Independent Peer Review of the SEDAR 74 Gulf of Mexico Red Snapper Review

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Individual Independent Peer Reviewer Report

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1. Executive Summary

I have reviewed the model proposed for stock assessment of Red Snapper (*Lutjanus campechanus*) in the Gulf of Mexico, that was presented for the SEDAR 74 research track review. Together with other reviewers, I have identified several concerns related to data handling and model configuration and cannot at this point recommend that the model be pursued in a SEDAR operational track. The most important of my concerns relate to how uncertainty in fish removals are handled, and in how the complexity of the model is managed. We have also identified issues with the SEDAR research track process, which I believe makes it unlikely that another conclusion could be reached at this point. The main issue is that the assessment team was given tasks that were not aligned with the data provisions that could be made. The model presented to the review panel had therefore not been subject to the usual critical evaluation that the assessment team would perform themselves, since final model diagnostics cannot be run until data are provided.

I find that the research has been conducted with adequate scientific standards and rigor, and explored relevant modeling approaches for meeting the specific challenges of this stock and fisheries. Partly the research indicates negative conclusions, that some of the explored model constructs do not provide a good fit for the stock. Partly the research is not conclusive, mainly due to limitations in data provisions.

2. Background

This review evaluated a proposal for a new stock assessment model for the Red Snapper (*Lutjanus campechanus*) in the Gulf of Mexico. The proposal has been developed through a SEDAR research track (SouthEast Data, Assessment and Review), was evaluated through the SEDAR process, and the review is identified as *SEDAR 74* (see Annex 2). The review panel consisted of three reviewers from Center for Independent Experts (CIE), three reviewers participating as members of the Gulf Scientific and Statistical committee (Gulf SSC), and a chair. The review took place in Tampa, Florida on Dec 12-15 2023. In addition to the Terms of Reference (see Annex 2) the panel commented on whether the proposed assessment model should be further developed in a SEDAR operational track assessment.

The panel jointly wrote a summary report (“SEDAR 74 Red Snapper Research Track Peer Review Summary Report”). In addition, each of the CIE reviewers wrote independent reports, of which this is one.

The Red Snapper fisheries in the Gulf of Mexico is a regulated fishery that is monitored by both fisheries dependent and fisheries independent methods. It is currently assessed with the methods reviewed in *SEDAR 52*. Key challenges for the assessment include frequent changes in regulation, and a fishing mortality pattern dominated by discards and recreational fishing.

3. Reviewer role

I participated in this review as an expert in sampling, applied statistics and stock assessment. I do not have expertise concerning the biology of the Red Snapper or the ecology or fisheries in the Gulf of Mexico. I received background material in due time and read those in preparation for the panel review meeting in Tampa. At the request of the assessment team, I participated in an online pre-workshop meeting, where reviewers were invited to provide input for the presentations at the workshop, in particular any input that would require intensive computations. At the panel review meeting in Tampa we received informative presentations from the assessment team, and had opportunity to ask questions and have discussions during and after presentations. I participated in all these discussions and contributed particularly to discussions about data handling and model validation. The review panel spent a good amount of time at the meeting discussing joint recommendations that are provided in the *SEDAR 74 Red Snapper Research Track Peer Review Summary Report*. Mostly, I find myself in agreement with other reviewers about the topics that were discussed. One exception is discussed in this report, and I have also included in here a few topics that were not discussed at the meeting. One example is my concern about interaction with other nations' fisheries, which I did not think of until the end of the meeting. Another is the motivation for investigating a two-stock model, which was suggested by another reviewer in post-meeting correspondence. I also treat model selection and model validation in much more detail than what we had opportunity to discuss at the panel review meeting.

4. Comments on NMFS review processes

The National Marine Fisheries Service (NMFS) review process worked well. The reading material was delivered in due time before the panel review took place, and the on-site panel review was very useful in clarifying questions about the assessment, the modeling and the research track process. The reviewers were given ample time for discussions, both with the assessment team and between themselves. The assessment team provided well prepared presentations and the public comments provided useful insights.

I do think the review process would have been more useful for the development of the assessment if it had been arranged later in the process. The results presented to the reviewers were obtained using preliminary data. I will remark on this several times in this report and it is my opinion that even research track reviews are best conducted after final data preparations. This is because the assessment team will not have finished their own critical review of the model until these data are provided. A scientific product is best put under review after the scientists developing it themselves have deemed it to be ready. While I hope that feedback from reviewers will be supporting further development, similar advice could have been solicited by less formal mechanisms than a panel review.

The background material (Appendix 1) was well organized, but rather extensive for a 14 day contract. The SEDAR website did a good job of identifying the documents that needed careful study and it is extremely valuable to have so much detail readily available as questions come up during the review. Still I feel that the obligation to read all the provided material conflicts with the need to study selected material in depth. I think the NMFS process would benefit from a clear distinction between what material reviewers should be well familiarized with and what they are only expected to have read quickly. The process needs some clear guidelines for what volume of material it is acceptable to provide for mandatory reading. As it is hard to predict which material will prove valuable in providing additional detail, I think it would be acceptable to provide unlimited background material, as long as reviewers are not obliged by contract to take time away from studying the most central documents.

The *Great Red Snapper Count* study was an important source of information to be considered for this assessment. An important part of that consideration was to critically assess whether this study can be considered to have obtained reliable bounds on the absolute abundance of Red Snapper in the Gulf of Mexico. As the Great Red Snapper Count has been peer-reviewed before, it would have been a great support if those review reports were included in the background material, or at least referenced in the main reports. If they were deliberately excluded in order to obtain an independent consideration, this should have been made explicit in the Terms of Reference, as those reviews are publicly available.

5. Findings

5.1 Data provisions

For research track assessments it is acceptable that models are developed and diagnosed with historic data, but the data need to be obtained with the same accuracy standards as for operational assessments. Important compositional data were not estimated for use in the model. Rather than accurate estimates of frequencies of age and length groups, probably biased raw frequency data were used instead (these are referred to as nominal length and age compositions in SEDAR74-SAR1-Section IV). Fish-stock assessment models are based on approximations and theory and usually rely on estimation of latent variables. They can therefore not be evaluated purely based on consideration of model structure and data quality, but must be subject to diagnostic analysis. Such diagnostics cannot be interpreted for models parameterized against inaccurate data. The use of nominal compositional data was not decided by the assessment team, but was rather dictated by the kind of data provision facilitated by the research track process. At the same time, the SEDAR 74 workshops had Terms of Reference that mandated investigation of spatial structures and fleet structures not used in the operational track assessment. Historical compositional data provided for the operational track assessment could therefore not be used. I find that the mandate for the research track was not aligned with the data provisions available to them, and find it premature to arrange a panel review before the assessment team has been able to do their own critical evaluation of final model diagnostics.

5.2 Information from other nations

The Stock-ID workshop presents detailed considerations of migration and spatial variation in Red Snapper habitat and fisheries for the part of the Gulf of Mexico that falls withing the exclusive economic zone of the USA. I found it striking that no discussion was provided about what is known about Red Snapper stock dynamics and fishery dynamics south of the US border. It is of course understandable if exchange of detailed data is limited across national administrations, but that is not given and I would have expected it to be explicitly treated in the Stock-ID report. Even if exchange of detailed data does not take place, there is probably public information that could be considered to understand the risk of partial data coverage of the stock. The assessment model is based on an assumption that the stock harvested by US fisheries can be fully understood if it is decoupled from the fisheries in other coastal nations. This assumption should have been made explicit and discussed.

5.3 Data - utilization of age-composition

One clear example of how model development is dependent on accurate data is the use of model fits to make decisions on model structure and which data streams to utilize. In the proposed model inaccurate composition data was used in this manner to exclude age-composition data in favor of length composition data for landings. While the panel was given a careful justification for this decision in a presentation, it was mainly based on analysis with preliminary and inaccurate composition data. Those analyses should be revisited with accurate data. Should the conclusions about which compositional data streams are best suited for the model stand with updated data, a careful analysis should be conducted to understand why. For instance the relative precision of length-composition estimates and age-composition estimates could be investigated. The value of age data over length data is generally recognized and Stock Synthesis is fundamentally an age-structured model (Methot & Wetzel 2013, Appendix A). We therefore have strong reasons to expect that the model is best parameterized directly against age-composition data, rather than through a fit to length-compositions. I consider these prior notions more important than subtle model fit indicators, unless a clear explanation is obtained for why the age-compositions are not suited. It is argued in the assessment process report (SEDAR74-SAR1-Section IV) that many of the variables governing stock dynamics are better predicted by knowledge of length than of age. That is often true for parameters such as maturation and selectivity. I consider those arguments as support for using a length-structured assessment model, rather than favoring an indirect parametrization of an age-structured model. It should also be noted that such considerations are balanced by other arguments favoring age-structured models. For instance the probability of transitioning between length groups between observations of the stock typically have to be estimated for length-structured models, while the transitioning between age-groups can be calculated from the time between observations.

When configuring the model for these preliminary composition data, the assessment team did in many cases use the number of fish sampled as indicators of sample size. They do not suggest that this configuration will be applied when accurate data are delivered, and I would recommend that this configuration not be applied. In multi-stage sampling designs, I do not think the number of ultimate sampling units should be considered the effective sample size unless one can justify that primary and intermediate sampling units do not cluster the selections at all. If no estimates of effective sample size exist, I think the number of primary sampling units should be used. This is more conservative and that quantity is also known to figure in approximately unbiased estimates of sampling variance for low sampling intensities (Williams 2000).

5.4 Data – uncertain removals

The Gulf of Mexico Red snapper fishery presents a great challenge to the assessment team, in that so much of the total fishing mortality is due to discards and recreational fishing. Recreational landings are less reliably documented than commercial landings, and the demographic composition and the mortality rate of discarded fish is not accurately known. Highly adaptive regulation with frequent changes in minimum sizes also contribute to the challenges of determining the total number and demographic properties of discarded fish. The proposed assessment model recognizes this uncertainty and is formulated with various features to capture it. In particular, time-varying retention functions and spatially varying mortality rates are formulated to capture the uncertainty in discards, and the uncertainty in total discards and landings have been reflected in the relative error estimates (CVs) that are provided as input to the model. It is not clear however, that the model is given data that allows it to distinguish selectivity from retention or discard mortality from total discard, so these parameters may not be simultaneously estimable and many of them are kept fixed in the model. This fixing of parameters is appropriate, as it is better to make explicit assumptions, than to have important quantities arbitrarily determined by the model. One can argue that the model should carry forward this uncertainty and produce the full range of plausible values for stock indicators, but I do not find this advisable for two reasons. First of all, it is not practically possible within the chosen modeling framework, as the model parametrization will fail to converge if parameters are not sufficiently constrained. Secondly, actionable information cannot have too large uncertainty. In order to be useful for managers, the uncertainty needs to be traced to the most impactful assumptions, which integrated assessment modeling does not directly facilitate. While managers need to be well informed about uncertainty in order to consider the risk of management decisions, it is the scientists that are equipped to make informed decisions in the face of limited information, and different assumptions need to be coordinated in scientifically plausible ways. I therefore find that it is better to make explicit assumptions in these cases and use sensitivity analysis to convey the uncertainty in the model estimates.

The principle of fixing parameters when the data is not informative has not been consistently applied to the proposed assessment model. The large CVs provided to the model for uncertain landings and discards, allows for total historical abundance to be somewhat arbitrarily determined without any clear way for input data to constrain it. Recognizing that the data do not contain sufficient information to simultaneously estimate both selectivity, retention, and all the sources of the total fishing mortality leaves the modelers with limited information to guide the choice of deciding which parameters to fix and which to delegate to the model for estimation. The decision about which parameters the model should be allowed to estimate should be based on a consideration of how the input data informs the model and should be modeled as known or with highly constrained uncertainty unless the data are demonstrably informative. For the case of removals in general, it must be considered if the model has any other source of information that can allow it to infer total historical abundance. The consequences of these kinds of hard assumptions can be investigated by sensitivity analyses, which will serve to highlight this considerable uncertainty and to package the crucial assumptions into a set of scenarios that are manageable for decision makers. Depending on which variables are modeled as known, the complex representation of removals may even be simplified by taking components of the removals out of the model and replacing the components with data pre-processing. That is; assumptions about what historical removals have actually occurred may be implemented as corrections to the data streams, rather than utilizing Stock Synthesis modules for handling e.g., discards. Compared to keeping parameters fixed, such an approach would not have any obvious advantages with respect to parametrization. There will not be fewer free variables to estimate. But one cannot expect all assumptions that need to be investigated for the removals to have built-in support in SS3, so some pre-processing of removals is expected and it may be easier to handle all assumptions about these data in the same manner. All uncertainties about removals that I could identify are recognized in the assessment process report (SEDAR74-SAR1-Section IV), with the possible exception of discard rates prior to the start of discard monitoring. These are implicitly modeled as 0, without any explicit justification. If the discarding believed to have occurred before discard monitoring was set up is not negligible, assumptions about those discards should also be included in the sensitivity analysis investigating the uncertainty of removals.

For some discard and recreational landings data, model diagnostics indicated a poor model fit. In addition to the general concerns about the quality of these data streams, some of the problematic data points have been explicitly discussed in the assessment process report. Some of them are classified as anomalies in the report and sampling error is indicated as a likely explanation for extreme data points in other cases. These are reasonably suggested to be treated as outliers or otherwise corrected in the operational assessment. The current approach of applying weighting factors to force the model to fit these data should in my opinion not be considered for operational assessments. Poor fits to data should be carefully considered and treated either as a model mis-specification or as a data error. If poor fit is deemed to come from erroneous data, it is not appropriate to force the model to utilize that erroneous information. Rather, the offending data points should be omitted or corrected, or improvements to the observational models should be considered. If the poor fit is deemed to indicate model mis-specification, the issue should ideally be resolved by re-specifying the model. If an appropriate model cannot be identified, forcing a fit may be retained as a pragmatic option, but use of lambda emphasis factors should reflect high confidence in the data the model is being forced to fit.

Much of the uncertainty from removals comes from historic practices. But also for recent years the assessment is faced with the challenge of having a large number of removals accounted for by discards and private recreational fishing, for which it is difficult to get good data. Since stock assessment methods in general are so dependent on good accounting for fishing mortality, I consider it a good avenue for future research to find ways of improving the precision of that information.

5.5 Data – index weighting

While quality concerns about removals need to be resolved with appropriate assumptions, relative abundance indices may simply be omitted entirely if one is not confident that they are reflecting the trends in stock size. The data workshop and assessment team did a critical evaluation and only retained some indices. This was important, particularly to make sure the indices that did not track abundance were by design not included without explicit justification. However, the indices have clear differences in quality and precision, even when these are not necessarily quantified in a comparable manner. I do not agree with the decision to standardize the CV of all abundance indices to a common annual mean. This implicit assumption that all the indices are equally precise is not likely to be correct, and no justification for it was provided. Rather, since a coherent framework for estimating the error of the indices is lacking, a deliberate subjective quantification of their precision should be used. In such a subjective quantification it is more natural to think of the CVs as a way to specify the weighting of the signals from the different abundance indices. That may encapsulate other concerns than just precision, such as unquantified variable bias. For example, one may assign higher CVs to the remaining fisheries-dependent indices, since they are based on samples that are not designed to be informative about abundance trends, and they rely heavily on assumptions made during index standardization.

5.6 Data – The Great Red Snapper Count

The total abundance estimated by the kind of models considered in this review relies heavily on the information that is fed into the Baranov catch equation and thus is very sensitive to assumptions about natural mortality and the accuracy of removals. It is therefore of great value for model validation purposes to have independent estimates of the total abundance, such as presented for this stock by the Great Red Snapper Count (GRSC, SEDAR74-RD88). I do however not agree that this resource is best utilized by attempting to fit the estimate for a single year as an abundance index with exactly known catchability and no compositional data. I have three fundamental concerns. First of all, the GRSC does not provide sufficient information to exactly specify the catchability. Secondly, it has to be ensured that the abundance information is constraining the appropriate age groups, so compositional data need to be included. The GRSC did reveal substantial abundance of fish in habitats and size groups not subject to fishing and not covered by fisheries independent monitoring. My third concern is that I do not think that a single-year observation should be treated as an index. Panel discussions indicate that my views may differ from other reviewers in this regard, but I think it is important.

In general, I am concerned that such a complex model may have solutions that accommodate a single data point but do not generalize well. For the proposed model, I am particularly concerned as the parameters determining total abundance are either fixed (natural mortality) or proposed by this review to become fixed (removals). I therefore think that it is a much better approach to use the GRSC abundance estimate to evaluate assumptions on natural mortality and removals. This is of particular value for this assessment, where the assessment team will have to make difficult decisions on historical removals as discussed earlier in this report. If a plausible range of the total abundance can be derived from the GRSC, along with plausible ranges for the age or size composition, model predictions of abundance by size/age could be used to exclude some model variants. That could be either variants of the uncertain data streams for removals, or variants of the specification of natural mortality. If such an analysis is to be undertaken, it would however be important to respect that the GRSC is a single study with numerous caveats for the total abundance estimate.

The error sources identified in the GRSC report (SEDAR74-RD88) would have to be carefully examined, as well as those identified by the independent peer review of the GRSC. In particular, the analysis should pay close attention to fundamental issues with observation techniques. Possible attraction or repulsion of fish from video surveys should be considered, as well as the usual observation issues for acoustic surveys; acoustic blind zones, vessel avoidance, target strength variability, and species identification issues. It should also be noted that the estimation error for the total abundance estimate may be much larger than reported, as carefully explained by one of the GRSC peer-reviewers (Christman 2021). The correct calculation of composition data will also come with additional uncertainties.

While the GRSC scientists are generally conservative in their estimation, carefully avoiding assumptions that would overestimate abundance, both unresolved issues with observation biases and the estimation uncertainty may lead to inference error in either direction. That is, the actual catchability of the GRSC may be over 1, and the point estimate reported should not be treated as an absolute lower bound. As direct empirical validation data is so scarcely found for stock assessments, the development of a rigorous lower bound on the abundance in 2018 would be an extremely valuable undertaking. There are, however, many issues that need to be resolved, and I would recommend that the required work be considered for long term research.

5.7 Model – framework

Priority modeling issues are summarized by Terms of Reference 1-4 for the SEDAR 74 Assessment Process Workshop (SEDAR74-SAR1-Section IV). This mandates a range of effects and data sources to consider for the model development. These were all addressed by the model or commented on in the report, except it is not clear to me if any investigation into estimating growth within the model was attempted. (ToR 2e of SEDAR74-SAR1-Section IV).

Given this mandate, it was apt to choose a generic and flexible modeling framework such as Stock Synthesis (SS3). The range of models that can be implemented with SS3 generally require that removals are well known. This is not a good fit to the Gulf of Mexico Red Snapper fishery, but I have not been able to identify other kinds of models that would be better suited. I therefore think that an SS3 model, with due acknowledgment of the uncertainty of removals, is a scientifically sound approach to assessment of this stock.

Even with good data and with correct identification of key drivers of stock dynamics, it takes considerable time and research to put together a new model that ensures better estimates of management parameters. The complexity of this task grows quickly with the number of prioritized modeling issues, since modeling choices that fit one issue may not fit another. Since time is always limited, I think the model development would benefit from a clearer prioritization of its Terms of Reference. The special circumstance of this fishery, with so much fishing mortality accounted for by discards and recreational fishing, was well known up front. I think the challenges in adapting standard assessment methods to this situation should have been recognized and given a very high priority relative to other concerns. Moreover, the goal of producing accurate estimates of management parameters should take precedence over all the other goals. Given how much effort has been put into accommodating requests to experiment with specific model features and include specific data sources, I think that the overarching goal could be made more explicit.

5.8 Model – formulation

The population model was mostly formulated in accordance with best practices, with careful attention to important assumptions such as natural mortality. A few choices deviated from common practice without a clear justification. The plus-group for the compositional data was set so low that for some data streams it was much larger than regular age groups. Likewise, the model plus-group was set so low that a large fraction of the estimated population would fall in the plus-group. These choices are counter-intuitive and should be justified and any justification based on model fit should be re-done when accurate compositional data are provided. The recruitment function was formulated with a fixed steepness close to the maximal possible steepness value, effectively making recruitment completely independent of stock size. If steepness is not estimable and an arbitrary fixed value needs to be made, it would be more natural to consider a plausible value. Since recruitment is highly variable the inferences about management parameters are likely not very sensitive to this choice. Also concerning recruitment, the recruitment deviations were not constrained to average to zero, and the estimated deviations show temporal trends. Some remarks about this in the report (SEDAR74-SAR1-Section IV) indicate that this choice was deliberate, intending to allow the model to capture unknown shifts in population productivity. While this could be a viable approach to produce indications of shifts in productivity, predictions will still be based on averages over the entire time series and the detected shifts will bias the predictions. A stable productivity regime has deviations averaging to zero, and that assumption should be enforced if a recruitment model fitting the data cannot be identified (which is often the case). Extreme deviations from the idealized recruitment model should be explicitly modeled as regime shifts, if that is what they are considered to represent. Otherwise, model projections will be biased by the productivity from past regimes. If extreme deviations are considered to be temporary departures from the model, they will bias projections unless the deviations are constrained to sum to zero.

In general, concerns about ecosystem or climate effects are difficult to incorporate as they affect the parameters that these kinds of models are generally poorly informed about, namely natural mortality and recruitment. Identifying factors that contribute to variation in natural mortality or recruitment does not help determining the effects quantitatively unless they can be used to suggest functional forms for the model or relate the model to new data sources. Usually we must be content with investigating the ranges of uncertainty. This I find better addressed with sensitivity analyses.

Based on recommendations from the Stock-ID workshop. The model was configured with three spatial regions. This recommendation was not based on clear indications that there are several stocks in the Gulf of Mexico, but rather it reflected an interest in capturing spatial variation in the fisheries. This configuration seems poorly supported by the current data streams, and key parameters describing fisheries, like fleet selectivity, had to be configured as mirrored between fleets. Moreover, the spatial granularity of data collection did not fit well with the spatial variation in fishing behavior, and the three-area model was somewhat pragmatically defined in the first place. The considerations favoring a three-area approach were based on area delineations around the Cape

San Blas, but this did not fit with the statistical zones used in the fisheries statistics. I therefore consider that a simpler two-area approach with better support from data streams may be a better approach. As the data situation is improving in the regions east of the Mississippi river, a three-area option may become of interest, even if it is not supported by the data right now.

While the Stock-ID workshop only identified one stock in the Gulf. It did also show that the Mississippi river outflow presents a very strong barrier to larval drift, and possibly segregates the population also at the adult age. This could lead to independent stock dynamics between the two regions on shorter time-scales, which could be of interest to reflect in the model. A two-stock approximation could be considered.

5.9 Model – sensitivity analysis

Due to the preliminary status of the compositional data, only selected sensitivity analyses were performed. As a minimum, the prediction of key management parameters should be investigated for all quantitative assumptions that the parameters are suspected to be sensitive to. In this assessment obvious candidates are: start year of the assessment, the steepness parameter for the recruitment function, and the specification of natural mortality. In addition, the many assumptions about removals should be investigated. Ideally, all quantitative model assumptions are investigated in a global sensitivity analysis (Saltelli 2002), when resources allow. But this requires careful consideration of how results are presented to managers, who should not be expected to consider all the modeling details. For an extensive sensitivity analysis, results should be structured so that managers may consider first the most uncertain choices that have the largest effect on management parameters.

For this assessment model, an extensive sensitivity analysis should be considered for assumptions about removals. I do not believe that the current configuration, which models landings as highly uncertain, is viable (see section 5.4), and it does not capture all the uncertainty about these data. I therefore think it is necessary to make harder assumptions on removals, and instead investigate uncertainty through a sensitivity analysis. A sensitivity analysis of removals will in part be an investigation of variants for some data streams. That is; several variants of, for instance, landings data may be prepared, reflecting different assumption about reporting error. In part, it will also be an investigation about the sensitivity to any fixed parameters describing retention, selectivity, and discard mortality. Alternatively, the model could be simplified and some or all of the assumptions about removals now represented as fixed model parameters could be incorporated into data stream variants. While the sensitivity analysis needs to investigate plausible ranges for all quantitative assumptions about removals, the results will have to be carefully organized if they are to be informative for managers. I would suggest identifying a small set of assumptions that has the largest contribution to the combined effect on management parameters and provide alternative estimates for only those variants.

A carefully conducted analysis of the uncertainty in the data streams may also be very informative for designing future improvements in data collection.

Another point of complexity that needs to be addressed, for sensitivity analysis to be actionable for managers, is the selection of management parameters to provide sensitivities for. For instance, estimates of abundance and fishing mortality rates may each be very sensitive to assumptions about removals or natural mortality, but still have systematically compensating effects on reference points or maximum sustainable yield calculations. Some care is therefore warranted in deciding which management parameters the sensitivity analysis should be designed for.

Sensitivity analysis may also be used to address stakeholder concerns about otherwise unquantified effects relating to ecosystem and climate factors. This is probably best incorporated into the sensitivity analysis of natural mortality.

5.10 Model – complexity

It is common for stock assessment models to be formulated with variables that are not directly observed, so called latent variables. These are included because they help incorporate our understanding of stock dynamics, fishery dynamics and observation error into the model. Even if we would consider our understanding of these systems to be complete and correct, it is far from obvious that such latent variables can be estimated to a precision high enough to provide reliable inference. Simpler and less realistic models may provide better estimates and projections, if they rely less on parameters that are not well known. Deciding which model variants are best cannot be resolved only by investigating model fit. The issue with an overly complex model is not that it does not fit the data, but that the data do not sufficiently constrain the model. While it is possible to directly investigate the model’s prediction of independent observations for some parameters like survey indices or catch compositions, direct validation of the estimates of management parameters are not available. Moreover, independent observations are no longer independent if they are used to inform the model formulation, so a careful consideration of model complexity is necessary prior to any direct check on predictive power.

The assessment process report (SEDAR74-SAR1-Section IV) does not present much critical consideration of model complexity. Mostly this subject is commented on in the context of model stability. Since direct validation data are not available, any decision about how complex the different model components should be is partly a subjective one. Personally, I think that a model that runs into convergence issues when it is modified to be slightly more complex is likely to already be overly complex. I have already pointed out some situations where I think the data are not able to properly constrain the model. For instance, total landings are modeled with high uncertainty. Although most retention parameters are currently kept fixed, another example that may be considered is the model formulation that attempts to simultaneously estimate retention and selectivity without compositional information on discards. In general, I think the model would benefit from a critical assessment of which complications are warranted. That includes any complications suggested by this review.

Related to this issue is also the concern about what basis managers and stakeholders have for accepting a new model as a better approach than the methods that are currently operational. It can be argued that a more detailed representation of stock dynamics, fisheries dynamics and observation error is to be preferred. But as I have tried to argue above, it is not at all clear that a more complex representation can be supported by the data. Acceptance of a new model can be obtained by making clear the rationale for important modeling choices and demonstrating that they have the expected effects. In order to demonstrate that a new model is an improvement over a current model, a bridging and continuity analysis could be set up. Bridging analysis entails computing management parameters for several model variants that are related to each other by small model changes. This allows the assessment team to demonstrate the effect of each model choice in isolation and demonstrate that the results change in the expected direction. It can also be a way to justify any added complexity, by showing that added complications do indeed affect the results. Ideally, one of the models in the bridging analysis is the currently operational model, so that the proposed model can be obtained as a series of stepwise changes to the currently operational assessment. Continuity analysis entails running the new proposed model and the current operational model with the same data versions, to ensure that differences to earlier approaches are indeed an effect of changes to the model, and not corrections to underlying data.

When diagnostics are comparable between models, they can also be a very useful tool to ensure that the new model is likely to provide better predictions than the current operational model. See section **Error! Reference source not found.**.

This review has pointed out some possible simplifications of the proposed model. The revision of how removals are dealt with will probably represent a simplification, as well as suggesting the two-area alternative. Before considering suggestions that would complicate the model, I would suggest implementing either a bridging analysis or a model selection strategy. See section **Error! Reference source not found.**. If a model selection strategy is successfully implemented, other modeling decisions may also be revisited. For instance, the forms for the selectivity function and the fleet structure could be considered simplified.

5.11 Model diagnostics and validation

The assessment process report contains diagnostics in the form of inspection of CVs of estimated parameters, visualizations of fits to data, and plots of residuals. Normalized residual plots were presented at the panel review. As recognized by the assessment team, these diagnostics were all preliminary, as the model was not yet parameterized against the accurate compositional data. Moreover, these diagnostics are all indicators of model fit. The diagnostics should also include approaches that can indicate if the data are not properly constraining the model, such as *cross-validation* or *hindcast*. Neither of these terms have universally accepted usage. I am thinking of cross-validation as iteratively leaving out one or more random years in the time series and comparing the fit of indices and catch compositions to those obtained with the full data set. This is analogous to how cross-validation is done when a model is fitted to replicate observations, but the interpretation is different. High sensitivity to the exact data composition is however indicative of poorly constrained models. An example of this kind of analysis is provided by Aldrin *et al.* (2021). I think of hindcast as forecasting observations (indices and catch compositions) from truncated time-series and comparing the forecasts with the actual observations. An example of this kind of analysis is provided by Kell *et al.* (2016). The hindcast-approach directly assesses the predictive power of the model, and can be a powerful tool for model selection. For instance, the current operational assessment and the proposed model could be compared in this way. It is however important to note that the inference that can be made about predictive power hinges on the independence of observations predicted. Once data have informed model development in any way, they are no longer to be considered as strictly independent. In order to make sure hindcast analysis can be done on actual independent observations, a model selection strategy may be developed that makes clear which data should be held back for final validation and model selection, and which data the assessment team should be allowed to use iteratively for model development. Since the latest few years of data have not been used in the model development so far, it seems it is still an option for the assessment team to reserve some data for the final validation analysis.

5.12 Recommendations for assessment

I provide my recommendation in what I consider to be the order of importance. However final priorities should also incorporate information about resource availability. I do not recommend prioritizing tasks unless accurate data provisions for it can be made in time. For each recommendation, I will refer to relevant sections of the report in parenthesis.

The following short-term recommendations should be considered as part of the process to move this assessment towards an operational assessment track:

1. Obtain accurate composition data, appropriate estimates based on the sampling designs used to collect them (5.1).
2. Configure the model with landings and other removals assumed to be known, and implement a sensitivity analysis to capture uncertainty in data streams and fixed parameters quantifying removals. In addition to uncertainties already recognized, make explicit assumptions about discards that occurred before discard monitoring was established. (5.4, 5.9).
3. Remove or correct data points that are not plausible, instead of forcing fits to unreliable data with lambda emphasis factors (**Error! Reference source not found.**).
4. Implement appropriate weighting of abundance indices by specifying CVs that reflect their relative quality (**Error! Reference source not found.**).
5. Include age-composition data in model parameterization when available, unless a clear explanation for why they are not suited can be identified (5.3).
6. Configure compositional data with effective sample-size estimates informed by the number of primary sampling units sampled, rather than the total number of fish measured (**Error! Reference source not found.**).
7. Do not use the single year observation from the Great Red Snapper Count in the model parametrization (**Error! Reference source not found.**). Consider instead my long-term recommendation with respect to this study.
8. Simplify the model's spatial structure to a two-area model (**Error! Reference source not found.**).

9. Change the model formulation with respect to recruitment (steepness and recruitment deviation constraints) and age-structure (plus-group) or provide a clear justification for the choices made (**Error! Reference source not found.**).
10. Implement sensitivity analyses for key assumptions about natural mortality, start year and recruitment parameters (**Error! Reference source not found.**).
11. Implement bridging and continuity analyses (**Error! Reference source not found.**).
12. Implement a model selection strategy and compute model selection criteria comparing the model to the current operational model (**Error! Reference source not found.**).
13. Investigate a two-stock approximation to capture any decoupled stock dynamics for the areas separated by the Mississippi river outflow, with one stock for each area (**Error! Reference source not found.**).
14. Develop a three-area model as a model option for a sensitivity analysis, in order to facilitate incorporation of improved data streams from fisheries east of the Mississippi river. Investigate if reasonable adjustments to data streams can support the preferred area delineation at Cape San Blas (**Error! Reference source not found.**).

The following long-term recommendations should be considered for future research tracks:

1. Analyze the assumptions behind the Red Snapper Count data to obtain the full plausible range for the actual abundance in the year of the data collection for the age groups most precisely sampled. Include information about catchability assumptions and sampling error identified in this review and the review of the Red Snapper Count. Use this information to reduce the range of plausible configurations for removals and natural mortality in the assessment (**Error! Reference source not found.**).
2. Take advantage of the sensitivity analysis I have recommended for removals to investigate the accuracy of total removals for the last few years. Use this to identify ways of improving data collection in the long term. Quantitatively consider the effect of improving the data streams that are currently least certain. Consider new data collection strategies, such as observer coverage of the recreational segment, mandatory self-reporting for more segments, improvements in phone-survey sampling of recreational fishing and more experimentation on discard mortality rates (**Error! Reference source not found.**, **Error! Reference source not found.**).
3. Analyze available information to inform on the credibility of treating the Red Snapper stock dynamics in the US exclusive economic zone as being independent of the other coastal nations in the Gulf of Mexico (**Error! Reference source not found.**).

5.13 Comments and Recommendations for the Research Track Assessment Process

In my discussion above, I have made some comments that are relevant for how the research track is set up. I will summarize those in the following three recommendations, with reference to relevant sections above in parentheses:

1. Make sure the research goals for the assessment track is aligned with which data provisions can be made. If it is desired to research new area or fleet configurations, upstream data providers must be equipped to deliver estimates of compositional data that are of the same quality that goes into operational tracks, although they need not be provided for the full range of years the operational track uses (**Error! Reference source not found.**).
2. Set clear priorities between research goals and explicitly make sure the goals about which data sources to utilize and which model constructs to experiment with are subordinate to the goal of providing reliable estimates of management parameters (**Error! Reference source not found.**).
3. Make the research on the fundamental challenges of a high discard-fishery high priority (**Error! Reference source not found.**).

I have the impression that the research track was rushed to conclusion, as a peer-review was set up even before the assessment team had been given data to perform their own critical evaluation of the proposed assessment model. This may in part have been done due to expectations about updates in assessment methods for the operational assessment track. I would therefore also add the recommendation:

4. Make sure the operational track is independent of the research track and that it can continue to produce advice if the research track does not produce expected results.

Discussions during the panel review also revealed that the assessment team felt a strong obligation to accommodate recommendations from the Stock-ID workshop and the data workshop. As mentioned before (**Error! Reference source not found.**) the complexity of a model grows quickly as inclusion of specific data sources and model constructs become hard requirements. The assessment team is responsible for not only identifying the technical means to include data sources and to estimate requested parameters within the model. They also have to make sure they understand the model behavior well, and that model modifications do indeed lead to better estimate of management variables. The latter is particularly challenging when direct validation data are not available, as is the case for stock assessments. Modelers need to be disciplined to avoid complicating models to the point that they lose predictive power (see section **Error! Reference source not found.**). This may be in direct conflict with accommodating all workshop recommendations. I therefore think it is important that the assessment team is allowed to work autonomously and prioritize their efforts towards achieving the most important goals. I find the inclusive SEDAR process commendable, and believe it has great potential for supporting assessment development. I am however a bit worried that the input from stakeholders and data-collectors have had a too prescriptive effect on the assessment team. I would therefore recommend:

5. Make sure that the assessment team has the final say in all modeling decisions and are given ample room to prioritize their efforts towards achieving the overarching goals. Require the team to comment on and justify all deviations from workshop recommendations, but make sure it is acceptable to argue not only in terms of strict scientific considerations, but also in terms of resource limitations and concerns about model complexity.

5.14 Summary by Terms of Reference

I believe that the paragraphs above address all the Terms of Reference (ToRs) for this review, except ToR 6 which is provided in the "SEDAR 74 Red Snapper Research Track Peer Review Summary Report". For the convenience of the reader I here summarize findings and recommendations for each ToR and cross reference relevant sections above in parenthesis:

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?*

Most notably, data provisions were not adequate for the assessment approach. Compositional data were not prepared properly (5.1), rather nominal age and length frequencies were used as preliminary proxy data. Since analysis on these data was integral to much of the justification about data decisions, I find that such decisions were not justified satisfactorily (5.3). The most important aspects of data uncertainty are those related to removals. While these are within normal or expected levels for both commercial landings, recreational landings, and discards, the fraction of removals ascribed to discards and recreational fishing is unusually high. These uncertainties were clearly acknowledged, although I have some reservations about how they are accommodated in the model and doubt if the input data series are sufficient to support this assessment approach unless it is modified with recommendations from this panel review (5.4).

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?*

I find that the mandate for the modeling was clearly stated in the Terms of Reference for the assessment process workshop (SEDAR74-SAR1-Section IV), although I think the formulation would benefit from a clearer prioritization of the ToRs. In particular I think that the task of developing estimates of parameters used in management should have been much more explicitly put front and center. (5.7). I find that scientifically sound methods where chosen to address this mandate, but I am not convinced that the model can be robustly parameterized with the current configuration (5.4, 5.10). It is however premature to conclude on that matter as the assessment has not been investigated with accurate input data (5.1, 5.11). With few exceptions I find that the assessment model was configured properly and used consistently with standard practices (5.8). I consider that the question of whether the methods were appropriate for the available data is covered by my comments on ToR 1.

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.

In general, I find that the uncertainties in the assessment need to be further explored with extensive sensitivity analyses once accurate compositional data are prepared. The current approach to capture the uncertainty conflicts with model stability and precision in parameters used by management (5.4, 5.9). Mostly I find that the important sources of uncertainty are well recognized, except that I find them to be under-appreciated with regards to data from The Great Red Snapper Count (5.6). I find that information about ecosystem and climate factors are too scarce to be quantitatively incorporated into management reference points (5.8, 5.9).

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.

I provide short and long-term recommendations for improving the assessment in section 5.12.

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

I provide recommendations for improving the Research Track Assessment process in section 5.13.

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

The panel prepared a Review Workshop Summary Report. See the document "SEDAR 74 Red Snapper Research Track Peer Review Summary Report" authored by Gulf Scientific and Statistical committee members; Jim Nance (chair), Sean Powers, Michael Allen, and Steven Saul, and Center for Independent Experts reviewers; Patrick Cordue, Matthew Cieri, and Edvin Fuglebakk.

6. Conclusions

The SEDAR 74 assessment research track has investigated a range of model constructs and evaluated the use of a range of data sources for the stock assessment of the Gulf of Mexico Red Snapper (*Lutjanus campechanus*). I have evaluated its progress and find that the model is not yet ready to be incorporated into an operational assessment track. I have provided comments and recommendations that I believe can be implemented to obtain a viable operational model, as well as comments for improving future SEDAR research tracks.

The assessment team has been working with preliminary and inaccurate composition data, as data provisions were not aligned with the model configurations they were tasked with considering. Since the assessment team themselves has not yet had the material to evaluate the model, it could not be expected that a review panel would recommend the model for operational assessment at this point.

I want to remark that the Gulf of Mexico Red Snapper assessment is faced with particular challenges in modeling a fishery with unusual fishing mortality patterns. It is far from trivial to adapt standard assessment approaches to this situation.

7. References

Literature that was provided as background material for the review has been cited by their identifiers in Annex 1, other references are listed below:

Aldrin, M., F.L. Aanes, I.F. Tvete, S. Aanes, and S. Subbey. 'Caveats with Estimating Natural Mortality Rates in Stock Assessment Models Using Age Aggregated Catch Data and Abundance Indices'. *Fisheries Research* 243 (November 2021): 106071. https://doi.org/10.1016/j.fishres.2021.106071.

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Williams, Rick L. ‘A Note on Robust Variance Estimation for Cluster-Correlated Data’. *Biometrics* 56, no. 2 (June 2000): 645–46. https://doi.org/10.1111/j.0006-341X.2000.00645.x.

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	19 January 2022 Updated: 24 February 2022

		Fisheries	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	Carissa Gervasi, Matthew	15 April 2022

	support ecosystem considerations in the assessment and management process	McPherson, and M. Karnauskas	
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	Kevin A. Thompson, Theodore S.	29 April 2022

	stationary video surveys	Switzer, and Sean F. Keenan	
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 northern Gulf of Mexico 1980 and 1986-2019	Steven Garner, Robert Allman, Beverly Barnett and Naeem Willett	20 May 2022
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	30 June 2022 Update: 5 July 2022 Updated: 25 July 2022 Updated: 25

		Barnett	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 Gulf of Mexico Red Snapper (*Lutjanus campechanus*)	SEDAR 74 Discard Mortality Ad-Hoc Working Group	16 February 2023
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	Stephen T. Szedlmayer & Peter A. Mudrak	

	Recruitment of Age-0 Red Snapper in the Northeast Gulf of Mexico during 2010 and 2011	
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 artificial reef area off Alabama in the northern Gulf of Mexico	William F. Patterson III, James H. Cowan Jr, Charles A. Wilson, and Robert L. Shipp
SEDAR74-RD16	Red snapper (*Lutjanus campechanus*) demographic structure in the northern Gulf of Mexico based on spatial patterns	Andrew J. Fischer, M. Scott Baker Jr., and Charles A. Wilson

	in growth rates and morphometrics	
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 (*Lutjanus campechanus*) in the U.S. Gulf of Mexico	Brad E. Erisman, Derek G. Bolser, Alexander Ilich, Kaitlin E. Frasier, Cassandra N. Glaspie, Paula T. 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	Sean F. Keenan, Theodore S. Switzer, Kevin A. Thompson, Amanda J.

	in the Northeastern Gulf of Mexico: Implications for Fishery-Independent Surveys	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	William F Patterson III, Clay E Porch,

	catch rates, species composition, and selectivity in the northern Gulf of Mexico recreational fishery	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	V. Rohith Reddy Matli, Shiqi Fang,

	Hypoxia in the Northern Gulf of Mexico	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 structure in the U.S. Atlantic and Gulf of Mexico	David S. Portnoy, Andrew T. Fields, Jonathan B. Puritz, Christopher M. 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	Steven B. Scyphers, F. Joel Fodrie, Frank J. Hernandez Jr., Sean P.

	among Recreational Anglers in the Northern Gulf of Mexico	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 snapper and validating survival with acoustic telemetry	Gregory W. Stunz, Judson M. Curtis, and Alex Tompkins
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

Appendix 2 – Performance Work Statement

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 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.

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

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

1. 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.
2. 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.
3. 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:

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South Atlantic Fishery Management Council
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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.

Appendix 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.

Annex 3 – Panel membership and list of participants

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

Chris Schieble .... LADWF
Mike Schmidtke .... SAFMC Staff
Camilla Shireman..
Matt Streich...TAMUCC
Kevin Thompson...NMFS SEFSC
James Tolan .... TPWD
Brendan Turley...NMFS SEFSC
Ana Vaz...NMFS SEFSC