

SEDAR 11: Review of large coastal sharks

June 5 to 9, 2006
Bay Point Marriott
Panama City, Florida

Executive Summary

The SEDAR 11 Review Panel met from 5 to 9 June 2006, in Panama City, FL to review the data and assessments for the large coastal shark complex. The panel consisted of a CIE Chair, two CIE reviewers, and two independently invited reviewers. Those species comprising the largest portion of the landings were treated separately as Gulf of Mexico blacktip shark, Atlantic blacktip shark and sandbar shark. The remaining species (e.g., smooth hammerhead, nurse shark, silky shark) were treated as a group. Each reviewer was assigned a specific stock assessment to review and I was assigned the sandbar shark assessment.

Overall, the data utilized in the assessment of the Large Coastal Shark complex were the best available to the analysts at the time, and the assessment of the status of the complex was the best possible given the data available. However, the assessment did a poor job at representing the status of the Large Coastal Shark complex (in any of the formulations: i.e. 22, 11, or 9 species) because of the potential for conflicting/ mismatching information from various species components in the catch and abundance index data. Therefore, it was unclear to the Panel what exactly the results of the assessment represented, making it impossible to support use of the results for management of the complex.

The population model for sandbar sharks and resulting population estimates were the best possible given the data available. The change in stock status in the 2006 assessment from the more optimistic status in 2002 appears to be mainly attributable to revisions in the life history parameters in the current assessment. The population is assessed to be less productive than was assumed in 2002.

In 2006, the 3-part SEDAR process of data workshop, assessment workshop, and review workshop was adopted for large coastal sharks. This process resulted in a more thorough review at all stages of the process, which was not possible with the previous stock assessments. For this reason and those concerning the life history parameters given above, the Panel is confident that the 2006 assessment for sandbar sharks gives a more reliable estimate of stock status than obtained from the 2002 and earlier assessments.

Sandbar stock status was determined from the results of a range of model fits reflecting the Panel's uncertainty about life history parameters. All results indicate that the stock is overfished and that overfishing is occurring. The target year to rebuild the stock is estimated to be 2070.

The Panel accepted that the stock of blacktip sharks in the Gulf of Mexico is not overfished and that overfishing is not taking place, but it did not accept the absolute estimates of stock status. The three abundance indices believed to be most representative of the stock were consistent with each other, suggesting that stock abundance has been increasing over a period of declining catch during the past 10 years.

For blacktip sharks in the Atlantic, the Panel concluded that the data used for the analyses were treated appropriately. However, it was unclear whether catch estimates prior to 1991 adequately represented historical removals. Moreover, it was impossible to judge the extent to which each of the standardized catch-rate series reflected real trends in the abundance of the stock. Therefore, given the widely differing results arising from the different models, the status of the stock of Atlantic blacktip shark was deemed to be uncertain, and no reliable estimates of abundance, biomass or exploitation rate were advanced. Further, in the absence of reliable estimates of abundance, biomass and exploitation rates, no reliable estimates of stock status were suggested.

The data available for all of the species/species groups consisted of landings and various catch rate indices. These catch rate indices were usually short-term and many were restricted to limited areas, life stages, or both. While catch rate indices may inform population models of trends, they do not provide any information on life history parameters (e.g., steepness parameter for spawner/recruit relationships), which are critical to the reference points used in these assessments. While the workshop reports called for more life history research, there needs to be a focus on the kind of research that is needed to provide the necessary information for the population model in terms of density independent/dependent conditions, such as estimating mortality at different population levels.

Background

The review workshop of the 11th Southeast Data, Assessment, and Review (SEDAR) process was convened in Panama City, Florida from June 5 to June 9, 2006. The purpose of the workshop was to review the results of the previous workshops on assessment data and stock assessments of the large coastal shark complex (LCS) that had been held in late 2005 and early 2006, respectively, and to develop the stock status assessment that will be provided to the appropriate management agency (Highly Migratory Species). This was the first time that the LCS species were reviewed using the SEDAR process. Those species comprising the largest portion of the landings were treated separately as Gulf of Mexico blacktip shark, Atlantic blacktip shark and sandbar shark. The remaining species (e.g., smooth hammerhead, nurse shark, silky shark) were treated as group. Participants at the meeting are listed below and the terms of reference for the meeting follow.

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Terms of Reference for the Review Workshop

1. Evaluate whether data used in the analyses are treated appropriately and are adequate for assessing the stocks; state whether or not the input data are scientifically sound.
2. Evaluate the adequacy, appropriateness, and application of the methods used to assess the populations; state whether or not the methods are scientifically sound.
3. Recommend appropriate or best-estimated values of population parameters such as abundance, biomass, and exploitation (if possible).
4. Evaluate the adequacy, appropriateness, and application of the methods used to estimate stock status criteria (population benchmarks such as MSY, Fmsy, Bmsy, MSST, MFMT). State whether or not the methods are scientifically sound.
5. Recommend appropriate values for stock status criteria (if possible).
6. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status and, if appropriate, evaluate stock rebuilding; state whether or not the methods are scientifically sound.
7. Recommend probable values for future population condition and status (if possible).
8. Ensure that all desired and necessary assessment results (as listed in the SEDAR Stock Assessment Report Outline) are clearly and accurately presented in the Stock Assessment Report and that such results are consistent with the Review Panel's consensus regarding adequacy, appropriateness, and application of the data and methods.

9. Evaluate the Data and Assessment Workshops with regard to fulfilling their respective Terms of Reference and state whether or not the Terms of Reference for previous workshops are adequately addressed in the Data Workshop and Stock Assessment Report sections;
10. Develop recommendations for future research for improving data collection and stock assessment.
11. Prepare a Consensus Report summarizing the peer review Panel's evaluation of the reviewed stock assessments and addressing these Terms of Reference. (Drafted during the Review Workshop with a final report due two weeks after the workshop ends.)

Review Activities

A large amount of background material from the data and assessment workshops and other supporting information for the individual stock assessments were made available to reviewers on the SEDAR website as of May 9 (Appendix A). The same material was provided at the meeting on a CD.

The meeting began at 1 pm on Monday June 5 at the Bay Point Marriott Hotel. Each reviewer had been assigned a specific assessment prior to the meeting: Steve Campana – Gulf of Mexico blacktip, John Casey – Atlantic blacktip, Colin Simpfendorfer – other species in complex and I was assigned sandbar sharks.

Enric Cortes and Liz Brooks presented their respective stock assessments at the beginning of the week starting with the species in the large coastal shark complex that were being considered as group. In turn the review committee requested further work to be done that was meant to clarify patterns presented or test the stock assessment models' sensitivity to assumptions being made. Both presenters did an excellent job of presenting their material and providing timely feedback on the additional work that was assigned. Each of the reviewers provided a summary of findings with respect to each of the terms of reference for their assigned stocks. These draft summaries received two reviews by all present before being included into the consensus report for a final editorial review. The consensus report has been finalized and is now available at (as of June 19):

http://www.sefsc.noaa.gov/sedar/Sedar_Documents.jsp?WorkshopNum=11&FolderType=Review

Summary of Findings

The specific findings for each of the assessments with respect to points 1, 2, 4, 6, and 10 of the terms of reference are summarized below.

1. Evaluate whether data used in the analyses are treated appropriately and are adequate for assessing the stocks; state whether or not the input data are scientifically sound.

Large Coastal Sharks

The Review Panel considered that the data had in general been appropriately handled. However, the assessment was carried out for a complex of up to 22 species, and this meant that data were combined for all of these species. As such the data do not represent the trends in any one species, or even the status of the group as a whole, because opposing trends in different species could cancel each other out. The Review Panel therefore considered that although the data were well handled, they may not be appropriate for assessing the status of the complex.

In addition, the Panel identified a number of issues related to the data used in the assessment. Species composition of the catch series used was not specified, nor was the species composition of the catch-rate series (see below; species composition data for the commercial fishery were only available from 1995 onwards). If there were significant differences in the species composition of either of these data sets over time, then the assessment is likely to have produced results that do not reflect the status of the complex as a whole, or even the main components. Similarly, if the catch series had a significantly different composition from those of the abundance indices, then there is a mismatch in the signals to the model, with abundance changes not reflecting the composition of the catch.

Standardization of catch-rate series was not carried out in a consistent fashion. Different types of standardization were used, although by the time of the Assessment Workshop, most had used the Delta method. This change in standardization for some of the indices was not updated in the documentation, and the Panel recommends that in future, the details of the index standardization be updated to reflect the finalized information. The application of a variety of standardization techniques may have resulted in indices potentially being biased in the decline/increase that they predict or perhaps in different coefficients of variation (CV). (The Panel recognized that the base model did not use CV to weight the indices, but some sensitivity runs did.)

Sandbar shark

Landings data were available from the commercial fishery, the recreational fishery, the Mexican fishery and as bycatch from the Gulf menhaden fishery. There was no shark bycatch information from the larger Atlantic menhaden fishery, and the Review Panel was unable to determine how important that omission was in estimating total removals from the sandbar shark population. Landings prior to 1981 were extrapolated back to 1975 to match the earliest date for the catch-rate series, based upon a number of assumptions related to subsequent catches. There was discussion about the possibility of there being records of landings in the earlier years; if true then efforts should be made to locate those records.

The population was designated as being in an unfished or virgin state in 1975, while at the same time it was recognized that there had been a smaller scale commercial fishery for sandbar sharks in the years 1935–1951. There was also discussion about the

completeness of the landing records for the mid-1980s and whether or not landings from Mexico and perhaps Cuba during this time period had been properly accounted for.

A number of fishery-dependent and -independent catch-rate series were used for the stock assessment. These data series had been evaluated during the Data Workshop, where standardized indices had been developed using generalized linear models, assuming a form of the Delta distribution. All recommended series were used in either the main model run or in sensitivity runs. The Virginia Institute of Marine Science (VIMS) longline series was the only one used in the model runs that had observations prior to 1985. Size and maturity stage information was reported as being collected from the VIMS longline and some of the other series, but those data were not supplied to the stock assessment scientists. Given that the VIMS survey was a designed fishery-independent survey, it would have been helpful to have the size information to see if the component of the population that it was monitoring had been changing over time.

The Panel concluded that the data, even with the shortcomings identified above, were the best currently available for evaluating the stock status of sandbar sharks.

Blacktip shark (Gulf of Mexico)

The data were treated appropriately, and were adequate for the models used to assess the stocks. However, there were deficiencies in the data provided. Historical catches were assumed to be negligible in the assessment model, resulting in the assumption that a virgin population was present in 1981. Yet there was an eightfold increase in commercial catches between 1985 and 1986, suggesting that catches before 1986 were grossly underestimated. Alternative methods for estimating historical catch, such as examination of fish processor records, might prove useful for this purpose.

The various abundance indices were inconsistent among themselves; some showed declining trends, some showed increasing trends, and others were relatively flat. This issue might be addressed if selection of abundance indices was restricted to those most likely to provide reasonable coverage of the population. The three indices believed to be most representative of trends in the stock are bottom longline observer, NMFS longline southeast survey, and Panama City gillnet survey (for juveniles).

Evidence that the abundance indices and commercial catch were sampling the same population component was missing. Maps showing the extent of spatial overlap would help address this.

No information on size or age composition of the indices or catch was presented. An analysis of such data would ensure that the indices are representative of the catch, and can be used as a diagnostic of the adequacy of the age-structured model.

The life history parameters entered into the stock assessment model appear to be unrealistic, because they were changed in order to increase steepness above the minimum level required for a self-sustaining population. The estimates of M at age were set at levels below that recommended by the Data Workshop ($M = 0.1$ for adults), and first-year survival was set at values higher than those shown in a field study. It was suggested that the inconsistency between expected and assumed life history parameters could have been

due to an unknown source contributing pups to the population. Indicators of stock identity such as mtDNA, tagging studies, and phenotypic characters all suggest that blacktip in the Gulf of Mexico and Atlantic are different stocks, so it is unlikely that pups from the Atlantic contributed to the Gulf stock. An alternate explanation is that the expected life history parameters are incorrect and may need to be re-evaluated.

Blacktip Shark (Atlantic)

The Review Panel considered that the data used for the analysis had been treated appropriately and represented the best estimates of assessment input information currently available to the data and assessment workshops. However, the Panel noted the following points.

There was a large increase in the catches after 1990. Commercial catch estimates for the period prior to 1995 were derived using information from more recent years, to apportion catch between the Gulf of Mexico and the Atlantic. These observations led the Panel to conclude that the commercial catch data may be unreliable prior to 1991 at least.

The standardized catch-rate indices showed conflicting trends, and the Panel was unable to judge the extent to which each of the series reflected real trends in the abundance of the stock. Additionally, the time-series of catch-rate indices was relatively short compared with the time-series of catch estimates.

The Panel discussed the appropriateness of applying a single selectivity vector to commercial catch-rate indices and considered that, as the catch-rate series are derived from different fleets operating in different areas and at different times, applying a single selectivity vector may be inappropriate. Moreover, while the separate indices themselves may be good indicators of abundance for the fraction of the population that they sample, the application of an inappropriate selectivity vector may bias the model fit. The Panel proposed that careful examination of size and age composition of the catch-rate index data be undertaken to establish whether appropriate fleet-specific size/age selectivity vectors can be derived.

The life history parameters entered into the stock assessment model appear to be unrealistic, because they were changed in order to increase steepness above the minimum level required for a self-sustaining population. The estimates of M at age were set at levels well below those recommended by the Data Workshop and first-year survival was set higher than values derived from a field study. It was suggested that the inconsistency between expected and assumed life history parameters could have been due to an unknown source contributing pups to the population. Indicators of stock identity all suggest that blacktip in the Atlantic and Gulf of Mexico are different stocks, so it is unlikely that pups from the Gulf of Mexico contribute to the Atlantic stock component. An alternative explanation is that the expected life history parameters are incorrect and need to be re-examined.

2. Evaluate the adequacy, appropriateness, and application of the methods used to assess the populations; state whether or not the methods are scientifically sound.

Large Coastal Sharks

The assessment used a Bayesian surplus production model to assess the population. This method is appropriate for the assessment. Although the method was appropriate, the Review Panel identified a number of concerns related to the assessment:

- The assumption of equal weighting for all the abundance indices means that the large numbers of recent indices that have a flat trend reduce the contribution of the few longer time-series that often showed larger declines in abundance. The longer time-series are the only ones that provide information on abundance from earlier in the assessment period. The Panel also considered the possibility that those series that have lower CVs could be more heavily weighted. However, a sensitivity test was run that examined use of a weighting scheme related to the inverse of the CV of the series. This resulted in a more pessimistic status of the stock for the 22-species complex (overfished and overfishing occurring), but similar results for the 11 and 9 species complexes. The Review Panel therefore considered the approach used at the data workshop, where the series were examined in detail and evaluated for their representation of stock abundance, to be suitable when used in conjunction with equal weighting of indices.
- In a similar way, the abundance indices are based on surveys or data that represent different proportions of the range of the species complex. For example, the Panama City NMFS Laboratory gillnet survey (PC gillnet) abundance series was relatively localized, while the NMFS Southeast longline survey (NMFS SE LL) covered significant proportions of the geographic range of the complex. The Review Panel was concerned that indices that represent relatively small portions of the geographic range are likely to be less representative of the overall abundance of the complex, because year-to-year variation in catches is likely to be greater in such series through localized effects. Again, the assumption of equal weighting of all catch-rate series does not represent the spatial extent of the data series, and consideration should be given to weighting the series by geographic extent (e.g. proportion of species range).
- The aggregation of data from 22/11/9 species into the Large Coastal Shark complex forces an assessment on a group of species with diverse life histories. If the species composition of the catch or catch-rate series has changed over the assessment period, then the assumption that the model has a single value of intrinsic rate of population increase (r) is incorrect, and r can change over time, possibly reflecting changing species composition.
- The assessments are for the Gulf of Mexico and Atlantic combined, and indications are that the abundance indices from these two areas represent different dominant species in the catch. Given that the updated data provided on the species composition of the abundance indices indicated that the two regions were dominated by different species, the Panel considered that aggregation of these areas may lead to misleading results.

Sandbar shark

An age-structured population model with state-space dynamics for some of the components and prior distributions assigned to some of the parameters was fitted to the data. No age data were used in the model, and the age structure was used mainly to incorporate different natural mortalities- and selectivities-at-age for the different fisheries (i.e. commercial, recreational, bycatch in menhaden fishery). Catch-rate indices were assumed to be proportional to population size, albeit with series-specific catchabilities and selection curves dependent upon whether they were commercial- or recreational-fishery-dependent, or fishery-independent series.

The model adequately incorporated the information from the available catch-rate indices and was the best available for the data provided. However, while catch-rate indices can inform on trends, they do not necessarily help generate understanding of the life history patterns that underpin stock status estimation. Pup survival was the only life history parameter to be estimated in the model, and other parameters such as natural mortality-at-age and the prior mode for pup survival had to be adjusted so that the steepness parameter remained within a reasonable range for the species.

Blacktip sharks (Gulf of Mexico)

The assessment used a state-space age-structured surplus production model to assess the population. This method was both scientifically sound and appropriate for assessing the population, given the data available. Nevertheless more informative models with improved capabilities would be possible if size or age composition data were available (e.g. a forward-projecting age-structured model). Use of these models would require a time-series of age/size structure in both the abundance indices and catch.

The assessment model assumed the presence of a virgin population at the start of the time-series. Simulations to investigate the influence of a depleted population at the start of the current time-series would be helpful.

Blacktip sharks (Atlantic)

The Review Panel considered that given the information available, the methods used to assess the Atlantic blacktip are scientifically sound and appropriate. However, the Panel agreed that the results largely highlighted the lack of consistency in signals in the catch-rate series.

4. Evaluate the adequacy, appropriateness and application of the methods used to estimate stock status criteria (population benchmarks such as MSY, F_{MSY} , B_{MSY} , MSST, MFMT). State whether or not the methods are scientifically sound.

Large Coastal Sharks

The Review Panel was unable to evaluate whether the methods used to determine the reference points for a stock complex were appropriate. The Review Panel noted that it was assumed that maximum sustainable yield (MSY) occurred at 50% of virgin biomass/numbers (i.e. the inflection point in the production curve). There is evidence to suggest that in some slower growing species, such as some of the shark species, MSY occurs at lower levels of depletion (50–70% of virgin biomass/numbers). If the 50% assumption is incorrect, then the calculations of MSY in the model will be incorrect, and the reference points used in the assessment (e.g. F_{MSY} and B_{MSY}) to determine if the stock is overfished, or if overfishing is occurring, will be inappropriate. In addition, the status of the stocks will also be worse than estimated and have a higher likelihood of being overfished or of overfishing occurring.

Sandbar shark

The methods used to estimate stock status were appropriate for the population model used in the assessment. They allowed the Panel to test the impact of different assumptions about the data and life history parameters on estimating stock status. In particular, using the maturity-at-age structure from the 2002 assessment, various ways of discounting the high 1983 recreational catch, running the 2002 assessment with 2006 life history parameters, starting the assessment in 1981, and a 10% increase to the 2004 catch in anticipation of post-season revisions, all resulted in not only the same findings of overfished and overfishing occurring, but the estimates were also clustered close together on the phase plot (Figure 1). A model run with the 2002 assumption of constant mortality was unsuccessful. Ultimately, the methods used for estimating stock status were found to have been much more sensitive to assumptions about life history parameters than the catch and catch-rate data used in the model.

Blacktip sharks (Gulf of Mexico)

The methods used in the assessment for estimating stock status criteria were adequate, appropriate, and scientifically sound.

Blacktip sharks (Atlantic)

The Panel concluded that, given appropriate and reliable input data, the methods available to the assessment workshop to derive estimates of stock status criteria are scientifically sound. However, the assessment model did not provide reliable estimates of abundance, biomass or exploitation rate for Atlantic blacktip. Hence, the results from the methods did not provide reliable estimates of stock status.

6. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status and, if appropriate, evaluate stock rebuilding; state whether or not the methods are scientifically sound.

Large Coastal Sharks

Given appropriate model inputs, the methods used in the assessment would be adequate, appropriate, and scientifically sound for a single species. However, the Panel could not evaluate whether projections made for a species complex using this model would be meaningful.

Sandbar shark

Generation times were calculated for the base model and the sensitivity runs in the cluster around the base model (Figure 1), and these ranged from 27 to 28 years. All generation times were estimated using a cumulative survival of 0.1% as the cut-off. Despite the uncertainty associated with the life history parameters, all model projections were quite close. Given that the data and the model are the best currently available, then the same can be said for the projections, assuming that the productivity of the stock continues to be as estimated in the assessment.

Blacktip sharks (Gulf of Mexico)

The methods used for population projections were appropriate and scientifically sound.

Blacktip sharks (Atlantic)

Given that the current status of Atlantic blacktip is unknown, no reliable population projections were possible.

10. Develop recommendations for future research for improving data collection and stock assessment.

Research recommendations are included in the reports from the data and assessment workshops, and the list below is not intended to replace these but is presented to emphasize particular needs that came up during the panel review (not ordered).

A. Large Coastal Sharks

- a) Issue: Lack of species-specific data, and the inability to identify carcasses/logs/fins to species level.
 - Improve dockside monitoring of catches.

- Increase observer coverage of the commercial fleet.
 - Use biochemical and/or genetic testing of products (carcasses/logs/fins) to produce reliable species identifications.
- b) Issue: Lack of life history data for some species within the large coastal shark species complex, which results in no meaningful estimate of intrinsic rate of increase (r) for use in assessments.
- Conduct research on the life history of all species in the complex, including regular sampling and analysis of the main species.
 - Use life tables (or other similar approaches) to estimate population parameters such as r .
- c) Issue: Limited numbers of longer term abundance (catch rate) data.
- Utilize all appropriate abundance series available, e.g. the Schwartz data from North Carolina.
- d) Issue: Geographic range of abundance surveys is variable, and those with limited geographic coverage are more likely to reflect localized changes than stock-wide changes.
- Evaluate alternative weighting schemes or modelling approaches for abundance data that take account of the geographic range of the surveys.
- e) Issue: Lack of species and size composition and effort data for abundance surveys.
- Provide information on species and size composition.
 - Obtain trends in deployed fishing effort at least for the catch-rate index series in Data Workshops and present them in the Assessment Workshop report, together with corresponding trends in catches and catch rate.
- f) Issue: Information on the type and quality of the standardization used for abundance indices was not always available.
- Document the method of standardization used for all catch-rate indices.
 - Where possible, use the same standardization methods for all indices.
- g) Issue: Assessment of the Large Coastal Shark (LCS) complex does not represent the status of the stocks, or any particular component of the stocks.
- Develop species-specific assessments for the main components of the LCS complex, where possible. Continuing with the current approach will only result in confusion with regards to the status of these resources.

- As an interim step, an improvement may be achieved if the complex can be split into smaller groups based on species with similar life history characteristics, or which occur within the same regions (e.g. the Gulf of Mexico or the Atlantic).

B. Sandbar shark

- a) Issue: There were uncertainties concerning appropriate values for life history parameters in determining stock status.
 - While the workshop reports called for more life history research, there needs to be a focus on the kind of research that is needed to provide the necessary information for the population model in terms of density independent/dependent conditions such as estimating mortality at different population levels.
- b) Issue: The population model assumed that catch rate indices were proportionally related to population size.
 - Many of the indices are based on longline gear and the assumption of proportionality needs to be assessed for this kind of gear through literature review and directed research.
- c) Issue: There were a number of catch rate indices used here and it was not obvious what components of the sandbar population were being monitored by these indices.
 - Using information on the size composition of catches from these indices if available would be helpful in this matter.
 - Maps of where (and when) the catch rate series are located along with location of the fisheries would aid in the interpretation of these series.
- d) Issue: The assessment used an age-structured model but no age information was used.
 - The predicted age compositions for the population and the catch in the model may provide useful diagnostics for the performance of the model. Research should be directed into developing these diagnostics including verification with any available data on age composition. One example of a diagnostic indicator is the mean size/age in the catch, population and from any catch rate index that may collect size composition data.
- e) Issue: No information on sandbar bycatch from the Atlantic menhaden fishery and no sense of how important this information is for accounting for all removals from the population.
 - Determine if these data are available and include in next assessment. If these data are not available then design a study to collect information on shark bycatch either through logbooks or onboard observers.

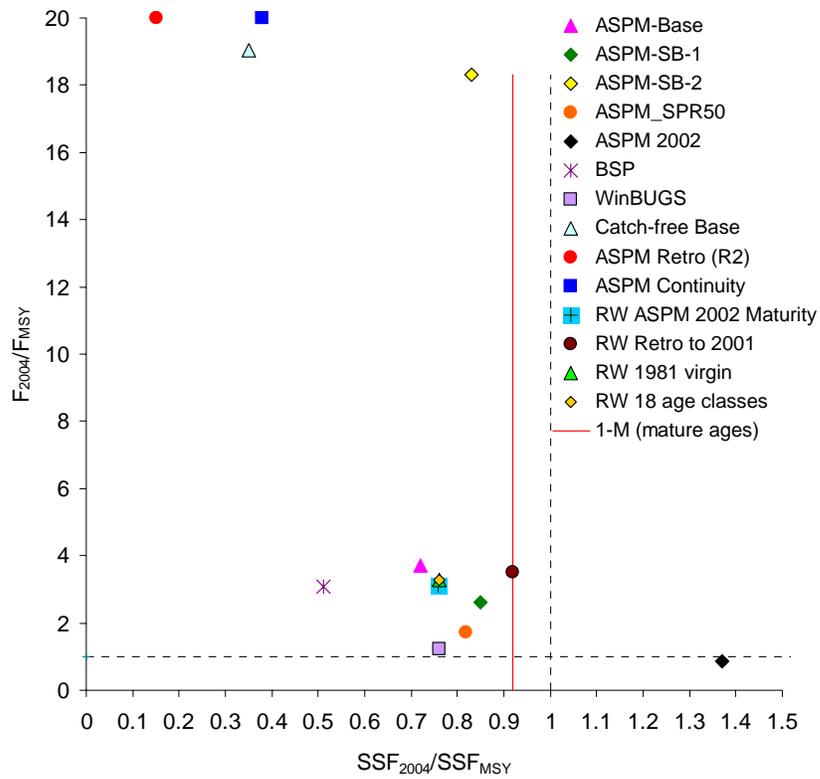


Figure 1. Phase plot with results for all of the base and sensitivity runs for sandbar shark. Stock status for 2004.

C. Blacktip shark (Gulf of Mexico)

- a. Issue: Historical catches are assumed to be negligible in the assessment model, resulting in the assumption that a virgin population was present in 1981.
 - Explore alternative methods for estimating historical catches, such as examination of fish processor records.
 - Simulate the existence of a depleted population at the start of the assessment time-series, rather than using the current assumption of a virgin population.
- b. Issue: The life history parameters entered into the stock assessment model appear to be unrealistic, because they were changed in order to increase steepness above the minimum level required for a self-sustaining population. The estimates of M at age were set at levels below that recommended by the Data Workshop ($M = 0.1$ for adults), and first year survival was set at values higher than those shown in a field study. There are several possible explanations for this. One is that the life history parameters need to be re-evaluated; another is that an unknown source is contributing pups to the population.
 - Re-examine the life history characteristics, particularly reproduction.
 - Explore possible alternative recruitment sources to the population.
- c. Issue: The assessment model provided a poor fit when all the abundance indices were applied, and there was poor consistency among these indices.
 - Restrict selection of abundance indices to those that are most likely to provide reasonable coverage of the population. The following indices should be examined to see if they are the most representative: bottom longline observer, NMFS longline southeast survey, and Panama City gillnet survey (for juveniles).
 - Evidence that the abundance indices and commercial catch were sampling the same population component was missing. Maps of spatial overlap would help address this.
 - No information on size or age composition of the indices or catch was presented. An analysis of such data would ensure that the indices are representative of the catch, and could be used as an additional diagnostic of the adequacy of the age-structured model.
- d. Issue: Point estimates of stock status do not provide information on the statistical confidence associated with the estimates.
 - Presentation of posterior distributions for F/F_{msy} and B/B_{msy} in relation to reference points would aid interpretation of stock status.

- e. Issue: Current data sampling protocols do not collect data that can be used to provide improved stock assessments.
 - Collect length frequency data from commercial landings and increase data collection from the recreational fishery as additional measures of model fit, among other things.
 - Examine trends in mean size in the catch as an indication of overexploitation.

D. Blacktip shark (Atlantic)

- a. Issue: Reliability of catch data.
 - Any additional sources of information on catches should be sought and examined. The catch data especially for the period prior to 1995 should be re-examined to establish whether all removals have been accounted for and whether they are realistic estimates of actual removals.
 - Estimates of blacktip bycatch in the fishery for Atlantic menhaden should be derived if possible, and catch information from logbooks and trip weigh-out records from the Florida east coast gillnet fleet for the period 1985–1991 may also be available.
- b. Issue: Consistency of catch-rate indices.
 - The Panel suggests that careful examination of size and age composition of the catch-rate index data should be undertaken to establish whether appropriate fleet-specific size/age selectivity vectors can be derived.
- c. Issue: Trends in fishing effort.
 - Trends in deployed fishing effort at least for the catch-rate index series should be developed in future Data Workshops and presented in the Assessment Workshop report, together with corresponding trends in catches and catch rate. It would also be informative to document time-series trends in deployed fishing effort for all fleets that exploit Atlantic blacktip if such data are available.
- d. Issue: Information on size and age compositions.
 - It would be informative to examine simple metrics such as mean age and mean size in the catches as a whole, and by fleet and geographic area. These may give a crude indication of trends in exploitation rate.

- e. Issue: Life history parameters for Atlantic blacktip.
 - The life history parameters entered into the stock assessment model appear to be unrealistic, because they had to be changed in order to increase steepness above the minimum level required for a self-sustaining population. The Panel recommends that data pertaining to life history characteristics be re-examined, and that information that may identify alternative sources of recruitment to the population be explored.

Participation of Industry

It was unfortunate that more representatives from the fishing industry could not attend the meeting. Mr. Hudson was there for most of the time, while Mr. Harrison missed most of the meeting because of other commitments. Mr. Hudson's knowledge of the shark industry with respect to participants, history, and landing statistics were highly detailed, to say the least. However, it was difficult for the reviewers to put his comments into perspective as they did not have the same level of knowledge. We did sympathize with his difficulty in relating the stock assessment results to his own experience. The only estimates of population numbers for sandbar shark reported was in the range 96,600 to 103,000 fully mature animals in 2004. Knowing the total weight landed and the average weight of a dressed animal, he could very quickly calculate that around 20,000 animals were being landed annually and the population of mature animals would be wiped out in a matter of a few years. It would have been more helpful to report the estimate for the exploitable population, which consists of both mature and immature animals. This estimate would have probably been much higher, close to an order of magnitude and more consistent with the fishing industry's perception. This is not to say that the stock status determination was wrong. The data and the model still indicate that the productivity of this species is lower than determined in 2002 and hence the determination of overfished and overfishing occurring.

Respectfully submitted on 20 June, 2006,

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Appendix A. References

- Anon. Large coastal shark complex data workshop report. 12 January 2006. 114 pp. (plus 47 individual working papers).
- Anon. Sedar 11 Large Coastal Shark Complex Assessment Workshop Report. Prepared by the SEDAR 11 Stock Assessment Panel 8 May 2006. 226 pp. (plus 10 working papers).
- Heist, E.J and J.R. Gold. 1999. Microsatellite DNA variation in sandbar sharks (*Carcharhinus plumbeus*). *Copeia*. 1999:182–186.
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- Keeney, D.B., M.R. Heupel, R.E. Hueter and E .J. Heist. 2005. Microsatellite and mitochondrial DNA analyses of the genetic structure of blacktip shark (*Carcharhinus limbatus*) nurseries in the northwestern Atlantic, Gulf of Mexico, and Caribbean Sea. *Molecular Ecology*.14: 1911–1923.
- McAllister, M.K. and E.A. Babcock. Bayesian surplus production model with the sampling importance resampling algorithm (BSP): a User's Guide. 5/9/2006. Draft. 40 pp.
- McAllister, M.K., E.K. Pikitch, and E.A. Babcock. 2001. Using demographic methods to construct Bayesian priors for the intrinsic rate of increase in the Schaefer model and implications for stock rebuilding. *Can. J. Fish. Aquat. Sci.* 58: 1871–1890.
- Meyer, R. and R. B. Millar. 1999. BUGS in Bayesian stock assessments. *Can. J. Fish. Aquat. Sci.* 56: 1078–1086.
- Spiegelhalter, D. A. Thomas, N. Best and D. Lunn. 2003. WinBUGS User Manual. Version 1.4, January 2003. <http://www.mrc-bsu.cam.ac.uk/bugs>.

Appendix B. Statement of work

Consulting Agreement between the University of Miami and Dr. Stephen Smith

Statement of Work

May 2, 2006

General

The Large Coastal Shark Complex (LCS), blacktip shark, and sandbar shark are currently managed by the Highly Migratory Species Division of the National Marine Fisheries Service. In the past, Shark Evaluation Workshops were conducted to analyze the available data and assess the status of the complex. For the current assessment, it was recommended that the assessment follow the guidelines set forth by the South East Data, Assessment, and Review (SEDAR) process. Although SEDAR is a joint process for stock assessment and review of the South Atlantic, Gulf of Mexico, and Caribbean Fishery Management Councils; NOAA Fisheries, SEFSC and SERO; and the Atlantic and Gulf States Marine Fisheries Commissions, it was felt that this process would work for the LCS as well. SEDAR is organized around three workshops: data, assessment, and review. Input data are compiled during the data workshop, population models are developed during the assessment workshop, and an independent peer review of the data and assessment models is provided by the review workshop. SEDAR documents include a data report produced by the data workshop, a stock assessment report and summary produced by the assessment workshop, a review panel report evaluating the assessment (drafted during the review panel workshop), and collected stock assessment documents considered in the SEDAR process.

The peer review panel is composed of stock assessment experts, other scientists, and representatives of councils, fishing industries, and non-governmental conservation organizations. For each assessment considered during the review workshop, a panel member will be chosen to serve as review leader whose responsibilities include ensuring that panel comments regarding the assessment are accurately documented in the consensus report and assisting the chair in drafting the report during the workshop.

NMFS-SEFSC requests the assistance of three assessment scientists from the Center for Independent Experts (CIE): one to serve as Chair and two to serve as a technical reviewer for the LCS SEDAR 11 Review Panel that will consider assessments for the Large Coastal Shark complex, blacktip shark, and sandbar shark. No consensus opinion among the three CIE panelists is sought.

The review workshop for LCS SEDAR 11 will take place at the Bay Point Marriott, in Panama City, Florida, from 1:00 p.m. on Monday, June 5, 2006 through 12:00 p.m. on Friday, June 9, 2006.

Meeting materials will be forwarded electronically and in hard copy if requested. Please contact Julie A. Neer (Shark SEDAR Coordinator; 850-234-6541 ext. 240 or Julie.neer@noaa.gov) for additional details.

SEDAR Assessment Review Panel Tasks

The LCS SEDAR 11 Review Panel will evaluate the large coastal shark complex, blacktip shark, and sandbar shark stock assessments, including input data, assessment methods, and model results as put forward in stock assessment reports. The Assessment Review Panel will:

1. Evaluate whether data used in the analyses are treated appropriately and are adequate for assessing the stocks; state whether or not the input data are scientifically sound.
2. Evaluate the adequacy, appropriateness, and application of the methods used to assess the populations; state whether or not the methods are scientifically sound.
3. Recommend appropriate or best estimated values of population parameters such as abundance, biomass, and exploitation (if possible).
4. Evaluate the adequacy, appropriateness, and application of the methods used to estimate stock status criteria (population benchmarks such as MSY, Fmsy, Bmsy, MSST, MFMT). State whether or not the methods are scientifically sound.
5. Recommend appropriate values for stock status criteria (if possible).
6. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status and, if appropriate, evaluate stock rebuilding; state whether or not the methods are scientifically sound.
7. Recommend probable values for future population condition and status (if possible).
8. Ensure that all desired and necessary assessment results (*as listed in the SEDAR Stock Assessment Report Outline*) are clearly and accurately presented in the Stock Assessment Report and that such results are consistent with the Review Panel's consensus regarding adequacy, appropriateness, and application of the data and methods.
9. Evaluate the Data and Assessment Workshops with regard to fulfilling their respective Terms of Reference and state whether or not the Terms of Reference for previous workshops are adequately addressed in the Data Workshop and Stock Assessment Report sections;
10. Develop recommendations for future research for improving data collection and stock assessment.
11. Prepare a Consensus Report summarizing the peer review panel's evaluation of the reviewed stock assessments and addressing these Terms of Reference. (Drafted during the Review Workshop with a final report due two weeks after the workshop ends.)

The Assessment Review Panel's primary duty is to review the assessments as presented. In the course of this review, the Chair may request a reasonable number of sensitivity

runs, additional details regarding the existing assessment, or similar items from technical staff. However, the Review Panel is not authorized to conduct an alternative assessment or to request an alternative assessment from the technical staff present. If the review panel finds that either the input data or the stock assessment are not adequate and reliable, the panel shall outline in its report the remedial measures necessary to correct the shortcomings.

The Review Panel Report is a product of the overall Review Panel, and is NOT a CIE product. The CIE will not review or comment on the Panel's report, but shall be provided a courtesy copy, as described below under "Specific Tasks." The CIE products to be generated are the Chair's and Reviewer's reports, also discussed under Specific Tasks.

The review workshop for SEDAR 11, Large Coastal Sharks, will take place at the Bay Point Marriott, in Panama City, Florida, 5 June 2006 (beginning at 1:00 pm) through 9 June 2006 (ending at 1:00 pm). Meeting materials will be forwarded electronically and in hard copy if requested. Please contact Julie A. Neer (Shark SEDAR Coordinator; 850-234-6541 ext. 240 or Julie.neer@noaa.gov) for additional details.

Hotel Arrangements

Marriott's Bay Point Resort Village
4200 Marriott Drive
Panama City, Florida 32408
Reservations: 1-800-644-2650
Group rate of \$149 excluding tax guaranteed through May 5, 2006.

Specific Tasks

The Review Panelist's duties will occupy up to a maximum of 14 workdays each; several days prior to the meeting for document review; five days at the SEDAR meeting, and several days following the meeting to ensure that final review comments on documents are provided to the Chair and to complete their individual CIE review reports.

Roles and responsibilities:

The CIE designees shall serve as technical reviewers for an LCS SEDAR 11 Stock Assessment Review Panel workshop to be held June 5 – 9, 2006 in Panama City, Florida (See attached agenda.). The workshop panel shall review stock assessments for the large coastal shark complex, blacktip sharks, and sandbar sharks under the jurisdiction of the National Marine Fisheries Service Highly Migratory Species Division. Roles and responsibilities of the technical reviewers include:

1. Prior to the meeting the CIE reviewers shall be provided with the stock assessment reports and associated documents. The reviewers shall read these documents to gain an in-depth understanding of the stock assessments and the

resources and information considered in the assessments.

2. During the Review Panel meeting, the reviewers shall participate, as peers, in panel discussions on assessment validity, results, recommendations, and conclusions. The reviewers also shall participate in the development of the Consensus Report.
3. Following the Review Panel meeting, the reviewers shall review and provide comments to the Panel Chair on the Consensus Report.
4. No later than June 23, 2006, each reviewer shall submit a written CIE Reviewer Report¹ consisting of the findings, analysis, and conclusions (see annex 1 for details) to Dr. David Sampson, via email to David.Sampson@oregonstate.edu, and to Mr. Manoj Shivlani, via email to mshivlani@rsmas.miami.edu.

¹ All CIE reports will undergo an internal CIE review before they are considered final.

Draft Agenda: SEDAR 11: Large coastal sharks

Monday, June 5, 2006

1:00 p.m.	Convene	
1:00 – 1:30	Introductions and Opening Remarks	Julie A Neer
	<i>- Agenda Review, Task Assignments</i>	
1:30 – 3:30	Large Coastal Sharks Assessment Presentation	TBD
3:30 – 3:45	Break	
3:45 – 6:00	Large Coastal Sharks Discussion	Chair
	<i>- Data, Methods, Results Evaluation</i>	
	<i>- identify additional analyses, sensitivities, corrections</i>	
6:00 – 8:00	Dinner Break	
8:00 – 10:00	Evening session if necessary	Chair
	<i>- Continue deliberations or work session</i>	

Tuesday, June 6, 2006

8:00 a.m. – 12:00 p.m.	Large Coastal Sharks Assessment Discussion	Chair
	<i>- Review additional analyses, sensitivities</i>	
	<i>- Initial recommendations and comments</i>	
12:00 p.m. – 2:00 p.m.	Lunch Break	
2:00 p.m. – 4:00 p.m.	Sandbar Shark Assessment Presentation	Chair
	<i>- Data, Methods, Results Evaluation</i>	
	<i>- identify additional analyses, sensitivities, corrections</i>	
4:00 p.m. – 4:15 p.m.	Break	
4:15 p.m. – 6:15 p.m.	Sandbar Shark Discussion	Chair
	<i>- Data, Methods, Results Evaluation</i>	
	<i>- identify additional analyses, sensitivities, corrections</i>	
6:15 – 8:00	Dinner Break	
8:00 – 10:00	Evening session if necessary	Chair
	<i>- Continue deliberations or work session</i>	

Wednesday, June 7, 2006

8:00 a.m. – 12:00 p.m.	Sandbar Shark Discussion	Chair
	<i>- Review additional analyses, sensitivities</i>	
	<i>- Initial recommendations and comments</i>	
12:00 p.m. – 2:00 p.m.	Lunch Break	

2:00 p.m. – 4:00 p.m.	Blacktip Shark Assessment Presentation - <i>Data, Methods, Results Evaluation</i> - <i>identify additional analyses, sensitivities, corrections</i>	Chair
4:00 p.m. – 4:15 p.m.	Break	
4:15 p.m. – 6:15 p.m.	Blacktip Shark Discussion - <i>Data, Methods, Results Evaluation</i> - <i>identify additional analyses, sensitivities, corrections</i>	Chair
6:15 – 8:00	Dinner Break	
8:00 – 10:00	Evening session if necessary - <i>Continue deliberations or work session</i>	Chair
<u>Thursday, June 8, 2006</u>		
8:00 a.m. – 12:00 p.m.	Blacktip Shark Discussion - <i>Review additional analyses, sensitivities</i> - <i>Initial recommendations and comments</i>	Chair
12:00 p.m. – 2:00 p.m.	Lunch Break	
2:00 p.m. – 4:00 p.m.	Review Workshop Terms of Reference - <i>Review TORs and draft consensus statements</i>	Chair
4:00 p.m. – 4:15 p.m.	Break	
4:15 p.m. – 6:15 p.m.	Continue TOR review	Chair
6:15 – 8:00	Dinner Break	
8:00 – 10:00	Evening session if necessary - <i>Continue deliberations or work session</i>	Chair
<u>Friday, June 9, 2006</u>		
8:00 a.m. – 12:00 p.m.	Final Review of Panel Documents - <i>Large Coastal Sharks Consensus Summary</i> - <i>Sandbar Shark Consensus Summary</i> - <i>Blacktip Shark Consensus Summary</i>	Chair
12:00 p.m.	ADJOURN	

Annex I. Contents of SEDAR and CIE Reports.

SEDAR Consensus Summary Contents

I. Terms of Reference

List each Term of Reference, and include a summary of the Panel discussion regarding the particular item. Include a clear statement indicating whether or not the criteria in the Term of Reference are satisfied.

II. Additional Comments

Provide a summary of any additional discussions not captured in the Terms of Reference statements.

III. Stakeholder Comments

Stakeholder representatives on the Panel are encouraged to submit brief statements summarizing their opinions regarding stock status, analytical methods, and input data.

IV. Recommendations for Future Workshops

Panelists are encouraged to provide suggestions to improve the SEDAR process.

Contents of CIE Chair Report

1. Synopsis/summary of the meeting – to provide context for the comments rather than to rewrite the summary report. (The latter is a product of the meeting, and is not a CIE product.)
2. Views on the meeting process, including recommendations for improvements on:
 - The meeting process itself;
 - The outcome(s) of the meeting;
 - Materials provided for the meeting, including their timeliness, relevance, content, and quality;
 - The guidance provided to run the meeting.
3. Other observations on the meeting process.
4. Appendices, including:
 - Statement of Work;
 - Bibliography of the materials provided for the meeting;
 - Summary report (if available at the time of report submission).

Contents of CIE Reviewer Reports

1. Each report shall be prefaced with an executive summary of findings and/or recommendations.
2. The main body of each reviewer report shall consist of a background, description of review activities, summary of findings, and conclusions/recommendations. The report shall address points 1, 2, 4, 6, and 10 under the above heading: SEDAR Assessment Review Panel Tasks.
3. Each reviewer report shall also include as separate appendices the bibliography of materials provided by the Center of Independent Experts and a copy of the Statement of Work.

Please refer to the following website for additional information on report generation:

<http://www.rsmas.miami.edu/groups/cie>.