Center for Independent Experts (CIE) Independent Peer Review

of

SEDAR 74 Gulf of Mexico

Red Snapper Stock Assessment

Individual peer review report

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Executive summary

The research track stock assessment of Gulf of Mexico red snapper was reviewed at a four-day meeting in Tampa, Florida, in December 2023. The Review Panel consisted of a Chair, three CIE reviewers, and three non-CIE reviewers. The purpose of the research track assessment was to develop a reasonably complete specification of model structure and data sources for a planned operational assessment of Gulf of Mexico red snapper. The Stock Identification workshop had specified that three areas be used in the model. The Data Workshop had provided the Assessment Team with landing and discard series, biomass indices, an absolute abundance index, and raw composition data for each of the three areas.

The decision made at the Data Workshop, that raw composition data were adequate for model development, was flawed. Composition data need to be stratified and scaled to be representative of the sampled fishery landings/discards or the surveyed population. Any decisions regarding model development or the inclusion or exclusion of data sources, based on model runs using raw composition data are not defensible because it can always be argued that different conclusions would have been reached had the representative composition data been used.

The Assessment team concluded from model runs, using raw composition data, that the commercial age data should not be used in the assessment and that a preference should be given to length frequencies. This is an extraordinary decision as it is well known that age frequencies should be favoured over length frequencies because they contain more information on total mortality and recruitment strengths.

There were also other features of the assessment model which were not ideal.

The use of a single stock with three areas was specified by the Stock Identification workshop. However, given the low transfer rates (1-2%) of larvae across the recommended boundaries it would be better to assess the stock using separate assessment models for each sub-population, each with its own stock-recruitment relationship. That is not to contradict the conclusion that Gulf of Mexico red snapper is a single biological stock (i.e., a meta-population with sub population structure) but to note that a single stock-recruitment relationship is inappropriate when there is so little larval transfer across the sub-population boundaries (e.g., as spawning stock biomass from Texas and Louisiana does not provide any recruitment to Florida).

A key feature of this assessment is that total removals are very uncertain. This is primarily due to the large components of recreational landings and discards within the total removals from the population. A key challenge of the assessment is to properly incorporate the uncertainty of total removals into the modelling framework. This includes potential bias in the landing and discard estimates. Fitting to landing and discard series as if they were independent random variables is a poor approach and does not capture the uncertainty or the potential biases. A better approach is to do a sensitivity analysis with alternative total removal series (assumed as known) which encompass the full range of uncertainty.

It was premature to include the Great Red Snapper Count estimates in the model as potential biases have not been quantified and composition data were not available. Composition data are needed in each area to estimate the selectivities which would be expected to vary across areas, dependent on the different survey methods used. The use of the estimates as absolute abundance ("catchability" or q = 1) is not appropriate. The potential for bias in the estimates is obvious in the comparisons of density estimates from acoustics and ROV methods. The average density from the ROV was approximately 9 times higher than the average density from acoustics at the same stations. The biases for the methods used in the Great Red Snapper Count need to be quantified and used to produce informed priors for the associated catchabilities before the estimates can be used in a model.

The research track assessment never had any chance of success because the Assessment Team were asked to work with raw composition data. Decisions made based on model runs using such data could never be defensible because different decisions could have been made if representative composition data had been used. This is why the Review Panel did not ask the Assessment Team to perform any model runs during the review meeting. However, because no model runs were requested it gave the Review Panel extra time to consider how the assessment could be improved. Several of the recommendations made for this assessment may be more widely applicable than just Gulf of Mexico red snapper.

Background

SEDAR 74 was a "research track" stock assessment of Gulf of Mexico (GOM) red snapper. The research nature of the assessment encouraged a philosophy of starting with a "clean slate" to review all aspects of the stock identification, data, and modelling decisions in an effort to produce a new and improved stock assessment model.

The Review Meeting was the fourth main stage of the process which was preceded by the Stock Identification Workshop, the Data Workshop, and the Assessment Workshop. The review consisted of a brief online pre-review meeting and a four-day, in-person meeting in Tampa, Florida, from 12-15 December 2023. The Review Panel consisted of a Chair, three CIE reviewers, and three non-CIE reviewers (see Appendix 3).

This report is one of three individual CIE reviewer reports and, although it is a stand-alone document, it is best read in conjunction with the reports from the other two reviewers and the Summary Report (which is a product of the full Review Panel).

Review activities

Prior to the Review Meeting the three workshop reports and supporting documents were accessed on the SEDAR 74 website. The main workshop reports were read in detail and other documents were read, as required, prior to and during the meeting. With over 150 documents made available for the review it was not feasible to read every document in detail.

The Assessment Team requested that a pre-review meeting take place online. A suitable time was found to accommodate the different time zones and most of the Review Panel were able to attend the meeting. Introductions were made and the Assessment Team asked if there were any model runs or other analysis that the Review Panel would like to request before the main meeting. I requested that normalised residuals be provided for the fits to the biomass/abundance indices and that the standard deviation of the normalised residuals (SDNR) also be provided. I also requested that the main differences between the previous assessment and the research track assessment be presented (as did another reviewer). I asked how long the model runs took and we were told it was about 1 hour per run, dependent on the machine used. In anticipation that the Review Panel might require many runs to be undertaken, a non-CIE member of the Review Panel offered to bring a powerful desktop to the meeting. It was agreed that this would be useful.

The Review Meeting started on Tuesday 12 December. After the usual introductions, housekeeping and process statements, the Assessment Team started with a presentation on the life history parameters and data used in the model they had developed. I noted that stock identification was not in the TOR for the review. I commented that this was an unfortunate omission because if the stock identification is flawed then the subsequent stock assessment is also flawed.

The presentation included the change in natural mortality (M) from the last assessment. Primarily, there was a change in the method used to estimate M and an older maximum age of 57 years was adopted (rather than 48 years previously). The overall effect was that the estimate (of average 2+ M) increased from 0.094 to 0.104 (despite the increase in maximum age). Also of note, was the use of a steepness (h) value of 0.99 for "mathematical convenience". I noted that this was not appropriate as mean recruitment is expected to decline at low levels of spawning stock biomass for almost every fish species. I also noted that the assumption would affect reference points. I was told that it didn't affect reference points as SPR proxies were used (which is another issue, but it is outside the TOR).

The presentation continued with landing and discard series, then moved on to indices, including that the index time series were all being given equal weight in the model fitting. I made a comment that not all indices were equally precise, and it was not appropriate *a priori* to give them equal weight. I also noted that the Great Red Snapper Count (GRSC) estimates should not have been included as estimates of absolute abundance. This is because any survey method which attempts to obtain absolute abundance/biomass has assumptions and scaling "constants" which can lead to bias. Also, I noted that estimating selectivities for the GRSC without any composition data was inappropriate (as then there is no information in the model on such selectivities).

After lunch, on the Tuesday, the composition data used in the model were presented. These were primarily length frequencies and I made the point that length frequencies need to be properly stratified and scaled before use in a model. I also said that the drivers of length need to be identified and used in the stratification. This is not quite correct and I did correct this statement the next day. What I meant was that without the drivers of length being known then even a stratified random sampling approach can lead to noisy data (by chance) and that a post-stratification using the drivers of length can give better results. In any case, the main point is that "nominal" length frequencies (i.e., raw, unscaled length data) were used in the model runs. Obviously, if the properly scaled length frequencies were used then model runs could produce different results and the scaled length frequencies could be fitted better or worse than the raw data.

The issue of age frequency data mainly being excluded from the model runs was also discussed. Again, the issue was that raw age data were used rather than properly constructed age frequencies. I noted that "extraordinary decisions required extraordinary justification". Jurisdictions all over the world have spent huge sums of money to obtain age data *because* it contains far more information than length data. The Assessment Team agreed to give a presentation the following day to explain how they had reached their decision.

The basic model setup was presented which included the estimation of recruitment deviations that were not constrained to average to zero. This resulted in the last 30 odd years of recruitment averaging well above expected recruitment. By definition, this is a "regime shift" – which I pointed out. This apparently confused the meeting participants, so I added that I didn't think there had been a regime shift, just that the absence of the constraint on recruitment deviations had led to an apparent regime shift (i.e., being an artifact of the poor approach taken).

There was some discussion of the large CVs that were recommended by the Data Working Group for landings and discards. Attempts to use the large CVs had failed as the model would not converge. Some of the large CVs were removed to enable convergence but landing and discard series were modified by the model in some years for some fisheries. I pointed out that the model had no genuine basis on which to "correct" landings or discards and that they shouldn't be fitted as data but should rather be assumed known. When there is large uncertainty in discards and landings, exploration of that uncertainty needs to be done through sensitivity analysis with multiple runs performed with landings and discards assumed known (i.e., lots of scenarios which cover the full range of uncertainty and allow for potential bias).

On Wednesday, presentations by the Assessment Team continued with the fits to the landings and discards presented. One of the Review Panel queried the CVs on the recreational landings and discards thinking that they were a bit low. It turned out that the CVs had not included the uncertainty on estimates of effort. Therefore, the actual imprecision on these estimates is a lot higher.

The fits to the biomass indices were presented with the requested normalised residuals and SDNRs. I noted that it was clear that too much weight had been given to some indices (SDNRs much greater than 1) and some index reweighting was required.

Composition fits and estimated selectivities were shown, as were retention curves and selectivities for discard-only fleets. With about 20 fisheries over the three different areas the graphs of estimated curves were complex.

The presentation on why age frequency data for commercial fleets were excluded was given. The main reason appeared to be that when the raw age frequencies were included, the fits to the discards were very poor.

At some stage in the proceedings, a member of the Assessment Team had asked for suggestions on how the complexity of the model could be reduced. It was apparent to most people that, with over 1800 parameters being estimated, and most of them being "nuisance" parameters, the model was too complex and was "cumbersome".

I suggested that it would be worth exploring combining discards and landings outside of the model to avoid modelling them explicitly. That way, total removals or catch would be the focus of the modelling exercise. Although there are many "bells and whistles", the way these models obtain information on starting biomass is through fitting the average trend across the indices using the "known" catch history (the catch should be assumed known on individual runs and multiple runs need to be done to explore the uncertainty in catch history, including potential bias).

After the presentations were completed the Review Panel had a discussion of the issues that had arisen. It was quickly agreed that the model needed to be simplified. Members supported my idea to combine landings and discards outside of the model. We also agreed that the available data did not support a three-area model and it would be best to return to the two-area model (as a base case). We also agreed that the age data needed to be in a base model and that properly scaled length and age frequencies needed to be used. We agreed that there was little point in asking for the Assessment Team to perform model runs overnight (with the existing data).

On Thursday the Review Panel spent the day working on a presentation to give to the meeting with our main conclusions and recommendations. A complete draft of the presentation was completed on Thursday. On Friday morning between 8.30 am and 9.30 am the Review Panel revised the draft and finalised the presentation. The objective of giving the presentation was to stimulate discussion about the issues so that the Review Panel could obtain a better understanding of the Assessment Team's views on the issues.

Dr Saul presented the presentation to the meeting at 9.30 am. Other members of the Review Panel, including myself, offered comments at times to clarify the presentation. There was useful discussion on a number of points and the position of the Assessment Team on a number of issues was clarified in my mind.

The meeting was adjourned at about lunchtime.

I was assigned the job of writing the first draft for TOR 1 in the Summary Report. I drafted this on Saturday morning before going to the airport to fly back to New Zealand.

In New Zealand I drafted my CIE report and made further contributions and editorial suggestions on the Summary Report. I also checked on how much larval transfer was expected between the boundaries recommended by the Stock Identification workshop and found that it was only about 1-

2% (Karnauskas & Paris, 2021). Therefore, I concluded that it was better to approximate the meta-population of GOM red snapper using separate assessments of each sub-population rather than separate areas within a single stock assessment. The point being that separate stock-recruitment relationships are a much closer approximation to reality than a single stock-recruitment relationship (which implies, for example, that spawning stock biomass from Florida can supply recruitment to Texas).

Summary of findings

Before considering the strengths and weaknesses to each TOR for the Research Track Assessment (RTA), I will cover the main weakness of the RTA.

The RTA was undertaken under the assumption that decisions on model structure, and the inclusion or exclusion of data sources, could be made using model runs which used raw composition data. Below is the typical wording that appeared in various data sections of the Assessment Workshop report:

> "Nominal compositions were provided for the Research Track Assessment as they were deemed sufficient for model development as the intent of this assessment was not to estimate stock status or directly inform management. Weighted compositions will be requested for future Operational Track Assessments."

The flaw in this argument is obvious to stock assessment modellers who are familiar with the production of scaled age and length frequencies. Model runs using raw composition data can produce very different results from model runs which use properly scaled composition data. This is because the scaled length or age frequencies can be very different from the raw length or age frequencies.

The decision to exclude commercial age data from the base model was primarily based on model runs using the raw composition data:

> "Models using age composition for the commercial fleets were developed as part of the Research Track Assessment but ultimately rejected in favor of the length-based models. Length-based models were ultimately preferred because they had reduced residual patterns in the fits to the composition data and generally improved fits to landings and discards."

The decision to favour length frequencies over associated age frequencies is extraordinary given the opposite approach has been favoured in fisheries stock assessment for many decades. It is also intuitively obvious that age frequencies are to be favoured. For example, a given age frequency has a single associated length frequency, but a given length frequency is generally consistent with many age frequencies. Further, composition data are scaled so that they will be representative of the landings/discards for the sampled fishery and they may differ greatly from the raw composition data. Obviously, any decisions about including or excluding data need to be made using the actual data (and not using a proxy which could be very different from the actual data).

The wording "length-based models" in the above paragraph is misleading. Length-based modelling is where the internal accounting system of a model only keeps track of fish numbers by length class. Primarily fitting length data in an age-structured model is not "length-based" modelling. In an age-based model (such as SS3) the internal accounting system only keeps track of numbers at age. Numbers at length are produced as required, from the numbers at age, the mean lengths at age, and the CVs of length at mean length at age. The workings of SS3 were apparently not known to the Assessment Team who said in the assessment report: "Because SS models individual fish growth internally and tracks fish from birth, it grows fish by length bins before eventually converting lengths to ages (based on the growth curve).” This confusion may be partly why the age data were rejected in favour of length data. But there was also a very poor assessment TOR which must have contributed: “Investigate fitting length composition data directly within the SS3 model as opposed to developing age-length keys and converting length frequency to age composition external to the modeling process”. This appears to be an instruction to favour length frequencies over age frequencies.

The stock identification is outside the TOR for the review and GOM red snapper are considered to be one biological stock (a meta population with sub populations). I have no issue with this conclusion except I would note that most settlement of larvae occurs within the area of spawning (Karnauskas & Paris 2021). There is enough interchange between areas (1-2%) to prevent genetic isolation. However, from a modelling point of view it makes more sense to model the two or three sub-populations with their own stock-recruitment relationships, rather than a single stock with two or three areas. I would note that the decision to use a three-area model, with a single stock-recruitment relationship and a steepness of 0.99, is equivalent to assuming that a single reef with mature red snapper in the GOM can maintain the whole stock indefinitely, at any level of fishing mortality, provided that the spawning biomass on the single reef is maintained.

The RTA had no chance of a successful conclusion given the flawed assumption that raw data were good enough for model development. However, some good did come out of the RTA as, given that there was no point in requesting model runs, the Review Panel were able to spend a lot more time developing recommendations to simplify and progress the model development.

Each of the TOR for the RTA review are considered below.

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?

The purpose of the RTA was to develop a reasonably complete specification of model structure and data sources for an operational GOM red snapper stock assessment. Unfortunately, the inadequate preparation of the composition data meant that this objective could not be achieved. The composition data used in the model runs were “raw” or “nominal” in that they were not stratified and scaled to be representative of the sampled fishery catch/discards or the surveyed population. The decision to proceed with raw composition data and to use model runs with such data to make decisions on model structure and the inclusion or exclusion of data sources was flawed. Decisions based on such model runs are not defensible because it can always be argued that different conclusions would have been reached had the representative composition data been used.

The bullet points for this TOR are considered in turn below:

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

The Data working group supplied landing and discard series, composition data, and indices for each of the three areas specified by the Stock Identification working group. The data and indices were adequately prepared except for the composition data, as already noted, and the GRSC, which requires further analysis before it can be used in a stock assessment (see below). Careful consideration was given to which indices to include but some of the fishery-dependent time series could perhaps be excluded (further consideration should be given to whether they are likely to be hyper-stable).

It was premature to include the GRSC estimates in the model as potential biases have not been quantified and composition data were not available. It is extremely unlikely that the selectivity for the survey estimates is uniform across ages 2 years and older (as suggested in Stunz et al. 2021). Composition data are needed in each area to estimate the selectivities which would be expected to vary across areas, dependent on the different survey methods used. The use of the estimates as absolute abundance ("catchability" or q = 1) is not appropriate. The potential for bias in the estimates is obvious in the comparisons of density estimates from acoustics and ROV methods. The average density from the ROV was approximately 9 times higher than the average density from acoustics at the same stations (Stunz et al. 2021, Figure 7). There are obvious reasons why the acoustic method may produce under-estimates of density, but there are reasons why the ROV could be producing over-estimates (e.g., species identification, potential double counting on the four orthogonal transects at each station, and attraction of red snapper to the ROV, including the tether). The biases for the methods used in the GRSC need to be quantified and used to produce informed priors for the associated catchabilities (qs) before the estimates can be used in a model.

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

The Data working group recommended CVs for different time periods to acknowledge the uncertain estimates of landings and discards. They also supplied the estimated CVs that were calculated from sampling designs (landings and indices) and CPUE analyses. The key feature of this assessment is that total removals are very uncertain. This is primarily due to the large components of recreational landings and discards within the total removals from the population. The key challenge of the assessment is to properly incorporate the uncertainty of total removals into the modelling framework. This includes potential bias in the landing and discard estimates, which was not acknowledged in the assessment.

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

A model developed within the SS3 modelling package is appropriate for the available data. The package is specifically designed to deal with these types of data (multiple landing and discard series across specific areas and area-specific biomass/abundance and composition times series). However, the basis on which these types of models obtain information on levels of virgin and current biomass is undermined by great uncertainty in total removals. Although there are many "bells and whistles", the basic principle of these models is that known catch (landings plus dead discards) and the relative trend in biomass (e.g., the biomass has declined 30% in the last 10 years) allow the starting biomass to be estimated (i.e., taking large catches, relative to the starting biomass, causes biomass to decline; taking small catches leads to little change in biomass).

The Assessment Team fitted the landing and discard series within the model as uncertain quantities (annual CVs applied to the estimated landings and discards). When the recommended (large) CVs were used the model failed to converge to an estimate. As already noted, this is perhaps to be expected. When smaller CVs were used (and thus total removals were assumed to be more accurately known than they are) then the model was able to converge. However, the model changed some of the annual landings and discards to improve fits to other data within the model. This is an undesirable feature of this approach. It is inappropriate for the model to be allowed to change input landings and discards (because it almost certainly has no genuine information with which to do so – it is likely just fitting noise in indices or compositions). Also, the statistical assumption made in SS3, that the estimators of landings and discards are independent random variables, is contradicted by the fits to the landings and discards series. For most series, most of the residuals are equal to zero as most values are fitted exactly (see the Assessment report, Figures 133-138). Therefore, the normalised residuals for a given series would not follow a N(0,1) distribution as would be expected if the statistical assumptions were met.

It is far better to run alternative plausible scenarios of landing and discard series, that are assumed known when input into the model. In this way the uncertainty and potential bias in landings and discards and the sensitivity of model results to those uncertainties can be fully explored.

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

The Assessment Team used a three-area model with explicit modelling of landings and discards. The model had about two thousand parameters and appeared to need more data and better-quality data than was available. In particular, the eastern area was quite data poor and many of the parameters had to be borrowed from the central region. On balance, the return to the two-area model (as a base model) would be more appropriate for now. When more data are available for the eastern area then a three-area model could be developed and considered. Indeed, given the low larval transfer, the preferred approach is to assess two sub-populations. One for the west and one for the current central and east combined.

As already noted, the composition data and the GRSC data were not adequately prepared to support the purpose of the RTA. Decisions on model structure and data sources for a particular stock assessment require that representative composition data are used and that biomass indices are unbiased (q = 1 for the GRSC estimates was not appropriate).

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?

The stock assessment was undertaken using SS3, which is ideal for the types of data available and is a well-tested package. However, the chosen model is very complex given the three areas, the multiple fleets and indices in each area, and the explicit modelling of landings and discards. The assessment team were aware of this issue and there was a verbal request for any ideas on how to simplify the model.

The specific bullet points are covered below.

- Are methods scientifically sound and robust?

As already noted, the main purpose of the RTA could not be achieved with raw composition data. So, scientifically the approach was flawed. Decisions made on the basis of model runs using the raw composition data were not robust as different results could have been reached if the actual data had been used.

The spatial structure followed the recommendations of the Stock Identification workshop. This was perhaps not the best recommendation as the eastern area had to borrow many parameters from the central area because of the lack of data. Also, the Assessment Team chose to do a single stock assessment with three areas. The assumption of a single stock-recruitment relationship is inappropriate as it implies, for example, that recruitment in Texas can be obtained from spawning biomass in Florida.

- Are priority modeling issues clearly stated and addressed?

The key feature of the RTA is that recreational landings and discards are very uncertain. This was not sufficiently acknowledged as a major problem and was therefore not properly addressed. See TOR 3 below for a discussion of how to deal with this issue.

- Are the methods appropriate for the available data?

SS3 is an ideal package to use for the stock assessment given the available data. The use and treatment of the GRSC estimates was not appropriate. As noted, the estimates should not have been treated as absolute abundance given the potential biases; selectivities should not have been estimated in the absence of length frequencies.

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

The model was in general properly configured and parameterised following “standard practice” for this jurisdiction. Unfortunately, some of the standard practices around the treatment of uncertain landings and discards is not appropriate. In particular, the specification of annual CVs to account for the uncertainty in landings and discards and fitting them in the model is not appropriate when CVs are high, and the errors are corelated across years. See TOR 3 below.

The use of multiple areas and a single stock-recruitment relationship is not appropriate. There is little larval transfer across areas, so the better approach is to perform two assessments. One for the western sup-population and one for the central and east regions combined. This ensures that each sub-population gets its own stock-recruitment relationship.

The recruitment deviations were estimated without a penalty/parameterisation to force them to average to 0. In the base model the estimated recruitment deviations averaged well above 1, which undermines the definition of R_0. The point is that average recruitment over say a 30-year period needs to be at the expected level for the stock given the stock-recruitment relationship (i.e., recruitment deviations need to average about 0).

A steepness of 0.99 was assumed for “mathematical convenience”. The consequences of this for model fits are not immediately obvious. However, it is very poor practice to assume that recruitment is independent of the level of spawning stock biomass. A plausible fixed value can be used (with sensitivities) or steepness can be estimated with an informed prior.

The start year of 1950 needs to be reconsidered as it may be that model results are sensitive to the initial catch assumptions. If possible, it is generally better to extend the catch history back in time to when there was little catch. Some experimentation and sensitivity analysis with start years should be undertaken to determine when to start the model.

The plus group for the population should be at an age when only a small percentage of the fish remain alive. For fish with a maximum age of over 50 years, 20 years is not an appropriate plus group. Likewise, the plus group for age data should be at a level that there are few fish in the plus group.

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.

The key uncertainties in the assessment are the imprecision and potential bias in the estimates of recreational landings and especially discards. It appears that only sampling uncertainty in the catch/discard rates is included in the CVs provided and uncertainty in estimated effort is not included. In any case, no provision for potential bias is acknowledged in the modelling approach. The estimates were included in the model and fitted as independent random variables with the specified CVs.

There are several problems with this approach. The obvious one is that the model almost certainly doesn't have any valid information on which to change landings/discard numbers (there are no extremely precise and unbiased indices or composition data that can help with estimating landings/discards). So, the model will change the input numbers if it helps with a fit elsewhere, but these changes are not necessarily improvements. Also, the model will not change input landings/discards which have very high CVs (i.e., are very poorly known) if it cannot improve the fit by doing so. The uncertainty in the landings/discard series will not flow through into the width of confidence intervals in any sensible fashion because the average decadal catch, for example, is relatively well known since the estimators are assumed to be unbiased with independent errors. Finally, and crucially, there are potential biases in the catch/discard estimators which have not been considered.

In the Recommendations section (below) I give an approach that can be used to much better capture the uncertainty and potential biases associated with the poorly known total removals (landings plus dead discards).

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

The current assessment model needs to be simplified and the key uncertainty in landings and discards needs to be appropriately modelled. The variability in landings and discards is driven by sampling issues and has nothing to do with ecosystem or climate factors. Variability in estimated recruitment deviations may be related to climate factors. However, it is notoriously difficult to find any robust relationships between recruitment and climate variables. Ideally, climate change would be factored into management reference points but, for this assessment, there are much more pressing and basic issues that need to be addressed first.

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.

The research recommendations from the Data Workshop appear reasonable.

There do not appear to be any designed-based estimators of red snapper biomass/abundance available (other than the GRSC). All of the indices appear to use a GLM or delta-lognormal model in their construction, which brings assumptions that may not be satisfied and which therefore may introduce bias. The GRSC was an attempt to produce designed-based estimators for at least some parts of the GOM. The estimates should be reworked with consideration of the potential biases and development of informed priors for the qs. Scaled length frequencies should be produced to allow the estimation of selectivities.

The research recommendations from the Assessment Workshop are problematic. I will consider each in turn.

In terms of recreational landing and discard data the main problem is not prominent peaks and troughs or depredation estimates. Instead, there is a fundamental problem with how to model highly uncertain and potentially biased estimates of recreational landings and discards. The scientists who are most familiar with the surveys used to provide these estimates need to consider what the potential biases are. Modellers then need to develop methods to deal with such data in a stock assessment. I describe one possible approach below but in the long term, better approaches could be developed.

Estimation of growth in the model would require conditional age at length data to be used. This is something that could be considered when the model has been simplified.

There is a recommendation to look at later start years, which I disagree with. The start year of 1950 is probably too late as results are probably very sensitive to the assumed initial catches. A much earlier start year is probably going to be better.

There is a recommendation which I do not understand:

"Currently the model includes length-converted age composition data for surveys, where possible. It would benefit the model to include real age composition for trawl surveys in the future".

I do not understand the term "real age composition". It is perfectly valid to construct age frequencies from a length frequency and an associated age-length key. This produces a **real** age frequency. Another option is to sample directly for age which is also valid. The latter is not generally needed for a trawl survey as an age-length key can easily be constructed from fish sampled during the survey.

- 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.

Below is a list of recommendations for simplifying and improving the assessment. The approach would also make the assessment more transparent and easier to review. I am not sure that completing the work required is feasible within the next six months but many of the recommendations need to be **tried** for the next assessment whenever it may occur. The Review Panel recommended a one-stock two-area (west/central & east) model as the base model. However, as most larval settlement is within the area where spawning occurred it makes more sense to approximate the GOM red snapper meta-population with sub-populations that each have their own stock-recruitment relationship.

- Perform assessments for two sub-populations (west/central & east combined). This ensures that each sub-population has its own stock-recruitment relationship.
- A three-sub-population model (west, central, east) could be considered as a sensitivity. Model the west separately. If necessary, perhaps model central and east as a two-area model (to allow east to borrow parameters from central).
- Look at alternative earlier start years for the model(s) (well before 1950).
- Focus the model(s) on total removals by combining the landings and discards for most fisheries (see Appendix 4 for specific details on how to construct total removals and associated length frequencies).
- Only use properly stratified and scaled length and age frequencies.
- Focus on age frequencies in preference to length frequencies.
- Use a plausible value for steepness and/or estimate it in the model(s) with an informed prior.
- Within each model, constrain the estimated recruitment deviations to average to zero.
- Consider removing some of the relative biomass times series if they are likely to be hyper-stable (this is particularly applicable to fishery-dependent indices).
- Use a reweighting method for the biomass time series (the idea being that the SDNRs should be not too different from 1).
- Use primary sampling units for the starting effective sample sizes for composition data (e.g., do not use number of fish but rather the number of stations)
- Perform an extensive sensitivity analysis which will include the potential bias in historical landings/discards and more recent landings/discards (the lowest stock status is likely to be associated with a low historical landing/discard scenario and a high recent landing/discard scenario). **Whether landings and discards are modelled separately or modelled as total removals assume that the series for each fishery is assumed known.**
- Perform bridging runs from the old assessment to the new base model(s).
- Produce standard diagnostics for the model(s).

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

The RTA process needs to be in **parallel** to the stock assessment process for providing management advice. This is because research conducted to improve stock assessment methods, or a particular stock assessment, cannot be guaranteed to be successful within a given timeframe. Also, it is very difficult for any research on a particular stock assessment to be successful if there is a bottleneck in the provision of data. If they think it is necessary, the team doing the stock assessment need to be allowed to investigate each data source fully. For problematic data or indices, they need to be allowed to work with the raw data and to use a variety of analysis methods (given the sampling designs). For example, even for well-designed surveys, post-stratification is sometimes needed. The same is true for stratification and scaling of length frequencies (i.e., if the drivers of length in the catch can be established through a linear modelling exercise).

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 Summary Report was prepared by the Review Panel according to the required deadlines.

Recommendations

My main recommendations are given under the Summary of findings for TOR 4. These target improving the stock assessment.

The key recommendations are:

- Perform separate assessments for west/east or west/central/east rather than using a single model with two/three areas (i.e., do an assessment for each sub population to ensure that each has its own stock-recruitment relationship).
- Use properly scaled composition data.
- Favour age frequencies over length frequencies.
- Consider earlier start years for the model(s).
- Try modelling total removals (formed outside the model(s)) rather than explicitly modelling landings and discards within the model(s).
- Whether landings and discards are modelled separately or modelled as total removals assume that the series for each fishery is known.
- Perform an extensive sensitivity analysis which will include the potential bias in historical landings/discards and more recent landings/discards (the lowest stock status is likely to be associated with a low historical landing/discard scenario and a high recent landing/discard scenario).

Conclusions

The RTA never had any chance of success because the Assessment Team were asked to work with raw composition data. Decisions made based on model runs using such data could never be defensible because different decisions could have been made if representative composition data had been used. This is why the Review Panel did not ask the Assessment Team to perform any model runs during the review meeting. However, because no model runs were requested it gave the Review Panel extra time to consider how the assessment could be improved. Several of the recommendations made for this assessment may be more widely applicable than just GOM red snapper.

Critique of NMFS Review Process

The review process serves a valuable purpose by subjecting the Data and Assessment Workshop outputs to independent external review. However, it sometimes appears that the Review Workshop is like an “ambulance at the bottom of the cliff”. The Data Workshop TOR include, for both commercial and recreational catch statistics: “Provide length and age distributions for both landings and discards if feasible”. As already noted, the RTA had no chance of success without properly scaled composition data. Had the Data Workshop included an external reviewer or even if the TOR had been externally reviewed then the RTA may have had a chance to fulfil its purpose.

Acknowledgements

The review meeting was conducted in a friendly and collegial atmosphere. The Assessment Team are thanked for their good work prior to and during the meeting. Thanks also to all of those who organized the review meeting and the provision of documents and data.

Appendix 1: Bibliography of materials provided for review

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

SEDAR74-DW-02	Reef Fish Observer Program Metadata	Sarina Atkinson, Judy Gocke, Stephanie Martinez, Elizabeth Scott-Denton	15 December 2021
SEDAR74-DW-03	Coastal Fisheries Logbook Program Metadata	Sarina Atkinson, Michael Judge, Refik Orhun	15 December 2021
SEDAR74-DW-04	LA Creel/MRIP Red Snapper Private Mode Landings and Discards Calibration Procedure	Office of Fisheries Louisiana Department of Wildlife and Fisheries	19 January 2022 Updated: 24 February 2022 4 May 2022
SEDAR74-DW-05	Florida State Reef Fish Survey Metadata	Tiffanie Cross	23 January 2022
SEDAR74-DW-06	A description of Florida's Gulf Coast recreational fishery and release mortality estimates for the central and eastern subregions (Mississippi, Alabama, and Florida) with varying levels of descender use	Julie L. Vecchio, Dominique Lazarre, Beverly Sauls, Marie Head, Trevor Moncrief	8 March 2022
SEDAR74-DW-07	Size and age information for Red Snapper, *Lutjanus campechanus*, collected in association with fishery-dependent projects along Florida's Gulf of Mexico coast	Julie Vecchio, Jessica Carrol, Dominque Lazarre, Beverly Sauls	3 March 2022
SEDAR74-DW-08	Electronic Monitoring Documentation of Red Snapper (*Lutjanus campechanus*) Catches in the Eastern Gulf of Mexico Commercial Reef Fish Bottom Longline Fishery	Max Lee, Carole Neidig, and Daniel Roberts	18 March 2022
SEDAR74-DW-09	The Reproductive Biology of Red Snapper in Mississippi Waters	Nancy J. Brown-Peterson and Anna K. Millender	12 April 2022 Updated: 31 May 2022 Updated: 14 June 2022
SEDAR74-DW-10	Methodology Description for a Simple Ratio Calibration of Texas Private Boat Red Snapper Annual Landings Estimates	NMFS Office of Science and Technology	15 April 2022

SEDAR74-DW-11	Evaluating Uncertainty in Gulf Red Snapper Estimates: A Preliminary Sensitivity Analysis of Non-Sampling Errors in the Region's Recreational Fishing Surveys	NMFS Office of Science and Technology	15 April 2022
SEDAR74-DW-12	SEFSC Computation of Uncertainty for General Recreational Landings-in-Weight Estimates, with Application to SEDAR 74 Gulf of Mexico Red Snapper	Matthew Nuttall and Kyle Dettloff	15 April 2022
SEDAR74-DW-13	Standardized Catch Rate Indices for Red Snapper (*Lutjanus campechanus*) during 1981-2019 by the U.S. Gulf of Mexico Charterboat and Private Boat Recreational Fishery	Gulf Fisheries Branch, Sustainable Fisheries Division	14 April 2022
SEDAR74-DW-14	Trip Interview Program Metadata	Sarah Beggerly, Molly Stevens, and Heather Baertlein	15 April 2022
SEDAR74-DW-15	Gulf of Mexico Red Snapper (*Lutjanus campechanus*) Commercial and Recreational Landings Length and Age Compositions	Molly H. Stevens	15 April 2022 Updated: 1 July 2022
SEDAR74-DW-16	System dynamics of red snapper populations in the Gulf of Mexico to support ecosystem considerations in the assessment and management process	Carissa Gervasi, Matthew McPherson, and M. Karnauskas	15 April 2022
SEDAR74-DW-17	Standardized Catch Rate Indices for Red Snapper (*Lutjanus campechanus*) during 1993-2006 by the U.S. Gulf of Mexico Vertical Line Fishery	Gulf of Mexico Branch, Sustainable Fisheries Division	15 April 2022
SEDAR74-DW-18	A Summary of Observer Data from the Size Distribution of Red Snapper Discards from Recreational Fishery Surveys in the Eastern Gulf of Mexico	Dominique Lazarre	15 April 2022
SEDAR74-DW-19	CPUE Expansion Estimation for Commercial Discards of Gulf of Mexico Red Snapper	Stephanie Martínez Rivera, Sarina Atkinson, Steven G. Smith, Kevin J. McCarthy	15 April 2022

SEDAR74-DW-20	Gulf of Mexico Red Snapper (*Lutjanus campechanus*) Smooth Age Length Keys	Lisa E. Ailloud	15 April 2022 Updated: 10 March 2023
SEDAR74-DW-21	Using a Censored Regression Modeling Approach to Standardized Catch Per Unit Effort for Red Snapper (Lutjanus campechanus) during 1986-2019 from the Southeast Region Headboat Survey in the U.S. Gulf of Mexico	Gulf of Mexico Fisheries Branch	18 April 2022 Updated: 27 May 2022
SEDAR74-DW-22	Commercial Landings of Red Snapper (*Lutjanus campechanus*) from the Gulf of Mexico 1964 - 2020	M. Refik Orhun	19 April 2022
SEDAR74-DW-23	Indices of abundance for Red Snapper (*Lutjanus campechanus*) on natural reefs in the eastern Gulf of Mexico using combined data from three independent video surveys	Kevin A. Thompson, Theodore S. Switzer, Mary C. Christman, Sean F. Keenan, Christopher Gardner, Katherine E. Overly, Matt Campbell	20 April 2022 Updated: 27 April 2022 Updated: 26 May 2022
SEDAR74-DW-24	Develop an updated Connectivity Modeling Simulation recruitment index for recruitment forecasting	Ana Vaz and M. Karnauskas	27 April 2022
SEDAR74-DW-25	Summary of Management Actions for Red Snapper (Lutjanus campechanus) from the Gulf of Mexico (1984 - 2022) as Documented within the Management History Database	G. Malone, K. Godwin, S. Atkinson, A. Rios	29 April 2022
SEDAR74-DW-26	Red Snapper Abundance Indices from Bottom Longline Surveys in the Northern Gulf of Mexico	Adam G. Pollack and David S. Hanisko	28 April 2022
SEDAR74-DW-27	Indices of abundance for Red Snapper (*Lutjanus campechanus*) on artificial reefs on the West Florida Shelf from stationary video surveys	Kevin A. Thompson, Theodore S. Switzer, and Sean F. Keenan	29 April 2022
SEDAR74-DW-28	SEAMAP Reef Fish Video Survey: Relative Indices of Abundance of Red Snapper	Matthew D. Campbell, Kevin R. Rademacher, Paul Felts, Joseph	29 April 2022 Updated: 4 May 2022

		Salisbury, Jack Prior	
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-	30 June 2022 Update: 5 July 2022 Updated: 25 July 2022

		Cox, and Beverly Barnett	Updated: 25 August 25
SEDAR74-DW-37	Estimation of length composition of commercial discards for Gulf of Mexico red snapper	Smith, S.G., S. F. Atkinson, and S. Martinez-Rivera	12 August 2022
SEDAR74-DW-38	Estimation of a Post-IFQ Commercial Vertical Line Abundance Index for Gulf of Mexico Red Snapper Using Reef Fish Observer Data	Smith, S.G.	30 August 2022
SEDAR74-DW-39	SEAMAP Vertical Longline Survey (2012-2021): Indices of Abundance of Gulf of Mexico Red Snapper, *Lutjanus campechanus*	Mark Albins, John Mareska, Sean Powers	13 July 2022
SEDAR74-DW-40	Modeling fecundity at age in Gulf of Mexico Red Snapper to help evaluate the best measure of reproductive potential	Susan Lowerre-Barbieri and Claudia Friess	18 July 2022
Documents Prepared for the Assessment Process			
SEDAR74-AP-01	A meta-analysis of red snapper (*Lutjanus campechanus*) discard mortality in the Gulf of Mexico	Chloe Ramsay, Julie Vecchio, Dominque Lazarre, Beverly Sauls	16 November 2022
SEDAR74-AP-02	Final Report of the SEDAR 74 Ad-hoc Discard Mortality Working Group for 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 Recruitment of Age-0 Red Snapper in the Northeast Gulf of Mexico during 2010 and 2011	Stephen T. Szedlmayer & Peter A. Mudrak
SEDAR74-RD04	Depth and Artificial Reef Type Effects on Size and Distribution of Red Snapper in the Northern Gulf of Mexico	J. Jaxion-Harm & S. T. Szedlmayer
SEDAR74-RD05	A cage release method to improve fish tagging studies	Laura Jay Williams*, Jennifer L. Herbig, Stephen T. Szedlmayer
SEDAR74-RD06	Mortality Estimates for Red Snapper Based on Ultrasonic Telemetry in the Northern Gulf of Mexico	Laura Jay Williams-Grove & Stephen T. Szedlmayer
SEDAR74-RD07	Acoustic positioning and movement patterns of red snapper *Lutjanus campechanus* around artificial reefs in the northern Gulf of Mexico	Laura Jay Williams-Grove & Stephen T. Szedlmayer
SEDAR74-RD08	Depth preferences and three-dimensional movements of red snapper, *Lutjanus campechanus*, on an artificial reef in the northern Gulf of Mexico	Laura Jay Williams-Grove & Stephen T. Szedlmayer
SEDAR74-RD09	A Comparison of Fish Assemblages According to Artificial Reef Attributes and Seasons in the Northern Gulf of Mexico	J. Jaxion-Harm, S. T. Szedlmayer & P.A. Mudrak

SEDAR74-RD10	A Comparison of Fish and Epibenthic Assemblages on Artificial Reefs with and without Copper-Based, Anti-Fouling Paint	Stephen T. Szedlmayer & Dianna R. Miller
SEDAR74-RD11	Movement patterns of red snapper *Lutjanus campechanus* based on acoustic telemetry around oil and gas platforms in the northern Gulf of Mexico	Aminda G. Everett, Stephen T. Szedlmayer, Benny J. Gallaway
SEDAR74-RD12	Changes in Shrimping Effort in the Gulf of Mexico and the Impacts to Red Snapper	Benny J. Gallaway, Scott W. Raborn, Laura Picariello, and Nathan F. Putman
SEDAR74-RD13	Using Common Age Units to Communicate the Relative Catch of Red Snapper in Recreational, Commercial, and Shrimp Fisheries in the Gulf of Mexico	Nathan F. Putman & Benny J. Gallaway
SEDAR74-RD14	Distribution and Age Composition of Red Snapper across the Inner Continental Shelf of the North-Central Gulf of Mexico	Sean P. Powers, J. Marcus Drymon,[1] Crystal L. Hightower, Trey Spearman, George S. Bosarge, and Amanda Jefferson
SEDAR74-RD15	Age and growth of red snapper, *Lutjanus campechanus*, from an 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 in growth rates and morphometrics	Andrew J. Fischer, M. Scott Baker Jr., and Charles A. Wilson
SEDAR74-RD17	Temporal Age Progressions and Relative Year-Class Strength of Gulf of Mexico Red Snapper	Robert J. Allman and Gary R. Fitzhugh
SEDAR74-RD18	Age structure of red snapper (*Lutjanus campechanus*) in the Gulf of Mexico by fishing mode and region	Robert J. Allman, Linda A. Lombardi-Carlson, Gary R. Fitzhugh, and William A. Fable
SEDAR74-RD19	Regional differences in the age and growth of red snapper (*Lutjanus campechanus*) in the U.S. Gulf of Mexico	Courtney R. Saari, James H. Cowan Jr., and Kevin M. Boswell
SEDAR74-RD20	A Comparison of Size Structure, Age, and Growth of Red Snapper from	Matthew K. Streich, Matthew J. Ajemian, Jennifer J. Wetz, Jason A.

	Artificial and Natural Habitats in the Western Gulf of Mexico	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 in the Northeastern Gulf of Mexico: Implications for Fishery-Independent Surveys	Sean F. Keenan, Theodore S. Switzer, Kevin A. Thompson, Amanda J. Tyler-Jedlund, and Anthony R. Knapp

SEDAR74-RD31	Estimating Exploitation Rates in the Alabama Red Snapper Fishery Using a High-Reward Tag–Recapture Approach	Dana K. Sackett, Matthew Catalano, Marcus Drymon, Sean Powers, and Mark A. Albins
SEDAR74-RD32	Spatial Heterogeneity, Variable Rewards, Tag Loss, and Tagging Mortality Affect the Performance of Mark–Recapture Designs to Estimate Exploitation: an Example using Red Snapper in the Northern Gulf of Mexico	Dana K. Sackett and Matthew Catalano
SEDAR74-RD33	Modeling the spatial distribution of commercially important reef fishes on the West Florida Shelf	S.E. Saul, J.F. Walter III, D.J. Die, D.F. Naar, B.T. Donahue
SEDAR74-RD34	Descriptions of the U.S. Gulf of Mexico Reef Fish Bottom Longline and Vertical Line Fisheries Based on Observer Data	Elizabeth Scott-Denton, Pat F. Cryer, Judith P. Gocke, Mike R. Harrelson, Donna L. Kinsella, Jeff R. Pulver, Rebecca C. Smith, and Jo Anne Williams
SEDAR74-RD35	The potential for unreported artificial reefs to serve as refuges from fishing mortality for reef fishes	Dustin T. Addis, William F. Patterson III, Michael A. Dance, and G. Walter Ingram Jr.
SEDAR74-RD36	Immature and mature female Red Snapper habitat use in the north-central Gulf of Mexico	A.J. Leontiou, Wei Wu, and Nancy J. Brown-Peterson
SEDAR74-RD37	Importance of Depth and Artificial Structure as Predictors of Female Red Snapper Reproductive Parameters	Nancy J. Brown-Peterson, Robert T. Leaf, and Andrea J. Leontiou
SEDAR74-RD38	Demographic differences in northern Gulf of Mexico red snapper reproductive maturation	Melissa W. Jackson, James, H. Cowan, Jr. and David L. Nieland
SEDAR74-RD39	Estimating the Dependence of Spawning Frequency on Size and Age in Gulf of Mexico Red Snapper	C. E. Porch, G. R. Fitzhugh, E. T. Lang, H. M. Lyon & B. C. Linton
SEDAR74-RD40	Regional Differences in Florida Red Snapper Reproduction	Nancy J. Brown-Peterson, Karen M. Burns, and Robin M. Overstreet
SEDAR74-RD41	Multidecadal meta-analysis of reproductive parameters of female red snapper (*Lutjanus campechanus*) in the northern Gulf of Mexico	Nancy J. Brown-Peterson, Christopher R. Peterson, and Gary R. Fitzhugh

SEDAR74-RD42	A Comparison of Red Snapper Reproductive Potential in the Northwestern Gulf of Mexico: Natural versus Artificial Habitats	Hilary D. Glenn, James H. Cowan Jr. & Joseph E. Powers
SEDAR74-RD43	Temporal and spatial comparisons of the reproductive biology of northern Gulf of Mexico (USA) red snapper (*Lutjanus campechanus*) collected a decade apart	Dannielle H. Kulaw, James H. Cowan Jr., and Melissa W. Jackson
SEDAR74-RD44	Effect of circle hook size on reef fish catch rates, species composition, and selectivity in the northern Gulf of Mexico recreational fishery	William F Patterson III, Clay E Porch, Joseph H Tarnecki, and Andrew J Strelcheck
SEDAR74-RD45	Experimental Assessment of Circle Hook Performance and Selectivity in the Northern Gulf of Mexico Recreational Reef Fish Fishery	Steven B. Garner, William F. Patterson III, Clay E. Porch, and Joseph H Tarnecki
SEDAR74-RD46	Simulating effects of hook-size regulations on recreational harvest efficiency in the northern Gulf of Mexico red snapper fishery	Steven B. Garner, William F. Patterson III, John F. Walter, and Clay E. Porch
SEDAR74-RD47	Effect of reef morphology and depth on fish community and trophic structure in the northcentral Gulf of Mexico	Steven B. Garner, Kevin M. Boswell, Justin P. Lewis, Joseph H. Tarnecki, William F. Patterson III
SEDAR74-RD48	Linear decline in red snapper (*Lutjanus campechanus*) otolith D14C extends the utility of the bomb radiocarbon chronometer for fish age validation in the Northern Gulf of Mexico	Beverly K. Barnett, Laura Thornton, Robert Allman, Jeffrey P. Chanton, and William F. Patterson III
SEDAR74-RD49	Changes in Reef Fish Community Structure Following the Deepwater Horizon Oil Spill	Justin P. Lewis, Joseph H. Tarnecki, Steven B. Garner, David D. Chagaris & William F. Patterson III
SEDAR74-RD50	The Utility of Stable and Radioisotopes in Fish Tissues as Biogeochemical Tracers of Marine Oil Spill Food Web Effects	William F. Patterson III, Jeffery P. Chanton, David J. Hollander, Ethan A. Goddard, Beverly K. Barnett, and Joseph H. Tarnecki
SEDAR74-RD51	A Review of Movement in Gulf of Mexico Red Snapper: Implications for Population Structure	William F. Patterson, III

SEDAR74-RD52	Changes in Red Snapper Diet and Trophic Ecology Following the Deepwater Horizon Oil Spill	Joseph H. Tarnecki and William F. Patterson III
SEDAR74-RD53	Population Structure of Red Snapper in the Northern Gulf of Mexico	John R. Gold and Eric Saillant
SEDAR74-RD54	Mitochondrial DNA variation among red snapper (*Lutjanus campechanus*) from the Gulf of Mexico	Jeff Camper, John R. Gold, and Robert C. Barber
SEDAR74-RD55	A molecular approach to stock identification and recruitment patterns in red snapper (*Lutjanus campechanus*)	R.W. Chapman, S.A. Bortone, and C.M. Woodley
SEDAR74-RD56	Stock Structure, connectivity, and effective population size of red snapper (*Lutjanus campechanus*) in the U.S. waters of the Gulf of Mexico	David S. Portnoy
SEDAR74-RD57	Mitochondrial DNA variation among 'red' fishes from the Gulf of Mexico	John R. Gold and Linda R. Richardson
SEDAR74-RD58	Population structure of red snapper (Lutjanus campechanus) in U.S. waters of the western Atlantic Ocean and the northeastern Gulf of Mexico	Christopher M. Hollenbeck, David S. Portnoy, Eric Saillant, John R. Gold
SEDAR74-RD59	Population structure and variance effective size of red snapper (*Lutjanus campechanus*) in the northern Gulf of Mexico	Eric Saillant and John R. Gold
SEDAR74-RD60	Population Structure and Variation in Red Snapper (Lutjanus campechanus) from the Gulf of Mexico and Atlantic Coast of Florida as Determined from Mitochondrial DNA Control Region Sequence	Amber F. Garber, Michael D. Tringall and Kenneth C. Stuck
SEDAR74-RD61	Genetic homogeneity among geographic samples of snappers and groupers: evidence of continuous gene flow	John R. Gold and Linda R. Richardson
SEDAR74-RD62	Population Structure of Red Snapper from the Gulf of Mexico as Inferred from Analysis of Mitochondrial DNA	J. R. Gold, E Sun, and L. R. Richardson

SEDAR74-RD63	DNA Microsatellite Loci and Genetic Structure of Red Snapper in the Gulf of Mexico	Ed Heist and John R. Gold
SEDAR74-RD64	Genetic impacts of shrimp trawling on red snapper (Lutjanus campechanus) in the northern Gulf of Mexico	Eric Saillant, S. Coleen Bradfield, and John R. Gold
SEDAR74-RD65	Genetic variation and spatial autocorrelation among young-of-the-year red snapper (*Lutjanus campechanus*) in the northern Gulf of Mexico	Eric Saillant, S. Coleen Bradfield, and John R. Gold
SEDAR74-RD66	Connections between Campeche Bank and Red Snapper Populations in the Gulf of Mexico via Modeled Larval Transport	Donald R. Johnson, Harriet M. Perry, and Joanne Lyczkowski-Shultz
SEDAR74-RD67	Red snapper, *Lutjanus campechanus*, larval dispersal in the Gulf of Mexico	Donald R. Johnson and Harriet M. Perry
SEDAR74-RD68	Historical population demography of red snapper (*Lutjanus campechanus*) from the northern Gulf of Mexico based on analysis of sequences of mitochondrial DNA	Christin L. Pruett, Eric Saillant, and John R. Gold
SEDAR74-RD69	Microsatellite Variation Among Red Snapper (*Lutjanus campechanus*) from the Gulf of Mexico	John R. Gold, Elena Pak, and Linda R. Richardson
SEDAR74-RD70	Genomics overrules mitochondrial DNA, siding with morphology on a controversial case of species delimitation	Carmen del R. Pedraza-Marron, Raimundo Silva, Jonathan Deeds, Steven M. Van Belleghem, Alicia Mastretta-Yanes, Omar Domınguez-Domı´nguez, Rafael A. Rivero-Vega, Loretta Lutackas, Debra Murie, Daryl Parkyn, Lewis H. Bullock, Kristin Foss, Humberto Ortiz-Zuazaga, Juan Narvaez-Barandica, Arturo Acero, Grazielle Gomes, and Ricardo Betancur-R
SEDAR74-RD71	SEDAR52-WP-20: Use of the Connectivity Modeling System to estimate movements of red snapper (*Lutjanus campechanus*) recruits in the northern Gulf of Mexico	M. Karnauskas, J. F. Walter III, and C. B. Paris

SEDAR74-RD72	Fine-scale partitioning of genomic variation among recruits in an exploited fishery: causes and consequences	Jonathan B. Puritz, John R. Gold & David S. Portnoy
SEDAR74-RD73	Historical Population dynamics of red snapper (*Lutjanus campechanus)* in the northern Gulf of Mexico	J. R. Gold and C. P. Burridge
SEDAR74-RD74	Red Snapper Larval Transport in the Northern Gulf of Mexico	Donald R. Johnson, Harriet M. Perry, Joanne Lyczkowski-Shultz & David Hanisko
SEDAR74-RD75	Talking Smack: the archaeology and history of Pensacola's red snapper fishing industry	Nicole Rae Bucchino
SEDAR74-RD76	Distribution, Abundance, and Age Structure of Red Snapper (*Lutjanus campechanus*) Caught on research Longlines in the U.S. Gulf of Mexico	Karen M. Mitchell, Terry Henwood, Gary R. Fitzhugh, and Robert J. Allman
SEDAR74-RD77	SEDAR31-DW15: Spatio-temporal dynamics in red snapper reproduction on the West Florida Shelf, 2008-2011	Susan Lowerre-Barbieri, Laura Crabtree, Theodore S. Switzer, and Robert H. McMichael, Jr.
SEDAR74-RD78	SEDAR52-WP-15: Reproductive data compiled for the Gulf of Mexico Red Snapper, *Lutjanus campechanus*, SEDAR 52	G.R. Fitzhugh, H.M. Lyon, V.C. Beech, P.M. Colson
SEDAR74-RD79	Trophic ecology of red snapper *Lutjanus campechanus* on natural and artificial reefs: interactions between annual variability, habitat, and ontogeny	Rachel A. Brewton, Charles H. Downey, Matthew K. Streich, Jennifer J. Wetz, Matthew J. Ajemian, Gregory W. Stunz
SEDAR74-RD80	Comparing reproductive capacity of nearshore and offshore red snapper, *Lutjanus campechanus*, on artificial reefs in the western Gulf of Mexico	Ricky J. Alexander
SEDAR74-RD81	Reduction of juvenile red snapper bycatch in the U.S. Gulf of Mexico shrimp trawl fishery	Benny J. Gallaway and John G. Cole
SEDAR74-RD82	A Life History Review for Red Snapper in the Gulf of Mexico with an Evaluation of the Importance of Offshore Petroleum Platforms and Other Artificial Reefs	Benny J. Gallaway, Stephen T. Szedlmayer, and William J. Gazey

SEDAR74-RD83	Delineation of Essential Habitat for Juvenile Red Snapper in the Northwestern Gulf of Mexico	Benny J. Gallaway, John G. Cole, Robert Meyer, and Pasquale Roscigno
SEDAR74-RD84	Retrospective Analysis of Midsummer Hypoxic Area and Volume in the Northern Gulf of Mexico, 1985−2011	Daniel R. Obenour, Donald Scavia, Nancy N. Rabalais, R. Eugene Turner, and Anna M. Michalak
SEDAR74-RD85	Space-Time Geostatistical Assessment of Hypoxia in the Northern Gulf of Mexico	V. Rohith Reddy Matli, Shiqi Fang, Joseph Guinness, Nancy. N. Rabalais, J. Kevin Craig, and Daniel R. Obenour
SEDAR74-RD86	Fusion-Based Hypoxia Estimates: Combining Geostatistical and Mechanistic Models of Dissolved Oxygen Variability	Venkata Rohith Reddy Matli, Arnaud Laurent, Katja Fennel, Kevin Craig, Jacob Krause, and Daniel R. Obenour
SEDAR74-RD87	Application of three-dimensional acoustic telemetry to assess the effects of rapid recompression on reef fish discard mortality	Erin Collings Bohaboy, Tristan L. Guttridge, Neil Hammerschlag, Maurits P. M. Van Zinnicq Bergmann, and William F. Patterson III
SEDAR74-RD88	The Great Red Snapper Count: Estimating the Absolute Abundance of Age-2+ Red Snapper (*Lutjanus campechanus*) in the U.S. Gulf of Mexico	Stunz, G. W., W. F. Patterson III, S. P. Powers, J. H. Cowan, Jr., J. R. Rooker, R. A. Ahrens, K. Boswell, L. Carleton, M. Catalano, J. M. Drymon, J. Hoenig, R. Leaf, V. Lecours, S. Murawski, D. Portnoy, E. Saillant, L. S. Stokes., and R. J. D. Wells
SEDAR74-RD89	Spawning origins and ontogenetic movements for demersal fishes: An approach using eye-lens stable isotopes	Julie L. Vecchio, Ernst B. Peebles
SEDAR74-RD90	Discard mortality of red snapper released with descender devices in the U.S. South Atlantic	Brendan J. Rhunde, Nathan M. Bacheler, Kyle W. Shertzer, Paul J. Rudershausen, Beverly Sauls, and Jeffrey A. Buckel
SEDAR74-RD91	Spatial and Temporal Influences of Nearshore Hydrography on Fish Assemblages Associated with Energy Platforms in the Northern Gulf of Mexico	Ryan T. Munnelly, David B. Reeves, Edward J. Chesney, Donald M. Baltz
SEDAR74-RD92	Lessons learned from practical approaches to reconcile mismatches between biological population structure and stock units of marine fish	Lisa A. Kerr, Niels T. Hintzen, Steven X. Cadrin, Lotte Worsøe Clausen, Mark Dickey- Collas, Daniel R. Goethel, Emma M.C. Hatfield, Jacob P. Kritzer, and Richard D.M. Nash

SEDAR74-RD93	Defining spatial structure for fishery stock assessment	Steven X. Cadrin
SEDAR74-RD94	Genomic analysis of red snapper, *Lutjanus campechanus*, population 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 among Recreational Anglers in the Northern Gulf of Mexico	Steven B. Scyphers, F. Joel Fodrie, Frank J. Hernandez Jr., Sean P. Powers & Robert L. Shipp
SEDAR74-RD98	Testing the efficacy of recompression tools to reduce the discard mortality of reef fishes in the Gulf of Mexico	Oscar E. Ayala
SEDAR74-RD99	Understanding resource-conserving behaviors among fishers: Barotrauma mitigation and the power of subjective norms in Florida's reef fisheries	Chelsey A. Crandall, Taryn M. Garlock, and Kai Lorenzen
SEDAR74-RD100	Recreational angler attitudes and perceptions regarding the use of descending devices in Southeast reef fish fisheries	Judson M. Curtis, Alex K. Tomkins, Andrew J. Loftus, and Gregory W. Stunz
SEDAR74-RD101	Venting or rapid recompression increase survival and improve recovery of red snapper with barotrauma	Karen L. Drumhiller, Matthew W. Johnson, Sandra L. Diamond, Megan M. Reese Robillard and Gregory W. Stunz
SEDAR74-RD102	Descender devices or treat tethers: Does barotrauma mitigation increase opportunities for depredation?	J. Marcus Drymon, Amanda E. Jefferson, Crystal Louallen-Hightower, and Sean P. Powers
SEDAR74-RD103	Sink or swim? Factors affecting immediate discard mortality for the	J.R. Pulver

	Gulf of Mexico commercial reef fishery	
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

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

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.

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

Requirements

NMFS requires three (3) reviewers to conduct an impartial and independent peer review in accordance with this Performance Work Statement (PWS), OMB guidelines, and the TORs below. The reviewers shall have a working knowledge in stock assessment, statistics, fisheries science, and marine biology sufficient to complete the primary task of providing peer-review advice in compliance with the workshop Terms of Reference fisheries stock assessment. Expertise in Stock Synthesis and the usage of age vs length structured modeling approaches and the associated diagnostics would be helpful.

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

Tasks

Task 1) Review Preparation

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

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

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

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

Task 2) Complete Panel Review Meeting

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

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

Task 3) Complete Independent Peer Review

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

Task 4) Contributions to the Summary Report

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

Task 5) Final Peer Review and Summary Report

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

Foreign National Security Clearance

When reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for reviewers who are non-US citizens. For this reason, the reviewers shall provide the requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for their security clearance. This information shall be submitted at least 30 days in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Foreign National Guest website. The contractor is required to use all appropriate methods to safeguard Personally Identifiable Information (PII).

Place of Performance

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

Period of Performance

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

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

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

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

Applicable Performance Standards

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

Confidentiality and Data Privacy

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

Travel

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

Government Furnished Resources

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

Project Contacts:

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

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

Annex 1: Peer Review Report Requirements

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

2. The report must contain a background section, description of the individual reviewers' roles in the review activities, summary of findings for each TOR in which the weaknesses and strengths are described, and conclusions and recommendations in accordance with the TORs.

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

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

   c. Reviewers shall elaborate on any points raised in the summary report that they believe might require further clarification.

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

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

3. The report shall include the following appendices:

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

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

Review Workshop Terms of Reference

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

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

3. Consider how uncertainties in the assessment, and their potential consequences, are addressed.
   - Comment on the degree to which methods used to evaluate uncertainty reflect and capture the significant sources of uncertainty in the population, data sources, and assessment methods.
   - Comment on the likely relationship of this variability with possible ecosystem or climate factors and possible mechanisms for encompassing this into management reference points.

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

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

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

Annex 3: Tentative Agenda - SEDAR 74 Gulf of Mexico Red Snapper Research Track Assessment Review
Tampa, FL
Dec 12-15, 2023

Tuesday:

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

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

Wednesday:

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

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

Thursday

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

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

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

<u>Friday</u>

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

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

Appendix 3: Panel Membership and 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

Appendix 4: Combining recreational landings and discards to produce total removals and combining associated length frequencies.

This appendix describes an approach for combining recreational landings and discards to produce total removals. The incorporation of potential bias is covered. Also, an approach for constructing associated length frequencies for the total removals is described.

The survey design for estimating recreational landings and discards changes across state and time but generally involves an estimate of CPUE for landings and discards and an estimate of total effort which is used to scale the CPUE. The potential biases may also change across time given the different approaches. It may be best to apply these equations at the stratum level and then combine across strata, but for illustrative purposes I will assume a single stratum (or this can be considered as an approximation, dealing with average bias across strata).

First, we define the random variables,

L = estimated landings (number of fish)

A = estimated total effort

R_L = average number of fish landed per unit of effort

Then, $L = AR_L$

Similarly let,

D = estimated discards (number of fish)

R_D = average number of fish discarded per unit of effort

Then, $D = AR_D$

If we assume that p_{die} is the proportion of discarded fish that die, then the total removals from the population are estimated by T:

$$T = L + p_{die}D = A(R_L + p_{die}R_D)$$

This is the equation that would be used for the base model where no bias is assumed (i.e., just replace the random variables with particular realisations). However, for recreational landings and discards there is the potential for bias in the estimate of total effort (e.g., not sampling the full population of anglers; not randomly sampling, for example, because of refusals to participate) and CPUE (e.g., tendencies to exaggerate/mis-remember with increasing time; self-reporting of discards). It may be that there are many competing biases which to some extent cancel out, but, nevertheless, there is the potential for a consistent bias across years for a given survey.

Let,

$E(A) = b_F\, a$, where a = total effort, b_F = effort bias factor

$E(R_L) = b_L\, r_l$, where r_l = landings cpue, b_L = landings CPUE bias factor

$E(R_D) = b_D\, r_d$, where r_d = discard cpue, b_D = discard CPUE bias factor

If all the bias factors are 1 then the estimators are unbiased, with their expectations (E) equal to the true values.

Assuming that A is independent of R_L and R_D, then,

$$E(T) = b_F\ a\ (b_L\ r_l + p_{die}\ b_D\ r_d)$$

This equation shows that the bias in total effort affects both landings and discards and that the estimate of total removals (T) is biased.

If we knew the bias factors, then we could adjust T to be unbiased:

$$T_{adj} = (L/b_L + p_{die}\ D/b_D)\ /\ b_F$$

If we have a plausible range for each of the bias factors and for p_{die}, then using this equation we can construct a “low” total removal series and a “high” total removal series.

For example, we might believe, after analysing a particular survey and discussing the potential bias with people familiar with the particular survey, that,

$1/1.2 < b_F < 1.2$

$1/1.1 < b_L < 1.1$

$1/1.4 < b_D < 1.4$

$0.5 < p_{die} < 0.9$

The low total removal series comes from the high values of the bias factors and the low value of p_{die}. Similarly, the high series comes from the low values of the bias factors and the high value of p_{die}.

The exercise of constructing a low, base, and high total removal series would need to be done for each recreational fishery in each time block. For commercial fisheries probably just a base series is needed.

For historical catches which are uncertain there also needs to be low, base, and high series. Take note of how the catches were reconstructed. There will be some factors or proportions that were assumed. This is where the potential bias will arise.

It is important to note that the lowest stock status estimates are likely to come from a low historical series and a high recent series. This is because low historical catches tend to decrease estimates of virgin/starting biomass and high recent catches tend to decrease current biomass.

Combining length frequencies (LF) for landings and discards for given estimates of landing and discard numbers is straightforward. Note, that the landing and discard numbers change with each scenario, being different for the low, base, and high series. Simply multiply the proportions from the landings LF by the estimated number of landings to get the number landed in each length class. Then apply the proportions from the discard LF to the number of discards adjusted by the proportion that are assumed to die. Add the landings and dead discards within length classes and then divide by the total number of removals to get the proportions at length for the removals.

When there is an LF for the landings but no LF for the discards then we can assume a constant retention function to transform the landings LF into a total removals LF. The shape of the retention function could be guided by the regulations at the time and/or a similar fishery where retention curves can be estimated (i.e., from the LF for total discards and the LF for total landings; within each length class divide the number of landed fish by the total number of landed and discarded fish).

As we only have an LF for the landings there is the issue of the discarded fish that are in length classes that were not landed. We must assume some proportion of the discarded number to be in these length classes. This is useful as it makes the assumption transparent whereas if a retention curve is just assumed in a model, which fits landings and discards separately, then we may never know how many fish in unlanded length classes there actually are when the model is fitted (I suppose that they could be output and checked for plausibility, but it may be quicker to put in a plausible value outside the model).

We need to match up the numbers landed and discarded with the shape of the retention curve that we want.

Let,

> n_L = number landed (in the particular scenario in a given year)
>
> n_D = number discarded (excluding those in length classes not landed)
>
> For the ith length class, $r_i = q\ p_i$ where the p_i are specified, non zero, and the q is to be calculated.

The p_i give the shape of the retention curve whereas the r_i are the proportion retained in each length class.

Let n_{Ci} be the number caught in the ith length class, then the number landed in the ith length class is

$$n_{Li} = q\ p_i\ n_{Ci}$$

and $$n_{Ci} = n_{Li} / (q\ p_i)$$

We just need to find q to have the retention curve fully specified and to be able to transform the LF for the landings into an LF for the total removals (excluding the fish discarded in length classes not landed).

We have the total number of fish caught in the landed length classes, so we sum across landed length classes:

$$\mathrm{Sum}_i (n_{Li}/qp_i) = n_L + n_D$$

Which gives,

$$q = \mathrm{Sum}_i (n_{Li}/p_i) / (n_L + n_D)$$

With q calculated we can then get the number in each landed length class that were caught.

A length frequency needs to be assumed for the discarded fish in the non-landed length classes to give the full LF for the caught fish (SS3 doesn't allow just the landed length classes to be fitted). This discard LF should just follow the shape of the adjusted landed LF but some experimentation may be needed with the proportion of discarded fish in the non-landed length classes. The retention curve then needs to be applied to the LF of caught fish to give separate LFs for landed and discarded fish. The assumption of the proportion of discards that die can then be applied to the discard LF and the LF for the total removals can be obtained.

Note that when the model is run with total removals, rather than landings and discarded fish separated, the model outputs of total removals (e.g., a recommended catch) can be transformed into landings and discards. There is some maths involved but the length frequency of the total removals can be output from the model and the (assumed) retention curve together with the discard mortality rate can be used to calculate discards and landings. When the retention curve is not assumed (i.e., when there were landing and discard LFs) then there is an implied retention curve. It is the best fit (outside the model) to the annual landing and discard LFs (e.g., calculate the retention curve for each year and do a least-squares fit to all of the curves assuming some functional form, or just average them across years within length class).

The approach described above moves complexity from within the model to outside the model. The only way to be sure which approach is best for a particular case is to try it. I suggest modelling the west and east sub-populations separately (i.e., the old separation, but two different models each with their own stock-recruitment relationships). As a first step, I suggest trying the above approach just on the western sub-population and see how it compares to modelling the landings and discards explicitly for the western sub-population.