be written more generally and allow for more flexibility in model structure, in keeping with the best available data/analysis**.

During the Review Workshop, an additional concern emerged regarding the transfer of model diagnostics, sensitivity analysis, reference point construction, and projections from the Research Track to the Operational assessment. This was very different when comparing the Gulf of Mexico region to other U.S. regions, such as the North Pacific, Northeast, and West Coast. In those regions, the Research Track process typically includes fully developed models with diagnostics, sensitivities, reference points, and, in some cases, projections. Including these items ensures complete transparency in understanding how the proposed model operates. It also allows both internal and external reviewers to provide input on elements critical to the management process. For instance, the relocation of projections to the Operational assessment phase means that valuable insights into potential time frames for average recruitment or size at age in projections were not obtained. Therefore, **it is recommended that the Research Track process from other regions be examined to discern which aspects of the previous benchmark process are best suited for examination in the Gulf of Mexico Research Track process and which are more appropriately shifted to the Operational/Management Track assessment**. It should be noted that other regions have or are still grappling with this same issue, so it might be good to collaborate if possible.

Final Thoughts

Overall, this was a pleasant review. The Assessment Team and support staff were professional and very kind. Additionally, the Team did a wonderful job trying to explain many aspects of the assessment and how they arrived at their decisions. They were also very candid in answering questions and really helpful in explaining the process. The accommodations and the company of the other Reviewers were wonderful. I learned a lot from this Review, from the other Reviewers, and from the Assessment Team.

The SEDAR process is really in a transition in this region, from the old Benchmark/Update structure to one centered around Research/Operational Assessment. As such, there was a lack of clarity on what should be in a Research Track assessment and how much effort should be placed on seemingly small tasks: such as data scaling. Overall, this was a complex model with a lengthy and complex data process. Unfortunately, that complexity, lack of clarity on the process, and inadequate data preparation led to a less-than-favorable review. That said, there was a lot of time, effort, and resources put into this assessment. I am confident that with a bit more work and after following some of the suggestions from this report and others, a well-functioning base model and outputs in line with best practices can be achieved in relatively short order. Many of the foundation stones for such an assessment are already in place.

Literature Cited

Allen, G.R., 1985. FAO Species Catalogue. Vol. 6. Snappers of the world. An annotated and illustrated catalogue of lutjanid species known to date. FAO Fish. Synop. 125(6):208 p. Rome: FAO. (Ref. 55)

Lorenzen K. 2000. Allometry of natural mortality as a basis for assessing optimal release size in fish-stocking programmes. Canadian Journal of Fisheries and Aquatic Sciences 57(12):2374-2381.

Then AY, JM Hoenig, NG Hall, and DA Hewitt. 2015. Evaluating the predictive performance of empirical estimators of natural mortality rate using information on over 200 fish species. ICES Journal of Marine Science 72(1):82-92

Appendix 1: Bibliography of materials provided for review

Document #	Title	Authors	Date Submitted
Documents Prepared for the Stock ID Process			
SEDAR74-SID-01	Hot Spot Maps of General Recreational Landings for Gulf of Mexico Red Snapper	Matthew A. Nuttall and Vivian M. Matter	25 February 2021
SEDAR74-SID-02	A Lagrangian biophysical modeling framework informs stock structure and spawning-recruitment of red snapper (*Lutjanus campechanus*) in the northern Gulf of Mexico	M. Karnauskas and C. B. Paris	12 March 2021
SEDAR74-SID-03	Insights into the Spatial Dynamics of Red Snapper in the Gulf of Mexico from Gulf-Wide Fishery Independent Surveys	Theodore S. Switzer, Adam G. Pollack, Katherine E. Overly, Christopher Gardner, Kevin A. Thompson, Matt Campbell	15 March 2021
SEDAR74-SID-04	Mississippi Red Snapper Data Summary	Trevor Moncrief	12 March 2021
SEDAR74-SID-05	Spatial analysis of Southeast Regional Headboat Survey Catch Records	Nikolai Klibansky	29 July 2021
SEDAR74-SID-06	Some thoughts on dividing the northern Gulf of Mexico red snapper stock into eastern and western components at the statistical area 9/10 border	Benny J. Gallway and Peter A. Mudrak	30 July 2021
Documents Prepared for the Data Workshop			
SEDAR74-DW-01	General Recreational Survey Data for Red Snapper in the Gulf of Mexico	Nuttall, MA	26 January 2022 Updated: 10 June 2022

SEDAR74-DW-02	Reef Fish Observer Program Metadata	Sarina Atkinson, Judy Gocke, Stephanie Martinez, Elizabeth Scott-Denton	15 December 2021
SEDAR74-DW-03	Coastal Fisheries Logbook Program Metadata	Sarina Atkinson, Michael Judge, Refik Orhun	15 December 2021
SEDAR74-DW-04	LA Creel/MRIP Red Snapper Private Mode Landings and Discards Calibration Procedure	Office of Fisheries Louisiana Department of Wildlife and Fisheries	19 January 2022 Updated: 24 February 2022 4 May 2022
SEDAR74-DW-05	Florida State Reef Fish Survey Metadata	Tiffanie Cross	23 January 2022
SEDAR74-DW-06	A description of Florida's Gulf Coast recreational fishery and release mortality estimates for the central and eastern subregions (Mississippi, Alabama, and Florida) with varying levels of descender use	Julie L. Vecchio, Dominique Lazarre, Beverly Sauls, Marie Head, Trevor Moncrief	8 March 2022
SEDAR74-DW-07	Size and age information for Red Snapper, *Lutjanus campechanus*, collected in association with fishery-dependent projects along Florida's Gulf of Mexico coast	Julie Vecchio, Jessica Carrol, Dominque Lazarre, Beverly Sauls	3 March 2022
SEDAR74-DW-08	Electronic Monitoring Documentation of Red Snapper (*Lutjanus campechanus*) Catches in the Eastern Gulf of Mexico Commercial Reef Fish Bottom Longline Fishery	Max Lee, Carole Neidig, and Daniel Roberts	18 March 2022
SEDAR74-DW-09	The Reproductive Biology of Red Snapper in Mississippi Waters	Nancy J. Brown-Peterson and Anna K. Millender	12 April 2022 Updated: 31 May 2022 Updated: 14 June 2022

SEDAR74-DW-10	Methodology Description for a Simple Ratio Calibration of Texas Private Boat Red Snapper Annual Landings Estimates	NMFS Office of Science and Technology	15 April 2022
SEDAR74-DW-11	Evaluating Uncertainty in Gulf Red Snapper Estimates: A Preliminary Sensitivity Analysis of Non-Sampling Errors in the Region's Recreational Fishing Surveys	NMFS Office of Science and Technology	15 April 2022
SEDAR74-DW-12	SEFSC Computation of Uncertainty for General Recreational Landings-in-Weight Estimates, with Application to SEDAR 74 Gulf of Mexico Red Snapper	Matthew Nuttall and Kyle Dettloff	15 April 2022
SEDAR74-DW-13	Standardized Catch Rate Indices for Red Snapper (*Lutjanus campechanus*) during 1981-2019 by the U.S. Gulf of Mexico Charterboat and Private Boat Recreational Fishery	Gulf Fisheries Branch, Sustainable Fisheries Division	14 April 2022
SEDAR74-DW-14	Trip Interview Program Metadata	Sarah Beggerly, Molly Stevens, and Heather Baertlein	15 April 2022
SEDAR74-DW-15	Gulf of Mexico Red Snapper (*Lutjanus campechanus*) Commercial and Recreational Landings Length and Age Compositions	Molly H. Stevens	15 April 2022 Updated: 1 July 2022
SEDAR74-DW-16	System dynamics of red snapper populations in the Gulf of Mexico to support ecosystem considerations in the assessment and management process	Carissa Gervasi, Matthew McPherson, and M. Karnauskas	15 April 2022
SEDAR74-DW-17	Standardized Catch Rate Indices for Red Snapper (*Lutjanus campechanus*) during 1993-2006 by the U.S. Gulf of Mexico Vertical Line Fishery	Gulf of Mexico Branch, Sustainable Fisheries Division	15 April 2022
SEDAR74-DW-18	A Summary of Observer Data from the Size Distribution of Red Snapper Discards from Recreational Fishery Surveys in the Eastern Gulf of Mexico	Dominique Lazarre	15 April 2022

SEDAR74-DW-19	CPUE Expansion Estimation for Commercial Discards of Gulf of Mexico Red Snapper	Stephanie Martínez Rivera, Sarina Atkinson, Steven G. Smith, Kevin J. McCarthy	15 April 2022
SEDAR74-DW-20	Gulf of Mexico Red Snapper (*Lutjanus campechanus*) Smooth Age Length Keys	Lisa E. Ailloud	15 April 2022 Updated: 10 March 2023
SEDAR74-DW-21	Using a Censored Regression Modeling Approach to Standardized Catch Per Unit Effort for Red Snapper (Lutjanus campechanus) during 1986-2019 from the Southeast Region Headboat Survey in the U.S. Gulf of Mexico	Gulf of Mexico Fisheries Branch	18 April 2022 Updated: 27 May 2022
SEDAR74-DW-22	Commercial Landings of Red Snapper (*Lutjanus campechanus*) from the Gulf of Mexico 1964 - 2020	M. Refik Orhun	19 April 2022
SEDAR74-DW-23	Indices of abundance for Red Snapper (*Lutjanus campechanus*) on natural reefs in the eastern Gulf of Mexico using combined data from three independent video surveys	Kevin A. Thompson, Theodore S. Switzer, Mary C. Christman, Sean F. Keenan, Christopher Gardner, Katherine E. Overly, Matt Campbell	20 April 2022 Updated: 27 April 2022 Updated: 26 May 2022
SEDAR74-DW-24	Develop an updated Connectivity Modeling Simulation recruitment index for recruitment forecasting	Ana Vaz and M. Karnauskas	27 April 2022
SEDAR74-DW-25	Summary of Management Actions for Red Snapper (Lutjanus campechanus) from the Gulf of Mexico (1984 - 2022) as Documented within the Management History Database	G. Malone, K. Godwin, S. Atkinson, A. Rios	29 April 2022
SEDAR74-DW-26	Red Snapper Abundance Indices from Bottom Longline Surveys in the Northern Gulf of Mexico	Adam G. Pollack and David S. Hanisko	28 April 2022

SEDAR74-DW-27	Indices of abundance for Red Snapper (*Lutjanus campechanus*) on artificial reefs on the West Florida Shelf from stationary video surveys	Kevin A. Thompson, Theodore S. Switzer, and Sean F. Keenan	29 April 2022
SEDAR74-DW-28	SEAMAP Reef Fish Video Survey: Relative Indices of Abundance of Red Snapper	Matthew D. Campbell, Kevin R. Rademacher, Paul Felts, Joseph Salisbury, Jack Prior	29 April 2022 Updated: 4 May 2022
SEDAR74-DW-29	Gulf State Recreational Catch and Effort Surveys Transition Workshop Summary Report	Gulf MRIP Transition Team	29 April 2022
SEDAR74-DW-30	Red Snapper Abundance Indices from Groundfish Surveys in the Northern Gulf of Mexico	Adam G. Pollack and David S. Hanisko	1 May 2022
SEDAR74-DW-31	Red Snapper (*Lutjanus campechanus*) larval indices of relative abundance from SEAMAP Fall Plankton Surveys, 1986 to 2019	David S. Hanisko, Adam G. Pollack, Denice M. Drass, Pamela J. Bond, Christina Stepongzi, Taniya Wallace, Andrew Millet, Christian M. Jones, Glenn Zapfe and Consuela Cowan	2 May 2022 Updated: 13 July 2022
SEDAR74-DW-32	Co-Producing a Shared Characterization of Depredation in the Gulf of Mexico Reef Fish Fishery: 2022 Workshop Summary Report	Marcus Drymon, Ana Osowski, Amanda Jefferson, Alena Anderson, Danielle McAree, Steven Scyphers, Evan Prasky, Savannah Swinea, Sarah Gibbs, Mandy Karnauskas, Carissa Gervasi	2 May 2022
SEDAR74-DW-33	Fisherman Feedback: Red Snapper - Response Summary	Gulf of Mexico Fishery Council Staff	4 May 2022
SEDAR74-DW-34	Description of age, growth, and natural mortality of Red Snapper from the	Steven Garner, Robert Allman,	20 May 2022

	northern Gulf of Mexico 1980 and 1986-2019	Beverly Barnett and Naeem Willett	
SEDAR74-DW-35	Red Snapper General Recreational Open and Closed Season Discard Development	Gulf of Mexico Fisheries Branch	24 June 2022
SEDAR74-DW-36	Best practices for standardized reproductive data and methodology to estimate reproductive parameters for Red Snapper in the Gulf of Mexico	Susan Lowerre-Barbieri, Claudia Friess, Nancy Brown-Peterson, Heather Moncrief-Cox, and Beverly Barnett	30 June 2022 Update: 5 July 2022 Updated: 25 July 2022 Updated: 25 August 25
SEDAR74-DW-37	Estimation of length composition of commercial discards for Gulf of Mexico red snapper	Smith, S.G., S. F. Atkinson, and S. Martinez-Rivera	12 August 2022
SEDAR74-DW-38	Estimation of a Post-IFQ Commercial Vertical Line Abundance Index for Gulf of Mexico Red Snapper Using Reef Fish Observer Data	Smith, S.G.	30 August 2022
SEDAR74-DW-39	SEAMAP Vertical Longline Survey (2012-2021): Indices of Abundance of Gulf of Mexico Red Snapper, *Lutjanus campechanus*	Mark Albins, John Mareska, Sean Powers	13 July 2022
SEDAR74-DW-40	Modeling fecundity at age in Gulf of Mexico Red Snapper to help evaluate the best measure of reproductive potential	Susan Lowerre-Barbieri and Claudia Friess	18 July 2022
Documents Prepared for the Assessment Process			
SEDAR74-AP-01	A meta-analysis of red snapper (*Lutjanus campechanus*) discard mortality in the Gulf of Mexico	Chloe Ramsay, Julie Vecchio, Dominque Lazarre, Beverly Sauls	16 November 2022
SEDAR74-AP-02	Final Report of the SEDAR 74 Ad-hoc Discard Mortality Working Group for	SEDAR 74 Discard Mortality Ad-Hoc Working Group	16 February 2023

	Gulf of Mexico Red Snapper (*Lutjanus campechanus*)		
Documents Prepared for the Review Workshop			
SEDAR74-RW-01	Using stakeholder knowledge to better understand uncertainty in the Gulf of Mexico red snapper stock assessment mode	Carissa L. Gervasi, Matthew McPherson, Mandy Karnauskas, J. Marcus Drymon, Evan Prasky, Hannah Aycock	24 November 2023
Final Stock Assessment Reports			
SEDAR74-SAR1	Gulf of Mexico Red Snapper	SEDAR 74 Panels	
Reference Documents			
SEDAR74-RD01	Data Availability for Red Snapper in Gulf of Mexico and Southeastern U.S. Atlantic Ocean Waters	R. Ryan Rindone, G. Todd Kellison & Stephen A. Bortone	
SEDAR74-RD02	Fine-Scale Movements and Home Ranges of Red Snapper around Artificial Reefs in the Northern Gulf of Mexico	Maria N. Piraino & Stephen T. Szedlmayer	
SEDAR74-RD03	Influence of Age-1 Conspecifics, Sediment Type, Dissolved Oxygen, and the Deepwater Horizon Oil Spill on Recruitment of Age-0 Red Snapper in the Northeast Gulf of Mexico during 2010 and 2011	Stephen T. Szedlmayer & Peter A. Mudrak	
SEDAR74-RD04	Depth and Artificial Reef Type Effects on Size and Distribution of Red Snapper in the Northern Gulf of Mexico	J. Jaxion-Harm & S. T. Szedlmayer	
SEDAR74-RD05	A cage release method to improve fish tagging studies	Laura Jay Williams*, Jennifer L. Herbig, Stephen T. Szedlmayer	

SEDAR74-RD06	Mortality Estimates for Red Snapper Based on Ultrasonic Telemetry in the Northern Gulf of Mexico	Laura Jay Williams-Grove & Stephen T. Szedlmayer
SEDAR74-RD07	Acoustic positioning and movement patterns of red snapper *Lutjanus campechanus* around artificial reefs in the northern Gulf of Mexico	Laura Jay Williams-Grove & Stephen T. Szedlmayer
SEDAR74-RD08	Depth preferences and three-dimensional movements of red snapper, *Lutjanus campechanus*, on an artificial reef in the northern Gulf of Mexico	Laura Jay Williams-Grove & Stephen T. Szedlmayer
SEDAR74-RD09	A Comparison of Fish Assemblages According to Artificial Reef Attributes and Seasons in the Northern Gulf of Mexico	J. Jaxion-Harm, S. T. Szedlmayer & P.A. Mudrak
SEDAR74-RD10	A Comparison of Fish and Epibenthic Assemblages on Artificial Reefs with and without Copper-Based, Anti-Fouling Paint	Stephen T. Szedlmayer & Dianna R. Miller
SEDAR74-RD11	Movement patterns of red snapper *Lutjanus campechanus* based on acoustic telemetry around oil and gas platforms in the northern Gulf of Mexico	Aminda G. Everett, Stephen T. Szedlmayer, Benny J. Gallaway
SEDAR74-RD12	Changes in Shrimping Effort in the Gulf of Mexico and the Impacts to Red Snapper	Benny J. Gallaway, Scott W. Raborn, Laura Picariello, and Nathan F. Putman
SEDAR74-RD13	Using Common Age Units to Communicate the Relative Catch of Red Snapper in Recreational, Commercial, and Shrimp Fisheries in the Gulf of Mexico	Nathan F. Putman & Benny J. Gallaway
SEDAR74-RD14	Distribution and Age Composition of Red Snapper across the Inner Continental Shelf of the North-Central Gulf of Mexico	Sean P. Powers, J. Marcus Drymon,1 Crystal L. Hightower, Trey Spearman, George S. Bosarge, and Amanda Jefferson
SEDAR74-RD15	Age and growth of red snapper, *Lutjanus campechanus*, from an	William F. Patterson III, James H. Cowan Jr, Charles A. Wilson, and Robert L. Shipp

	artificial reef area off Alabama in the northern Gulf of Mexico	
SEDAR74-RD16	Red snapper (*Lutjanus campechanus*) demographic structure in the northern Gulf of Mexico based on spatial patterns in growth rates and morphometrics	Andrew J. Fischer, M. Scott Baker Jr., and Charles A. Wilson
SEDAR74-RD17	Temporal Age Progressions and Relative Year-Class Strength of Gulf of Mexico Red Snapper	Robert J. Allman and Gary R. Fitzhugh
SEDAR74-RD18	Age structure of red snapper (*Lutjanus campechanus*) in the Gulf of Mexico by fishing mode and region	Robert J. Allman, Linda A. Lombardi-Carlson, Gary R. Fitzhugh, and William A. Fable
SEDAR74-RD19	Regional differences in the age and growth of red snapper (*Lutjanus campechanus*) in the U.S. Gulf of Mexico	Courtney R. Saari, James H. Cowan Jr., and Kevin M. Boswell
SEDAR74-RD20	A Comparison of Size Structure, Age, and Growth of Red Snapper from Artificial and Natural Habitats in the Western Gulf of Mexico	Matthew K. Streich, Matthew J. Ajemian, Jennifer J. Wetz, Jason A. Williams, J. Brooke Shipley & Gregory W. Stunz
SEDAR74-RD21	A comparison of size and age of red snapper (*Lutjanus campechanus*) with the age of artificial reefs in the northern Gulf of Mexico	Tara S. Syc and Stephen T. Szedlmayer
SEDAR74-RD22	Age and growth of red snapper, *Lutjanus campechanus,* from the northern Gulf of Mexico off Louisiana	Charles A. Wilson and David L. Nieland
SEDAR74-RD23	Cross-shelf habitat shifts by red snapper (*Lutjanus campechanus*) in the Gulf of Mexico	Michael A. Dance and Jay R. Rooker
SEDAR74-RD24	Habitat-Specific Reproductive Potential of Red Snapper: A Comparison of Artificial and Natural Reefs in the Western Gulf of Mexico	Charles H. Downey, Matthew K. Streich, Rachel A. Brewton, Matthew J. Ajemian, Jennifer J. Wetz, and Gregory W. Stunz
SEDAR74-RD25	A meta-analytical review of the effects of environmental and ecological drivers on the abundance of red snapper	Brad E. Erisman, Derek G. Bolser, Alexander Ilich, Kaitlin E. Frasier, Cassandra N. Glaspie, Paula T.

	(*Lutjanus campechanus*) in the U.S. Gulf of Mexico	Moreno, Andrea Dell'Apa, Kim de Mutsert, Mohammad S. Yassin, Sunil Nepal, Tingting Tang, Alexander E. Sacco
SEDAR74-RD26	Daily movement patterns of red snapper (*Lutjanus campechanus*) on a large artificial reef	Catheline Y.M. Froehlich, Andres Garcia, and Richard J. Kline
SEDAR74-RD27	Movement of Tagged Red Snapper in the Northern Gulf of Mexico	William F. Patterson III, J. Carter Watterson, Robert L. Shipp & James H. Cowan Jr.
SEDAR74-RD28	Did the Deepwater Horizon oil spill affect growth of Red Snapper in the Gulf of Mexico?	Elizabeth S. Herdter, Don P. Chambers, Christopher D. Stallings, and Steven A. Murawski
SEDAR74-RD29	Red Snapper Distribution on Natural Habitats and Artificial Structures in the Northern Gulf of Mexico	Mandy Karnauskas, John F. Walter III, Matthew D. Campbell, Adam G. Pollack, J. Marcus Drymon & Sean Powers
SEDAR74-RD30	Comparison of Reef-Fish Assemblages between Artificial and Geologic Habitats in the Northeastern Gulf of Mexico: Implications for Fishery-Independent Surveys	Sean F. Keenan, Theodore S. Switzer, Kevin A. Thompson, Amanda J. Tyler-Jedlund, and Anthony R. Knapp
SEDAR74-RD31	Estimating Exploitation Rates in the Alabama Red Snapper Fishery Using a High-Reward Tag–Recapture Approach	Dana K. Sackett, Matthew Catalano, Marcus Drymon, Sean Powers, and Mark A. Albins
SEDAR74-RD32	Spatial Heterogeneity, Variable Rewards, Tag Loss, and Tagging Mortality Affect the Performance of Mark–Recapture Designs to Estimate Exploitation: an Example using Red Snapper in the Northern Gulf of Mexico	Dana K. Sackett and Matthew Catalano
SEDAR74-RD33	Modeling the spatial distribution of commercially important reef fishes on the West Florida Shelf	S.E. Saul, J.F. Walter III, D.J. Die, D.F. Naar, B.T. Donahue
SEDAR74-RD34	Descriptions of the U.S. Gulf of Mexico Reef Fish Bottom Longline and Vertical Line Fisheries Based on Observer Data	Elizabeth Scott-Denton, Pat F. Cryer, Judith P. Gocke, Mike R. Harrelson, Donna L. Kinsella, Jeff R. Pulver,

		Rebecca C. Smith, and Jo Anne Williams
SEDAR74-RD35	The potential for unreported artificial reefs to serve as refuges from fishing mortality for reef fishes	Dustin T. Addis, William F. Patterson III, Michael A. Dance, and G. Walter Ingram Jr.
SEDAR74-RD36	Immature and mature female Red Snapper habitat use in the north-central Gulf of Mexico	A.J. Leontiou, Wei Wu, and Nancy J. Brown-Peterson
SEDAR74-RD37	Importance of Depth and Artificial Structure as Predictors of Female Red Snapper Reproductive Parameters	Nancy J. Brown-Peterson, Robert T. Leaf, and Andrea J. Leontiou
SEDAR74-RD38	Demographic differences in northern Gulf of Mexico red snapper reproductive maturation	Melissa W. Jackson, James, H. Cowan, Jr. and David L. Nieland
SEDAR74-RD39	Estimating the Dependence of Spawning Frequency on Size and Age in Gulf of Mexico Red Snapper	C. E. Porch, G. R. Fitzhugh, E. T. Lang, H. M. Lyon & B. C. Linton
SEDAR74-RD40	Regional Differences in Florida Red Snapper Reproduction	Nancy J. Brown-Peterson, Karen M. Burns, and Robin M. Overstreet
SEDAR74-RD41	Multidecadal meta-analysis of reproductive parameters of female red snapper (*Lutjanus campechanus*) in the northern Gulf of Mexico	Nancy J. Brown-Peterson, Christopher R. Peterson, and Gary R. Fitzhugh
SEDAR74-RD42	A Comparison of Red Snapper Reproductive Potential in the Northwestern Gulf of Mexico: Natural versus Artificial Habitats	Hilary D. Glenn, James H. Cowan Jr. & Joseph E. Powers
SEDAR74-RD43	Temporal and spatial comparisons of the reproductive biology of northern Gulf of Mexico (USA) red snapper (*Lutjanus campechanus*) collected a decade apart	Dannielle H. Kulaw, James H. Cowan Jr., and Melissa W. Jackson
SEDAR74-RD44	Effect of circle hook size on reef fish catch rates, species composition, and selectivity in the northern Gulf of Mexico recreational fishery	William F Patterson III, Clay E Porch, Joseph H Tarnecki, and Andrew J Strelcheck

SEDAR74-RD45	Experimental Assessment of Circle Hook Performance and Selectivity in the Northern Gulf of Mexico Recreational Reef Fish Fishery	Steven B. Garner, William F. Patterson III, Clay E. Porch, and Joseph H Tarnecki
SEDAR74-RD46	Simulating effects of hook-size regulations on recreational harvest efficiency in the northern Gulf of Mexico red snapper fishery	Steven B. Garner, William F. Patterson III, John F. Walter, and Clay E. Porch
SEDAR74-RD47	Effect of reef morphology and depth on fish community and trophic structure in the northcentral Gulf of Mexico	Steven B. Garner, Kevin M. Boswell, Justin P. Lewis, Joseph H. Tarnecki, William F. Patterson III
SEDAR74-RD48	Linear decline in red snapper (*Lutjanus campechanus*) otolith D14C extends the utility of the bomb radiocarbon chronometer for fish age validation in the Northern Gulf of Mexico	Beverly K. Barnett, Laura Thornton, Robert Allman, Jeffrey P. Chanton, and William F. Patterson III
SEDAR74-RD49	Changes in Reef Fish Community Structure Following the Deepwater Horizon Oil Spill	Justin P. Lewis, Joseph H. Tarnecki, Steven B. Garner, David D. Chagaris & William F. Patterson III
SEDAR74-RD50	The Utility of Stable and Radioisotopes in Fish Tissues as Biogeochemical Tracers of Marine Oil Spill Food Web Effects	William F. Patterson III, Jeffery P. Chanton, David J. Hollander, Ethan A. Goddard, Beverly K. Barnett, and Joseph H. Tarnecki
SEDAR74-RD51	A Review of Movement in Gulf of Mexico Red Snapper: Implications for Population Structure	William F. Patterson, III
SEDAR74-RD52	Changes in Red Snapper Diet and Trophic Ecology Following the Deepwater Horizon Oil Spill	Joseph H. Tarnecki and William F. Patterson III
SEDAR74-RD53	Population Structure of Red Snapper in the Northern Gulf of Mexico	John R. Gold and Eric Saillant
SEDAR74-RD54	Mitochondrial DNA variation among red snapper (*Lutjanus campechanus*) from the Gulf of Mexico	Jeff Camper, John R. Gold, and Robert C. Barber
SEDAR74-RD55	A molecular approach to stock identification and recruitment patterns in red snapper (*Lutjanus campechanus*)	R.W. Chapman, S.A. Bortone, and C.M. Woodley

SEDAR74-RD56	Stock Structure, connectivity, and effective population size of red snapper (*Lutjanus campechanus*) in the U.S. waters of the Gulf of Mexico	David S. Portnoy
SEDAR74-RD57	Mitochondrial DNA variation among 'red' fishes from the Gulf of Mexico	John R. Gold and Linda R. Richardson
SEDAR74-RD58	Population structure of red snapper (Lutjanus campechanus) in U.S. waters of the western Atlantic Ocean and the northeastern Gulf of Mexico	Christopher M. Hollenbeck, David S. Portnoy, Eric Saillant, John R. Gold
SEDAR74-RD59	Population structure and variance effective size of red snapper (*Lutjanus campechanus*) in the northern Gulf of Mexico	Eric Saillant and John R. Gold
SEDAR74-RD60	Population Structure and Variation in Red Snapper (Lutjanus campechanus) from the Gulf of Mexico and Atlantic Coast of Florida as Determined from Mitochondrial DNA Control Region Sequence	Amber F. Garber, Michael D. Tringall and Kenneth C. Stuck
SEDAR74-RD61	Genetic homogeneity among geographic samples of snappers and groupers: evidence of continuous gene flow	John R. Gold and Linda R. Richardson
SEDAR74-RD62	Population Structure of Red Snapper from the Gulf of Mexico as Inferred from Analysis of Mitochondrial DNA	J. R. Gold, E Sun, and L. R. Richardson
SEDAR74-RD63	DNA Microsatellite Loci and Genetic Structure of Red Snapper in the Gulf of Mexico	Ed Heist and John R. Gold
SEDAR74-RD64	Genetic impacts of shrimp trawling on red snapper (Lutjanus campechanus) in the northern Gulf of Mexico	Eric Saillant, S. Coleen Bradfield, and John R. Gold
SEDAR74-RD65	Genetic variation and spatial autocorrelation among young-of-the-year red snapper (*Lutjanus campechanus*) in the northern Gulf of Mexico	Eric Saillant, S. Coleen Bradfield, and John R. Gold

SEDAR74-RD66	Connections between Campeche Bank and Red Snapper Populations in the Gulf of Mexico via Modeled Larval Transport	Donald R. Johnson, Harriet M. Perry, and Joanne Lyczkowski-Shultz
SEDAR74-RD67	Red snapper, *Lutjanus campechanus*, larval dispersal in the Gulf of Mexico	Donald R. Johnson and Harriet M. Perry
SEDAR74-RD68	Historical population demography of red snapper (*Lutjanus campechanus*) from the northern Gulf of Mexico based on analysis of sequences of mitochondrial DNA	Christin L. Pruett, Eric Saillant, and John R. Gold
SEDAR74-RD69	Microsatellite Variation Among Red Snapper (*Lutjanus campechanus*) from the Gulf of Mexico	John R. Gold, Elena Pak, and Linda R. Richardson
SEDAR74-RD70	Genomics overrules mitochondrial DNA, siding with morphology on a controversial case of species delimitation	Carmen del R. Pedraza-Marron, Raimundo Silva, Jonathan Deeds, Steven M. Van Belleghem, Alicia Mastretta-Yanes, Omar Domınguez-Domı´nguez, Rafael A. Rivero-Vega, Loretta Lutackas, Debra Murie, Daryl Parkyn, Lewis H. Bullock, Kristin Foss, Humberto Ortiz-Zuazaga, Juan Narvaez-Barandica, Arturo Acero, Grazielle Gomes, and Ricardo Betancur-R
SEDAR74-RD71	SEDAR52-WP-20: Use of the Connectivity Modeling System to estimate movements of red snapper (*Lutjanus campechanus*) recruits in the northern Gulf of Mexico	M. Karnauskas, J. F. Walter III, and C. B. Paris
SEDAR74-RD72	Fine-scale partitioning of genomic variation among recruits in an exploited fishery: causes and consequences	Jonathan B. Puritz, John R. Gold & David S. Portnoy
SEDAR74-RD73	Historical Population dynamics of red snapper (*Lutjanus campechanus)* in the northern Gulf of Mexico	J. R. Gold and C. P. Burridge
SEDAR74-RD74	Red Snapper Larval Transport in the Northern Gulf of Mexico	Donald R. Johnson, Harriet M. Perry, Joanne Lyczkowski-Shultz & David Hanisko

SEDAR74-RD75	Talking Smack: the archaeology and history of Pensacola's red snapper fishing industry	Nicole Rae Bucchino
SEDAR74-RD76	Distribution, Abundance, and Age Structure of Red Snapper (*Lutjanus campechanus*) Caught on research Longlines in the U.S. Gulf of Mexico	Karen M. Mitchell, Terry Henwood, Gary R. Fitzhugh, and Robert J. Allman
SEDAR74-RD77	SEDAR31-DW15: Spatio-temporal dynamics in red snapper reproduction on the West Florida Shelf, 2008-2011	Susan Lowerre-Barbieri, Laura Crabtree, Theodore S. Switzer, and Robert H. McMichael, Jr.
SEDAR74-RD78	SEDAR52-WP-15: Reproductive data compiled for the Gulf of Mexico Red Snapper, *Lutjanus campechanus*, SEDAR 52	G.R. Fitzhugh, H.M. Lyon, V.C. Beech, P.M. Colson
SEDAR74-RD79	Trophic ecology of red snapper *Lutjanus campechanus* on natural and artificial reefs: interactions between annual variability, habitat, and ontogeny	Rachel A. Brewton, Charles H. Downey, Matthew K. Streich, Jennifer J. Wetz, Matthew J. Ajemian, Gregory W. Stunz
SEDAR74-RD80	Comparing reproductive capacity of nearshore and offshore red snapper, *Lutjanus campechanus*, on artificial reefs in the western Gulf of Mexico	Ricky J. Alexander
SEDAR74-RD81	Reduction of juvenile red snapper bycatch in the U.S. Gulf of Mexico shrimp trawl fishery	Benny J. Gallaway and John G. Cole
SEDAR74-RD82	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	Benny J. Gallaway, Stephen T. Szedlmayer, and William J. Gazey
SEDAR74-RD83	Delineation of Essential Habitat for Juvenile Red Snapper in the Northwestern Gulf of Mexico	Benny J. Gallaway, John G. Cole, Robert Meyer, and Pasquale Roscigno
SEDAR74-RD84	Retrospective Analysis of Midsummer Hypoxic Area and Volume in the Northern Gulf of Mexico, 1985–2011	Daniel R. Obenour, Donald Scavia, Nancy N. Rabalais, R. Eugene Turner, and Anna M. Michalak

SEDAR74-RD85	Space-Time Geostatistical Assessment of Hypoxia in the Northern Gulf of Mexico	V. Rohith Reddy Matli, Shiqi Fang, Joseph Guinness, Nancy. N. Rabalais, J. Kevin Craig, and Daniel R. Obenour
SEDAR74-RD86	Fusion-Based Hypoxia Estimates: Combining Geostatistical and Mechanistic Models of Dissolved Oxygen Variability	Venkata Rohith Reddy Matli, Arnaud Laurent, Katja Fennel, Kevin Craig, Jacob Krause, and Daniel R. Obenour
SEDAR74-RD87	Application of three-dimensional acoustic telemetry to assess the effects of rapid recompression on reef fish discard mortality	Erin Collings Bohaboy, Tristan L. Guttridge, Neil Hammerschlag, Maurits P. M. Van Zinnicq Bergmann, and William F. Patterson III
SEDAR74-RD88	The Great Red Snapper Count: Estimating the Absolute Abundance of Age-2+ Red Snapper (*Lutjanus campechanus*) in the U.S. Gulf of Mexico	Stunz, G. W., W. F. Patterson III, S. P. Powers, J. H. Cowan, Jr., J. R. Rooker, R. A. Ahrens, K. Boswell, L. Carleton, M. Catalano, J. M. Drymon, J. Hoenig, R. Leaf, V. Lecours, S. Murawski, D. Portnoy, E. Saillant, L. S. Stokes., and R. J. D. Wells
SEDAR74-RD89	Spawning origins and ontogenetic movements for demersal fishes: An approach using eye-lens stable isotopes	Julie L. Vecchio, Ernst B. Peebles
SEDAR74-RD90	Discard mortality of red snapper released with descender devices in the U.S. South Atlantic	Brendan J. Rhunde, Nathan M. Bacheler, Kyle W. Shertzer, Paul J. Rudershausen, Beverly Sauls, and Jeffrey A. Buckel
SEDAR74-RD91	Spatial and Temporal Influences of Nearshore Hydrography on Fish Assemblages Associated with Energy Platforms in the Northern Gulf of Mexico	Ryan T. Munnelly, David B. Reeves, Edward J. Chesney, Donald M. Baltz
SEDAR74-RD92	Lessons learned from practical approaches to reconcile mismatches between biological population structure and stock units of marine fish	Lisa A. Kerr, Niels T. Hintzen, Steven X. Cadrin, Lotte Worsøe Clausen, Mark Dickey- Collas, Daniel R. Goethel, Emma M.C. Hatfield, Jacob P. Kritzer, and Richard D.M. Nash
SEDAR74-RD93	Defining spatial structure for fishery stock assessment	Steven X. Cadrin
SEDAR74-RD94	Genomic analysis of red snapper, *Lutjanus campechanus*, population	David S. Portnoy, Andrew T. Fields, Jonathan B. Puritz, Christopher M.

	structure in the U.S. Atlantic and Gulf of Mexico	Hollenbeck, and William F. Patterson, III
SEDAR74-RD95	A simulation framework to assess management trade-offs associated with recreational harvest slots, discard mortality reduction, and bycatch accountability in a multi-sector fishery	Erin C. Bohaboy, Daniel R. Goethel, Shannon L. Cass-Calay, William F. Patterson III
SEDAR74-RD96	Quantifying Delayed Mortality from Barotrauma Impairment in Discarded Red Snapper Using Acoustic Telemetry	Judson M. Curtis, Matthew W. Johnson, Sandra L. Diamond & Gregory W. Stunz
SEDAR74-RD97	Venting and Reef Fish Survival: Perceptions and Participation Rates among Recreational Anglers in the Northern Gulf of Mexico	Steven B. Scyphers, F. Joel Fodrie, Frank J. Hernandez Jr., Sean P. Powers & Robert L. Shipp
SEDAR74-RD98	Testing the efficacy of recompression tools to reduce the discard mortality of reef fishes in the Gulf of Mexico	Oscar E. Ayala
SEDAR74-RD99	Understanding resource-conserving behaviors among fishers: Barotrauma mitigation and the power of subjective norms in Florida's reef fisheries	Chelsey A. Crandall, Taryn M. Garlock, and Kai Lorenzen
SEDAR74-RD100	Recreational angler attitudes and perceptions regarding the use of descending devices in Southeast reef fish fisheries	Judson M. Curtis, Alex K. Tomkins, Andrew J. Loftus, and Gregory W. Stunz
SEDAR74-RD101	Venting or rapid recompression increase survival and improve recovery of red snapper with barotrauma	Karen L. Drumhiller, Matthew W. Johnson, Sandra L. Diamond, Megan M. Reese Robillard and Gregory W. Stunz
SEDAR74-RD102	Descender devices or treat tethers: Does barotrauma mitigation increase opportunities for depredation?	J. Marcus Drymon, Amanda E. Jefferson, Crystal Louallen-Hightower, and Sean P. Powers
SEDAR74-RD103	Sink or swim? Factors affecting immediate discard mortality for the Gulf of Mexico commercial reef fishery	J.R. Pulver
SEDAR74-RD104	Techniques for minimizing discard mortality of GoM of Mexico red	Gregory W. Stunz, Judson M. Curtis, and Alex Tompkins

	snapper and validating survival with acoustic telemetry	
SEDAR74-RD105	Utility of rapid recompression devices in the Gulf of Mexico red snapper fishery	Alex A. Tompkins
SEDAR74-RD106	Gulf of Mexico Fishery Ecosystem Plan	LGL Ecological Research Associates, Inc.
SEDAR74-RD107	Laser ablation–accelerator mass spectrometry reveals complete bomb 14C signal in an otolith with confirmation of 60-year longevity for red snapper (*Lutjanus campechanus*)	Allen H. Andrews, Christiane Yeman, Caroline Welte, Bodo Hattendorf, Lukas Wacker and Marcus Christl
SEDAR74-RD108	S68-DW-13: Marine Recreational Information Program Metadata for the Atlantic, Gulf of Mexico, and Caribbean regions	Vivian M. Matter and Matthew A. Nuttall
SEDAR74-RD109	S70-WP-03: Texas Parks and Wildlife Department's Marine Sport-Harvest Monitoring Program Metadata	Matthew A. Nuttall and Vivian M. Matter
SEDAR74-RD110	Texas Fishing Effort Survey - Final Project Report	NMFS Office of Science and Technology
SEDAR74-RD111	Artificial Attraction: Linking Vessel Monitoring System and Habitat Data to Assess Commercial Exploitation on Artificial Structures in the Gulf of Mexico	Christopher Gardner, Daniel R. Goethel, Mandy Karnauskas, Matthew W. Smith, Larry Perruso and John F. Walter III
SEDAR74-RD112	S68-DW-11: Estimates of Historic Recreational Landings of Scamp and Yellowmouth Grouper in the South Atlantic Using the FHWAR Census Method	Ken Brennan
SEDAR74-RD113	Understanding and Enhancing Angler Satisfaction with Fisheries Management: Insights from the "Great Red Snapper Count"	Steven B. Scyphers, J. Marcus Drymon, Kelsi L. Furman, Elizabeth Conley, Yvette Niwa, Amanda E. Jefferson, and Gregory W. Stunz
SEDAR74-RD114	Assessing reproductive resilience: an example with South Atlantic red snapper *Lutjanus campechanus*	Susan Lowerre-Barbieri, Laura Crabtree, Theodore Switzer, Sarah Walters Burnsed, Cameron Guenther

SEDAR74-RD115	Relative Effects of Multiple Stressors on Reef Food Webs in the Northern Gulf of Mexico Revealed via Ecosystem Modeling	David D. Chagaris, William F. Patterson III and Michael S. Allen

Performance Work Statement (PWS)
National Oceanic and Atmospheric Administration (NOAA)
National Marine Fisheries Service (NMFS)
Center for Independent Experts (CIE) Program
External Independent Peer Review
Under Contract #1305M219DNFFK0025

SEDAR 74 Gulf of Mexico Red Snapper Review

Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer reviews of highly influential and controversial science before dissemination, and that peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards[1].

Scope

The **SouthEast Data, Assessment, and Review (SEDAR)** is the cooperative process by which stock assessment projects are conducted in NMFS' Southeast Region. SEDAR was initiated to improve planning and coordination of stock assessment activities and to improve the quality and reliability of assessments.

The SEDAR 74 review workshop will be a CIE assessment review of the Research Track Assessment of 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

[1] https://www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/memoranda/2005/m05-03.pdf

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 assessment is appropriate for use by fishery managers.

The specified format and contents of the individual peer review reports are found in **Annex 1**. The Terms of Reference (TORs) of the peer review are listed in **Annex 2**. Lastly, the tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements
NMFS requires three (3) reviewers to conduct an impartial and independent peer review in accordance with this Performance Work Statement (PWS), OMB guidelines, and the TORs below. The reviewers shall have a working knowledge 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 fisheries stock assessment. Expertise in Stock Synthesis and the usage of age vs length structured modeling approaches and the associated diagnostics would be helpful.

The chair, who is in addition to the three reviewers, will not be provided by the CIE. Although the chair will be participating in this review, the chair's participation (e.g., labor and travel) is not covered by this contract.

Tasks
Task 1) Review Preparation

- Two weeks before the peer review, the Project Contacts will make all necessary background information and reports available electronically to the reviewers for the peer review. In the case where the documents need to be mailed, the Project Contacts will consult with the contractor 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 PWS scheduled deadlines specified herein.
- The CIE reviewers shall read all documents in preparation for the peer review.

The SEDAR 74 Stock ID Process and Data Workshop final reports, along with all associated working papers and reference documents, are currently available for download from the SEDAR website:

https://sedarweb.org/assessments/sedar-74/

The final Assessment Process report will be posted on the same website when available.

Task 2) Complete Panel Review Meeting

- Attend and participate in the panel review meeting. See annex 3 for additional information.

- The meeting will consist of presentations by NOAA and other scientists, stock assessment authors and others to facilitate the review, to answer any questions from the reviewers, and to provide any additional information required by the reviewers.

Task 3) Complete Independent Peer Review

- After the review meeting, reviewers shall conduct their independent peer review report in accordance with the requirements specified in this PWS, OMB guidelines, and TORs, in adherence with the required formatting and content guidelines; reviewers are not required to reach a consensus.
- Each reviewer shall then complete an independent peer review report in accordance with the requirements specified in this PWS, OMB guidelines, and TORs, in adherence with the required formatting and content guidelines.
- Reviewers are not required to reach a consensus.

Task 4) Contributions to the Summary Report

- Each reviewer shall assist the Chair of the meeting with contributions to the summary report.

Task 5) Final Peer Review and Summary Report

- Deliver their reports to the Government according to the specified milestones dates.

Foreign National Security Clearance

When 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 reviewers who are non-US citizens. For this reason, the reviewers shall provide 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 their security clearance. This information shall be submitted at least 30 days in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Foreign National Guest website. The contractor is required to use all appropriate methods to safeguard Personally Identifiable Information (PII).

Place of Performance

The place of performance shall be at the contractor's facilities, and in Tampa, FL.

Period of Performance

The period of performance shall be from the time of award through January 2024. Each CIE reviewer's duties shall not exceed 14 days to complete all required tasks.

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

Within two weeks of award	Contractor selects and confirms reviewers
2 weeks prior to the panel review	Contractor provides the pre-review documents to the reviewers
Dec 12-15, 2023	Panel review meeting in Tampa, Florida
Approximately 4 weeks later	Reviewers submit draft peer-review reports to the contractor for quality assurance and review
Within 2 weeks of receiving draft reports	Contractor submits independent Peer-Review reports to the Government

*The Chair's Summary Report will not be submitted to, reviewed, or approved by the Contractor.

Applicable Performance Standards
The acceptance of the contract deliverables shall be based on three performance standards: (1) The reports shall be completed in accordance with the required formatting and content; (2) The reports shall address each TOR as specified; and (3) The reports shall be delivered as specified in the schedule of milestones and deliverables.

Confidentiality and Data Privacy
This contract may require that services contractors have access to Privacy Information. Services contractors are responsible for maintaining the confidentiality of all subjects and materials and may be required to sign and adhere to a Non-disclosure Agreement (NDA).

Travel
All travel expenses shall be reimbursable in accordance with Federal Travel Regulations (http://www.gsa.gov/portal/content/104790), and all contractor travel must be approved by the COR prior to the actual travel. Any travel conducted prior to the receipt of proper written authorization from the COR will be done at the Contractor's own risk and expense. International travel is authorized for this contract. Travel is not to exceed $10,000.

Government Furnished Resources
The Government will provide all necessary information, data and documents to the Contractor for work required under this contract.

Project Contacts:
Larry Massey – NMFS Project Contact
150 Du Rhu Drive, Mobile, AL 36608
(386) 561-7080
larry.massey@noaa.gov

Julie Neer - SEDAR Coordinator
South Atlantic Fishery Management Council
4055 Faber Place Drive, Suite 201 North Charleston, SC 29405
julie.neer@safmc.net

Annex 1: Peer Review Report Requirements

1. The report must be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the science reviewed is adequate.

2. The report must contain a background section, description of the individual reviewers' roles 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 must describe in their own words the review activities completed during the panel review meeting, including a brief summary of findings, of the science, conclusions, and recommendations.

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

   c. Reviewers shall elaborate on any points raised in the summary report that they believe 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 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 report shall represent the peer review of each TOR, and shall not simply repeat the contents of the summary report.

3. The report shall include the following appendices:

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

Annex 2: Terms of Reference for the Peer Review
SEDAR 74 Gulf of Mexico Red Snapper Review
Review Workshop Terms of Reference

Review Workshop Terms of Reference

1. Evaluate the data used in the assessment, including discussion of the strengths and weaknesses of data sources and decisions. Consider the following:
   - Are data decisions made by the Data and Assessment processes justified?
   - Are data uncertainties acknowledged, reported, and within normal or expected levels?
   - Is the appropriate model applied properly to the available data?
   - Are input data series sufficient to support the assessment approach?

2. Evaluate and discuss the strengths and weaknesses of the methods used to assess the stock, taking into account the available data. Consider the following:
   - Are methods scientifically sound and robust?
   - Are priority modeling issues clearly stated and addressed?
   - Are the methods appropriate for the available data?
   - Are assessment models configured properly and used in a manner consistent with standard practices?

3. 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.
   - Comment on the likely relationship of this variability with possible ecosystem or climate factors and possible mechanisms for encompassing this into management reference points.

4. Provide, or comment on, recommendations to improve the assessment
   - Consider the research recommendations provided by the Data and Assessment processes in the context of overall improvement to the assessment, and make any additional research recommendations warranted.
   - If applicable, provide recommendations for improvement or for addressing any inadequacies identified in the data or assessment modeling. These recommendations should be described in sufficient detail for application, and should be practical for short-term implementation (e.g., achievable within ~6 months). Longer-term recommendations should instead be listed as research recommendations above.

5. Provide recommendations on possible ways to improve the Research Track Assessment process.

6. Prepare a Review Workshop Summary Report describing the Panel’s evaluation of the Research Track stock assessment and addressing each Term of Reference.

Annex 3: Tentative Agenda - SEDAR 74 Gulf of Mexico Red Snapper Research Track Assessment Review

Tampa, FL

Dec 12-15, 2023

Tuesday:

9:00 a.m.	**Introductions and Opening Remarks** *- Agenda Review, TOR, Task Assignments*	**Coordinator**
9:30 a.m. – 12:00 p.m.	**Assessment Presentations** **-** *Assessment Data & Methods* *- Identify additional analyses, sensitivities, corrections*	**Analytic Team**
12:00 p.m. – 1:00 p.m.	**Lunch Break**	
1:00 p.m. – 4:30 p.m.	**Assessment Presentations (continued)** **-** *Assessment Data & Methods* *- Identify additional analyses, sensitivities, corrections*	**Analytic Team**
4:30 p.m. – 5:00 p.m.	**ToR Review and Daily wrap up**	**Chair**
5:00 p.m. – 5:30 p.m.	**Public comment**	**Chair**

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

Wednesday:

9:00 a.m. – 12: p.m.	**Panel Discussion** **-** *Assessment Data & Methods* *- Identify additional analyses, sensitivities, corrections*	**Chair**
12:00 p.m. – 1:00 p.m.	**Lunch Break**	
1:00 p.m. – 4:30 p.m.	**Panel Discussion/Panel Work Session** *- Continue deliberations* *- Review additional analyses* *- Recommendations and comments*	**Chair**
4:30 p.m. – 5:00 p.m.	**ToR Review and Daily wrap up**	**Chair**
5:00 p.m. – 5:30 p.m.	**Public comment**	**Chair**

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

Thursday

9:00 a.m. – 12: p.m.	**Panel Discussion** **-** *Assessment Data & Methods* *- Identify additional analyses, sensitivities, corrections*	**Chair**
12:00 p.m. – 1:00 p.m.	**Lunch Break**	
1:00 p.m. – 4:30 p.m.	**Panel Discussion/Panel Work Session** *- Continue deliberations* *- Review additional analyses* *- Recommendations and comments*	**Chair**
4:30 p.m. – 5:00 p.m.	**ToR Review and Daily wrap up**	**Chair**
5:00 p.m. – 5:30 p.m.	**Public comment**	**Chair**

Thursday Goals: sensitivities and modifications identified, preferred models selected, projection analysis reviewed, Report draft continued

Friday

90:00 a.m. – 12:00 p.m.	**Panel Discussion**	**Chair**
	- Final sensitivities reviewed.	
	- Projections reviewed.	**Chair**
12:00 p.m. – 1:00 p.m.	**Lunch Break**	
1:00 p.m. – 4:00 p.m.	**Panel Discussion or Work Session**	**Chair**
	- *Review Reports*	
4:30 p.m. – 5:00 p.m.	**Public comment**	**Chair**
5:00 p.m.	**ADJOURN**	

Friday Goals: Complete assessment work and discussions, final base configuration available. Draft Reports reviewed.

Appendix 3: Panel membership or other pertinent information from the panel review meeting.

LIST OF PARTICIPANTS

Review Workshop Participants

Review Panel

Jim Nance (Chair)..GMFMC SSC
Mike Allen..GMFMC SSC
Matt Cieri..CIE Reviewer
Patrick Cordue..CIE Reviewer
Edvin Fuglebakk..CIE Reviewer
Sean Powers..GMFMC SSC
Steven Saul..GMFMC SSC

Analytic Team

LaTreese Denson..NMFS SEFSC
Matt Smith..NMFS SEFSC
Katie Siegfried..NMFS SEFSC

Appointed Observers

Pat Neukam..Charter/Commercial Fisherman
Dylan Hubbard..Fisherman

Council Representation

JD Dugas..Louisiana
Tom Frazer..Florida

Staff

Julie A Neer..SEDAR
Ryan Rindone..GMFMC Staff
Charlotte Schiaffo..GMFMC Staff

Workshop Observers

Luiz Barbieri..FWC
Max Birdsong..GMFMC Staff
John Froeschke..GMFMC Staff
Michael Drexler..Ocean Conservancy
Carissa Gervasi..NMFS SEFSC
Tiffany Hopper..TPWD
Challen Hyman..USF
Emily Muehlstein..GMFMC Staff
Bernie Roy..GMFMC Staff
Beverly Sauls..FWC
Carrie Simmons..GMFMC Staff
Carly Somerset..GMFMC Staff
Molly Stevens..NMFS SEFSC
Andy Strelcheck..SERO
Nathan Vaughan..NMFS SEFSC

Ed Walker..GMFMC
Sean Williams .... FWC

Workshop Observers via Webinar
Jason Adriance ....LADWF
Lisa Ailloud .... NMFS SEFSC
Steven Atran...
Kevin Anson ....GMFMC
Hannah Aycock ....
Kelsey Banks .... TAMUCC
Scott Bannon...AL DCNR
Jeff Barger..Ocean Conservancy
Beverly Barnett .... NMFS SEFSC
Samantha Binion-Rock ....NMFS SEEFSC
Kristan Blackhart .... NOAA
Harry Blanchet..LADWF
Ken Brennan .... NMFS SEFSC
James Bruce ....
Shannon Cass-Calay .... NMFS SEFSC
David Chagaris .... UFL
Rob Cheshire .... NMFS SEFSC
Manuel Coffill-Rivera..
Chip Collier ....SAFMC Staff
Juan Cortes...
Tiffanie Cross...FWC
Judd Curtis ....SAFMC Staff
David Die..University of Miami
Leonardo Eguia..
Thomas Flanagan...
Francesca Forrestal .... NMFS SEFSC
Steve Garner ....NOAA
Dakus Geeslin .... TPWD
Bob Gill ....GMFMC
Martha Guyas..ASA
David Hanisko .... NMFS SEFSC
Katie Harrington ....Mote Marine Lab
Meisha Key ....SEDAR
Michael Larkin...SERO
Max Lee ....Mote Marine Lab
Mara Levy...NOAA
Susan Lowerre-Barbieri..FWC
Daniel Luers...NOAA
John Mareska .... ALDCNR
Vivian Matter .... NMFS SEFSC
Maria McGirl ....FWC
Jack McGovern...SERO
Matthew Nuttall .... NMFS SEFSC

Adam Pollack.. NMFS SEFSC
Chloe Ramsay .... FWC
Ashford Rosenberg ....Shareholders Alliance
Skyler Sagarese.. NMFS SEFSC
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Mike Schmidtke..SAFMC Staff
Camilla Shireman ....
Matt Streich .... TAMUCC
Kevin Thompson.. NMFS SEFSC
James Tolan.. TPWD
Brendan Turley .... NMFS SEFSC
Ana Vaz... NMFS SEFSC