CIE INDEPENDENT PEER REVIEW REPORT: SEDAR 21 HIGHLY MIGRATORY SPECIES (HMS) SANDBAR, DUSKY, AND BLACKNOSE SHARKS REVIEW WORKSHOP

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EXECUTIVE SUMMARY

Stock assessments of blacknose (Gulf of Mexico and south Atlantic 'stocks'), dusky, and sandbar sharks were reviewed at the SEDAR 21 Review Workshop in Annapolis, Maryland, from April 18-22, 2011. This is the report of one member of a four person review panel. It should be read in conjunction with the Consensus Summary Report of each assessment and the CIE reports of the two other CIE reviewers.

Stock assessments for sharks are notoriously difficult to conduct and the four assessments under review were no exception. For sharks it is often very difficult to construct a catch history due to problems of reporting (e.g. due to being a bycatch and/or discarding and/or species miss-identification) and this uncertainty carries through into the calculation of fishery dependent abundance indices. One characteristic of sharks which actually assists in stock assessments is the life history parameters of the species which (if known) can tightly constrain estimates of productivity and plausible population dynamics, e.g. the abundance of low productivity species cannot be expected to increase or fluctuate dramatically, but of course can decline dramatically. The assessments under review had all of these features.

The four assessments were really at the low level of what could be considered acceptable assessments – noting that the review panel rejected the blacknose shark assessment for the Gulf of Mexico and the projections for South Atlantic blacknose and sandbar. Accepting the other assessments was not a simple decision. There were weaknesses in the assessments and many additional runs were undertaken to attempt to assess the potential impact of these short-comings. Those assessments accepted by the panel reflected those for which it was the judgment of the panel that qualitative stock status (e.g. status in relation to overfishing and overfished benchmarks) was fairly well known and thus represented the best available information.

The number and complexity of the assessments was very much at the upper limit of what could be reviewed in the time provided. For this reason I believe that the review panel did not have the time during the review to examine secondary issues (the finer details) of uncertainty / appropriateness of the data used and methods applied. The review was directed at the higher level issues. For future reviews with assessments of this complexity, I would not recommend reviewing more than two assessments.

REVIEW ACTIVITIES

PRE-MEETING

Meeting documents and materials were made available in electronic form in advance of the meeting via a dedicated FTP website and via the SEDAR website (see Appendix 1). I had thought that both had identical information and had relied on the FTP website due to ease of download. It wasn't until the meeting that I realized that I should have had access to the actual working papers from the Data

Workshop – these were on the website. This did not impact on the review though as the DW report provided sufficient details of the contents of these papers for initial reading and I was able to refer to important documents via the website during the review.

With three species and four stocks under consideration, the amount of background reading was considerable, but there was overlap in some of the materials that made it a little easier.

Early in the review the three CIE panel members decided to split up the drafting of the consensus report around the Terms of Reference (ToRs) and I was responsible for ToRs 2, 5, and 6, which related to the stock assessment and projection methodologies, and the approaches to describe uncertainty (see Appendix 2).

SUMMARY OF REVIEW WORKSHOP FINDINGS

The overall findings of the review workshop for the four stocks were:

Blacknose shark (Gulf of Mexico)

- that there were strong conflicts between the catch data, biological parameters, and the abundance indices considered by the data workshop to be the most reliable. These concerns were not resolved in the assessment nor the review workshop; and
- therefore, the review panel was not confident that the suite of model runs adequately described the likely status of the stock. The stock assessment was not accepted.

Blacknose shark (South Atlantic)

- that after additional sensitivity analyses were conducted during the review workshop, the stock assessment (which was comprised of multiple model runs) was accepted as the best available science on the status of the stock;
- that the projection methodology and projection results were not accepted due to concerns about how uncertainty was modeled and recommendations were made for a more appropriate projection methodology; and
- that blacknose in the South Atlantic is in an overfished state and overfishing is occurring. Total fishing mortality has increased considerably in recent years.

Dusky shark

- both the stock assessment (which comprised multiple model runs) and projections results represent the best available science and are suitable for management, but there is a considerable amount of uncertainty that must be considered; and
- that dusky shark is in an overfished state and overfishing is occurring, but that total fishing mortality has declined considerably over the last decade.

Sandbar sharks

- that after additional sensitivity analyses were conducted during the review workshop, the stock assessment (which was comprised of multiple model runs) was accepted as the best available science on the status of the stock;
- that the projection methodology and projection results were not accepted due to concerns about how uncertainty was modeled and recommendations were made for a more appropriate projection methodology; and
- that sandbar shark is in an overfished state, but that overfishing is not occurring. Total fishing mortality has decreased considerably in recent years.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

In the section below I first repeat the Consensus Panel report findings as provided in the Executive Summary of that report and then provide my own thoughts and commentary.

TOR 1: EVALUATE THE ADEQUACY, APPROPRIATENESS, AND APPLICATION OF DATA USED IN THE ASSESSMENT:

Data: The review panel examined all input parameters and data used in the four assessments. Uncertainties associated with some of the sources of information were addressed by the assessment team via sensitivity analysis.

Stock Units: The assessment team used genetic studies, life history characteristics and tagging information to develop one stock unit for sandbar, one for dusky, and two for blacknose (Gulf of Mexico stock and U.S. South Atlantic stock). The review panel accepted these but noted that if the sampling for the genetic and tagging studies occurred at a time when discrete populations were mixed, finer scale stock structure would not be detected. Additionally, if low rates of straying exist between populations or if genetic divergence is recent, genetic studies may not detect population structure even if populations are demographically uncoupled.

Life History Parameters: The review panel examined the biological characteristics for the four stocks and generally accepted that the information was used appropriately; expressed reservations about how the limited age and length data were used to derive selectivity's for the various fisheries and surveys: expressed a strong preference for including length data and a growth model or age-length key in the assessment model so abundance-at-age and selectivity can be estimated simultaneously; acknowledged that only limited length data were available and that the assessment models being used were not set up to fit to these data; and acknowledged that with the limited data and the models being used, the selectivity curves were sufficient for this assessment.

Abundance Indices: The review panel generally accepted the selection of indices, agreed with the assessment team that many of the indices were short relative to the life span of the stocks under assessment, that most exhibited annual variability that exceeds what might be expected for these stocks, and that several did not span the full geographic distribution of the stocks. Assessment results were sensitive to these changes, and the review panel appreciated that these variations were carried forward as sensitivity analyses.

Landings and Removals: Data issues identified by the data workshop panel include: under-reporting, species identification, spatial coverage, landings being aggregated for more than one species and whether data were included in more than one database creating the potential for double counting. The assessment workshop evaluated the effects of under- or overestimating landings and removals with model runs using higher and lower landings. The review panel agreed that this approach was a reasonable way to evaluate how model output is scaled to overall abundance, but noted that the approach would only work if over- or under-reporting, or other issues with landings and removals data were similar over the entire time series. Regarding the historical period—defined as the period from a year in which the population could be considered to

be at virgin levels, to the time at which landings data become available—the assessment team assumed that fishing effort increased during this period, and explored the effects of the assumed nature of this increase (e.g. linear versus exponential) on the assessment results using additional model runs with different assumptions. The review panel accepted this as a reasonable approach, but also agreed with the assessment team that there was considerable uncertainty about the removals during the historical period and therefore the status of the populations at the time when landings data became available.

Reviewer's comments

There was a significant range of data and biological inputs that required consideration by the various working groups and the assessment team themselves. In particular, much of the data came from sources outside of the agency responsible for the assessments. This can create problems where the assessment team does not have access to the fine scale data and also discussions of the appropriateness of different studies / abundance indices can be bogged down by vested interests of individual researchers. There was insufficient time to broach this topic with the assessment team, but it was clear from some of their comments that some aspects of the data workshop were time consuming and kept them from other tasks.

There were three things in particular that were of particular concern to me: 1) sexual dimorphism; 2) conversions to age from length; and 3) consideration of length data to estimate selectivity.

Given that monitoring of the reproductive potential of the stock is critical for a low productivity species, it was puzzling for the various studies indicating sexual dimorphism in growth, maturity, and mortality to be ignored and combined sex estimates derived.

For relatively long lived species like most sharks, the difference in mean length can be quite small across a range of age classes. In populations like these there can be relatively small changes in mean size of individuals in the catch, but they can reflect significant changes in the mean age of the catch. Given the collection of direct age estimates is both low and not uniform through time, it is highly likely that applying a single age-length key or statistical estimates from a growth curve to a length sample will result in biased estimates of the age composition of the catch. This is particularly likely to be a problem for the stocks under consideration that have experienced depletion over a relatively short period. It is strongly recommended that the length data not be converted to age estimates, unless an age-length key is available for the appropriate temporal-spatial strata. This will require stock assessment methods that can fit to length data and estimate length-based selectivity.

The assessment team indicated that it was not possible to estimate selectivity in the assessment due to the problems with the converted age data. None of the documentation presented the size data available in any detail. Upon request, some were made available to the assessment team, but surprisingly for some of the important series the data were not broken down by sex or year – this was typically for data series outside the control of the agency. The plots confirmed the patchiness of some of the series, but also indicated that some series were of sufficient quality to have been fitted to in an assessment. For others the descriptive analysis indicated that the data collection was not consistent through time and some length samples mostly related to early in the fishery and others later on when the stock was highly depleted. These factors were not necessarily taken into account

in the 'ad-hoc' determination of selectivity, but would have been considered in a formal integrated assessment. Some examples of the plots undertaken are provided in Figures 1 and 2 below.

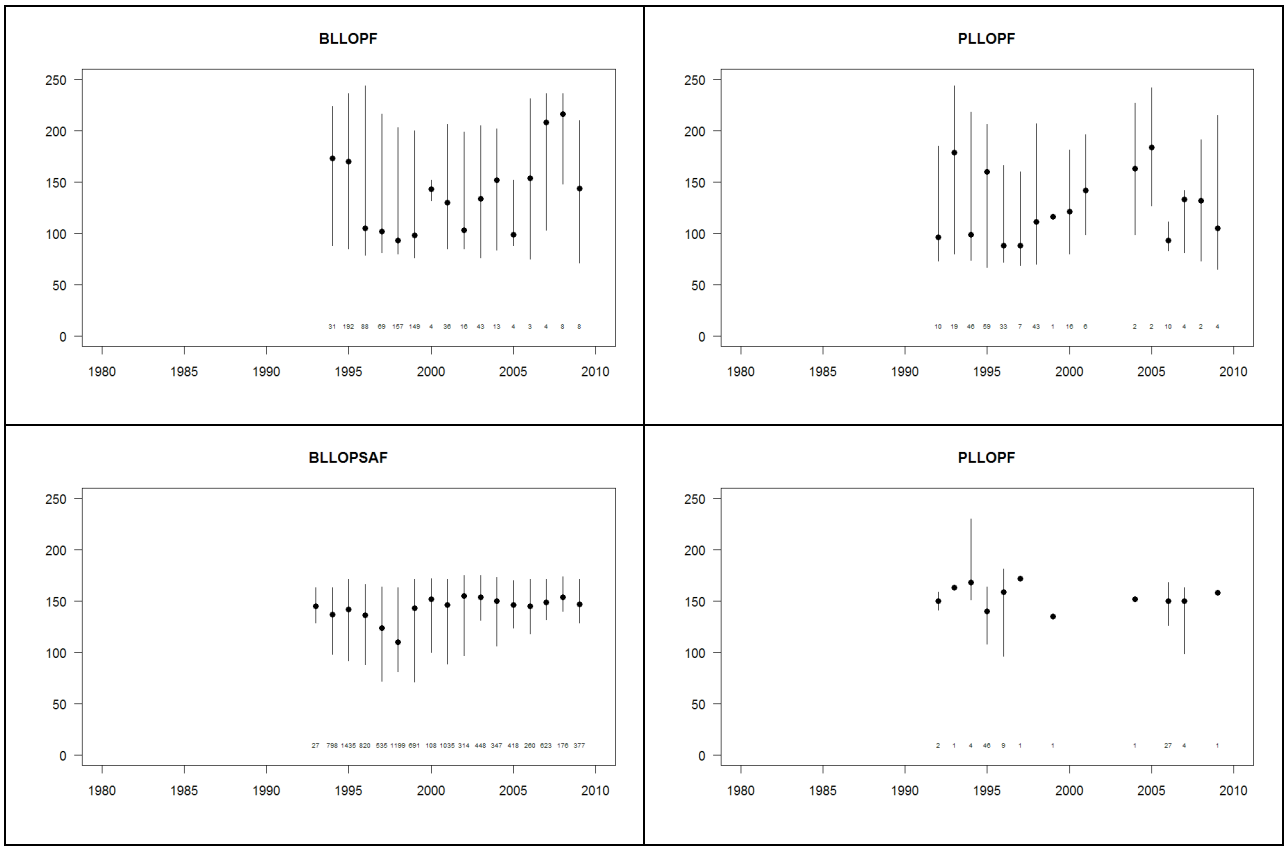

Figure 1: Summary of length frequency data for female dusky (top) and sandbar (bottom) sharks . They represent samples from the bottom (left) and pelagic (right) longline observer programs. The solid circles represent the median and the extent of the lines represents the 5th and 95th percentiles of the length distribution in each year. The values at the bottom represent the sample size for each year.

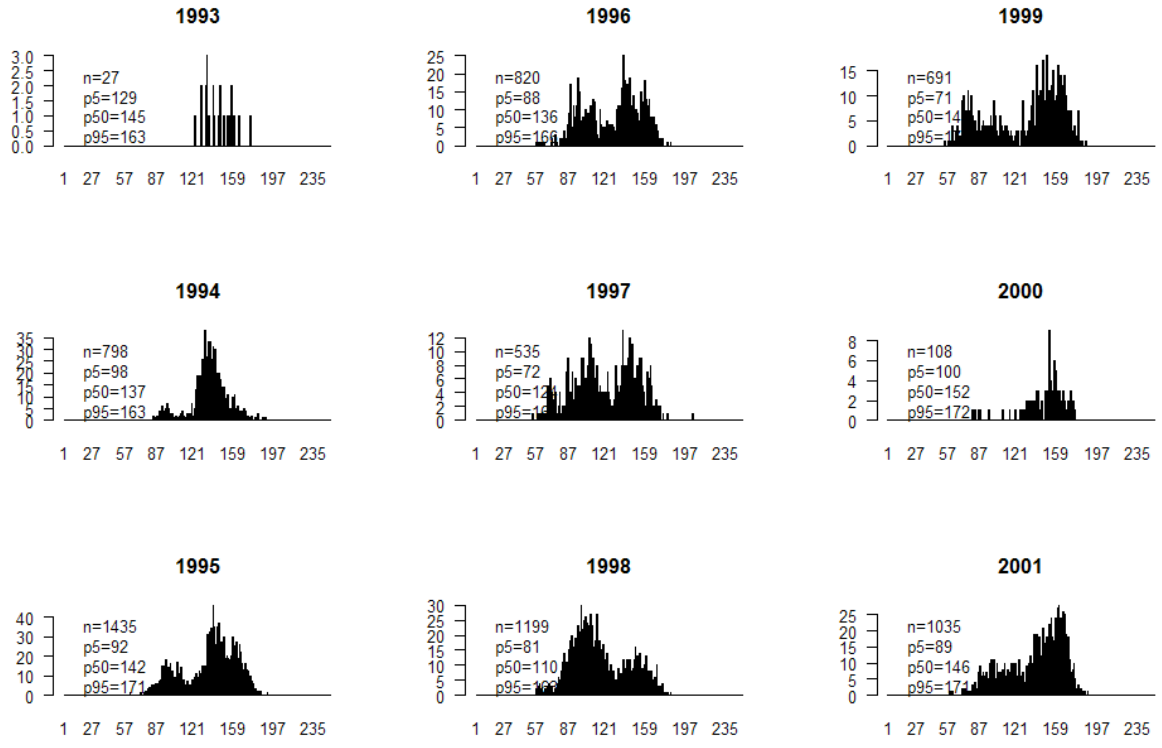

Figure 2: Length frequency for female dusky sharks collected by observers from bottom longline vessels (1993-2001). Note: n = sample size and pX = the xth percentile of the length frequency distribution.

ToR 2: Evaluate the adequacy, appropriateness, and application of methods used to assess the stock:

Assessment Models: Two assessment methods were used across the four stock assessments both being variants on the basic Age-structured Production Model (ASPM). For sandbar and the two blacknose stocks a state-space variant was used: the State-space age-structured production model (SPASM); while for the dusky assessment the catch-free variant was used: Age-structured catch-free production model (ASCFM). Overall it is the conclusion of the review panel that these approaches are appropriate to the assessment of these stocks given some of the particular issues that relate to shark assessments, e.g., uncertain catch histories, and low productivity.

SPASM – Sandbar and Blacknose shark assessments: The review panel concludes that the general population dynamics assumed in the assessment model are appropriate for the assessments, but it is not clear that the added complexity of SPASM over ASPM was useful. The review panel believes that using a model that did not include added complexity would not change the conclusions of the assessments or this review but would have made the models and model results easier to interpret, in particular allowing for easier analysis of the impacts of alternative data weighting scenarios.

Age-Structured Catch-Free Production Model (ASCFM) – Dusky Shark: The underlying population dynamics for ASCFM are essentially the same as those for SPASM – the major difference in the approaches being that absolute estimates of fishery removals are not used within ASCFM. This is the same modeling platform used for the previous dusky assessment and is necessary due to the difficulties in obtaining any sort of catch history. A concern of the review panel was the lack of simulation studies to determine the performance of the ASCFM under known conditions, particularly the response of the model to alternative scenarios about productivity when catches are known. This is further discussed under ToR 9.

Reviewer's comments

It was noted that the assessment team had hoped to use Stock Synthesis (SS) instead of the variant on the age-structured production model for the three stocks assessed with SPASM. Given that SS does not include the similar parameterization of some of the key biological processes important to shark assessment that are modeled within SPASM and also recognizing the resources and time available to the assessment team, in particular that three assessments were to be completed, it would have been difficult for them to develop SS models for these stocks. While SS could have allowed the separation of the sexes, and estimation of length-specific selectivity, it is not clear that these advantages would have outweighed the disadvantages of the lack of known important biological processes in SS and the resources available to undertake the necessary assessments with a new assessment platform.

Whilst the "ASPM" part of SPASM was considered appropriate for the assessments undertaken, at times I struggled to see the additional benefit that came from the additional complexity allowed through the state-space implementation. Briefly, in the three assessments the state-space component was implemented as a random walk on deviates on the fishery-specific effort trajectories. Effort was then used to predict catch through other model quantities, e.g. abundance and catchability. So catches are not assumed to be known without error and therefore the model trades off the penalties on the effort deviates with the CVs on the catch estimates. This is essentially a random walk in fishery-specific fishing mortality. This approach requires the estimation of a large number of additional parameters, although they are constrained deviates so that the effective number of estimated parameters is less than the absolute number.

A second issue of the SPASM model relates to the weighting of different data sources – a very well-known important issue in stock assessments. SPASM has incredible flexibility in the weighting of catch and CPUE data – through time specific CV's on individual catch and CPUE series ($w_{i,j}$); lambda scaling factors on individual series, and overall model CVs. When you add to this the process error variances on the effort deviates it made it difficult for both the assessment team and the review panel to determine the actual weightings that were being applied/estimated for the various data sources. This was particularly important in determining the weightings provided to the different abundance indices when trying to understand the fit to the series. The use of lambdas may also have theoretical implications for estimates of parameter uncertainty.

In the sandbar assessment, where an assumption was made to fit the catch data five times better than the CPUE indices, it essentially resulted in the assumption that catches were known without error and all the complexity with the state-space implementation and various lambdas just made things more difficult to understand. However, in the case of the Gulf of Mexico blacknose assessment where the catch and CPUE were given equal weight – the lack of fit to the shrimp trawl catches actually provided some insights into the tensions that were going on in the model between the catch series, key CPUE series, and productivity.

With the sandbar assessment, the review panel identified problems in fits to early catch data due to a mismatch between catch series and the different assumptions of the 'historic' and 'modern' periods. This was another example of where the added complexity of the modeling made the implementation of the assessment harder as there were more model options that are needed to be set.

With the Gulf of Mexico blacknose assessment, problems in the implementation of the state-space component meant that they were unable to get a satisfactory model where the selectivity for the shrimp bycatch fishery differed pre- and post- TED implementation. So the post-TED selectivity was assumed for the entire model period. This is another example where the additional complexity did not necessarily help in the assessment process.

Below are some other secondary comments on the use of SPASM for the three assessments which should be considered in either the interpretation of the results and/or the consideration of modeling approaches for future assessments:

Assuming fixed values or tight priors on pup survival, with other biological parameters fixed (e.g. fecundity and natural mortality) implies very tight, or exact estimates for key population productivity parameters such as the annual number of replacement spawners per spawner at low population size (α), which translates into steepness and F_{MSY}. This is not necessarily a bad thing – we know that the productivity of sharks is low, but people should be aware that the assumptions that go into the model tightly constrain some key reference points. The population trends were typically a 'one-way trip' so the data are unlikely to be that informative with respect to population productivity.

Both SPASM and the ASCFM removes catches starting from age 1 (depending on the selectivity of course), but there were several instances where size data suggested major catches of age-zero individuals. The problem with extending the catches back to age zeros relates to the assumption that it is at this stage where density dependence occurs, e.g. pup survival increases at lower stock sizes. Both the assumption that pup survival is the source of density dependence and the assumption that age zero catches are zero should be addressed in future assessments. In the current implementation, the use of catch in numbers meant that instead removing these fish at age 1 probably did not have a significant impact on the assessment results – but this might not hold if the fishing of age zeros was prior to density dependence.

The underlying population dynamics for Age-Structured Catch-Free Production Model (ASCFM) are essentially the same as those for SPASM – the major difference in the approaches being that

absolute estimates of fishery removals are not used within ASCFM. This is the same modeling platform used for the previous dusky assessment and is necessary due to the difficulties in obtaining any sort of catch history.

In the current implementation of ASCFM, effort series for the various fleets were used as input to the model and fishing mortality modeled as a function of effort. A random walk in fishing mortality is estimated through time, and specific to this assessment, a break point in F at the year 2000 was incorporated into the model to allow for significant change in management that occurred at that time (the ban on retention of dusky sharks).

In the case of a single fleet the relationship between effort and overall fishing mortality is relatively simple, but in this implementation multiple fleets were exploiting the stock. Estimates of relative effort for the fleets were determined. The actual quantity that is of interest would be the 'effective effort' of each fleet and this requires the incorporation of the catchability of each fleet, e.g. how many dusky sharks are caught per unit of effort for each fleet. One improvement to future dusky assessments will be the incorporation of information on the relative catchability of the different fleets and this could be done by comparing the ratios of CPUE for the different methods, with the same units of effort. Preferably this is done over a period when the fleets overlap and it is important to consider any differences in selectivity of the fleets when making such comparisons.

ToR 3: Recommend appropriate estimates of stock abundance, biomass, and exploitation:

The review panel accepted the model results for U.S. South Atlantic blacknose, sandbar and dusky sharks although there was considerable uncertainty in those results that should be conveyed as part of the review workshop recommendations.

Reviewer's comments

Given the considerable uncertainty that was present in each assessment it was just not possible to pick a single model run that adequately describes stock status. In the end numerous model runs were selected for each of the assessments accepted by the review panel. For the most part the model runs within each assessment have the same general stock status (i.e. quadrant in the phase plot), but it might be expected that the management responses might be different. Ideally management actions would be as robust as possible to uncertainty in current stock status and productivity.

ToR 4: Evaluate the methods used to estimate population benchmarks and stock status (e.g., MSY, FMSY, BMSY, MSST, MFMT, or their proxies); recommend appropriate management benchmarks, provide estimated values for management benchmarks, and declare stock status, consistent with the stock status determination criteria, benchmark, and biological reference points in the

CONSOLIDATED HMS FMP, PROPOSED FMPS AND AMENDMENTS, OTHER ONGOING OR PROPOSED MANAGEMENT PROGRAMS, AND NATIONAL STANDARDS.

U.S. South Atlantic Blacknose Shark: Results showed that the stock was overfished (SSF_{2009}/SSF_{MSY} of 0.43 to 0.64, all below MSST) and therefore subject to rebuilding. Current F values over all sensitivities also indicated that the stock was subject to overfishing (F_{2009}/F_{MSY} 3.26 to 22.53).

Sandbar Shark: Results showed that the stock was overfished and therefore subject to rebuilding. Current F values over most sensitivities indicated that the stock was not currently subject to overfishing (F_{2009}/F_{MSY} 0.29 to 0.93). However, the low productivity scenario did indicate overfishing (F_{2009}/F_{MSY} 2.62)

Dusky Shark: Results showed that the stock was overfished (SSB_{2009}/SSB_{MSY} of 0.41 to 0.50) and therefore subject to rebuilding. Current F values over all sensitivities also indicated that the stock was subject to overfishing (F_{2009}/F_{MSY} 1.39 to 4.35).

Reviewer's comments

In undertaking background reading for the assessments it was puzzling how the assessments seemed to consistently be able to estimate 'plausible' values of steepness – this is commonly a problem with other assessments. With natural mortality and maturity fixed, the M0 (estimated pup survival at low population sizes) is the key parameter than defines, the maximum reproductive rate (alpha), steepness, and ultimately F_{MSY}, which is a key management quantity. M0 was estimated in most of the assessments with a prior. I requested calculation of the 'inferred' prior for steepness that was being imposed via the prior on M0 and it was found that steepness estimates were very tightly confined. An example of this for dusky shark is presented in Figure 3. Thus, assumed prior knowledge about M0 provides very strong information on key reference points. This emphasizes the importance of appropriate biological parameters.

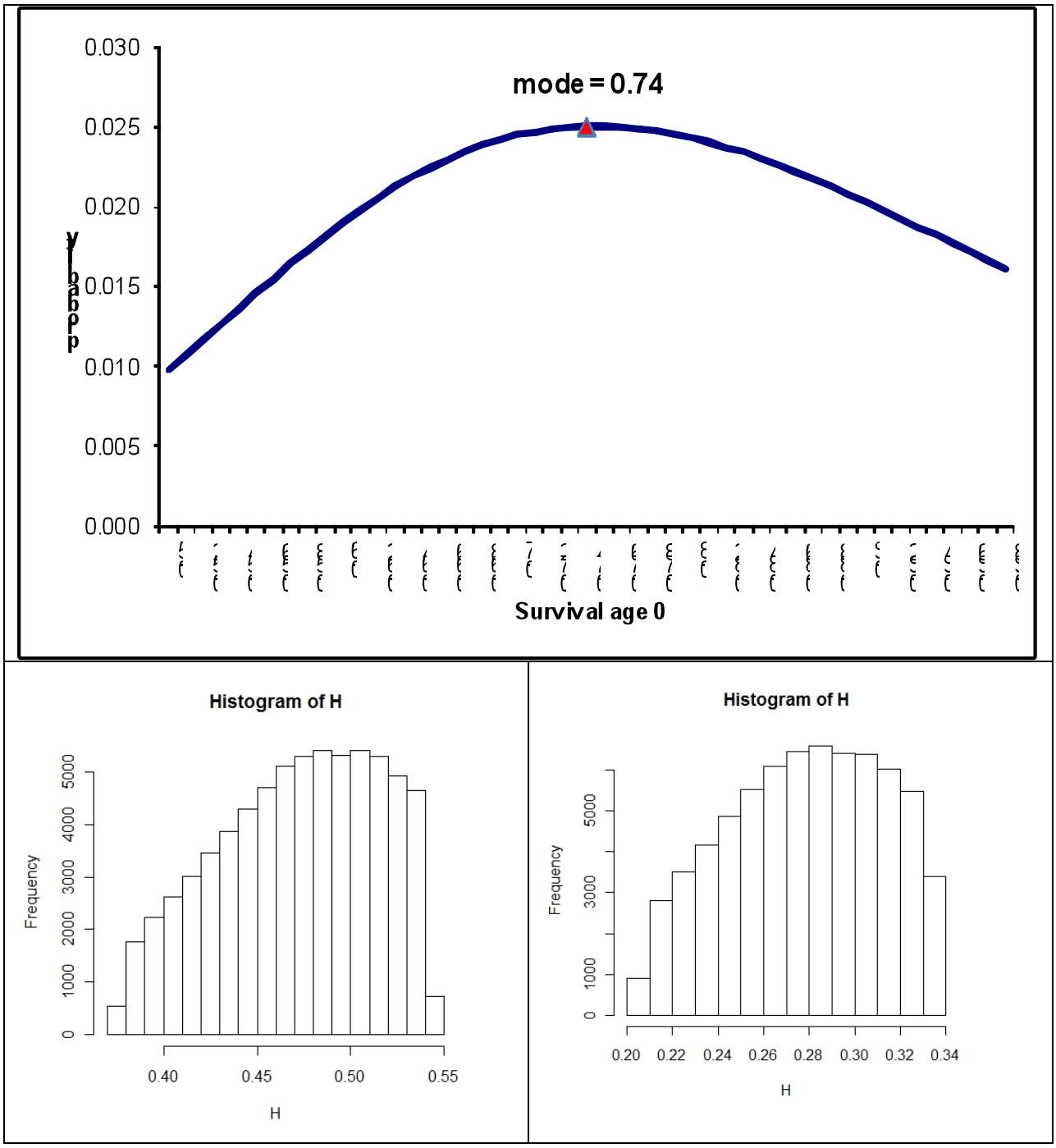

Figure 3: (top) Prior for M0 assumed in the dusky shark assessment and (bottom) the inferred priors for steepness based on the prior for M0 and the assumed values for other biological characteristics from the base mode (left) and high natural mortality sensitivity analysis (right).

ToR 5: Evaluate the adequacy, appropriateness, and application of the methods used to project future population status, rebuilding timeframe, and generation time; recommend appropriate estimates of future stock condition (e.g., exploitation, abundance, biomass).

Given the critical importance of incorporating uncertainty in the projections, the review panel did not accept the projections or projection method applied to the sandbar and south Atlantic blacknose stocks. However, it is the opinion of the review panel that the methodology applied to the dusky assessment is appropriate and those projection results valid.

Reviewer's comments

For the four stocks being assessed projection analyses are very important, in particular the propagation of uncertainty in the projections. This is for two reasons: 1) these stocks are currently all subject to rebuilding plans; and 2) some of the projection benchmarks rely not on the median of the projections, rather some percentile of the distribution.

Two approaches were used for undertaking projections and the split was the same as that for the assessment methods. For the stocks assessed using SPASM (sandbar, and the two blacknose stocks) projections were carried out using Pro-2Box. The sandbar shark assessment report describes the procedure as it was applied in that assessment and we have repeated the important elements below:

"Projections were bootstrapped ≥500 times by allowing for process error in the spawner-recruit relationship. Lognormal recruitment deviations with SD = 0.4, with no autocorrelation, were assumed. No other variability was introduced into the projections. Under these assumptions, the base model was projected at F = 0 to determine the year when the stock can be declared recovered with a 70% probability (SSF/SSFMSY > 1). If that year is >10, then management action should be implemented to rebuild the stock within the estimated rebuilding time+1 generation time."[Emphasis added]

An alternative approach was used for projections for the dusky shark assessment and is detailed below:

"Projections were governed with the same set of population dynamics equations as the original assessment model, but allowed for uncertainty in initial conditions at the beginning of the time series (that is, in 2009) as well as in underlying productivity. Projections were run using Monte Carlo bootstrap simulation, where initial biomass (B_{2009}^{boot}), fishing mortality (F_{2009}^{boot}), and pup survival at low biomass ($\exp(-M0)_{2009}^{boot}$) were sampled from a multivariate normal distribution with expectations equivalent to posterior modes from the base run, and standard deviations set to the posterior standard deviation (obtained numerically by rejection sampling of the "profile likelihood" posterior approximation). Covariance values were obtained from the Hessian approximation of the variance-covariance matrix at the posterior mode. The multivariate normal approximation was chosen because it reduces the probability of selecting values of the different parameters that are unlikely to have generated the data (for instance, high fishing mortality and low pup survival)."

The key difference between the two approaches is that the latter method considers uncertainty in two key additional model quantities, the abundance of the stock in the terminal year and the level of productivity. Further it incorporates the correlation that exists between these estimated quantities.

Given the critical importance of incorporating uncertainty in the projections, the review panel did not accept the projections or projection method applied to the sandbar and south Atlantic

blacknose stocks. However, it is the opinion of the review panel that the methodology applied to the dusky assessment is appropriate and those projection results valid.

Projections need to be undertaken for sandbar and south Atlantic blacknose stocks using a method similar to that applied to dusky shark. The projection methodology should at least:

- Incorporate uncertainty in the overall abundance estimate in the terminal year;
- Incorporate uncertainty in the key productivity parameters, if estimated;
- Incorporate any correlation in the estimation of the above quantities; and
- Incorporate low levels of stochasticity in future recruitment – consistent with the tightly constraining biology of the species.

In making this recommendation we were not aware of a generic package available to do the projections and that it was not possible to complete these projections within the review workshop. The revised projections were not available at the time of this report.

Even with a more accurate reflection of the within model uncertainty being propagated through the projections, the review panel were of the opinion that it was necessary to carry through the structural uncertainty considered in bracketing the current stock conditions (ToRs 3 and 4) through into the projections.

The review panel prepared a set of tables to contain the projection results. The key aspects of this table are:

- That multiple scenarios or possible 'states of nature' are included;
- Current terminal F's are included to allow comparisons across runs and to allow examination in the relative change in F necessary to achieve the particular rebuilding strategies;
- It includes projection scenarios requested by HMS that relate to the current management arrangements;
- It includes most of the results for dusky shark requested by the review panel – the others will be done after the meeting; and
- It has no results for sandbar and south Atlantic blacknose because as noted above a satisfactory package to undertake the projections was not available to the assessment team during the review workshop.

When considering results similar to those presented in the tables and developing a management response it is often useful to look not only at the results for particular scenarios, but also to examine the results in the context of a decision table. A management decision is made in the absence of knowing the true state of nature (i.e. which scenario is most correct), subsequently an important part of the process of making a management decision is having some indication of the consequences of making a decision if the true state of nature is different from that used to make the decision. Often a decision is made that performs 'best' (perhaps in terms of future stock sizes and removals) over the different states of nature without necessarily being the ideal management response for any single state of nature.

ToR 6: Evaluate the adequacy, appropriateness, and application of methods used to characterize the uncertainty in estimated parameters. Provide measures of uncertainty for estimated parameters. Ensure that the implications of uncertainty in technical conclusions are clearly stated.

The review panel concluded that the assessment team has used and applied appropriate methods to characterize uncertainty in the four stock assessments.

Future assessments could consider additional approaches to characterize uncertainty.

The approaches used by the assessment team are appropriate and the review panel has used the information provided by the assessment team to characterize the bounds of uncertainty in current and projected stock status under ToRs 3-5.

Reviewer's comments

There are many types of uncertainty that can be considered when undertaking a stock assessment. The first is the uncertainty within a single model which is typically estimated with some statistical procedure; a second is the uncertainty across different structural models (e.g. models with either different model structure or alternative assumptions about data inputs or biological assumptions); and a third is the impact on new data on parameter estimates, measured using an approach known as 'retrospective analysis', which can be useful for determining the potential for bias in parameter estimates. Often it is found that the structural uncertainty is greater than the within model uncertainty for a range of plausible structural models. All three approaches were applied to these assessments.

Approximated normal standard errors and likelihood profiles were used to characterize the uncertainty in both model parameters and other model outputs of interest, e.g. stock status in relation to benchmarks. Extensive sensitivity analyses were used to characterize structural uncertainty and retrospective analysis was used to assess the change in parameter estimates as new data were added.

The importance of structural uncertainty was recognized by both the assessment team and review panel. Because it was not considered appropriate to describe stock status with a single model, estimates of uncertainty in model parameters and key model outputs are provided under ToRs 3 - 5 where multiple model runs are used to characterize the status of the stock and the expected response to future management through projections.

Future assessments could consider additional approaches to characterize uncertainty. Within model uncertainty could be characterized using full Bayesian integration and this could also provide insights into model fit / convergence. Most of the sensitivity analyses were a single change from the reference model in either some model assumption or data input. Some of these changes represented plausible alternative states of nature and some changes were independent of others. In such circumstances it can be useful to evaluate all possible combinations of the sensitivity analyses,

e.g. make several changes at the same time. Through the automation of model running procedures such extensive sensitivity analyses can easily be implemented.

ToR 7: Ensure that stock assessment results are clearly and accurately presented in the Stock Assessment Report and that reported results are consistent with review panel recommendations. If there are differences between the assessment workshop and review workshop due to reviewer's requests for changes and/or additional model runs, etc., describe those reasons and results.

Assessment documentation prepared by the assessment team was comprehensive for use of input data, model description, results and sensitivity analysis selection.

Considerable improvement is needed in the provision of model diagnostics. Evidence of convergence should be included particularly for the base case, minimally in the form of convergence statistics and preferably as MCMC diagnostic plots. Sensitivity results should include for the base case and all sensitivities, as columns, the individual objective function components. Developing national standards in stock assessment documentation should be implemented.

Reviewer's comments

One aspect of the stock assessment which is important to examine, particularly those using SPASM, is the CVs estimated or assumed for the observation errors on the catch and CPUE series and the effort deviate penalties. State-space models trade off the observation and process errors and it is important to know the ratio of these variances to know what is driving the assessment. It took a couple of days of the workshop for the assessment team to be able to extract these from the model. These variances should be included as a standard output when presenting the results from state-space models.

ToR 8. Evaluate the SEDAR Process as applied to the reviewed assessments and identify any Terms of Reference that were inadequately addressed by the data or assessment workshops.

The review panel believes this SEDAR process has, overall, led to a comprehensive assessment of these stocks.

An independent reviewer participated in the data workshop and the assessment workshop report was also reviewed prior to being finalized for the review workshop. It remained unclear to the review panel whether placing greater emphasis on reviews earlier in assessment processes will automatically lead to better assessments.

The review panel believes that the ToRs of the data and assessment workshops were generally met.

There is a recommendation in the assessment workshop report that more time should be available for the data vetting process, while at the review workshop, the time available for the assessment modeling appeared to be one of the factors limiting further model development.

The review of four stocks in four days at the review workshop was only possible because three of the stocks used the same model and limited time was placed on the review of the data inputs.

The review panel endorses the assessment team recommendation that no more than probably two stocks be assessed at one time with the same number of participants. The review panel notes that the time required for a review workshop depends not only on the number of stocks, but also on the complexity of the individual assessments.

Reviewer's comments

Given the large number of people involved in the data and assessment webinar processes it was a surprise that only three analysts attended the review workshop. It appeared that the industry stakeholders boycotted the event, instead choosing to send emails to the panel. This was not useful and all stakeholders should be encouraged to attend the review workshop. Only this way can their knowledge and expertise be utilized by the review panel. In future I would strongly prefer NOT to be contacted by people who are not attending the review workshop.

In terms of evaluating the data workshop, the assessment team had my sympathy for the large number of data sets that they had to consider, in particular that many were from outside agencies. In the future, for assessments like these there might be more scope for data examination.

Having only three assessment scientists for the four assessments seemed a little light and there did seem to be a lack of experienced stock assessment personnel on the assessment team. The agency may want to consider having a senior assessment scientist overseeing the assessments in the future. This could be from within the region of the assessment or from other agency offices.

ToR 9. Consider the research recommendations provided by the data and assessment workshops and make any additional recommendations or prioritizations warranted. Clearly denote research and monitoring needs that could improve the reliability of future assessments. Recommend an appropriate interval for the next assessment, and whether a benchmark or update assessment is warranted.

The review panel considers the following to be priorities:

- Research on post-release survival by fishing sector and gear type.
- Research on fecundity and reproductive frequency.
- Regular collection of age-specific data.
- Tagging studies conducted in collaboration with international entities (e.g. Mexico).

- Evaluation of the individual indices of abundance via power analyses.
- A small study on how to make the best use of the knowledge of the data workshop participants for developing index rankings.
- Ensuring information about sex, length and age is collected.
- Research that improves the understanding of historical landings, both in the modern and historical period and to support the assumptions about when stocks are at virgin biomass if this assumption is carried forward in future assessments.
- Improved observer coverage particularly during periods of regulatory or gear changes (e.g. TEDs).
- Further model development using simpler and more complex models.
- Estimating fishery and survey selectivity's within the assessment model.
- Development of a two sex model.
- Fitting the model to either length or age data.
- Exploration of models that do not require an assumption that the population is at virgin levels at some point in time.
- If external age-length keys are used in future assessments, development of a key based on a growth model to better assign proportions-at-age in each length class.
- Simulation tests (management strategy evaluation) to test the performance of alternative assessment methods (including the catch-free model, ASPM, ASPIC, SS3, or stock specific models), recruitment parameterizations, harvest control rules, assessment frequency and data collection.

For Gulf of Mexico blacknose shark, the appropriate interval of the next assessment depends on progress made towards reconciling the issues raised during this assessment process. For Atlantic blacknose shark, dusky shark and sandbar shark, the review panel recognizes that population growth is expected to be relatively slow, but that modifications to the model may result in a different assessment of status. Benchmark assessments are recommended once the modifications are made. Additionally, for dusky shark, given the retrospective patterns in the present analysis and the resulting uncertainties in the assessment, updates using the existing model in the shorter term are also recommended. In the longer-term, development of a set of indicators (age-structure, total mortality estimates from catch curves, changes in abundance indices values) that could be used to determine whether status has changed sufficiently to warrant a full assessment, is recommended.

Reviewer's comments

I think that there is considerable scope for further development of these assessments using the currently available data. Data exist to develop sex-structured models and estimate selectivity curves inside an assessment – but fitting to size data, not length data converted to age. This examination was planned for the current assessments, but the assessment team did not have the necessary resources.

ToR 10. Prepare a Peer Review Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Provide a list of tasks that were not completed, who is responsible for completing each task, and when each task will be completed. Complete and submit the Final Summary Report within 3 weeks of workshop conclusion.

Please refer to the panel's summary report for its evaluation of the stock assessments based on the given terms of reference.

APPENDIX 1: BIBLIOGRAPHY OF MATERIALS PROVIDED FOR THE WORKSHOP

SEDAR 21

HMS Sandbar, Dusky, and Blacknose Sharks

Workshop Document List

Document #	Title	Authors	Working Group
Documents Prepared for the Data Workshop			
SEDAR21-DW-01	Standardized catch rates of sandbar and blacknose shark from a fishery independent survey in northwest Florida, 1996-2009.	John Carlson and Dana Bethea	Indices
SEDAR21-DW-02	Standardized catch rates of sandbar, dusky and blacknose sharks from the Commercial Shark Fishery Longline Observer Program, 1994-2009	John Carlson, Loraine Hale, Alexia Morgan and George Burgess	Indices
SEDAR21-DW-03	Standardized Catch Rates of Blacknose Shark from the Southeast Shark Drift Gillnet Fishery: 1993-2009	John Carlson and Michelle Passerotti	Indices
SEDAR21-DW-04	Standardized Catch Rates of Blacknose Shark from the Southeast Sink Gillnet Fishery: 2005-2009	John Carlson and Michelle Passerotti	Indices
SEDAR21-DW-05	The effect of turtle excluder devices (TEDS) on the bycatch of small coastal sharks in the Gulf of Mexico Peneid shrimp fishery	S.W. Raborn, K.I. Andrews, B.J. Gallaway, J.G. Cole, and W.J. Gazey	Catch Statistics
SEDAR21-DW-06	Reproduction of the sandbar shark *Carcharhinus plumbeus* in the U.S. Atlantic Ocean and Gulf of Mexico	Baremore, I.E. and L.F. Hale	Life History
SEDAR21-DW-07	Description of data sources used to quantify shark catches in commercial and recreational fisheries in the U.S.	Baremore, I.E., Balchowski, H., Matter, V, Cortes, E.	Catch Statistics

	Atlantic Ocean and Gulf of Mexico		
SEDAR21-DW-08	Standardized catch rates for dusky and sandbar sharks from the US pelagic longline logbook and observer programs using generalized linear mixed models.	Enric Cortés	Indices
SEDAR21-DW-09	Updated catches	Enric Cortés	Catch Statistics
SEDAR21-DW-10	Large and Small Coastal Sharks Collected Under the Exempted Fishing Program Managed by the Highly Migratory Species Management Division	Jackie Wilson	Catch Statistics
SEDAR21-DW-11	Abundance series from the MRFSS data set	Beth Babcock	Indices
SEDAR21-DW-12	Catches of Sandbar Shark from the Southeast US Gillnet Fishery: 1999-2009	Michelle S. Passerotti and John K. Carlson	Catch Statistics
SEDAR21-DW-13	Errata Sheet for 'CATCH AND BYCATCH IN THE SHARK GILLNET FISHERY: 2005-2006', NOAA Technical Memorandum NMFS-SEFSC-552	Michelle S. Passerotti and John K. Carlson	Catch Statistics
SEDAR21-DW-14	Data Update to Illegal Shark Fishing off the coast of Texas by Mexican Lanchas	Karyl Brewster-Geisz, Steve Durkee, and Patrick Barelli	Catch Statistics
SEDAR21-DW-15	An update of blacknose shark bycatch estimates taken by the Gulf of Mexico penaeid shrimp fishery from 1972 to 2009	W.J. Gazey and K. Andrews	Catch Statistics
SEDAR21-DW-16	A Negative Binomial Loglinear Model with Application for the Estimation of Bycatch of Blacknose Shark in the Gulf of Mexico Penaeid Shrimp Fishery	W.J. Gazey, K. Andrews, and B.J. Gallaway	Catch Statistics
SEDAR21-DW-17	Life history parameters for the sandbar shark in the Northwest Atlantic and Eastern Gulf of Mexico	Romine and Musick	Life History
SEDAR21-DW-18	Standardized catch rates of sandbar sharks and dusky sharks in the VIMS	Romine, Parsons, Grubbs, Musick,	Indices

	Longline Survey: 1975-2009	and Sutton	
SEDAR21-DW-19	Updating the blacknose bycatch estimates in the Gulf of Mexico using the Nichols method	Katie Andrews	Catch Statistics
SEDAR21-DW-20	Tag and recapture data for blacknose, *Carcharhinus acronotus*, sandbar, *C. plumbeus*, and dusky shark, *C. obscurus*, as kept in the NOAA Fisheries Southeast Fisheries Science Center Elasmobranch Tagging Management System, 1999-2009	D. Bethea and Carlson, J.K.	Life History
SEDAR21-DW-21	Age and growth of the sandbar shark, *Carcharhinus plumbeus*, in the Gulf of Mexico and southern Atlantic Ocean.	L. Hale and I. Baremore	Life History
SEDAR21-DW-22	Catch and bycatch in the bottom longline observer program from 2005 to 2009	Hale, L.F., S.J.B. Gulak, and J.K. Carlson	Catch Statistics
SEDAR21-DW-23	Identification and evaluation of shark bycatch in Georgia's commercial shrimp trawl fishery with implications for management	C. N. Belcher and C. A. Jennings	Catch Statistics
SEDAR21-DW-24	Increases in maximum observed age of blacknose sharks, *Carcharhinus acronotus*, based on three long term recaptures from the Western North Atlantic	Bryan S. Frazier, William Driggers, and Christian Jones	Life History
SEDAR21-DW-25	Catch rates and size distribution of blacknose shark *Carcharhinus acronotus* in the northern Gulf of Mexico, 2006-2009	J. M. Drymon, S.P. Powers, J. Dindo and G.W. Ingram	Indices
SEDAR21-DW-26	Reproductive cycle of sandbar sharks in the northwestern Atlantic Ocean and Gulf of Mexico	Andrew Piercy	Life History
SEDAR21-DW-27	Standardized catch rates for juvenile sandbar sharks caught during NMFS COASTSPAN longline surveys in Delaware Bay	Camilla T. McCandless	Indices

SEDAR21-DW-28	Standardized catch rates for sandbar and dusky sharks caught during the NEFSC coastal shark bottom longline survey	Camilla T. McCandless and Lisa J. Natanson	Indices
SEDAR21-DW-29	Standardized catch rates for sandbar and blacknose sharks caught during the Georgia COASTSPAN and GADNR red drum longline surveys	Camilla T. McCandless and Carolyn N. Belcher	Indices
SEDAR21-DW-30	Standardized catch rates for sandbar and blacknose sharks caught during the South Carolina COASTSPAN and SCDNR red drum surveys	Camilla T. McCandless and Bryan Frazier	Indices
SEDAR21-DW-31	Standardized catch rates of sandbar and dusky sharks from historical exploratory longline surveys conducted by the NMFS Sandy Hook, NJ and Narragansett, RI Labs	Camilla T. McCandless and John J. Hoey	Indices
SEDAR21-DW-32	Standardized catch rates of dusky and sandbar sharks observed in the gillnet fishery by the Northeast Fisheries Observer Program	NOT RECEIVED	Indices
SEDAR21-DW-33	Standardized catch rates for blacknose, dusky and sandbar sharks caught during a UNC longline survey conducted between 1972 and 2009 in Onslow Bay, NC	Frank J. Schwartz, Camilla T. McCandless, and John J. Hoey	Indices
SEDAR21-DW-34	Sandbar and blacknose shark occurrence in standardized longline, drumline, and gill net surveys in southwest Florida coastal waters of the Gulf of Mexico	Robert Hueter, John Morris, and John Tyminski	Indices
SEDAR21-DW-35	Atlantic Commercial Landings of blacknose, dusky, sandbar, unclassified, small coastal, and requiem sharks provided by the Atlantic Coastal Cooperative Statistics Program (ACCSP)	Christopher Hayes	Catch Statistics

SEDAR21-DW-36	Life history and population structure of blacknose sharks, *Carcharhinus acronotus*, in the western North Atlantic Ocean	William B. Driggers III, John K. Carlson, Bryan Frazier, G. Walter Ingram Jr., Joseph M. Quattro, James A. Sulikowski and Glenn F. Ulrich	Life History
SEDAR21-DW-37	Movements and environmental preferences of dusky sharks, *Carcharhinus obscurus*, in the northern Gulf of Mexico	Eric Hoffmayer, James Franks, William Driggers, and Mark Grace	Life History
SEDAR21-DW-38	Preliminary Mark/Recapture Data for the Sandbar Shark (*Carcharhinus plumbeus*), Dusky Shark (*C. obscurus*), and Blacknose Shark (*C. acronotus*) in the Western North Atlantic	Nancy E. Kohler and Patricia A. Turner	Life History
SEDAR21-DW-39	Catch rates, distribution and size composition of blacknose, sandbar and dusky sharks collected during NOAA Fisheries Bottom Longline Surveys from the U.S. Gulf of Mexico and U.S. Atlantic Ocean	Walter Ingram	Indices
SEDAR21-DW-40	Standardized catch rates of the blacknose shark (*Carcharhinus acronotus*) from the United States south Atlantic gillnet fishery, 1998-2009	Kristin Erickson and Kevin McCarthy	Indices
SEDAR21-DW-41	Index of Abundance of Sandbar Shark (*Carcharinus plumbeus*) in the Southeast Region, 1992-2007, From United States Commercial Fisheries Longline Vessels	Heather Balchowsky and Kevin McCarthy	Indices
SEDAR21-DW-42	Examination of commercial bottom longline data for the construction of indices of abundance of dusky shark in the Gulf of Mexico and US South Atlantic	Kevin McCarthy	Indices

SEDAR21-DW-43	Indices of abundance for blacknose shark from the SEAMAP trawl survey	Walter Ingram	Indices
SEDAR21-DW-44	Standardized catch rates of sandbar sharks (*Carcharhinus plumbeus*) and dusky sharks (*Carcharhinus obscurus)* from the large pelagic rod and reel survey 1986-2009	John F. Walter and Craig Brown	Indices
SEDAR21-DW-45	A note on the number of pups for two blacknose sharks (*Carcharhinus acronotus*) from the Gulf of Mexico	David Stiller	Life History
SEDAR21-DW-46	Mote LL index	Walter Ingram	Indices
Documents Prepared for the Assessment Process			
SEDAR21-AP-01	Hierarchical analysis of blacknose, sandbar, and dusky shark CPUE indices	Paul Conn	
SEDAR21-AP-02	Computer code for the SEDAR 21 age-structured catch-free model for dusky sharks	Sustainable Fisheries Branch – NMFS Beaufort Lab	
SEDAR21-AP-03	SEDAR 21 Sandbar Shark pre-review assessment process report	SEDAR 21 Assessment Process Panel	
SEDAR21-AP-04	SEDAR 21 Dusky Shark pre-review assessment process report	SEDAR 21 Assessment Process Panel	
SEDAR21-AP-05	SEDAR 21 Atlantic Blacknose Shark pre-review assessment process report	SEDAR 21 Assessment Process Panel	
SEDAR21-AP-06	SEDAR 21 Gulf of Mexico Blacknose Shark pre-review assessment process report	SEDAR 21 Assessment Process Panel	
Documents Prepared for the Review Workshop			
SEDAR21-RW-01	Computer code for the SEDAR 21 age-structured production model for sandbar sharks	Sustainable Fisheries Branch – NMFS Panama City Lab	

SEDAR 21-RW-02	Computer code for the SEDAR 21 age-structured production model for blacknose sharks	Sustainable Fisheries Branch – NMFS Beaufort Lab
Final Stock Assessment Reports		
SEDAR21-SAR1	Sandbar Shark	
SEDAR21-SAR2	Dusky Shark	
SEDAR21-SAR3	Gulf of Mexico Blacknose Shark	
SEDAR21-SAR4	Atlantic Blacknose Shark	
Reference Documents		
SEDAR21-RD01	SEDAR 11 (LCS) Final Stock Assessment Report	SEDAR 11 Panels
SEDAR21-RD02	SEDAR 13 (SCS) Final Stock Assessment Report	SEDAR 13 Panels
SEDAR21-RD03	Stock assessment of dusky shark in the U.S. Atlantic and Gulf of Mexico	E. Cortés, E. Brooks, P. Apostolaki, and C.A. Brown
SEDAR21-RD04	Report to Directed Shark Fisheries, Inc. on the 2006 SEDAR 11 Assessment for Sandbar Shark	Frank Hester and Mark Maunder
SEDAR21-RD05	Use of a Fishery-Independent Trawl Survey to Evaluate Distribution Patterns of Subadult Sharks in Georgia	Carolyn Belcher and Cecil Jennings
SEDAR21-RD06	Demographic analyses of the dusky shark, *Carcharhinus obscurus*, in the Northwest Atlantic incorporating hooking mortality estimates and revised reproductive parameters	Jason G. Romine & John A. Musick & George H. Burgess
SEDAR21-RD07	Observations on the reproductive cycles of some viviparous North American sharks	José I. Castro
SEDAR21-RD08	Sustainability of elasmobranchs caught as bycatch in a tropical prawn (shrimp) trawl fishery	Ilona C. Stobutzki, Margaret J. Miller, Don S. Heales, David T. Brewer

SEDAR21-RD09	Age and growth estimates for the dusky shark, *Carcharhinus obscurus,* in the western North Atlantic Ocean	Lisa J. Natanson, John G. Casey and Nancy E. Kohler
SEDAR21-RD10	Reproductive cycle of the blacknose shark *Carcharhinus acronotus* in the Gulf of Mexico	J. A. Sulikowski, W. B. Driggers III, T. S. Ford, R. K. Boonstra and J. K. Carlson
SEDAR21-RD11	A preliminary estimate of age and growth of the dusky shark Carcharhinus obscurus from the south-west Indian Ocean, with comparison to the western north Atlantic population	L.J. Natanson and N.E. Kohler
SEDAR21-RD12	Bycatch and discard mortality in commercially caught blue sharks *Prionace glauca* assessed using archival satellite pop-up tags	Steven E. Campana, Warren Joyce, Michael J. Manning
SEDAR21-RD13	Short-term survival and movements of Atlantic sharpnose sharks captured by hook-and-line in the north-east Gulf of Mexico	C. W. D. Gurshin and S. T. Szedlmayer
SEDAR21-RD14	Plasma catecholamine levels as indicators of the post-release survivorship of juvenile pelagic sharks caught on experimental drift longlines in the Southern California Bight	Barbara V. Hight, David Holts, Jeffrey B. Graham, Brian P. Kennedy, Valerie Taylor, Chugey A. Sepulveda, Diego Bernal, Darlene Ramon B, Randall Rasmussen and N. Chin Lai
SEDAR21-RD15	The physiological response to capture and handling stress in the Atlantic sharpnose shark, *Rhizoprionodon terraenovae*	Eric R. Hoffmayer & Glenn R. Parsons
SEDAR21-RD16	The estimated short-term discard mortality of a trawled elasmobranch, the spiny dogfish (*Squalus acanthias*)	John W. Mandelman & Marianne A. Farrington
SEDAR21-RD17	At-vessel fishing mortality for six species of sharks caught in the northwest Atlantic and Gulf of Mexico	Alexia Morgan and George H. Burgess
SEDAR21-RD18	Evaluating the physiological and physical consequences of capture on post-release survivorship in large	G.B. Skomal

	pelagic fishes	
SEDAR21-RD19	The Physiological Response of Port Jackson Sharks and Australian Swellsharks to Sedation, Gill-Net Capture, and Repeated Sampling in Captivity	L. H. Frick, R. D. Reina, and T. I. Walker
SEDAR21-RD20	Serological Changes Associated with Gill-Net Capture and Restraint in Three Species of Sharks	C. Manire, R. Hueter, E. Hull and R. Spieler
SEDAR21-RD21	Differential sensitivity to capture stress assessed by blood acid–base status in five carcharhinid sharks	John W. Mandelman & Gregory B. Skomal
SEDAR21-RD22	Review of information on cryptic mortality and the survival of sharks and rays released by recreational fishers	Kevin McLoughlin and Georgina Eliason
SEDAR21-RD23	Pathological and physiological effects of stress during capture and transport in the juvenile dusky shark, *Carcharhinus obscurus*	G. Cliff and G.D. Thurman
SEDAR21-RD24	Pop-off satellite archival tags to chronicle the survival and movements of blue sharks following release from longline gear	Michael Musyl and Richard Brill
SEDAR21-RD25	Evaluation of bycatch in the North Carolina Spanish and king mackerel sinknet fishery with emphasis on sharks during October and November 1998 and 2000 including historical data from 1996-1997	Chris Jensen and Glen Hopkins
SEDAR21-RD26		
SEDAR21-RD27		

APPENDIX 2: STATEMENT OF WORK

Attachment A: Statement of Work for Dr. Shelton Harley (SPC)

External Independent Peer Review by the Center for Independent Experts

SEDAR 21 Highly Migratory Species (HMS) Sandbar, Dusky, and Blacknose sharks Review Workshop

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 Technical Representative (COTR), 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 21 will be a compilation of data, a benchmark assessment of the stock, and an assessment review for conducted for HMS Sandbar, Dusky, and Blacknose sharks. The review workshop provides an independent peer review of SEDAR stock assessments. The term review is applied broadly, as the review panel may request additional analyses, error corrections and sensitivity runs of the assessment models provided by the assessment workshop panel. The review panel is ultimately responsible for ensuring that the best possible assessment is provided through the SEDAR process. The stocks assessed through SEDAR 21 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**. The tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. CIE reviewers shall have expertise, working knowledge, and recent experience in stock assessment, statistics, fisheries science, and marine biology sufficient to complete the primary task of reviewing the technical

details of the methods used for the assessment. Each CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein.

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review during the panel review meeting scheduled in Annapolis, MD during 18-22 April 2011.

Statement of Tasks: Each CIE reviewers 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 information (full name, title, affiliation, country, address, email) to the COTR, 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 background documents, reports, foreign national security clearance, and other information concerning pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Foreign National Security Clearance: When CIE 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 CIE reviewers who are non-US citizens. For this reason, the CIE reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/sponsor.html).

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.

Panel Review Meeting: 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 can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator. Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility 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.

Other Tasks – Contribution to Summary Report: Each CIE reviewer may assist the Chair of the panel review meeting with contributions to the Summary Report, based on the terms of reference of the review. Each CIE reviewer is not required to reach a consensus, and should provide a brief summary of the reviewer's views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

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

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
2) Participate during the panel review meeting in Savannah, Georgia during 18-22 April 2011.
3) In Annapolis, Maryland during 18-22 April 2011 as specified herein, conduct an independent peer review in accordance with the ToRs (**Annex 2**).
4) No later than 6 May 2011, 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 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.

21 March 2011	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
4 April 2011	NMFS Project Contact sends the CIE Reviewers the pre-review documents
18-22 April 2011	Each reviewer participates and conducts an independent peer review during the panel review meeting
6 May 2011	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
20 May 2011	CIE submits CIE independent peer review reports to the COTR
27 May 2011	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on substitutions. The COTR 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 COTR 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 COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:
(1) each CIE report shall completed with the format and content in accordance with **Annex 1**,
(2) each 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 COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the CIE reports to the NMFS Project Contact and Center Director.

Support Personnel:

William Michaels, Program Manager, COTR
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Key Personnel:

NMFS Project Contact:

Julie A Neer, SEDAR Coordinator
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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.

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

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

   c. Reviewers should elaborate on any points raised in the Summary Report that they feel might require further clarification.

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

   e. The CIE independent 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 CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.

3. The reviewer report shall include the following appendices:

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

Annex 2: Tentative Terms of Reference for the Peer Review

SEDAR 21 Highly Migratory Species (HMS) Sandbar, Dusky, and Blacknose sharks Review Workshop

1. Evaluate the adequacy, appropriateness, and application of data used in the assessment.
2. Evaluate the adequacy, appropriateness, and application of methods used to assess the stock.
3. Recommend appropriate estimates of stock abundance, biomass, and exploitation.
4. Evaluate the methods used to estimate population benchmarks and stock status(*e.g., MSY, Fmsy, Bmsy, MSST, MFMT, or their proxies*); recommend appropriate management benchmarks, provide estimated values for management benchmarks, and declare stock status, consistent with the stock status determination criteria, benchmark, and biological reference points in the Consolidated HMS FMP, proposed FMPs and Amendments, other ongoing or proposed management programs, and National Standards.
5. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status, rebuilding timeframe, and generation time; recommend appropriate estimates of future stock condition (e.g., exploitation, abundance, biomass).
6. Evaluate the adequacy, appropriateness, and application of methods used to characterize the uncertainty in estimated parameters. Provide measures of uncertainty for estimated parameters. Ensure that the implications of uncertainty in technical conclusions are clearly stated.
7. Ensure that stock assessment results are clearly and accurately presented in the Stock Assessment Report and that reported results are consistent with Review Panel recommendations. If there are differences between the AW and RW due to reviewer's requests for changes and/or additional model runs, etc., describe those reasons and results.
8. Evaluate the SEDAR Process as applied to the reviewed assessments and identify any Terms of Reference that were inadequately addressed by the Data or Assessment Workshops.
9. Consider the research recommendations provided by the Data and Assessment workshops and make any additional recommendations or prioritizations warranted. Clearly denote research and monitoring needs that could improve the reliability of future assessments. Recommend an appropriate interval for the next assessment, and whether a benchmark or update assessment is warranted.
10. Prepare a Peer Review Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Provide a list of tasks that were not completed, who is responsible for completing each task, and when each task will be completed. Complete and submit the Final Summary Report within 3 weeks of workshop conclusion.

The review panel may request additional sensitivity analyses, evaluation of alternative assumptions, and correction of errors identified in the assessments provided by the assessment workshop panel; the review panel may not request

a new assessment. Additional details regarding the latitude given the review panel to deviate from assessments provided by the assessment workshop panel are provided in the *SEDAR Guidelines* and the *SEDAR Review Panel Overview and Instructions*.

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

Annex 3: Tentative Agenda

SEDAR 21 Highly Migratory Species (HMS) Sandbar, Dusky, and Blacknose sharks Review Workshop

Annapolis, Maryland April 18-22, 2011

Monday

1:00 p.m.	**Convene**	
1:00 – 1:30	**Introductions and Opening Remarks**	**Coordinator**
	- Agenda Review, TOR, Task Assignments	
1:30 – 3:30	**Assessment Presentation**	**TBD**
3:30 – 4:00	**Break**	
4:00 – 5:00	**Continue Presentation/Discussion**	**Chair**
5:00 p.m. - 6:00 p.m.	**Panel Work Session**	**Chair**

Tuesday

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

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

Wednesday

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

Wednesday Goals: Final sensitivities identified, Preferred models selected, Projection approaches approved, Summary report drafts begun

Thursday

8:30 a.m. – 11:30 a.m.	**Panel Discussion**	**Chair**
	- Final sensitivities reviewed.	
	- Projections reviewed.	
11:30 a.m. – 1:00 p.m.	**Lunch Break**	

1:00 p.m. – 3:30 p.m.	**Panel Discussion or Work Session**	**Chair**
3:30 p.m. - 3:45 p.m.	**Break**	
3:45 p.m. - 6:00 p.m.	**Panel Work Session** *- Review Consensus Reports*	**Chair**

Thursday Goals: Complete assessment work and discussions. Final results available. Draft Summary Report reviewed.

Friday

8:30 a.m. – 12:00 p.m.	**Panel Work Session**	**Chair**
12:00 p.m.	**ADJOURN**	

APPENDIX 3: LIST OF PARTICIPANTS

Workshop Panel

Larry Massey, Chair ..... NMFS SEFSC
Jamie Gibson ..... CIE Reviewer
Neil Klaer ..... CIE Reviewer
Shelton Harley ..... CIE Reviewer

Analytic Representation

Enric Cortés ..... NMFS SEFSC Panama City
Kate Andrews ..... NMFS SEFSC Beaufort
Paul Conn ..... NMFS AFSC

Rapporteur

Ivy Baremore ..... NMFS SEFSC Panama City

HMS Representation

Karyl Brewster-Geisz ..... NMFS

Observers

..... SERO
..... SERO

Staff

Julie Neer ..... SEDAR
Tyree Davis ..... NMFS Miami