Center for Independent Experts (CIE) Peer Review of Highly Migratory Species Bonnethead Shark and Atlantic Sharpnose Shark Assessment

Prepared by:

Panayiota Apostolaki

Assignment undertaken for:

Center for Independent Experts

October 2013

Table of contents

Executive summary

Bonnethead and Atlantic sharpnose are both small coastal sharks that can be found in the Gulf of Mexico and North Atlantic. Their management is part of the US Highly Migratory Species Fisheries Management Plan; for quota purposes they are part of the non-blacknose small coastal shark group. Both species are caught in commercial and recreational fisheries and as by-catch in fisheries such as the shrimp trawl fishery. Prior to 2002, both species were assessed as part of the Small Coastal Shark Complex but since 2002, they have been assessed individually.

The 2013 stock assessments workshop for bonnethead and Atlantic sharpnose stocks took place in June 2013 and were conducted under the SEDAR framework. A state-space, age-structured production model (SSASPM) was used within a Bayesian statistical framework for their stock assessment. Information about all key elements of the species life-history (growth, maturity, mortality, etc.) was available together with catch data and relative abundance indices.

The assessment results for both species showed that the populations are unlikely to be overfished and overfishing is not currently taking place. According to the basecase scenario, the size of the population at the end of the time period of the calculations (2011) is above the population size that corresponds to MSY (16% more for bonnethead and 52% more for sharpnose). Similarly, current (2011) fishing mortalities are well below MSY levels for both species.

Dr Panayiota Apostolaki was commissioned to provide an independent review of the stock assessment reports entitled

a) SEDAR 34, Stock Assessment Report, HMS Atlantic Sharpnose Shark and
b) SEDAR 34, Stock Assessment Report, HMS Bonnethead Shark

in accordance with the SoW. The review was desk based and this document provides the outcome of this review.

The approach used for the assessment is appropriate and fits well the data available for the two species. However, although the choice of the quantitative approach is fit for purpose, there are some important weaknesses in the assumptions used or the way calculations were done that reduce the power of the analysis. Additional work is therefore required to address those issues and ensure that outcomes will provide a robust basis for management decisions.

Specific comments and recommendations under each Term of Reference are shown below:

TOR 1. Evaluate the data used in the assessment, addressing the following:

a) **Are data decisions made by the assessment panel sound and robust?**

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

c) **Are data applied properly within the assessment model?**

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

The Panel had access to the relevant information required to do a stock assessment using an age-structured production model. The approaches used to standardise the indices were in line with relevant guidance. The level of uncertainty in the individual values was within expected levels but the inter-annual variability that the CPUE series exhibited is considerable and it is not what would be expected given the life history of the shark species they describe. Overall, the stock assessment reports explain well how decisions were taken and many of the decisions made by the panel are sound. The report also provides a good insight into uncertainties in the data and understanding of the fish and fisheries dynamics and suggests ways to incorporate them into the assessments. However, there are a few areas in which the choices made by the Panel are not robust and require either better justification or reconsideration of the appropriate approach. Specifically, for Atlantic sharpnose, the values of the biological parameter chosen for the model are reasonable and reflect the information that was available to the Panel and the approaches that the Panel adopted. The parameters used to configure the bonnethead model also reflected the decisions of the Panel but they did not reflect the biological information described to be available to the panel. This is an important issue that needs to be addressed.

Recommendations for additional work to address the relevant issues are listed below.

Recommendation 1.1. Bonnethead shark should be assessed as two different stocks. At the very least, a sensitivity run using the biology and fishery data from Gulf of Mexico and one that uses the data from the Atlantic should be included in the stock assessment report (similar to the sensitivity runs done for Atlantic sharpnose).

Recommendation 1.2. The results of the calculations of natural mortality for each of the different models used should be presented to provide insight into the level of uncertainty in the adopted values.

Recommendation 1.3. The methodology used to calculate shrimp by-catch before 1972 needs to be presented and the authors need to revisit the values currently used for shrimp bycatch during that period to either correct them or explain why the adopted values are correct.

Recommendation 1.4 The values used to describe by-catch of bonnethead in the shrimp fishery for years 2006-2011 need to be checked (Table 2.5.1) and corrected. If this is not just a typo, the relevant calculations need to be redone using the correct by-catch values.

Recommendation 1.5. Inconsistencies in the selectivity patterns adopted for each fleet need to be corrected and, if those were also introduced into the model, the analysis needs to be rerun using the correct selectivity curves.

TOR 2. Evaluate the methods used to assess the stock, taking into account the available data.

a) **Are methods scientifically sound and robust?**
b) **Are assessment models configured properly and used consistent with standard practices?**
c) **Are the methods appropriate for the available data?**

The level of detail in the model is appropriate and reflects well the amount and type of data available to describe the species dynamics and exploitation. The statistical framework used to fit models to observations is widely used and the incorporation of priors offers additional flexibility in increasing the amount of information that is utilized in the calculations. Overall, the analysis uses well-documented and tested assessment approaches and the application of the models is consistent with standard practices. However, I have some concerns about the way the assessment model is configured (and consistency in its configuration) and about some of the specific formulae chosen for the calculations.

Recommendations for additional work to address those issues are provided below.

Recommendation 2.1 The formula used to calculate monthly catches in the stock assessment model needs to be revisited to ensure that it does not introduce an error in the estimates of fishing effort.

Recommendation 2.2. I would recommend that another sensitivity run is done to test how the model predictions would change if gender-specific life history is simulated.

Recommendation 2.3 Inconsistencies with choices of CV multipliers need to be corrected and the models rerun if needed.

Recommendation 2.4 The information about pdfs used to characterise some of the parameters need to be corrected or clarified (Tables 3.5.6).

Recommendation 2.5 The analysis either needs to calculate the maximum yield in numbers that can be achieved and use that as a reference or acknowledge that what

they are presenting as MSY in numbers is not exactly that and explain why they have opted for that value and what it means in terms of bias in the findings.

TOR 3 Evaluate the assessment findings with respect to the following:

a) **Are abundance, exploitation, and biomass estimates reliable, consistent with input data and population biological characteristics, and useful to support status inferences?**
b) **Is the stock overfished? What information helps you reach this conclusion?**
c) **Is the stock undergoing overfishing? What information helps you reach this conclusion?**
d) **Is there an informative stock recruitment relationship? Is the stock recruitment curve reliable and useful for evaluation of productivity and future stock conditions?**
e) **Are the quantitative estimates of the status determination criteria for this stock reliable? If not, are there other indicators that may be used to inform managers about stock trends and conditions?**

The analysis presented absolute values of stock size and fishing mortality as well as reference points based on MSY to describe the status of the population and exploitation levels at the end of the calculations (2011). The MSY-based references were presented in numbers due to concerns about weight calculations. These parameters and reference values are widely used to describe current and future status of stocks. The authors have considered an extensive set of sensitivity runs to address some of the challenges with the data and stock structure. The high level findings from the sensitivity runs remained broadly the same as those from the basecase run adding consistency in the findings of the model. With a couple of exceptions, the presentation of findings and choice of benchmarks provide enough material to build a good picture of the current status of the stock and the performance of the model.

For sharpnose, the basecase analysis, together with the sensitivity runs, provide reliable abundance and other estimates that reflect the input parameters and knowledge of the stock dynamics and life histories.

However, for bonnethead, although the outcomes are consistent with input data, it is questionable whether they present reliable abundance estimates that can support status inferences. This is because it is unclear how representative of the bonnethead stock(s) the parameterisation of the model is. Given that fundamental issue, it is difficult to make conclusive statements about the status of both the Gulf of Mexico and Atlantic stocks.

Recommendation 3.1 Stock assessment results for two separate stocks that reflect the biology and fleet activity in the Gulf of Mexico and Atlantic should be presented for bonnethead.

TOR 4. Evaluate the stock projections, rebuilding timeframes, and generation times, addressing the following:

a) **Are the methods consistent with accepted practices and available data?**
b) **Are the methods appropriate for the assessment model and outputs?**
c) **Are the results informative and robust, and useful to support inferences of probable future conditions?**
d) **Are key uncertainties acknowledged, discussed, and reflected in the projection results?**

The projection model used is a detailed model that represents well the stocks that the Panel wanted to simulate and is an appropriate model with which to combine the methodology used in the stock assessment (but see some comments about improvements below). The quantities calculated in the projections are appropriate to assess the condition of the stock in the future and a wide range of exploitation levels are considered to provide a comprehensive picture of possible future catch scenarios and stock status under each of them. Uncertainties in parameter values are acknowledged explicitly by inputting the results of the stock assessments (estimated parameters and outcomes) as distributions. Also, uncertainty in future stock exploitation levels is taken into account by running the projections for a wide range of catches. Overall, the analysis captured uncertainty well and the presentation of the results using probabilities was fit for purpose and provided a good picture of the robustness of the predictions. I have provided recommendations below about a few things that need further consideration or clarifications.

Recommendation 4.1 Some further analysis would be recommended to provide an insight as to how successful using the two bivariate distribution was in reducing the risk of selecting values of the variables that have not generated the data.

Recommendation 4.2 Unless the authors provide evidence that suggest that the set of by-catch estimates used in the basecase run represent a high estimate of those values, I would recommend that another run be done that uses by-catch values for shrimp fisheries that are greater than those used in the basecase.

Recommendation 4.3 For bonnethead, projections should also be run for the additional scenario described in Recommendation 3.1.

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

a) **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**
b) **Ensure that the implications of uncertainty in technical conclusions are clearly stated.**

The statistical and scenario-based approach used is appropriate and allows for uncertainty in input data and stock and fleet dynamics to be incorporated in the analysis. The way results are presented (use of probability density functions or probabilities of meeting specified targets) also communicates well the uncertainty in the results and how it affects conclusions. Issues related to this TOR and recommendations to address them have already been captured under previous TORs. Those are:

- need to include additional runs to reflect information about stock structure for bonnethead (**Recommendation 1.1**),
- need to provide all relevant information so it is possible to judge whether uncertainty in the values of natural mortality is adequately captured (**Recommendation 1.2**),
- need to provide insight into the effects that adoption of a single gender population dynamics model have on model predictions (**Recommendation 2.2**),
- need to add a high by-catch in shrimp fisheries scenario in the analysis (**Recommendation 4.2**).

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

a) **Clearly denote research and monitoring that could improve the reliability of, and information provided by, future assessments.**
b) **Provide recommendations on possible ways to improve the SEDAR process.**

The research recommendations that the Panel made are appropriate and will add value to future stock assessments. I have added recommendations for additional research below.

Recommendation 6.1 The necessary work to produce separate stocks assessments for bonnethead in the Gulf of Mexico and Atlantic should be undertaken as a priority.

Recommendation 6.2 I recommend that work is undertaken to increase the robustness of by-catch estimates for the shrimp fishery.

Recommendation 6.3 Additional work to improve the explanatory power of the standardization models for CPUEs or help understand the contradictory trends among the CPUEs series is also recommended.

Recommendation 6.4 Collection of data to support calculations of gear selectivity and improve the quality of the relevant results is also recommended.

Recommendation 6.5 Work to improve the quality of estimates of post release mortality will also be beneficial.

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

The quantitative approaches used to analyse the data and run the assessments are of good standards already and therefore, there are just a couple of improvements that I would suggest. Recommendations for additional modelling work are included below.

Recommendation 7.1 I recommend the use of a model that explicitly models both genders and age 0 fish.

Recommendation 7.2 Further work to ensure that biomass estimates are reliable and can be used to support status inference should also be undertaken.

Recommendation 7.3 I recommend inclusion of formal checks in the projection code to ensure that model results reflect stock status at equilibrium.

TOR 8. Prepare a Peer Review Report summarizing the Reviewer's evaluation of the stock assessment and addressing each Term of Reference.

The present document is the Peer Review Report

Background

Bonnethead and Atlantic sharpnose are both small coastal sharks that can be found in the Gulf of Mexico and North Atlantic; bonnethead shark is a sphyrnid species ranging from the Yucatán Peninsula in the Gulf of Mexico to North Carolina in the western North Atlantic Ocean and the Atlantic sharpnose shark is a carcharhinid species ranging from the Yucatán Peninsula in the Gulf of Mexico to New Jersey in the western North Atlantic. Both species are caught in fisheries that target them as well as fisheries that catch them as bycatch such as shrimp trawl fisheries. They are managed as part of the US Highly Migratory Species Fisheries Management Plan; for quota purposes they are part of the non-blacknose small coastal shark group.

Prior to 2002, both species were assessed as part of the Small Coastal Shark Complex but since 2002, they have been assessed individually. The previous stock assessment for each of the two species took place in 2007 and indicated that for both species, the corresponding stock was not overfished and overfishing was not occurring. The stock assessment model used in 2007 was a state-space, age-structured production model (SSASPM); the same model was used in the latest (2013) stock assessment, as well. However, a range of new data and information have become available since the 2007 assessment including new information about movement of individuals and genetic differentiation between individuals in the Gulf of Mexico and North Atlantic and new info about reproductive biology and maximum age.

The 2013 stock Assessments Workshop for bonnethead and Atlantic sharpnose stocks took place in June 2013 and the work continued after that to finalise the assessments which are the focus of this review. The stocks assessments, including their findings, are presented in two documents entitled:

c) SEDAR 34, Stock Assessment Report, HMS Atlantic Sharpnose Shark and
d) SEDAR 34, Stock Assessment Report, HMS Bonnethead Shark

The Terms of Reference that the Workshop Panel followed for the assessment of the two species are listed below:

1) Update the approved SEDAR 13 bonnethead/Atlantic sharpnose shark model with data through 2011. Provide a model consistent with the previous assessment configuration to incorporate and evaluate any changes allowed for this update.

2) Evaluate and document the following specific changes in input data or deviations from the benchmark model.

a. Review updated life history information (reproductive parameters)
b. Evaluate fishery-independent abundance indices derived for Mississippi, Alabama, Georgia, and South Carolina, (only for Atlantic sharpnose: the

Gulf of Mexico SEAMAP Nearshore Coastal Longline Program, and the NMFS NE Longline Program,)

c. Evaluate MRFSS/MRIP conversion factors

d. Evaluate commercial and recreational discard information

3) Document any changes or corrections made to model and input datasets and provide updated input data tables. Provide commercial and recreational landings and discards in numbers and weight. Provide available average weights by gear and year used to derive average number of fish calculations.

4) Update model parameter estimates and their variances, model uncertainties, and estimates of stock status and management benchmarks. In addition to the base model, conduct sensitivity analysis to address uncertainty in data inputs and model configuration and consider runs that represent plausible, alternate states of nature.

5) Project future stock conditions regardless of the status of the stock. Develop rebuilding schedules, if warranted. Provide the estimated generation time for each unit stock. Stock projections shall be developed in accordance with the following:

A) If the stock is overfished, then utilize projections to determine:

- *Year in which F=0 results in a 70% probability of rebuilding (Year F=0p70)*
- *Target rebuilding year (Year F=0p70 + 1 generation time) (Yearrebuild)*
- *F resulting in 50% and 70% probability of rebuilding by Yearrebuild*
- *Fixed level or removals (TAC) allowing rebuilding of stock with 50% and 70% probability*

B) Otherwise, utilize a P approach to determine:*

- *The F needed and corresponding removals associated with a 70% probability of overfishing not occurring (P* = 0.3)*

C) If data-limitations preclude classic projections (i.e. A, B above), explore alternate projection models to provide management advice.

6) Develop a stock assessment report to address these TORs and fully document the input data, methods, and results.

As mentioned above, the model used for the 2013 stock assessment was the same as the one used in the previous assessment. However, the configuration differed and some of the main changes introduced included:

- New estimates of discards from the shrimp trawl fishery for years 1972 onwards,
- New CPUE series that were not available or not used in the previous stock assessments,
- A higher maximum age for both species,
- New maturity ogive.

Although findings from recent tagging and genetic studies also suggested that bonnethead sharks in the Gulf of Mexico and the Atlantic Ocean belong to two distinct stocks, the Workshop Panel decided to undertake a stock assessment for a single combined bonnethead stock.

The assessment results for both species showed that the populations are unlikely to be overfished and overfishing is not currently taking place. According to the basecase scenario, the size of the population at the end of the time period of the calculations (2011) is above the population size that corresponds to MSY (16% more for bonnethead and 52% more for sharpnose). Similarly, current (2011) fishing mortalities are well below MSY levels for both species.

Three CIE reviewers have been commissioned to provide an impartial and independent peer review (desk review) of these stock assessments in accordance with the SoW and ToRs listed in Appendix 2. This document presents my comments on the stock assessment reports. Further details on the reviewers' role and the review request of the CIE are presented below and in Appendix 2.

Description of the Reviewer's Role in the Review Activities

I was contracted to provide an independent review of two documents entitled

a) SEDAR 34, Stock Assessment Report, HMS Atlantic Sharpnose Shark and
b) SEDAR 34, Stock Assessment Report, HMS Bonnethead Shark

in accordance with the SoW (listed in Appendix 2). As part of this review, I also read background documents and reports that are relevant to the reviewed stock assessment reports (listed in Appendix 1). The review was desk based and took place in September and October 2013. This document provides the outcome of this review.

Summary of findings

TOR 1. Evaluate the data used in the assessment, addressing the following:

a) **Are data decisions made by the assessment panel sound and robust?**

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

c) **Are data applied properly within the assessment model?**

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

The Panel had access to the relevant information required to do a stock assessment using an age-structured production model. They had information about key biological processes (i.e. natural mortality, maturity and reproduction, growth) and about exploitation (i.e. catch series, CPUE series, gear selectivity). For Atlantic sharpnose, the values of the biological parameters chosen for the model are reasonable and reflect the information that was available to the Panel and the approaches that the Panel adopted. Where new information was available, the appropriate analysis was undertaken to update the input parameters. The Panel also requested additional analysis in a couple of cases, for example to calculate the amount of sharks taken in the shrimp trawl fishery as by-catch and that was an appropriate action given concerns with the original approach. The parameters used to configure the bonnethead model also reflected the decisions of the Panel but they did not reflect the biology that information available to the panel described. This is an important issue which I have discussed in more detail below.

The approaches used to standardise the indices were in line with relevant guidance. The level of uncertainty in the individual values was within expected levels but the inter-annual variability that the CPUE series exhibited is considerable and it is not what would be expected given the life history of the shark species they describe (e.g. very big increase in stock size in a very short period of time). They also supported contradictory trends and that undermines the level of reliability and quality of representations that would characterise the series as a group. However, as mentioned elsewhere, the stock assessment picks some signals from them (and the other input data), which suggests that they can support the stock assessment.

Overall, the stock assessment reports explain well how decisions were taken and a lot of the decisions made by the panel are sound. However, there are a few areas in which the choices made are not robust and require either better justification or reconsideration of the appropriate approach. The report provides a good insight into

uncertainties in the data and understanding of the fish and fisheries dynamics and suggests ways to incorporate them into the assessments (see more on this in TOR2).

I have provided more details on each of the issues I have identified below.

Decision to run a single stock assessment for bonnethead

The information presented at the Workshop indicated that bonnethead in the Gulf of Mexico belong to a different stock from the bonnethead in the Atlantic Ocean. Despite that, the Panel decided to run a single stock analysis. The explanation given was that consideration of the relevant data was outside the scope of the Workshop and adding such considerations would delay the provision of management advice. I fail to see the validity of this argument. The Panel had a considerable amount of information split up by stock already; info about stock biology was available by stock, a lot of the catch series came from only the Gulf of Mexico or North Atlantic so, at least to the reader, it does not seem like there was a lot of work needed to split catches by stock. CPUEs could also be split by stock and some of the work that would support this process had already been done because all the calculations mentioned above were done for the assessment of the Atlantic sharpnose, which uses a lot of the CPUEs that were also used for bonnethead.

The Panel then went on to combine the biological info available for the two stocks to a single set of input data. Again, given the differences in the stocks' biology, the combined datasets did not really provide a realistic picture of the stocks for which they were used. This is a serious weakness of the stock assessment for bonnethead and further work is needed to address it. The Panel stated that they understand that by combining life history parameters they add uncertainty in the stock assessment. I do not think that this statement reflects the situation (i.e. level of inaccuracy) adequately. I have provided more explanation in other sections of this review of the reasons why this is an important issue to be addressed.

Natural Mortality

For both species, the values of natural mortality were calculated using a range of life history invariant methods. The results from the method that gave the highest survivorship were used for the calculations. However, the results from the other methods were not presented. So, it is not possible to assess the level of variability in the natural mortality values that were considered.

Shrimp by-catch prior 1972

It is not clear why the Panel decided to keep the same values for shrimp by-catch as those used in the 2007 assessment. The justification in the report is that those values were calculated based on expert opinion but there is no discussion as to whether expert opinion has changed since 2007. Elsewhere (S34_WP_20) the process followed is described as: "*For the historic landings (1950-1971), bycatch estimates were*

obtained by applying the mean ratio of shrimp to sharks caught by year for the period 1972-2005". If that's the case and given that the estimates of shark by-catch for the period 1972 onwards have changed since the previous stock assessment, it is not clear why it is correct to keep the same by-catch estimates for years prior to 1972 as in the 2007 assessment. This choice has led to two sub-series of bycatch estimates that are very different. For example, it is difficult to see how the bycatch for sharpnose jumped from 326 thousands in 1971 to more than a million in 1972. The report does not provide any reasons that would explain such a big difference from one year to the next. Therefore there are two issues of relevance here: a) the decision of the Panel to keep the original estimates for the years from 1972 is not appropriately explained or justified and b) the big differences in the bycatch estimates in conjunction with lack of any explanation why this might represent reality make one question the reliability of that data series and thus, the accuracy of the stock assessment results.

Shrimp by-catch in recent years for bonnethead

The report indicates that the catches used for shrimp bonnethead by-catch in years 2006-2011 were equal to the mean of the by-catch values for years 2003-2005. However, the values of by-catch for years 2006-2011 presented in Table 2.5.1 are not the mean of the values shown for years 2003-2005. If this is just a typo it needs to be corrected. If not, the assessment runs need to be done again using the correct values.

Selectivity assigned to each fishery or CPUE

The details provided about the choice of the selectivity curve assigned to each fishery do not allow one to judge whether the choice was appropriate. However, based on the information available there seems to be inconsistency in the selectivity curves assigned to each fishing pattern. For example, for sharpnose, the selectivity assigned to SEAMAP-SA is the same as the selectivity assigned to GADNR Trawl. So, both appear to be fully selective at age 3. However, those two fishing patterns (fleets) are assigned different selectivities for bonnethead sharks; the former achieves maximum selectivity at age 5 while the latter achieves maximum selection at age 1. So, two gears that appear to catch sharks of the same length for one species, when used for another species they catch fish of very different sizes. This does not sound correct. So, if it is correct, an explanation is needed why this might be the case. The same is true for ATL Coastspan LL and BLLOP.

Minor points:

- The statement that the Panel had trouble accepting such high numbers of discards for the shrimp by-catch (Section 2.2.2.5) does not appear sound given that the values calculated using the stratified nominal estimates also produced similarly high values. Also, it is a different explanation from the one given in S34_WP18.

- I really do not understand what the logic (need?) was behind the calculation of catches in weight. The relevant section concludes that the results of those calculations show that commercial and recreational fisheries catch larger sharks than the shrimp trawl fishery. Surely, the selectivity curves can provide that information. So, I do not understand what the point was of the additional analysis. Did it guide the choice of selectivity curves assigned to each fishery? If not, it seems to me that it is redundant. In any case, on the specific steps, I do not think it is right to compare the average weight from observed data to weight that was calculated using the weight at length formula because they are not compatible. For example, for sharpnose, for recreational catches, an average weight of 6.71 lb dw was used to get catches in weight. But for the shrimp fishery, the weight at length equation was used to calculate average weight from average length. However, those two numbers are not comparable because the W-L equations cannot even produce the former number (the maximum weight that one can calculate from the W-L equation is about 4lb dw using the maximum length of about 80 cm).

TOR 2. Evaluate the methods used to assess the stock, taking into account the available data.

a) Are methods scientifically sound and robust?

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

c) Are the methods appropriate for the available data?

An age-structured production model is used to simulate the dynamics of the stock, which also allows for process and observation errors in state and data variables to be modeled. The model uses a monthly time step for the calculations and models each fleet separately. There is no spatial disaggregation in the model but the data presented do not provide information about spatial heterogeneity in the species dynamics. So, spatial disaggregation is not supported by the data for each stock (but see comments about simulating a single/combined versus separate stocks for bonnethead). The adopted configuration assumes a single gender and does not explicitly model age 0 fish (they are part of the stock recruitment function). The model also uses a single/combined selectivity vector to calculate MSY and associated benchmarks.

The level of detail in the model is appropriate and reflects well the amount and type of data available to describe the species dynamics and exploitation. The statistical framework estimates the value of parameters by minimizing the objective function (log-likelihood) and uses prior probability distributions to represent current knowledge of estimated parameters and associated uncertainty. The model is fitted to observed catches and CPUE indices and the log-likelihood also includes a contribution from process error for effort deviations. Effort is treated as a fixed parameter for the first part of the calculations (until 1972) and then is treated as a

constant with annual deviations. This type of approach to fit models to observations is widely used and the incorporation of priors offers additional flexibility in increasing the amount of information that is utilized in the calculations.

Overall, the analysis uses well-documented and tested assessment approaches and the application of the model is consistent with standard practices. However, I have some concerns about the way the assessment model is configured (and consistency in its configuration) and about some of the specific formulae chosen for the calculations. More details are needed to show that those are correct or if not, explain how those were corrected. I have provided more information below:

Formula used to calculate catches each month:
The formula used to calculate the catches taken by each fleet each month (Eq. 7) uses a parameter (tau) to capture the duration of the fishing season for each fleet. However, it is not explained whether this calculation is done during months when the fleet does not operate, and there is not anything in the formulation of the Equation that suggests that such consideration is taken into account automatically. I tried to find this parameterisation of the formula in the programming code but I was not able to do so. Please, confirm that the model does not use that equation for parts of the year when a fleet does not operate (and hence it does not overestimate the amount of catches that correspond to a given fishing mortality).

Gender specific parameters
Information presented on the biology of the bonnethead highlight a number of differences between male and female individuals (this is true, but to a lesser degree, for sharpnose, too). However, the model configuration is for a single gender. By doing so, the model fails to capture those differences and take advantage of the relevant information.

CV multipliers
Problems with model convergence meant that for both species, assumptions had to be made about the confidence assigned to effort, catches, and CPUE indices. For the sharpnose model more confidence was assigned in the catch series compared to the indices and the explanation given for that decision was the lack of a consistent signal and annual variability in CPUE indices. However, even though such observation is also true for bonnethead, the confidence assigned to catches was the same as that assigned to CPUE indices. It is not clear why this is the best selection for bonnethead or whether it makes a difference whether the same weight was assigned to both catches and CPUEs for this species.

Simulation of fish of age 0
The model is not currently simulating age 0 individuals but it is clear that some of the fleets that are catching both sharpnose and bonnethead species are taking age-0 fish.

Although the catches of age 0 individuals are accounted for (by removing fish from older age classes) because the calculations are in numbers and survival of age 0 fish is lower than older fish, it is likely that the current configuration overestimates the impact of the fisheries that catch age-0 fish. Given that a considerable proportion of the catches comes from age 0 fish (shrimp by-catch), explicitly modelling age 0 fish will improve the accuracy of the model.

PDF for effort deviation

Table 3.5.6 shows that a lognormal distribution was used to describe effort deviations for the different fleets. However, based on that information, negative values are permitted/calculated for the parameter. This is not right since a lognormal distribution can only start from above zero and does not take negative values. The values in the table should be checked.

Weight of catches and MSY calculations

The report indicates that catch in weight calculated using the SSASPM may not be directly comparable to catch in weight calculated using the R code because the latter calculates weight at age of the catch for all fleets combined while the former is calculated for each fleet separately. Given that MSY is calculated using a single selectivity which, although not clear in the report, I assume it is the combined selectivity for all the fleets, the weight at age of the catch used in MSY is the combined weight at age for all fleets. If this could lead to results that are not comparable to the findings of the SSASPM, why have the calculations for the F_{MSY} not been done using catches in numbers instead of catches in weight? The F_{MSY} and N_{MSY} that would be found by maximising yield in weight would not be the same as those that would correspond to the maximum yield in numbers. So, using the MSY in numbers when it was the biomass that was maximized is misleading. Notwithstanding that, I do not expect that this would have a considerable impact on the overall conclusions because the majority of catches come from the smallest age group (hence the smallest weight at age group) and that means that the difference between the MSY in numbers and the number of fish that produce the MSY in biomass should not be considerable.

TOR 3. Evaluate the assessment findings with respect to the following:

a) **Are abundance, exploitation, and biomass estimates reliable, consistent with input data and population biological characteristics, and useful to support status inferences?**
b) **Is the stock overfished? What information helps you reach this conclusion?**
c) **Is the stock undergoing overfishing? What information helps you reach this conclusion?**

d) **Is there an informative stock recruitment relationship? Is the stock recruitment curve reliable and useful for evaluation of productivity and future stock conditions?**
e) **Are the quantitative estimates of the status determination criteria for this stock reliable? If not, are there other indicators that may be used to inform managers about stock trends and conditions?**

The analysis presented absolute values of stock size and fishing mortality as well reference points based on MSY to describe the status of the population and exploitation levels at the end of the calculations (2011). The findings do not include biomass estimates but provide spawning stock fecundity estimates. Similarly MSY is expressed only in number of fish. This is because of concerns about the calculation of weight in the stock assessment and because it was not directly comparable to the corresponding weight values that the model used for the projections. The presentation of values in number of fish only is adequate, but I have already highlighted concerns about the way MSY in number of fish was calculated (see previous section). With that exception, the presentation of findings and range of benchmarks used provide enough material to build a good picture of the current status of the stock and the performance of the model. For the latter, the results include plots of the posterior distributions together with the corresponding priors and the value of the AIC and objective function for each run. For both species, convergence of the model was achieved in all cases (although some additional assumptions were required for a small number of them) and the results indicated that the model makes use of additional information in input data, implying that the posteriors are more informative than (or different from) their priors.

The signals from the CPUE series are not consistent with each other and that is reflected in the relatively flat fits that the model achieves. The authors have considered an extensive set of sensitivity runs to addresses some of the challenges with the data and stock structure. The high level findings from the sensitivity runs remained broadly the same as those from the basecase run, indicating consistency in the findings of the model. The indicators used are appropriate to support and inform management decisions and in line with general practices and criteria.

For sharpnose, the basecase analysis together with the sensitivity runs provide reliable abundance and other estimates that reflect the input parameters and knowledge of the stock dynamics and life histories.

However, for bonnethead, although the outcomes are consistent with input data, I am not convinced that they present reliable abundance estimates that can support status inferences. This is because, as mentioned earlier, it is unclear how representative of the bonnethead stock(s) the parameterisation of the model is. Given that fundamental issue, it is difficult to make conclusive statements about the status of both the Gulf of

Mexico and Atlantic stocks. With that in mind, I have provided responses to the specific questions that are part of this TOR. I have done so for each of the two species separately and my conclusions assume that MSY in numbers have been calculated correctly (see my comments in the previous TOR about this).

Atlantic sharpnose

With the exception of the sensitivity run that uses only decreasing CPUE indices, all other runs predicted (mode of the distribution) that the size of the stock is at or above MSY levels. Similarly, estimates (mode of the pdfs) of current fishing mortality are below fishing mortality at MSY. Although there is some chance that fishing mortality is at or above MSY levels (given the CVs of the estimated values) that remains small in almost all of the runs. Similarly, for stock size and size of the mature population, although there is some chance that the stock is below its MSY size that probability is small. Given that a broad range of scenarios were considered and all but one supported the same high level conclusions and there is not any reason why more weight should be assigned to the findings of the single run that gave different results, it is reasonable to conclude that the stock is not overfished and overfishing is not currently taking place. It is important to note that although genetic studies have not provided strong evidence to suggest that individuals in the Gulf of Mexico and the Atlantic belong to two distinct populations, the analysis did include runs that assess the stocks as if they were two different ones. The results of those runs also suggest that the two parts of the population are not overexploited and the level of catches that are taken from each of them is below the MSY level. The estimated parameters (pdfs) in the stock recruitment function (survival at low stock biomass and recruitment at equilibrium) differ from their priors suggesting that the input data were informative. The Beverton-Holt stock recruitment curve is appropriate to characterise the life-history of this species (but see my comment earlier about separating age-0 fish from the stock recruitment function and modeling them as a separate age group), and although the values for the two parameters vary among the different runs, they do represent similar productivity curves.

Bonnethead

The basecase runs (modes of the pdfs) and the majority of the sensitivity runs indicate that the simulated stock is not overfished and overfishing in not taking place. There are three runs that gave different results; those were the run with only decreasing CPUE indices, the run without any indices, and the run that simulated a stock with the life history of the Atlantic stock (but used catches and CPUE indices from both the Atlantic and Gulf of Mexico). Based on these results, and given that the information we have does not suggest that the decreasing indices run or the run without catches should be weighted higher than any of the others, it is fairly reasonable to assume that the population as a whole (covering both Gulf of Mexico and the Atlantic) is probably not overfished and its size is above the combined MSY level (the run with the Atlantic biology is also not considered to be more representative of the whole stock

than any of the others). In terms of the individual stocks, there is some information in the results that suggest that a similar conclusion as above might be true for the Gulf of Mexico stock, but they are not enough to support any robust conclusions. The relevant findings are the following:

- The majority of catches are taken in the Gulf of Mexico, and so it is reasonable to assume that the catch levels considered in the runs are more representative of the level of catches taken from that stock, and
- The run that simulates the Gulf of Mexico biology with all the catches predicted that the stock is not overexploited.

Although the above information suggests that the stock in the Gulf of Mexico might not be overexploited, it is not conclusive since it is not known what the effect of the removal of the CPUE indices that reflect relative abundance in the Atlantic would be on the model predictions for the part of the stock in the Gulf of Mexico.

This paucity of conclusive evidence about stock status is even more profound for the part of the population that is in the Atlantic. Information from the runs considered is not adequate to reach any conclusions (even speculative ones) about the status of that stock. I have explained below why even the run that simulates the Atlantic biology cannot support any conclusions about that stock.

So, in summary, if one accepts the current configuration of the model (single stock) then the information provided is robust and the stock recruitment function can be used to reach conclusions about the status of the simulated stocks (but see my comments about modeling age-0 fish as a separate age class). However, I am not convinced that the current configuration and the values of indicators provide an accurate reflection of the status of the two stocks to support informed management decisions that will prevent overexploitation of the stocks.

Model run using the "Atlantic biology" for bonnethead

This run suggests that the bonnethead stock is overfished and overfishing is occurring. However, these findings can be misleading since the calculations use the catches taken from both stocks. This run could inform discussions about the status of the stock in the North Atlantic. However, it does not do so because the catches are not representative of the exploitation in the area and also the CPUEs are not area specific. A run using the "Atlantic biology" together with catch data and CPUEs from the Atlantic will provide the information about the status of the stock that is needed to reach a conclusion on the current exploitation levels and inform managers.

TOR 4. Evaluate the stock projections, rebuilding timeframes, and generation times, addressing the following:

a) **Are the methods consistent with accepted practices and available data?**
b) **Are the methods appropriate for the assessment model and outputs?**
c) **Are the results informative and robust, and useful to support inferences of probable future conditions?**
d) **Are key uncertainties acknowledged, discussed, and reflected in the projection results?**

A simpler extension of the SSASPM, which was implemented in R, was used to run projections for both species. The model used in the R projections uses an annual time step instead of the monthly time step used in SSAPSM. It also calculates the catches from all fleets combined, assuming that the relevant contribution from each fleet remains the same as that in the last year of the SSAPSM calculations (2011). The projections were run for 30 years starting from 2011. For the first three years of each run, catches were equal to current (2011) catches. After that, catches remained constant at a predefined level. A range of future catches was considered and for each of them the calculations produced the probability of future spawning stock fecundity and fishing mortality being greater than the fecundity or fishing mortality that corresponds to MSY. The projection model used is a detailed model that represents well the stocks that the Panel wanted to simulate, and is an appropriate model with which to combine the methodology used in the stock assessment (but see some comments about improvements below). The quantities calculated in the projections are appropriate to assess the condition of the stock in the future and a wide range of exploitation levels are considered to provide a comprehensive picture of possible future catch scenarios and stock status under each of them.

The choice to run the projections for a longer time period than originally considered is appropriate; short-term projections could have provided a misleading picture. However, although the authors suggest that 30 years were enough for the population to reach a state that approximates equilibrium, they do not explain whether any conditions are included in the projection model to confirm that is the case for any combination of biological parameters and exploitation levels considered. If the objective is to assess how the population will behave in the near future, then their approach is appropriate. However, if the implicit assumption in this approach is that the predictions will reflect the stock status once the stock has reached equilibrium, then that should become clear and also be part of the model. Nevertheless, given that the projection time is well above the generation time I do not expect that this is a serious weakness of the analysis.

Uncertainties in parameter values are acknowledged explicitly by inputting the results of the stock assessments (estimated parameters and outcomes) as distributions. Also, uncertainty in future stock exploitation levels is taken into account by running the

projections for a wide range of catches. The projections were also run for the sensitivity scenarios that were meant to capture uncertainty in the input data and stock structure. Overall, the analysis captured uncertainty well and the presentation of the results using probabilities was fit for purpose and provided a good picture of the robustness of the predictions. I have listed below a few things that need further consideration or clarifications.

Incorporation of uncertainty in calculations

The projections took uncertainty in biological parameters and initial (2011) conditions into account by drawing the values for the initial stock size and fishing mortality from a bivariate normal probability distribution. Similarly, the values of equilibrium recruitment and pup survival at low biomass were drawn from another bivariate normal distribution. The authors indicate that such an approach (using bivariate normal distributions) will reduce the probability of selecting values of the four parameters that were unlikely to have generated the data. This is correct but it does not eliminate that possibility. A way to do that is to start the projection from 1950 instead of 2011 using the catch data already available for the period 1950-2011 (the stock assessment model followed the catch data very closely anyway). In this case a bivariate distribution for current stock size and fishing mortality will not be needed and any combinations of the other two parameters that are not realistic (e.g. leads to stock extinction before 2011, etc.) would also be excluded.

Sensitivity analysis – Low catch scenario

The Panel indicated that the shrimp by-catch data used for the base-case run already constituted a high catch scenario. However, no justification was given why that was the case. As a result, uncertainty in shrimp by-catch was only assessed by reducing catches. This decision needs to be substantiated since, if it is not correct, it means that uncertainty in shrimp by-catch has not been considered fully.

Sensitivity run – Bonnethead – Atlantic biology and Gulf of Mexico biology

Two sensitivity runs were used to incorporate information that suggests that there are two distinct stocks of bonnethead; one that simulated the life history of the Gulf of Mexico stock and one that simulated the life history of the Atlantic stock. However, as discussed earlier (TOR 2) those are not considered appropriate to reflect the uncertainties in the model parameterisation.

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

a) **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**

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

The analysis uses a Bayesian statistical framework to capture uncertainty in model parameters and incorporates both process and observation errors. It also runs the assessment and projections under a wide range of scenarios to reflect possible states of reality in addition to the basecase one. I have made specific comments on the appropriateness of the approaches used to capture uncertainty under TOR 2 and TOR 3 and also identified areas where further work is needed. Overall, the approach used is appropriate and allows for uncertainty in the input data and stock and fleet dynamics to be incorporated in the analysis. The presentation of results (use of probability density functions or probabilities of meeting specified targets) also communicates well the uncertainty in the results and how it affects conclusions. Important issues mentioned in previous TORs that are relevant here are:

- need to run additional runs to reflect information about stock structure of bonnethead,
- need to provide all relevant information so that it is possible to judge whether uncertainty in values of natural mortality is adequately captured,
- need to provide insight into the effects that adoption of a single gender population dynamics model have on model predictions,
- need to add a high by-catch in shrimp fisheries scenario in the analysis.

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

a) Clearly denote research and monitoring that could improve the reliability of, and information provided by, future assessments.
b) Provide recommendations on possible ways to improve the SEDAR process.

The research recommendations that the Panel made are appropriate and will add value to future stock assessments. I have listed here those I consider would make the greatest difference.

a) Clearly, a priority is to undertake work to provide all the relevant information to run single stock assessments instead of running assessment models for stocks combined.

b) Good estimates of by-catch in shrimp fisheries are very important since they drive total catch values and thus influence model predictions on MSY.

Therefore, work to increase precision in those estimates would improve future model predictions. This refers to both catches before and after 1972.

c) Identification of additional information/factors that could improve the explanatory power of the standardization models for CPUEs or help understand the contradictory trends among the CPUEs series should also be supported.

d) Data collection to support calculations of gear selectivity and improve the quality of the results will also be beneficial.

e) Estimates of post release mortality are based on a small sample size so collection of additional data is recommended as well as species-specific collection of such data.

The SEDAR process is generally effective and achieves its objectives. Based on this specific SEDAR event and report, and previous experience in undertaking desk based reviews, I believe that if reviewers were given the option to have a short meeting (teleconference) with the relevant analysts, that would add value to the process.

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

The quantitative approaches used to analyse the data and run the assessments are of good standards already and therefore, there are just a couple of improvements that I would suggest. Improving the modelling approach can add some value but a model is as good as the data that one provides and in this case, it is the configuration of the model and input data which are weaker. I have recommended additional work to address the latter in the previous TOR. In addition to that, I would recommend the following:

Gender-specific and age 0 model
A model that explicitly models both genders and age 0 individuals will add realism and will be more appropriate to capture the dynamics of the stock and the fleets that are affecting it.

Projection model
The choice of population dynamics models for the stock assessment and the projections needs to be revisited to ensure that biomass estimates from the two models are compatible with each other. As mentioned earlier, it is important that the projection model can check whether equilibrium has been reached at the end of the

projection time. So, modification of the code to allow for such checks is recommended. Additional functionality to allow variation in the contribution that each fleet makes to the catches relative to other fleets over the years would also be useful.

TOR 8. Prepare a Peer Review Report summarizing the Reviewer's evaluation of the stock assessment and addressing each Term of Reference.

The present document is the Peer Review Report.

Conclusions and Recommendations

The assessment analysis uses appropriate approaches that reflect the level of detail in the input data and capture well the uncertainty in the input data and understanding of the fleet's dynamics. There are some equations that need to be explained further to provide assurances that they are correct or adjusted if they are not. For the Atlantic sharpnose, the configuration of the model is appropriate and reflects data available to the Panel. Overall, although improvements can be achieved, the outcomes provide a robust picture of the status of the stock that indicates that the stock is not overexploited and overexploitation does not take place. However, this statement is subject to my comments about the accuracy of the values used for shrimp by-catch. If those are not correct or there are multiple possible sets of data, then the calculations will need to be repeated.

My comments about the assessment approach are also valid for bonnethead. However, the choice of the Panel to conduct an assessment for a single stock is of great concern and the analysis has not covered a wide enough range of scenarios to reflect the information that was available to the Panel. My comment above about the shrimp bycatch values applies here as well. At present, the value of the outcomes in terms of informing managers and supporting management decision is questionable. For this reason, additional work is needed to increase the reliability of the assessment results.

A list of recommendations under each TOR is provided below.

TOR 1. Evaluate the data used in the assessment

Recommendation 1.1. Bonnethead shark should be assessed as two different stocks. At the very least, a sensitivity run using the biology and fishery data from the Gulf of Mexico and one that uses the data from the Atlantic should be included in the stock assessment report (similar to the sensitivity runs done for Atlantic sharpnose)

Recommendation 1.2. The results of the calculations of natural mortality for each of the different models used should be presented to provide an insight into the level of uncertainty in the adopted values.

Recommendation 1.3. The methodology used to calculate shrimp by-catch before 1972 needs to be presented and the authors need to revisit the values currently used for shrimp bycatch during that period to either correct them or explain why the adopted values are correct.

Recommendation 1.4. The values used to describe by-catch of bonnethead in the shrimp fishery for years 2006-2011 need to be checked (Table 2.5.1) and corrected. If this is not just a typo, the relevant calculations need to be redone using the correct by-catch values.

Recommendation 1.5. Inconsistencies in the selectivity patterns adopted for each fleet need to be corrected and, if those were also introduced into the model, the analysis needs to be rerun using the correct selectivity curves.

TOR 2. Evaluate the methods used to assess the stock

Recommendation 2.1 The formula used to calculate monthly catches in the stock assessment model needs to be revisited to ensure that it does not introduce an error in estimates of fishing effort.

Recommendation 2.2. I would recommend that another sensitivity run is done to test how the model predictions would change if gender-specific life history is simulated.

Recommendation 2.3 Inconsistencies with choices of CV multipliers need to be corrected and the model rerun if needed.

Recommendation 2.4 The information about pdfs used to characterise some of the parameters need to be corrected or clarified (table 3.5.6).

Recommendation 2.5 The analysis either needs to calculate the maximum yield in numbers that can be achieved and use that as a reference, or acknowledge that what they are presenting as MSY in numbers is not exactly that and explain why they have opted for that value and what it means in terms of bias in the findings.

TOR 3. Evaluate the assessment findings

Recommendation 3.1 Stock assessment results for two separate stocks that reflect the biology and fleet activity in the Gulf of Mexico and Atlantic should be presented for

bonnethead.

TOR 4. Evaluate the stock projections, rebuilding timeframes, and generation times

Recommendation 4.1 Some further analysis would be recommended to provide an insight as to how successful using the two bivariate distribution was in reducing the risk of selecting values of the variables that have not generated the data.

Recommendation 4.2 Unless the authors provide evidence that suggest that the set of by-catch estimates used in the basecase run represent a high estimate of those values, I would recommend that another run is done which will use by-catch values for shrimp fisheries that are greater than those used in the basecase.

Recommendation 4.3 For bonnethead, projections should also be run for the additional scenario described in Recommendation 3.1.

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

Recommendations to address issues related to this TOR have already been captured in previous TORs. Those are:

Recommendation 1.1. Bonnethead shark should be assessed as two different stocks. At the very least, a sensitivity run using the biology and fishery data from the Gulf of Mexico and one that uses the data from the Atlantic should be included in the stock assessment report (similar to the sensitivity runs done for Atlantic sharpnose)

Recommendation 1.2. The results of the calculations of natural mortality for each of the different models used should be presented to provide an insight into the level of uncertainty in the adopted values.

Recommendation 2.2. I would recommend that another sensitivity run is done to test how the model predictions would change if gender-specific life history is simulated.

Recommendation 4.2 Unless the authors provide evidence that suggest that the set of by-catch estimates used in the basecase run represent a high estimate of those values, I would recommend that another run is done which will use by-catch values for shrimp fisheries that are greater than those used in the basecase.

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

Recommendation 6.1 The necessary work to produce separate stocks assessments for bonnethead in the Gulf of Mexico and Atlantic should be undertaken as a priority.

Recommendation 6.2 I recommend that work is undertaken to increase the robustness of by-catch estimates for the shrimp fishery.

Recommendation 6.3 Additional work to improve the explanatory power of the standardization models for CPUEs or help understand the contradictory trends among the CPUEs series is also recommended.

Recommendation 6.4 Collection of data to support calculations of gear selectivity and improve the quality of the relevant results is also recommended.

Recommendation 6.5 Work to improve the quality of estimates of post release mortality will also be beneficial.

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

Recommendation 7.1 I recommend the use of a model that explicitly models both genders and age 0 fish.

Recommendation 7.2 Further work to ensure that biomass estimates are reliable and can be used to support status inference should also be undertaken.

Recommendation 7.3 I recommend inclusion of formal checks in the projection code to ensure that model results reflect stock status at equilibrium.

Appendix 1: Bibliography of materials provided for review

Reports reviewed

SEDAR34-SAR	Atlantic Sharpnose Sharks	SEDAR 34 Panel
SEDAR34-SAR	Bonnethead Sharks	SEDAR 34 Panel

Additional material

SEDAR34-WP-01	Standardized catch rates of Atlantic sharpnose sharks (Rhizoprionodon terraenovae) in the U.S. Gulf of Mexico from the Shark Bottom Longline Observer Program, 1994-2011	John Carlson and Simon Gulak
SEDAR34-WP-02	Standardized catch rates of bonnetheads from the Everglades National Park Creel Survey	John K. Carlson and Jason Osborne
SEDAR34-WP-03	Standardized Catch Rates of Bonnethead and Atlantic Sharpnose Shark from the Southeast Shark Drift Gillnet Fishery: 1993-2011	John Carlson, Alyssa Mathers and Michelle Passerotti
SEDAR34-WP-04	Tag and recapture data for Atlantic sharpnose, *Rhizoprionodon terraenovae*, and bonnethead shark, *Sphyrna tiburo*, in the Gulf of Mexico: 1999-2011	Dana Bethea and Mark Grace
SEDAR34-WP-05	Relative abundance of bonnethead and Atlantic sharpnose sharks based on a fishery-independent gillnet survey off Texas	Walter Bubley and John Carlson
SEDAR34-WP-06	Update to maximum observed age of Atlantic sharpnose sharks (*Rhizoprionodon terraenovae*) in the western North Atlantic Ocean based on a direct age estimate of a long term recapture	Bryan S. Frazier and Joshua K. Loefer
SEDAR34-WP-07	Validated age and growth of the bonnethead (*Sphyrna tiburo*) in the western North Atlantic Ocean	Bryan S. Frazier, Douglas H. Adams, William B. Driggers III, Christian M. Jones, Joshua K. Loefer, Linda A. Lombardi
SEDAR34-WP-08	A preliminary review of post-release live-discard mortality rate estimates in sharks for use in SEDAR 34	Dean Courtney
SEDAR34-WP-09	Standardized catch rates of Atlantic sharpnose (*Rhizoprionodon terraenovae*) and bonnethead (*Sphyrna tiburo*) sharks collected during a gillnet survey in Mississippi coastal waters, 1998-2011	Eric R. Hoffmayer, Glenn R. Parsons, Jill M. Hendon, Adam G. Pollack, and G. Walter Ingram, Jr.
SEDAR34-WP-10	Standardized catch rates of Atlantic sharpnose sharks (*Rhizoprionodon terraenovae*)	Eric R. Hoffmayer, Jill M. Hendon, and

	collected during a bottom longline survey in Mississippi coastal waters, 2004-2011	Adam G. Pollack
SEDAR34-WP-11	Standardized catch rates of Atlantic sharpnose sharks (Rhizoprionodon terraenovae) collected during bottom longline surveys in Mississippi, Louisiana, Alabama, and Texas coastal waters, 2004-2011	Eric Hoffmayer, Adam Pollack, Jill Hendon, Marcus Drymon, and Mark Grace
SEDAR34-WP-12	Atlantic Sharpnose Shark: Standardized index of relative abundance using boosted regression trees and generalized linear models	John Froeschke and J. Marcus Drymon
SEDAR34-WP-13	Atlantic Sharpnose Abundance Indices from SEAMAP Groundfish Surveys in the Northern Gulf of Mexico	Adam G. Pollack and G. Walter Ingram, Jr.
SEDAR34-WP-14	Bonnethead Abundance Indices from SEAMAP Groundfish Surveys in the Northern Gulf of Mexico	Adam G. Pollack and G. Walter Ingram, Jr.
SEDAR34-WP-15	Atlantic Sharpnose and Bonnethead Abundance Indices from NMFS Bottom Longline Surveys in the Western North Atlantic and Northern Gulf of Mexico	Adam G. Pollack and G. Walter Ingram, Jr.
SEDAR34-WP-16	Continuity Runs for Atlantic Sharpnose and Bonnethead SEAMAP Groundfish Surveys and NMFS Bottom Longline Surveys	Adam G. Pollack and G. Walter Ingram, Jr.
SEDAR34-WP-17	Variability in the Reproductive Biology of the Atlantic Sharpnose Shark in the Gulf of Mexico	Eric R. Hoffmayer, Jill M. Hendon, William B. Driggers III, Lisa M. Jones, and James A. Sulikowski
SEDAR34-WP-18	Shrimp Fishery Bycatch Estimates for Atlantic Sharpnose and Bonnethead Sharks in the Gulf of Mexico, 1972-2011	Xinsheng Zhang, Brian Linton, Enric Cortés and Dean Courtney
SEDAR34-WP-19	Standardized catch rates of Atlantic sharpnose and bonnethead sharks from the SEAMAP-South Atlantic Shallow Water Trawl Survey	Enric Cortés and J. Boylan
SEDAR34-WP-20	Updated catches of Atlantic sharpnose and bonnethead sharks	Enric Cortés and Ivy Baremore
SEDAR34-WP-21	Dead discards of Atlantic sharpnose sharks in the shark bottom longline fishery	John Carlson, Kevin J. McCarthy and Simon J.B. Gulak
SEDAR34-WP-22	Preliminary data on the reproductive biology of the bonnethead (Sphyrna tiburo) from the southeast U.S. Atlantic coast	Bryan Frazier, Jim Gelsleichter, and Melissa Gonzalez De Acevedo
SEDAR34-WP-23	Interannual site fidelity of bonnetheads (Sphyrna tiburo) to two coastal ecosystems in the western North Atlantic Ocean	William B. Driggers III, Bryan S. Frazier, Douglas H. Adams, Glenn F. Ulrich and Eric R. Hoffmayer
SEDAR34-WP-24	Size composition and indices of relative abundance of the Atlantic sharpnose shark	Robert J. Latour, Christopher F.

	(Rhizoprionodon terraenovae) in coastal Virginia waters	Bonzek, and J. Gartland
SEDAR34-WP-25	Mark/Recapture Data for the Atlantic Sharpnose Shark (Rhizoprionodon terranovae), in the Western North Atlantic from the NEFSC Cooperative Shark Tagging Program	Nancy E. Kohler, Danielle Bailey, Patricia A. Turner, and Camilla McCandless
SEDAR34-WP-26	Mark/Recapture Data for the Bonnethead (Sphyrna tiburo), in the Western North Atlantic from the NEFSC Cooperative Shark Tagging Program	Nancy E. Kohler, Elizabeth Sawicki, Patricia A. Turner, and Camilla McCandless
SEDAR34-WP-27	Preliminary mtDNA assessment of genetic stock structure of the bonnethead, Sphyrna tiburo, in the eastern Gulf of Mexico and northwestern Atlantic	Píndaro Díaz-Jaimes, Douglas H. Adams, Nadia S. Laurrabaquio-Alvarado, Elena Escatel-Luna
SEDAR34-WP-28	Standardized Catch Rates of Bonnethead and Atlantic Sharpnose Shark from the Southeast Sink Gillnet Fishery: 2005-2011	John Carlson, Alyssa Mathers and Michelle Passerotti
SEDAR34-WP-29	Relative abundance of Atlantic sharpnose and bonnethead shark from the northeastern Gulf of Mexico	John K. Carlson, Dana M. Bethea, Eric Hoffmayer, John Tyminski, Robert Hueter, R. Dean Grubbs, Matthew J. Ajemian, and George H. Burgess
SEDAR34-WP-30	Reproductive parameters for Atlantic sharpnose sharks (Rhizoprionodon terraenovae) from the western North Atlantic Ocean	William B. Driggers III, Eric R. Hoffmayer, John K. Carlson and Joshua Loefer
SEDAR34-WP-31	Tag-recapture results of bonnethead (Sphyrna tiburo) and Atlantic sharpnose (Rhizoprionodon terraenovae) sharks in the Gulf of Mexico and Florida Coastal Waters	John P. Tyminski, Robert E. Hueter, John Morris
SEDAR34-WP-32	Standardized catch rates of bonnethead (Sphyrna tiburo) from the South Carolina Department of Natural Resources trammel net survey	Bryan S. Frazier and Camilla T. McCandless
SEDAR34-WP-33	Tag and recapture data for Atlantic sharpnose, Rhizoprionodon terraenovae, and bonnethead, Sphyrna tiburo, sharks caught in the northern Gulf of Mexico from 1998-2011	Jill M. Hendon, Eric R. Hoffmayer, and Glenn R. Parsons
SEDAR34-WP-34	Standardized indices of abundance for Atlantic sharpnose sharks from the Georgia Department of Natural Resources red drum longline survey	C.T. McCandless, C.N. Belcher

SEDAR34-WP-35	Standardized indices of abundance for bonnethead and Atlantic sharpnose sharks from the Georgia Department of Natural Resources ecological monitoring trawl surveys	C.T. McCandless, J.Page, C.N. Belcher
SEDAR34-WP-36	Standardized indices of abundance for bonnethead and Atlantic sharpnose sharks caught during the South Carolina Department of Natural Resources red drum longline and Cooperative Atlantic States Shark Pupping and Nursery gillnet surveys	C.T. McCandless, B.S. Frazier
SEDAR34-WP-37	Standardized indices of abundance for bonnethead and Atlantic sharpnose sharks caught during the Cooperative Atlantic States Shark Pupping and Nursery longline surveys from South Carolina to northern Florida	C.T. McCandless, C.N. Belcher, B.S. Frazier, M. McCallister, R. Ford, J. Gelsleichter
SEDAR34-WP-38	Standardized indices of abundance for Atlantic sharpnose sharks from the University of North Carolina bottom longline survey	Frank Schwartz, Camilla McCandless, and John Hoey
SEDAR34-WP-39	A Summary of Evaluation Worksheets of abundance indices for Atlantic sharpnose shark and bonnethead shark	SEDAR 34 Panel

Appendix 2. Statement of Work for Dr Panayiota Apostolaki

External Independent Peer Review by the Center for Independent Experts

SEDAR 34: Highly Migratory Species Bonnethead Shark and Atlantic Sharpnose Shark Assessment Desk Review

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

Project Description SEDAR 34 will be a compilation of data, a standard assessment of the stock, and CIE assessment review conducted for HMS Bonnethead and Atlantic sharpnose sharks. The desk review provides an independent peer review of SEDAR stock assessments. The review is responsible for ensuring that the best possible assessment is provided through the SEDAR process and will provide guidance to the SEFSC to aid in their review and determination of best available science, and to HMS when determining if the assessment is useful for management. The stocks assessed through SEDAR 34 are within the jurisdiction of the Highly Migratory Species Division of NOAA Fisheries and the states of Texas, Louisiana, Mississippi, Alabama, Florida, Georgia, South Carolina, North Carolina, Virginia, Maryland, Delaware, Pennsylvania, New Jersey, New York, Connecticut, Rhode Island, Massachusetts, New Hampshire, and Maine. The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**.

Requirements for CIE Reviewers: Three CIE reviewers shall have the necessary qualifications to complete an impartial and independent peer review in accordance with the statement of work (SoW) tasks and terms of reference (ToRs) specified herein. The CIE reviewers shall have expertise in stock assessment, statistics, fisheries science, and marine biology sufficient to complete the tasks of the peer-review described herein. Each CIE reviewer's duties shall not exceed a maximum of 10 days to complete all work tasks of the peer review described herein.

Location of Peer Review: Each CIE reviewer shall participate and conduct an independent peer review as a desk review, therefore travel will not be required.

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

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer contact information to the COR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the assessment and other pertinent background documents for the peer review. Any changes to the SoW or ToRs must be made through the COR prior to the commencement of the peer review.

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

Desk Review: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. Modifications to the SoW and ToRs shall not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COR and CIE Lead Coordinator. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements.

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

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

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
2) Conduct an impartial and independent peer review in accordance with the tasks and ToRs specified herein, and each ToRs must be addressed (**Annex 2**).
3) No later than October 7, 2013, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and CIE Regional Coordinator, via email to Dr. David Sampson david.sampson@oregonstate.edu. Each CIE report shall be written using the format and content requirements specified in **Annex 1**, and address each ToR in **Annex 2**.

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

10 September 2013	CIE sends reviewer contact information to the COR, who then sends this to the NMFS Project Contact
17 September 2013	NMFS Project Contact sends the CIE Reviewers the assessment report and background documents
18 September through 02 October 2013	Each reviewer conducts an independent peer review as a desk review
07 October 2013	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
21 October 2013	CIE submits CIE independent peer review reports to the COR
28 October 2013	The COR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

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

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

Applicable Performance Standards: The contract is successfully completed when the COR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:
(1) The CIE report shall completed with the format and content in accordance with **Annex 1**,
(2) The CIE report shall address each ToR as specified in **Annex 2**,

(3) The CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

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

Support Personnel:

William Michaels, Program Manager, COR
NMFS Office of Science and Technology
1315 East West Hwy, SSMC3, F/ST4, Silver Spring, MD 20910
William.Michaels@noaa.gov Phone: 301-427-8155

Manoj Shivlani, CIE Lead Coordinator
Northern Taiga Ventures, Inc.
10600 SW 131st Court, Miami, FL 33186
shivlanim@bellsouth.net Phone: 305-383-4229

Roger W. Peretti, Executive Vice President
Northern Taiga Ventures, Inc. (NTVI)
22375 Broderick Drive, Suite 215, Sterling, VA 20166
RPerretti@ntvifederal.com Phone: 571-223-7717

Key Personnel:

NMFS Project Contact:

Julie Neer, SEDAR Coordinator
4055 Faber Place Drive, Suite 201
North Charleston, SC 29405
Julie.Neer@safmc.net Phone: 843-571-4366

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

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

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

3. The reviewer report shall include the following appendices:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of the CIE Statement of Work

Annex 2 – Terms of Reference

SEDAR 34: Atlantic Sharpnose and Bonnethead Shark Assessment Review

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

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

   - Comment on the degree to which methods used to evaluate uncertainty reflect and capture the significant sources of uncertainty in the population, data sources, and assessment methods

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

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

   c) Clearly denote research and monitoring that could improve the reliability of, and information provided by, future assessments.

   d) Provide recommendations on possible ways to improve the SEDAR process.

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

8. Prepare a Peer Review Report summarizing the Reviewer's evaluation of the stock assessment and addressing each Term of Reference.