Center for Independent Experts (CIE) Independent Peer Review of the Stock Assessment of Atlantic Blacktip Shark (*Carcharhinus limbatus*)
(SEDAR 65)

CIE Review prepared by:

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Executive Summary

An independent peer review of an assessment of Atlantic Blacktip Shark (*Carcharhinus limbatus*) was conducted October 29-30, November 2 and 4-5, 2020. The document presented here was prepared under contract to the Center for Independent Experts, it and addresses the Terms of Reference for the review.

The 2020 stock assessment represented the first application of the Stock Synthesis methodology for this stock. The previous (2006) assessment primarily used Bayesian surplus production approaches. However, the 2006 assessment was not accepted during the review process due to conflicting signals in the abundance indices that were unresolved.

Atlantic Blacktip Shark can be described as a data-rich species, and considerable new information has been added since the 2006 assessment. The available data were considered sufficient to meet the extensive data requirements of Stock Synthesis. To summarize, there is adequate catch information from the commercial fishery, but the data from 1980s is heavily informed by expert opinion. The recreational catch is reasonably well-described but there is an important and growing component that is caught and released. A mortality rate is applied to such discards, and it is based on well-described methods. There are some length composition samples, but not all fleets are well covered. Comparatively speaking, there are many available indices of abundance (including an unusually high number of fishery independent series) which are appropriately standardized. In contrast with the 2006 assessment, the abundance indices do not display marked conflicting signals.

The stock assessment results indicate that Atlantic blacktip shark are neither overfished nor is there overfishing occurring during the terminal year of the assessment (2018). Six sensitivity runs that varied selectivity, catch and productivity also came to the same conclusions. The review panel concluded that the stock assessment results and projections were robust, it and recommended their use for management purposes.

The review panel identified recommendations for future work that could further strengthen the assessment, some particularly important tasks included verifying commercial fishery catch data from the 1980s, exploring the functional form of the stock-recruitment relationship, and investigating the apparent dome shaped selectivity in several gear types.

The review was conducted virtually, given the current restrictions on travel and in-person meetings. While virtual meetings are not the preferred mechanism for detailed and efficient review, the process still went smoothly and there was a thorough examination of the work undertaken. Therefore, I can state that with confidence that the assessment results represent the best available science and provide an adequate basis for management decisions.

Background

The document presented here contains an independent peer review of a benchmark assessment of Blacktip Shark (*Carcharhinus limbatus*) conducted as part of the SEDAR (Southeast Data, Assessment and Review) process. The geographic extent of the stock considered was from southern Florida to New York. This review was prepared following a Center for Independent Experts (CIE) Review conducted (by Webinar) October 29-30, November 2 and 4-5, 2020. It is prepared under contract to the Center for Independent Experts, following the Performance Work Statement contained in Appendix 2. The documents reviewed may be found in Appendix 1, with the main documents being a draft report of a data workshop (SEDAR 2020a) and a draft assessment report referred to here as SEDAR65-SAR01.

The last full assessment was completed in 2006 (SEDAR 11, the full assessment may be found here: http://sedarweb.org/sedar-11-final-stock-assessment-report-large-coastal-sharks-blacktip-shark-and-sandbar-shark).

Description of the Individual Reviewer's Role in the Review Activities

My role in the process was as a CIE-appointed peer reviewer only. There were three independent experts comprising the review panel (Appendix 3). My role in the process was to prepare for the meeting by reading the extensive supplied materials (Appendix 1), attending the scheduled five-day long meeting by webinar, and to write a report summarizing my views according to the Terms of Reference.

During the course of the review, the review panel requested some additional analyses (see Appendix 4). The authors of the stock assessment provided comprehensive and timely responses to our requests, which were greatly appreciated. The additional analyses are discussed later in this report under the appropriate Term of Reference. I have structured the report to address each Term of Reference. The review panel's draft Summary Report is a consensus document, and I do not have any minority views to include here. However, there are some points that I will further emphasize below.

Summary of Findings for each ToR

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

   I prepared Section 1 of the Panel's consensus report, so my comments here are similar to those submitted in the consensus report, but some points are explained further.

   SEDAR 65 marks the first time that a Stock Synthesis model has been developed for Atlantic Blacktip Shark. As noted by the assessment team, Stock Synthesis offers a number of advantages compared with the assessment approach used in the

last assessment (SEDAR 11, Bayesian surplus production model), including the ability to combine several sources of information into a single analysis allowing for consistency in assumptions and permitting the uncertainty associated with all data sources to be propagated to the final model output. However, this flexible assessment approach can have very significant input data requirements. In particular, the model developed by the assessment team required a comprehensive set of input data, given that the model is sex-disaggregated, has three commercial fleets, a recreational fleet and ten indices of abundance. The available data to support the model appear to be quite limited, particularly length information. The assessment team was obliged to "mirror" the length frequency data for Fleet F1 (Comm-BL-kept) for three fleets, including F3 (Com-Other-Kept), S1 (Shark-BLL-Obs) and S2 (Shark-BLL-Res). This implies that the length composition for 3 of the 14 "fleets" in the model is assumed.

A further consideration is that 14 years have passed since the last assessment. In consequence, there has been an appreciable increase in the scientific basis for the stock assessment in all aspects of the input data required. There is new information available concerning life history, stock definition, and productivity. There also has been important work on post-release mortality. The indices of abundance considered in the SEDAR 11 assessment showed contradictory trends which limited confidence in the assessment, but in the current model the contradictory trends are much less apparent. In response to a question from the Review Panel, the assessment team characterized the stock as "data-rich" for a shark species. In result, there is a better foundation of data to build the assessment compared with SEDAR 11.

I felt it was very important to understand the nature of the important recreational fishery and the data collection programs that have been implemented. To that end, I requested during the pre-workshop meeting of the assessment review (October 21, 2020) to have further information on the recreational fishery sampling programs that have been in place, and what sort of intercalibration exercises that have been conducted. The assessment team quickly responded with comprehensive documentation (see Appendix One, Ref. Docs. 15-19), which provided a very helpful description of this critical aspect of the fishery. The key observation here is that the recreational fishery has been thoroughly studied, and the available recreational fishery catch data appear to accurately reflect reality. Nonetheless, the increasing quantity of discarded shark catches of unknown size and species identification represent an important challenge for future assessments.

In summary, there is adequate catch information from the commercial fishery, but the data from 1980s is reliant upon expert opinion. The recreational catch is reasonably well-described but there is an important and growing component that is caught and released. A mortality rate is applied to such discards, and it is based on well-described methods. There are some length composition samples, but not all fleets are well covered. Comparatively speaking, there are many available indices of abundance (including an unusually high number of fishery independent series) which are appropriately standardized.

a. Are data decisions made by the DW and AP sound and robust?

I considered the data decisions to be generally sound and robust. I appreciated the thorough documentation of data decisions in the report from the Data Workshop and the many supporting Working Papers which made it easy to come to that conclusion. Also, it was clear that influential data decisions were carefully considered by the assessment team members. An example of this diligence was illustrated on P. 28 of the Data Workshop report, where the assessment team tracked down the root of an anomalously high recreational fishery CPUE in 2009. This gives confidence to the credibility and robustness of the conclusions of the assessment team.

However, the review panel expressed some concern over the assumptions made to reconstruct the commercial fishery catches between 1981 and 1990, and noted that the reconstructions relied, to a large extent, on expert opinion rather than official data. Another significant data decision involved the use of the 1.39 conversion factor for conversion to whole weight from dressed weight. It was noted that other agencies use a conversion factor of 2.0 for large coastal sharks. However, the sensitivity analysis that explores the high catch scenario uses the latter conversion factor.

The panel requested a sensitivity analysis starting in 1990 to evaluate the influence of the uncertain catches in the 1980s. While noting that the analysis was somewhat problematic as the start of the truncated catch series was after exploitation had already occurred for many years, the results generally showed similar trends in SSF/SSF_{MSY} in the assessed time period for most configurations, but much higher uncertainty, confirming that catches are a key uncertainty in this assessment.

Perhaps I have missed it, but I could not find a clear description of the geographic extent of the stock. Section 2.3.1 of the Data Workshop Report discusses stock definition and while it reports new information that helps with the northward boundary of the stock, the precise boundaries are not provided.

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

Yes, data uncertainties are within normal or expected levels, generally speaking. As a data rich shark assessment, there are relatively few data uncertainties, and most are acknowledged. However, the growing number of released blacktip sharks in the recreational fishery in recent years comprise an increasing concern, as there is uncertainty regarding both the species identification and size of the released individuals. Given the dominance of the recreational fishery in the recent overall catch, this is an important and growing issue.

The form of the stock-recruitment relationship was the subject of some discussion by the Review Panel. The Panel discussed how to interpret the stock recruitment relationship when both the spawning stock fecundity and recruitment are in the units of age 0 pups. Also, there are no data about recruitment at low stock sizes, so that steepness had to be inferred from biological data. The Panel requested a sensitivity test that estimated steepness, which found, as expected, that the estimated trends were similar to the base model but the perception of MSY-based reference points was different. Since the steepness value assumed in the assessment is well supported by the biological data (many assessment models use a steepness value that is wholly assumed), the base model is considered appropriate.

The Panel also noted in some cases, fixing parameter values and external smoothing can mask uncertainty that is inherent in the data, and this can result in some loss of credibility and confidence in the uncertainty estimates in the model results.

c. Are data applied properly within the assessment model?

Generally speaking, the data are appropriately implemented in the Stock Synthesis model. For the indices of abundance, they were usually standardized using generalized linear models in a two-step delta lognormal approach. As mentioned in b) above, the Panel expressed concern that fixing some initial parameter values rather than allowing their estimation results in some loss of confidence in the model.

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

The assessment team described this stock as being data rich compared with other assessments, pointing to the available fishery independent indices, relatively complete life history information and gear-specific information concerning post release mortality. The review panel agrees with this characterization, and concludes that the available data are reliable and sufficient to support the assessment approach.

A caveat to the above conclusion is that commercial catch during the 1980s was a legacy dataset that had previously been reconstructed using expert opinion and other data sources in the absence of official statistics.

2. Evaluate and discuss the strengths and weaknesses of the method(s) used to assess the stock, taking into account the available data, and considering the following:

a. Are methods scientifically sound and robust?

Yes. The methods (Stock Synthesis) are well described in the literature (Methot and Wetzel 2013, Punt and Maunder 2013, and Zhu et al. 2016), and there have been several applications to large shark species. Stock Synthesis is part of the NOAA Fish and Fisheries Toolbox (Fish-Tools https://nmfs-fish-tools.github.io/). Stock Synthesis has also been recently used with the ICCAT (International Commission for the Conservation of Atlantic Tunas) shortfin mako assessment (https://www.iccat.int/Documents/Meetings/Docs/2019/REPORTS/2019_SMA_SA_ENG.pdf)

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

Yes, the model appears to be configured properly and is informed with a considerable amount of new information since the last assessment. As noted in the Summary Consensus Report of the Review Panel, the basic structure of the model includes a) Annual catches in weight/numbers from four fleets, and such catches are assumed to be known without error. b) Indices of abundance from 10 fleets are assumed log-normally distributed with externally estimated CV's (Francis adjusted). c) Length compositions are assumed to be multinomially distributed with Francis or Harmonic mean adjusted effective sample sizes. d) Parametric selection curves are estimated if sufficiency length composition data are available, otherwise the selectivity is mirrored from an assumed similar fleet. e) The underlying population model is sex- and age-structured, with Beverton-Holt stock-recruitment (with penalized deviations), sex-specific Von Bertalanffy growth, and a common length-weight relationship.

c. Are the methods appropriate for the available data?

The methods appear to be fully appropriate for the available data. However, I found it unusual that there was no attempt to complete a "continuity" analysis using the simpler models used SEDAR 11. Such bridging analyses are fairly standard and expected. I realize that much has changed since the 2006 assessment, but it would have been useful to evaluate the conclusions that might have been reached in SEDAR 65 if the SEDAR 11 methods were employed.

3. Evaluate the assessment findings and consider the following:
   a. Are abundance, exploitation, and biomass estimates reliable, consistent with input data and population biological characteristics, and useful to support status inferences?

I consider the extensive amount of work done establishing the inputs for the Stock Synthesis model was well described in SEDAR 2020a, and that the resulting estimates of abundance and mortality have an adequate foundation. The results flow from the final Stock Synthesis model which was accepted after examination of different model structures, model validation and sensitivity analyses.

b. Is the stock overfished? What information helps you reach this conclusion?

No, the stock is not overfished relative to the Minimum Stock Size Threshold (MSST = 0.861 in the base case). The base case assessment indicates that in the terminal year, SSF = 1.344 SSF_{MSST}. Six sensitivity runs that varied selectivity, catches and productivity also came to the conclusion that the stock was not overfished.

c. Is the stock undergoing overfishing? What information helps you reach this conclusion?

No, the stock is not undergoing overfishing relative to F_{MSY}, as the relative value of fishing mortality in the terminal year of the assessment is 0.509 in the base case. Six sensitivity runs that were completed came to the same 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?

While there is considerable scatter in the stock recruitment relationship (not unusual in any fish stock assessment), as noted by the review panel the most critical consideration is the steepness of the relationship between stock and recruitment. In this case, the steepness parameter was fixed at 0.40, and the choice was informed by biological information (which is not always the case). I conclude that the stock recruitment relationship is adequate 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?

Yes, the quantitative estimates of stock status are reliable for the reasons discussed above.

4. Evaluate the stock projections, including discussing strengths and weaknesses, and consider the following:

   a. Are the methods consistent with accepted practices and available data?

      Consistent with other members of the Review Panel, I concluded that the methods used in the projections were in line with accepted practices and available data. The projections were done using the standard methods available within Stock Synthesis. Due to a lack of time, instead of using MCMC to find the probabilities of exceeding reference points, the probabilities were calculated from the assumption that SSF/SSFMSY and F/FMSY were normally distributed around their MLE value with a standard deviation equal to the estimated standard error based on the likelihood. The stock assessment team presented information that showed for shortfin mako and sandbar sharks, the method was consistent with MCMC but slightly more pessimistic about the TAC that would allow rebuilding.

   b. Are the methods appropriate for the assessment model and outputs?

      Yes. The projection methods are appropriate for the assessment model outputs. Projections were done through 2043, which is roughly twice the estimated median generation time of 12.5 years. Future selectivity was assumed to be the same as the average in recent years, recruitment was generated from the stock recruit relationship. Modeling choices seemed appropriate and were well documented for the projections.

   c. Are the results informative and robust, and useful to support inferences of probable future conditions?

      Yes, the results of the projections appear to be informative and robust. Projections were made for a range of constant catch scenarios for the following models: (1) Base Model, (2) Logistic Sensitivity, (3) Drop CPUE Sensitivity, (4) High Catch Sensitivity, (5) Low Catch Sensitivity, (6) Low Productivity Sensitivity, and (7) High Productivity Sensitivity.

      However, the stock reconstruction from the base model implies a population that includes a significant fraction of individuals that are older than the oldest fish observed in a recent study of ages reported by Deacy and Moncrief-Cox (SEDAR65-DW-02) based on growth band counts from 269 females and 278 males (Figure 1). Projections based on this population may be misleading in that future catches from older fish may never be realized. *I suggest that the assessment team provide managers with estimates of the fraction of the exploited population that is projected to be older than the current oldest ages in the*

population. While this point was briefly discussed during the webinar review, I think it warrants further emphasis.

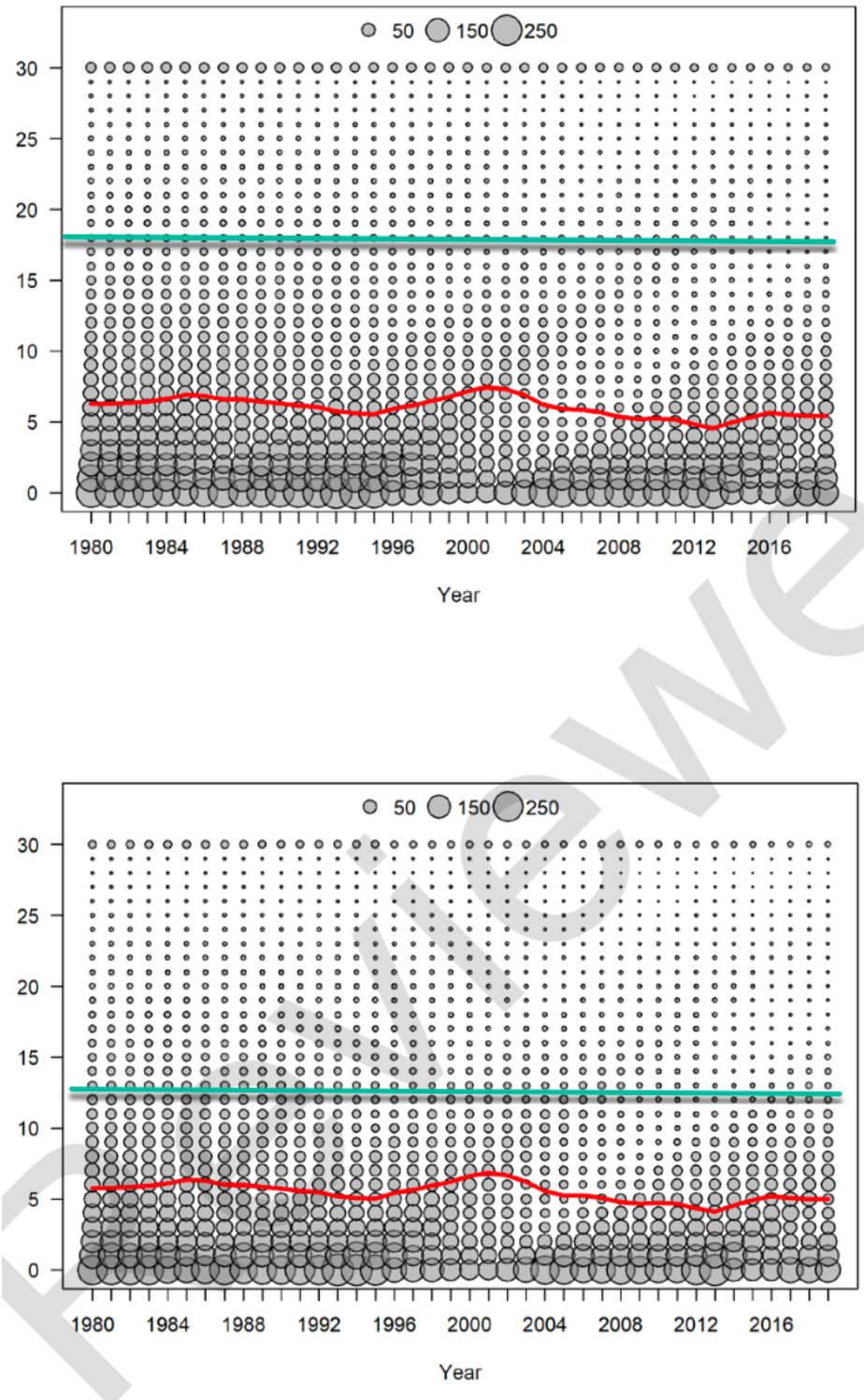

Figure 1. Bubble plot depicting the population (base case) from Fig. 3.B.9 of SEDAR 2020b. Females are shown on the top figure and males on the bottom. The horizontal green line indicates the oldest

ages observed in the catch, as reported in Deacy and Moncrief-Cox (SEDAR65-DW-02) based on growth band counts from 269 females and 278 males.

d. Are key uncertainties acknowledged, discussed, and reflected in the projection results?

Yes. Uncertainties have been investigated through the sensitivity analyses that covered a range of plausible scenarios. The sensitivities range from the most optimistic High Catch and Low Productivity cases, which imply that catches could more than double while still achieving management targets, to the more pessimistic Drop CPUE sensitivity, which would require reduction in catches. I mentioned a caveat in terms of the age structure, under point c. above, that I suggest requires some further clarification (research recommendation below).

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.

The stock assessment team assembled a comprehensive set of life history parameters shown in Table 2.13 in the draft assessment document. Most of the parameters were provided with precision estimates, such as the Standard Error of the estimates.

As described in the assessment report, a two-stage data weighting was used in the base case configuration (see Section 3.3.1.7 of the assessment report). In the first stage, survey CPUE variability is computed. In the second stage, the length composition data are adjusted for effective sample size. The assessment team also investigated the sensitivity of the results to alternative groupings of the indices.

When assessment parameters were not fixed by the analysts, uncertainty in estimated and derived parameters was obtained from Stock Synthesis output as the asymptotic parameter standard deviations at the converged solution. Time series trajectories of the two stock status metrics (SSF/SSF_{MSY}, F/F_{MSY}) are provided with approximate 95% asymptotic confidence intervals for the reconstructed population and the projections.

Finally, the impacts of uncertainty in the input data on stock assessment results and projections were investigated using sensitivity analyses.

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

The assessment report included six sensitivity runs, investigating the impacts of uncertainty in selection patterns, catch and productivity. Of the six runs, the two that varied selection patterns were considered by the assessment team to be the most complete.

The assessment team planned to provide estimates of credible intervals for reference points using MCMC techniques, but constraints associated with telework interfered with that plan, and only MLE results were available. However, the assessment team presented results for other shark species assessments (sandbar and shortfin mako) that indicated that MCMC and MLE results were comparable, but the MLE estimates were slightly more conservative for the two examples provided.

The documentation that reports the sensitivity analyses needs to be integrated into the overall assessment document (currently it is presented as a stand-alone document).

6. Consider the research recommendations provided by the Data Workshop and Assessment Process 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.

Of the recommendations contained in the Data Workshop report, I particularly support the following:

- Increase sampling intensity throughout range.
- Investigate sex and life stage specific movements of blacktip sharks.
- Distribute tagging efforts throughout the range to gain a more complete understanding of migratory and residence patterns.
- Given the importance of the recreational fishery, increase public education outreach activities to promote accurate species identification.
- Improve the MRIP process to filter biased sampling that leads to extreme fluctuations in catch data through a quality assurance process that is applied with an objective procedure.

Of the recommendations contained in the Assessment Process report, I particularly support the following:

- Investigate the apparent “cryptic biomass” of relatively old individuals in the population reconstruction (and projections). These individuals are

older than the oldest observed individuals in the age determination study reported earlier. I consider this to be one of the highest priorities for further work.

- Consider whether management actions such as minimum size regulations are adequately reflected in the recreational length sampling.

b. Provide recommendations on possible ways to improve the SEDAR process.

My comments on this topic are given in the next section entitled "The Review Process"

7. Consider whether the stock assessment constitutes the best scientific information available using the following criteria as appropriate: relevance, inclusiveness, objectivity, transparency, timeliness, verification, validation, and peer review of fishery management information.

The stock assessment, in my view, does reflect the best scientific information and provides an adequate basis for fisheries management decisions. While there are a few areas where the assessment could have been strengthened, including providing a retrospective and continuity analyses, I have relatively few concerns. I do note that the section of the Data Workshop Report entitled "Ecological Factors Affecting Blacktip Sharks" does highlight a lot of significant research still needed in order to approach an ecosystem-based management approach for this species. I particularly endorse the research recommendations listed in this section that aim to provide a better understanding of the stock distribution as it relates to ecological factors. Having such an understanding may assist us with more informed choices of abundance indices that reflect the dynamics of this shark species.

8. Provide suggestions on key improvements in data or modeling approaches that should be considered when scheduling the next assessment.

Research Recommendations

- When the assessment team was asked a similar question concerning research priorities, they responded that better knowledge of natural mortality would be very influential for the stock assessment. I agree strongly with this view, and note that life span is also a very important demographic parameter to confirm.
- The available information for age validation, according to SEDAR65-DW-02, contains one known age individual only. More work could be pursued to improve knowledge of age and growth.
- Species and fleet specific conversions between dressed weight and whole weight should be considered.
- A multi-species analysis of catch rates in the recreational fishery might be useful to extract an abundance index that is not biased by the issues with identification of sharks that are released alive.

- Longevity is poorly estimated and is one basis for estimates of M. Better estimates of longevity, and an independent estimate of natural mortality, for example from a tagging study, would be useful.
- The data workshop discussed whether blacktip sharks may be migrating northward. This migration could be modeled in a spatially explicit assessment. Spatially explicit models might also be useful for explaining differences in trends in indices from different locations.
- The apparent dome shaped selectivity in several gears implies that there are sharks in the population that are older than the oldest individual observed. Whether this is realistic could be validated with fishery independent research.

Recommendations for improvements to data for the assessment:

- As noted in the last assessment (SEDAR 11), the lack of data on catches and size distribution of catches during the peak of the fishery in the 1980s remains a key uncertainty in this assessment. Future work to improve catch reconstruction or evaluate model sensitivity to the catch reconstruction is recommended.
- There is a need to better characterize the length composition, particularly in recreational fisheries, which may be influenced by both state and federal regulations.

Recommendations to the assessment methods:

- Explore whether some other functional form of the stock recruit relationship would be more appropriate for this species, such as the low fecundity model that was used in the low productivity sensitivity. Explore using reference points that do not depend on MSY such as SPR-based reference points.
- Model runs that do not fix parameters should be explored to better characterize the uncertainty in parameter estimates. For example, if there is not enough data to estimate a selectivity parameter for two time blocks, rather than estimating it in one time block and applying the estimated value as a fixed parameter in the other, the data from both time blocks can be pooled to estimate the parameter.
- Bootstrapping the data could be used to quantify the uncertainty contained in the data. Current estimates of uncertainty are conditional on the full dataset and the modeling assumptions.
- Projections should be done using MCMC or profile likelihood methods to evaluate whether the normal approximation was adequate
- Investigate the timing and duration of the recruitment period, the duration of age 0 natural mortality, and the possibility of age 0 catches occurring during the recruitment period.

The Review Process

In spite of the review process being virtual, I found the review process to be generally effective. There was adequate time for questions and comprehensive responses from the stock assessment team, including additional analyses (see Appendix 4). The meeting agenda was logically organized, and key people attended the meeting that could assist with the CIE panel review, including an industry representative that provided very helpful background on the fishery and its development. The SEDAR coordinator did an excellent job in keeping the meetings working efficiently and used available tools to ensure that participants had ample notification of the upcoming meetings, break timings and overall requirements from the participants. The lead scientists did an excellent job in summarizing and presenting their work. In particular, I noted that the lead analyst was careful and considerate in fully explaining the rationale and logic of his approach. While this made for long presentations, it was time well spent. I also appreciated the willingness of the assessment team to conduct the additional exploration of the data that the review panel requested.

While the virtual platform worked quite well, there is no doubt that in-person meetings still are preferred for these types of reviews. In-person meetings allow more efficient exchange of ideas and ultimately result in a more thorough review.

The SEDAR website for document sharing worked well, and it was convenient to have access to the material before, during and after the meeting.

Conclusions

To re-iterate, the population model and assessment results provide a sound basis for fishery management decisions for Atlantic blacktip shark.

It was a pleasure to be a part of this review, and I thank the CIE and the meeting organizers for the opportunity.

Appendix 1: Bibliography of materials provided for review

Documents prepared for the SEDAR 65 Data workshop			
Document #	Title	Author	Date Received
SEDAR65-DW01	Reproductive parameters for blacktip sharks (Carcharhinus limbatus) from the western North Atlantic Ocean	Natanson et. al.	10/9/19 revised 10/29/19, 11/5/19 , 11/22/19
SEDAR65-DW02	Age and growth parameters for blacktip sharks, Carcharhinus limbatus, in the western North Atlantic Ocean	Deacy and Moncrief-Cox	10/8/19
SEDAR65-DW03	Bycatch estimates of blacktip shark in the south Atlantic coastal gillnet fishery	Carlson et. al.	9/25/19
SEDAR65-DW04	Bycatch estimates of blacktip shark in the shark bottom longline fishery	Carlson et. al.	9/25/19
SEDAR65-DW05	Size composition and indices of relative abundance of the Atlantic blacktip shark (Carcharhinus limbatus) in coastal Virginia waters	Latour et. al.	10/4/19 Modified 10/23/19
SEDAR65-DW06	Mark/recapture data for blacktip sharks, Carcharhinus limbatus, in U.S. Atlantic from the NOAA Fisheries Cooperative Shark Tagging Program	Cami McCandless	12/5/19
SEDAR65-DW07	Standardized catch rates of blacktip sharks, Carcharhinus limbatus, caught during the South Carolina Department of Natural Resources, Cooperative Atlantic States Shark Pupping and Nursery long-gillnet survey	Cami McCandless and Bryan Frazier	Received: 11/29/19 Revised: 12/31/19
SEDAR65-DW08	Standardized catch rates of blacktip sharks, Carcharhinus limbatus, from the NOAA Cooperative Atlantic States Shark Pupping and Nursery longline survey using generalized linear mixed models	Cami McCandless, Bryan Frazier, James Gelsleichter, and Carolyn Belcher	Received: 11/29/19
SEDAR65-DW09	Standardized catch rates of blacktip sharks, *Carcharhinus limbatus*, from the NOAA Cooperative Atlantic States Shark Pupping and Nursery longline survey	Cami McCandless and Lisa Natanson	Received: 11/29/19

SEDAR65-DW10	Standardized recruitment index for blacktip sharks caught during the South Carolina Department of Natural Resources, Cooperative Atlantic States Shark Pupping and Nursery short-gillnet survey	Bryan Frazier and Cami McCandless	Received: 11/29/19
SEDAR65-DW11	Standardized catch rates of blacktip sharks, *Carcharhinus limbatus*, from the South Carolina Department of Natural Resources red drum and Southeast Area Monitoring and Assessment Program longline surveys	Cami McCandless and Bryan Frazier	Received: 11/29/19
SEDAR65-DW12	Standardized catch rates of blacktip sharks, Carcharhinus limbatus, from the Georgia Department of Natural Resources, Southeast Area Monitoring and Assessment Program longline survey	Cami McCandless, Donna McDowell and Carolyn Belcher	Received: 11/29/19 Modified: 12/5/19
SEDAR65-DW13	Standardized catch rates of blacktip sharks (Carcharhinus limbatus) from the South Carolina Department of Natural Resources drumline survey	Bryan S. Frazier, Adam G. Pollack	Received: 11/26/19
SEDAR65-DW14	Estimation of blacktip shark, *Carcharhinus limbatus*, discards in the northeast gillnet fishery using data collected by the NOAA Northeast Fisheries Observer Program	Cami McCandless, Joe Mello, and Kathy Sosebee	12/5/19
SEDAR65-DW15	Distribution and Length Data for Blacktip Sharks Captured on the NOAA/NMFS/SEFSC/MSLABS Bottom Longline Survey in the Western North Atlantic Ocean	Adam G. Pollack, William B. Driggers III, David S. Hanisko and G. Walter Ingram, Jr.	10/29/19
SEDAR65-DW16	An index of abundance from the Marine Recreational Information Program data	Babcock	10/8/19
SEDAR65-DW17	Catch rates of blacktip sharks (Carcharhinus limbatus) in US Atlantic Ocean from the Shark Bottom Longline Observer Program, 1994-2018	Carlson et.al.	10/4/19

SEDAR65-DW18	Stress response and post-release mortality of blacktip sharks (*Carcharhinus limbatus*) captured in shore-based and charter boat-based recreational fisheries Stress response and post-release mortality of blacktip sharks (*Carcharhinus limbatus*) captured in shore-based and charter boat-based recreational fisheries.	Bryan Frazier	10/25/19
SEDAR65-DW19	Preliminary catches of blacktip sharks in the U.S. Atlantic ocean	Enric Cortes	10/24/19
SEDAR65-DW20	An Updated Literature Review of Post-release Live-discard Mortality Rate Estimates in Sharks for use in SEDAR 65	Dean Courtney and Alyssa Mathers	Received: 11/1/19 Revised: 12/4/19
SEDAR65-DW21	Estimating post-release mortality and capture stress of blacktip sharks in the gulf of mexico recreational fishery	John Mohan	Received: 12/6/19

Documents prepared for SEDAR 65 Assessment Workshop			
SEDAR65-AW01	Hierarchical analysis of U.S Atlantic blacktip shark recruitment indices.	Cami McCandless	1/9/2020
SEDAR65-AW02	Estimates of vital rates and population dynamics parameters of interest of blacktip sharks (*Carcharhinus limbatus*) in the Atlantic Ocean	Enric Cort*é*s	3/6/2020
SEDAR65-AW03	Reconciling indices of relative abundance of the Atlantic blacktip shark (Carcharhinus limbatus)	Robert Latour	3/6/2020
SEDAR65-AW04	Hierarchical Cluster Analysis and Cross-correlations of Selected CPUE Indices for the SEDAR 65 Assessment	Dean Courtney	3/6/2020
SEDAR65-AW05	Review of Available Length Composition Data Submitted for use in the SEDAR 65 Atlantic Carcharhinus limbatus Stock Assessment	Andrea Kroetz and Dean Courtney	3/12/2020
SEDAR65-AW06	Improving discard time series for use in assessment sensitivity analyses	Camilla McCandless, John Carlson, Xinsheng Zhang Enric Cortés	3/25/2020
Documents Prepared for SEDAR 65 Review Workshop			
SEDAR65-RW01	Updated Commercial Gillnet Length Composition Data for use in SEDAR 65	Dean Courtney, Alyssa Mathers, and Andrea Kroetz	9/18/2020
SEDAR65 RW02	Projections Conducted for the Atlantic Blacktip Shark Stock Synthesis Base Model Configuration at Alternative Fixed Total Allowable Catch (TAC) Limits	Dean Courtney	10/5/2020
Final Assessment Reports			
SEDAR65-SAR01	SEDAR 65 Atlantic Blacktip Shark Stock Assessment Report	Prepared by SEDAR staff	

Reference Documents			
SEDAR65-RD01	SEDAR64-RD-12 Model-estimated conversion factors for calibrating Coastal Household Telephone Survey (CHTS) charter boat catch and effort estimates with For Hire Survey (FHS) estimates in the Atlantic and Gulf of Mexico with application to red grouper and greater amberjack	Dettloff and Matter	July, 2019
SEDAR65-RD02	S65-RD02 SEDAR67-WP-06 Sample size sensitivity analysis for calculating MRIP weight estimates	Dettloff and Matter	10/18/19
SEDAR65- RD03	Report of the 2012 meeting of the iccat working group on stock assessment methods	Iccat wg stock assessment methods – madrid 2012	10/29/19
SEDAR65-RD04	Updated Post-release Live-discard Mortality Rate and Range of Uncertainty Developed for Blacktip Sharks Captured in Hook and Line Recreational Fisheries for use in the SEDAR	Courtney	10/30/19
SEDAR65-RD05	Community interactions and density dependence in the southeast United States coastal shark complex	Peterson et.al.	10/30/19
SEDAR65-RD06	Discard Mortality of Carcharhinid Sharks in the Florida Commercial Shark Fishery	Whitney	11/4/19
SEDAR65-RD07	Survey of the Florida Recreational Shark Fishery Utilizing Shark Tournament and Selected Longline Data	Hueter	11/1/19
SEDAR65 – RD08	Utility of citizen science data: A case study in land-based shark	Kesley J. Gibson, Matthew K. Streich, Tara S. Topping, Gregory W. Stunz	12/20/19
SEDAR 65-RD09	Stock synthesis (ss3) model runs conducted for North Atlantic shortfin mako shark	Dean Courtney, Enric Cortés, and Xinsheng Zhang	5/7/2020

SEDAR 65 – RD10	Stock synthesis model sensitivity to data weighting: an example from preliminary model runs previously conducted for north Atlantic blue shark	Dean Courtney, Enric Cortés, Xinsheng Zhang, and Felipe Carvalho	5/7/2020
SEDAR 65-RD11	Capture stress and post-release mortality of blacktip sharks in recreational charter fisheries of the Gulf of Mexico	John A. Mohan, Elizabeth R. Jones, Jill M. Hendon, Brett Falterman, Kevin M. Boswell, Eric R. Hoffmayer and R.J. David Wells	5/20/2020
SEDAR65-RD12	Proposal of implementation of low-fecundity spawner-recruitment relationship for shortfin mako in the North Atlantic.	Mikihiko Kai and Felipe Carvalho	6/24/2020
SEDAR65-RD13	Examples of Stock Synthesis diagnostic methods and results implemented for previously completed North Atlantic shortfin mako Stock Synthesis model runs.	Courtney, D., Carvalho, F., Winker, H., and L. Kell.	6/24/2020
SEDAR65-RD14	Example of a Stock Synthesis projection approach at alternative fixed total allowable catch (TAC) limits implemented for three previously completed North Atlantic shortfin mako Stock Synthesis model runs	Courtney, D. and J. Rice	6/24/2020
SEDAR65-RD15	Marine Recreational Information Program Transition to Improved Survey Designs	John Foster and Kelly Denit	10/22/2020
SEDAR65-RD16	APAIS At-a-Glance	NOAA Fisheries, Marine Recreational Information Program	10/22/2020
SEDAR65-RD17	Field Procedures Manual: Access-Point Angler Intercept Survey	Atlantic Coastal Cooperative Statistics Program	10/22/2020

SEDAR65-RD18	National Marine Fisheries Service's Marine Recreational Information Program Survey Design and Statistical Methods for Estimation of Recreational Fisheries Catch and Effort	Katherine J. Papacostas and John Foster	10/22/2020
SEDAR65-RD19	Review of the Marine Recreational Information Program. .	The National Academies of Sciences, Engineering, and Medicine	10/22/2020
SEDAR65-RD20	Age-specific natural mortality rates in stock assessments: size-based vs. density-dependent	Joseph E. Powers	10/30/2020
SEDAR65-RD21	Modelling the effects of density-dependent mortality in juvenile red snapper caught as bycatch in Gulf of Mexico shrimp fisheries: Implications for management	Robyn E. Forrest, Murdoch K. McAllister, Steven J.D. Martell, Carl J. Walters	10/30/2020

Appendix 2:

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

SEDAR 65 HMS Atlantic Blacktip Shark Assessment Review

Background

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

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer reviews of highly influential and controversial science before dissemination, and that peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards. (http://www.cio.noaa.gov/services_programs/pdfs/OMB_Peer_Review_Bulletin_m05-03.pdf).
Further information on the CIE program may be obtained from www.ciereviews.org.

Scope

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

SEDAR 65 will be a CIE assessment review conducted for HMS Atlantic Blacktip Shark. The review workshop provides an independent peer review of SEDAR stock assessments. The term review is applied broadly, as the review panel may request additional analyses, error corrections and sensitivity runs of the assessment models provided by the

assessment panel. The review panel is ultimately responsible for ensuring that the best possible assessment is provided through the SEDAR process. The stocks assessed through SEDAR 65 are the Atlantic stock of blacktip sharks in U.S. federal waters from Maine through Florida. The specified format and contents of the individual peer review reports are found in **Annex 1**. The Terms of Reference (TORs) of the peer review are listed in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3** and the technical specifications required for this review are listed in **Annex 4.**

Requirements

NMFS requires three (3) reviewers to conduct an impartial and independent peer review in accordance with the Performance Work Statement (PWS), OMB guidelines, and the TORs below. The reviewers shall have a working knowledge in stock assessment, statistics, fisheries science, and marine biology sufficient to complete the primary task of providing peer-review advice in compliance with the workshop Terms of Reference fisheries stock assessment. It would be preferable for reviewers to have an expertise in shark population dynamics and/or shark assessments.

Tasks for Reviewers

1) Two weeks before the peer review, the Project Contacts 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 Project Contacts will consult with the contractor on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the PWS scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

2) Additionally, two weeks prior to the peer review, the CIE reviewers will participate in a test to confirm that they have the necessary technical specifications provided in Annex 4 prepared in advance of the panel review meeting.

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

4) After the review meeting, reviewers shall conduct an independent peer review report in accordance with the requirements specified in this PWS, OMB guidelines, and TORs, in adherence with the required formatting and content guidelines; reviewers are not required to reach a consensus.

5) Each reviewer should assist the Chair of the meeting with contributions to the summary report. The Chair is not provided by the CIE under this contract.

6) Deliver their reports to the Government according to the specified milestones dates.

Place of Performance
The place of performance shall be online via gotowebinar.

Period of Performance
The period of performance shall be from the time of award through January 2021. Each CIE reviewer's duties shall not exceed 14 days to complete all required tasks.

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

Schedule	Deliverables and Milestones
Within two weeks of award	Contractor selects and confirms reviewers
2 weeks prior to the panel review	Contractor provides the pre-review documents to the reviewers
October 29, 30 and November 2, 4, 5 2020	Panel will attend and participate in review webinars lasting approximately four and a half hours each day held between the hours of 8 am -8 pm CT
Approximately 3 weeks later	Contractor receives draft reports
Within 2 weeks of receiving draft reports	Contractor submits final reports to the Government

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

Travel
Since this is a remote panel review, travel is neither required nor authorized for this contract.

Restricted or Limited Use of Data
The contractors may be required to sign and adhere to a non-disclosure agreement.

Project Contacts:

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Annex 1: Peer Review Report Requirements

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

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

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

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

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

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

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

3. The report shall include the following appendices:

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

Annex 2: Terms of Reference for the Peer Review

SEDAR 65 Atlantic Blacktip Shark Assessment Review Workshop Terms of Reference

Review Workshop Terms of Reference

9. Evaluate the data used in the assessment, including discussion of the strengths and weaknesses of data sources and decisions, and consider the following:
    a. Are data decisions made by the DW and AP 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?
10. Evaluate and discuss the strengths and weaknesses of the method(s) used to assess the stock, taking into account the available data, and considering the following:
    a. Are methods scientifically sound and robust?
    b. Are assessment models configured properly and consistent with standard practices?
    c. Are the methods appropriate for the available data?
11. Evaluate the assessment findings and consider 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?
12. Evaluate the stock projections, including discussing strengths and weaknesses, and consider 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?

13. 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.
14. Consider the research recommendations provided by the Data Workshop and Assessment Process 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.
15. Consider whether the stock assessment constitutes the best scientific information available using the following criteria as appropriate: relevance, inclusiveness, objectivity, transparency, timeliness, verification, validation, and peer review of fishery management information.
16. Provide suggestions on key improvements in data or modeling approaches that should be considered when scheduling the next assessment.
17. Prepare a Peer Review Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference.

Annex 3: Tentative Agenda - SEDAR 65 Atlantic Blacktip Shark Assessment Review

Via webinar

October 29 - November 5, 2020

Each day will consist of a 4.5 hour long webinar held between the times of 8 am and 8 pm CT

The start and end times of each webinar are dependent on CIE and analyst availability

October 29- Introductions and Opening Remarks
Coordinator
- Agenda Review, TOR, Task Assignments
Assessment Presentations Dean Courtney

October 30 – Assessment Presentation continued Dean Courtney

October 29 and 30 Goals: Initial presentations completed, sensitivities and modifications identified.

November 2 - Panel Discussion Chair
- Review additional analyses, sensitivities
- Consensus recommendations and comments Chair

November 2 Goals: Final sensitivities identified, preferred models selected, projection approaches approved, Summary report drafts begun

November 4 - Panel Discussion Chair
- Final sensitivities reviewed.
- Projections reviewed.

November 5 Panel Discussion or Work Session Chair
- Review Consensus Reports

November 4 and 5 Goals: Complete assessment work and discussions. Final results available. Draft Summary Report reviewed.

Annex 4: SEDAR 65 HMS Atlantic Blacktip Shark Review workshop minimum technical requirements

1. Computer
2. Microphone and speakers (headset recommended)
3. GoToWebinar desktop app (JavaScript enabled) available for download here: https://support.goto.com/webinar/help/download-now-g2w010002
4. Internet: 1 Mbps or better (wired preferred)
5. Web browser:
    a. Google Chrome v57 or later
    b. Mozilla Firefox v52 or later
    c. Internet Explorer v10 or later
    d. Microsoft Edge v12 or later
    e. Apple Safari v10 or later
6. Operating system
    a. Windows 7 - Windows 10
    b. Mac OS X 10.9 (Mavericks) - macOS 10.15 (Catalina)
7. 2GB of RAM (minimum), 4GB or more of RAM (recommended)
8. Smart phone for use as audio backup and internet hotspot (recommended)

Appendix 3: CIE Panel Membership

Beth Babcock	Chair	University of Miami: RSMAS
Anders Nielsen	CIE	DTU-Aqua Technical University of Denmark
John Neilson	CIE	Independent Fisheries Scientist
Joe Powers	CIE	Joseph Powers Consulting

Appendix 4: Additional Analyses Requested During the Meeting

Day 1

1. Check meaning of "CV weighting" for indices. Is the weight just the variance as calculated from the CV?. Done

2. Check timing of age zero processes, including natural mortality, density dependence and growth. See Powers (2014) and Forest et al (2013). Done.

3. Conduct a jitter analysis on the base model. Done.

4. Run a sensitivity analysis with freely estimated steepness. Done.

5. Run a sensitivity analysis with the low fecundity stock recruit relationship. Done

6. Try a later start year, such as 1990, to avoid the poor data period in the 1980s. Done

7. Instead of putting the year 2018 in its own time block, include it with the previous time block. Done.

Day 2

1. Finish jitter of base case. If jitter doesn't work, try retrospective analysis, or try manually changing starting values. Done.

2. Jitter the logistic sensitivity to see if lack of asymptotic fleet is why convergence is an issue. Not needed.

3. Correct the text on which selectivity was used in projections. Done.

4. Give more details on whether ratios of SSF/SSF_{MSY} and F/F_{MSY} are normally distributed, from sandbar or mako analyses, which compared MCMC to the normal approximation. Done.

5. Set M equal to the minimum M rather than the mean in the logistic sensitivity to see whether this changes the outputs in any way, or just rescales R_0. Not needed.

6. Try to do the later start year sensitivity requested Friday. Done.

Additional Literature Cited

Gibson KJ, Streich MK, Topping TS, Stunz GW (2019) Utility of citizen science data: A case study in land-based shark fishing. PLoS ONE 14(12): e0226782. https://doi.org/10.1371/journal. pone.0226782

Methot, Richard D. Jr., and Wetzel Chantell R. 2013, Stock synthesis: A biological and statistical framework for fish stock assessment and fishery management. Fisheries Research.

National Academies of Sciences, Engineering, and Medicine 2017. Review of the Marine Recreational Information Program. Washington, DC: The National Academies Press. https://doi.org/10.17226/24640.

Punt, André E., Maunder, Mark N. 2013. A review of integrated analysis in fisheries stock assessment. 2012. Fisheries Research.

SEDAR 2020. HMS Blacktip Shark SECTION II: Data Workshop Report. Draft report (January 2020).

Zhu, J., Maunder, M. N., Aires-da-Silva, A. M., Chen, Y. 2016. Estimation of growth within Stock Synthesis models: Management implications when using length-composition data. Fisheries Research