

# **Consensus Summary Report**

- A. Large Coastal Shark Complex**
- B. Sandbar Shark**
- C. Blacktip Shark – Gulf of Mexico**
- D. Blacktip Shark – Atlantic**

***Prepared by the SEDAR 11 (Large Coastal Sharks) Review Panel  
for:***

***NOAA/NMFS Highly Migratory Species Management Division***

**Edited by Andrew I. L. Payne for**

**SEDAR 11 (Large Coastal Sharks), 5–9 June 2006  
Panama City, FL**

## Executive summary

*The SEDAR 11 Review Panel met from 5 to 9 June 2006, in Panama City, FL. A CIE Chair, 2 CIE reviewers, and two independently invited reviewers made up the panel. The two local scientists responsible for the assessments did a good job at summarizing the outputs from the Data and Assessment Workshops that had led to the review.*

*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. Further, the Panel stressed that results of previous assessments that used the same approach and similar data (perhaps of lesser quality) would attract the same or even stronger negative criticisms. In summary, continued assessment of the Large Coastal Shark complex with the current approach and data was considered unlikely to produce effective management advice and was not recommended (although for continuity, output from such an approach should be made available when next the complex is subject to review). Instead, research, data analysis and model development to permit species-specific assessments for the main components (except for sandbar and blacktip, which are already assessed separately) of the complex (both permitted and prohibited species) was deemed a priority.*

*For **sandbar sharks**, the population model 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 to the life history parameters in the current assessment. The population is assessed to be less productive than was assumed in 2002. In 2006, the SEDAR process was adopted, resulting in more thorough review at all stages, which was not possible with the previous stock assessments. For this reason and those concerning life history parameters, the Panel was confident that the 2006 assessment provided a more reliable estimate of stock status than had been obtained from the 2002 and earlier assessments. Stock status was determined from the results of a range of model fits reflecting the Panel's uncertainty about life history parameters. All results indicated that the stock was overfished and that overfishing is occurring. The target year to rebuild the stock was estimated to be 2070.*

*In terms of **blacktip sharks in the Gulf of Mexico**, the Panel accepted that the stock is not overfished and that overfishing is not taking place, but 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. Based on life history characteristics, blacktip sharks are a relatively productive shark species, and a combination of these characteristics and recent increases in the most representative abundance indices suggests that the blacktip stock is relatively healthy. However, there was no scientific basis for advising an increase in catches at this time.*

*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. In summary, given that current status is unknown, no reliable population projections were possible, so no probable values for future population condition and status were provided. Consequently, the Panel concluded that there was no scientific basis for advising a change in catch levels.

Stakeholders proffered valuable insights during the week's review, and their opinion section is added to the report, although its contents do not wholly reflect Review Panel or expert thinking. In summary, stakeholders support the positive assessments of blacktip, though would be interested in seeing a non-separated (into Gulf and Atlantic components) evaluation, do not subscribe to the negative assessment of sandbar sharks, and support a move towards species-specific assessments rather than assessing a LCS complex, but feel that the current status of the components of the complex is better than the assessment implies.

Recommendations for future research contained in the Data and Assessment Workshop reports were endorsed, and others were added by the Panel. The report closes with a few comments on process, for future consideration.

## **1. Introduction**

### **1.1 Time and Place**

The SEDAR 11 (Large Coastal Sharks) Review Workshop met in Panama City, FL, from 5 to 9 June 2006.

### **1.2 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  $MSY$ ,  $F_{msy}$ ,  $B_{msy}$ ,  $MSST$ ,  $MFMT$ ). 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.)

### 1.3 List of Participants

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### 1.4 Review Workshop working papers

An impressive quantity of documentation was provided before the meeting by the facilitator. Much of this pertained to material provided to either the Data

Workshop or Assessment Workshop for each of the review stocks. No new literature or working papers were provided at the meeting.

## **2. Terms of Reference**

### **2.1 Background**

Generally, the Review Workshop is the third meeting in the SEDAR process, and this situation pertained to all stocks reviewed during SEDAR 11. The Panel records that the Terms of Reference set for Data Workshops and Assessment Workshops for the four “stocks” were fully met, at least to the extent feasible, a notable achievement given that data for assessing such species are traditionally (worldwide) very poor. Overall, short data time-series, recent biological and catch data, and minimal information on basic life history were unlikely to support the development of assessments rigorous to withstand peer-scrutiny for management purposes.

Notwithstanding, the Panel was impressed by the quantity and quality of the work that had gone into the various assessments. The presentations were well structured and clear, and the information provided through the presentations, and in response to questions, gave a sound basis for the Panel’s subsequent deliberations and conclusions.

### **2.2 Review of the Panel’s deliberations**

The deliberations on each species are presented in the form of responses to the terms of reference questions specifically, generally listing some of the issues and concerns that were raised in discussions, followed by relevant comments on and conclusions from the discussions, and suggestions for future research (the last two non-prioritized). Finally, in the subsequent subsections, endorsement of some of the Data and Assessment Workshop recommendations is provided, and some relevant stakeholder opinion is presented.

## **A. Large Coastal Shark Complex**

### Terms of reference

*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.*

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 the 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.)

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

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 NMFS longline southeast survey indicated that the two regions were dominated by different species, the Panel considered that aggregation of these areas may lead to misleading results.

*3. Recommend appropriate or best-estimated values of population parameters such as abundance, biomass, and exploitation (if possible).*

Given the multispecies nature of the assessment, it is unclear which, if any, of the scenarios gave the best estimate of the population parameters.

*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.*

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.

*5. Recommend appropriate values for stock status criteria (if possible).*

Given the concerns regarding reference values for a stock complex, no values for stock status criteria can be recommended.

*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.*

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.

*7. Recommend probable values for future population condition and status (if possible).*

The uncertainty as to what the results of the assessment represent makes recommendation of appropriate levels of future stock status impossible at the current time.

*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.*

The necessary results fulfilling the SEDAR stock assessment report outline were presented. The Review Panel did not request any additional runs of the models, but they did request clarification of several inputs and outputs from the models:

- Species composition of the catch and main catch-rate series to investigate whether there were substantive changes over time or between the two types of data (see Figures on following pages).

Figure 1. Species composition of the commercial landings of large coastal sharks (LCS – prohibited – sandbar – blacktip) by year. The percentage of this species group of total shark catch is given for each year.

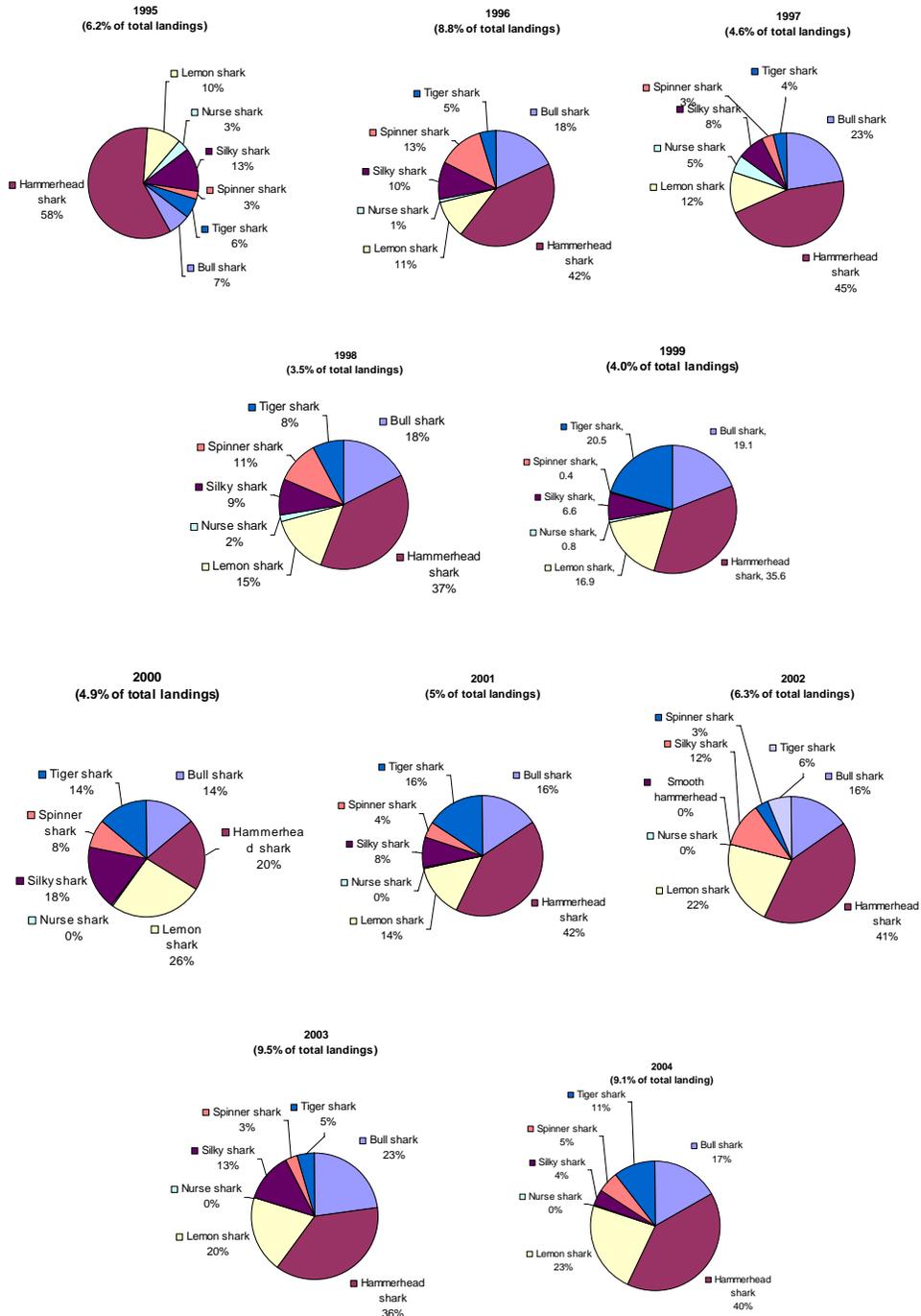
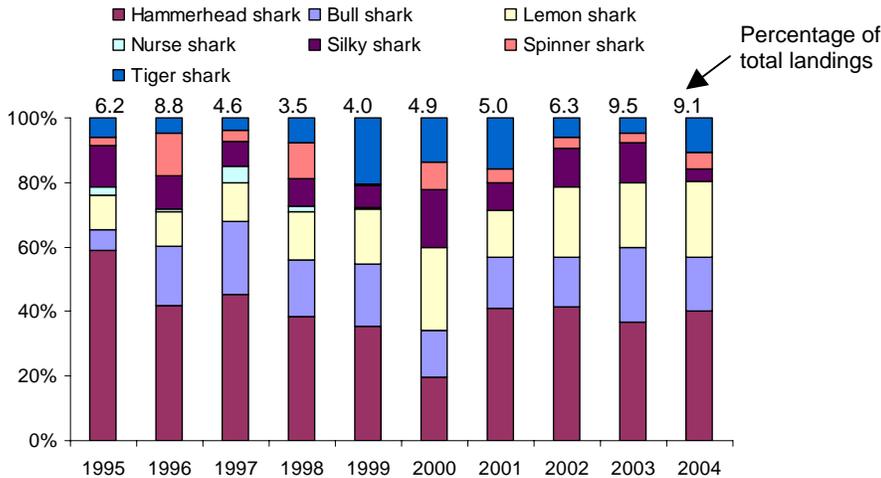
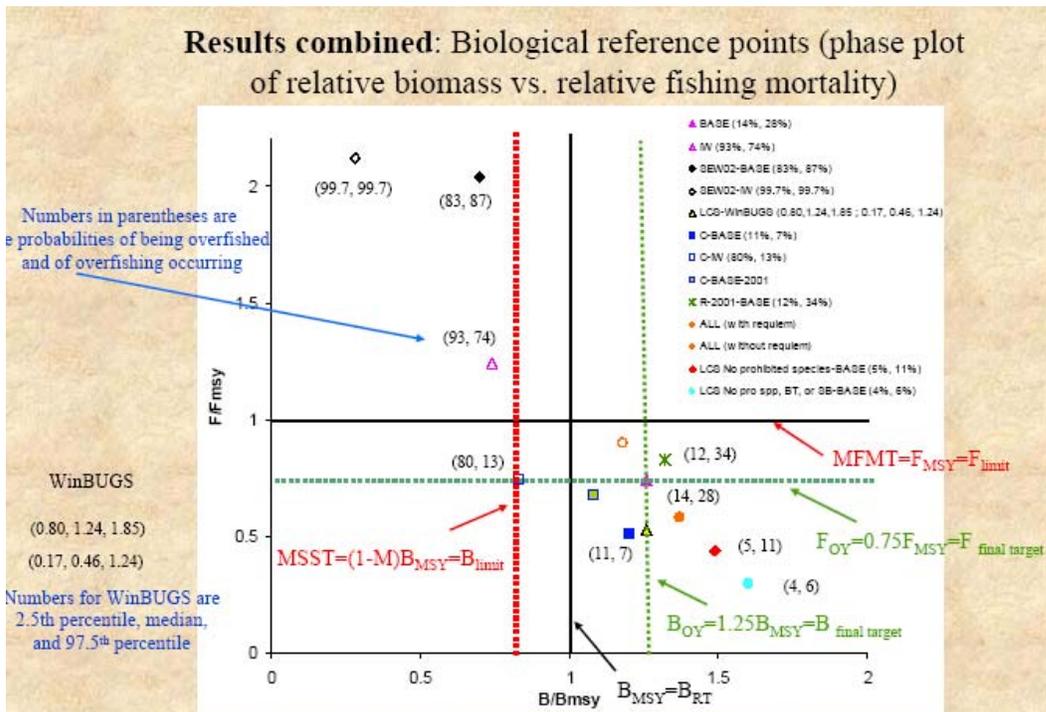


Figure 2. Proportional species composition of commercial shark landings, 1995–2004.



Data on the species composition of the main abundance indices was more difficult to obtain during the meeting, because the information needed to be sourced from originators of the data. However, preliminary investigation of the NMFS longline southeast survey data indicated that in the Gulf of Mexico (GOM), the indices were dominated by spinner and hammerhead sharks, while in the Atlantic (ATL), tiger sharks dominated.

- The probabilities of the outcomes of the base case and sensitivity runs of the model exceeding the two reference thresholds (overfished and overfishing occurring) were produced.



*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.*

The Data Workshop fulfilled its Terms of Reference. The Assessment Workshop fulfilled its Terms of Reference to the extent possible, given the limitations of the data.

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

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

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  $r$

Issue: Limited numbers of longer term abundance (catch rate) data.

- Utilize all appropriate abundance series available, e.g. the Schwartz data from North Carolina

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

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.

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

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).

### Conclusions

- The data utilized in the assessment of the Large Coastal Shark complex were the best available to the analysts at the time.
- The assessment of the status of the Large Coastal Shark complex was the best possible given the data available to the Data and Assessment Workshops.
- The assessment does 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 is unclear what exactly the results of the assessment represent, so the Panel cannot support use of the results for management of the Large Coastal Shark complex. Further, it is stressed that results of previous assessments that used the same approach and similar data (perhaps of lesser quality) would attract the same or even stronger negative criticisms.
- Continued assessment of the Large Coastal Shark complex with the current approach and data is unlikely to produce effective management advice and is not recommended.
- Research, data analysis and model development to permit species-specific assessments for the main components (except for sandbar and blacktip, which are already assessed separately) of the complex (both permitted and prohibited species) should be a priority.

### **B. Sandbar Shark**

#### Terms of reference

*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.*

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.

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

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.

*3. Recommend appropriate or best-estimated values of population parameters such as abundance, biomass, and exploitation (if possible).*

The base case produced estimates of the number of mature animals, total population biomass, and fishing mortality as 96 600, 30 600 t round weight, and 0.06, respectively. Sensitivity runs resulted in numbers of mature animals ranging from 103 000 to 96 600, total population biomass ranging from 27 600 to 36 600 t, and fishing mortality ranging from 0.05 to 0.13.

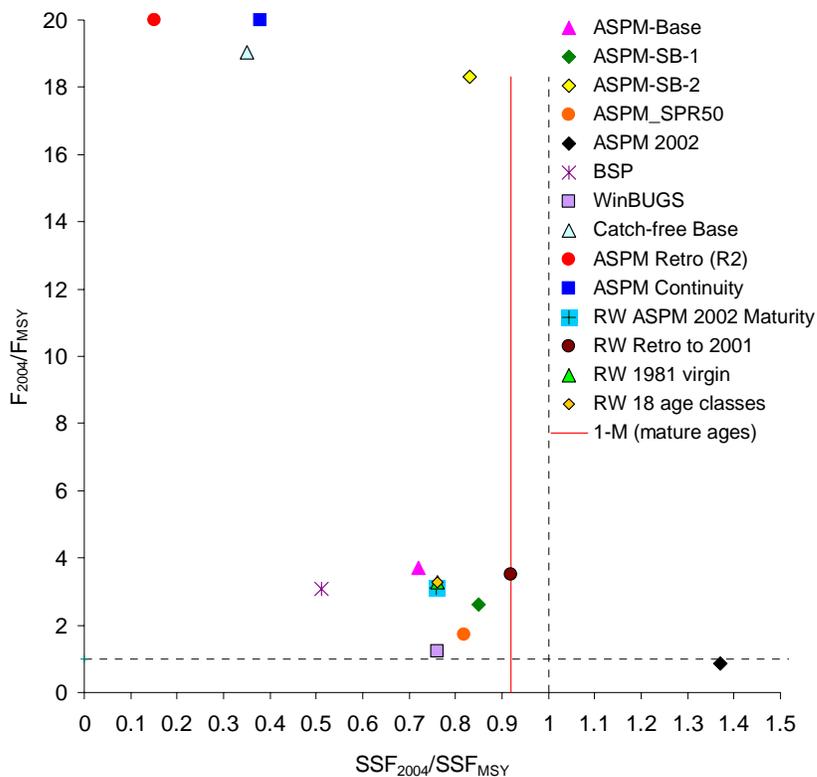
*4. Evaluate the adequacy, appropriateness, and application of the methods used to estimate stock status criteria (population benchmarks such as  $MSY$ ,  $F_{msy}$ ,  $B_{msy}$ ,  $MSST$ ,  $MFMT$ ). State whether or not the methods are scientifically sound.*

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 3). 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.

*5. Recommend appropriate values for stock status criteria (if possible).*

All the model runs using the data to 2004 resulted in the finding that the population of sandbar sharks was overfished and that overfishing was occurring. All comparisons led to the conclusion that the change in status in 2006 from that reported in 2002 was attributable mainly to the assumptions about the productivity of the stock (function of steepness, maturity at age, mortality) used in each assessment. In retrospect, the 2002 productivity assumptions were considered by the Panel to have been incorrect, given what is now known about the life history parameters for the population.

Figure 3. Phase plot with results for all the base and sensitivity runs for sandbar shark. Stock status for 2004



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.

Generation times were calculated for the base model and the sensitivity runs in the cluster around the base model (Figure 3), and these ranged from 27 to 28 years. All generation times were estimated using a cumulative survival of 0.1% as 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.

*7. Recommend probable values for future population condition and status (if possible).*

The base-case model estimated the status to be overfished and with overfishing occurring. The rebuilding timeframe under no fishing was calculated. This yielded an estimate of 38 years to rebuild. Adding the estimate of generation time (28 years), the target year for rebuilding the stock was estimated to be 2070. A constant  $F$  to achieve rebuilding by that date with 70% probability of  $B > B_{MSY}$  is  $F = 0.009$ ; the median of the bootstrap runs would achieve rebuilding by 2070 with  $F = 0.011$ . A similar exercise for constant TAC was performed, and rebuilding is achieved with 70% probability with a TAC of 220 t or with 50% probability with a TAC of 240 t. In all projections,  $F_{2004}$  was carried forward for the years 2005–2007, and the constant  $F$  or TAC was applied in years 2008 and beyond.

*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.*

All the assessment results were clearly presented in the Assessment Report and by the lead researcher. One omission noted was details on the final models used for standardizing catch-rate indices. Summary tables in the Data Workshop report only showed what was done during the meeting, not what was achieved after the meeting.

*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.*

Both workshops appeared to have fulfilled their respective terms of reference.

*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 in 2.3 below), so what follows is not intended to replace them but rather to emphasize specific needs for sandbar shark.

Issue: There are 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 type of research needed to provide the necessary information for the population model in terms of density-independent or -dependent conditions, such as estimating mortality at different population levels

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 that type of gear through literature review and directed research

Issue: A number of catch-rate indices were used, and it was not obvious which components of the sandbar population they were monitoring.

- Using information on the size composition of catches from these indices, if available, would be helpful
- Maps of where (and when) the catch-rate series are located, along with the location of the fisheries, would aid in interpreting these series

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 and population, and from any catch-rate index that may collect size composition data

Issue: No information on sandbar bycatch from the Atlantic menhaden fishery was provided, and there was no sense of how important such information is for accounting for all removals from the population.

- Determine if these data are available and, if so, include them in the next assessment. If data are not available, then design a study to collect information on shark bycatch either through logbook or onboard observers

## Conclusions

- The population model 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 to 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 gives a more reliable estimate of stock status than obtained from the 2002 and earlier assessments.

- 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.

### **C. Blacktip Shark – Gulf of Mexico**

#### Terms of reference

*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.*

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 recommended at the Data Workshop 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 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.

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

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.

*3. Recommend appropriate or best-estimated values of population parameters such as abundance, biomass, and exploitation (if possible).*

The base model produced estimates of total biomass of 193 000 t, mature numbers 19.8 million, and  $F_{2004}$  0.01. The precision around these estimates was very poor, so the Panel had little confidence that they represented the real abundance of the stock.

The three most reliable abundance indices indicated stable or increasing population numbers over the past 10 years during a period of declining catches. The results are consistent with each other, and consistent with the model estimates described above. However, a re-run of the model using only these three indices failed to converge. Similarly, a re-run of the model without the pelagic logbook index failed to converge. Both these findings are a concern.

*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.*

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

*5. Recommend appropriate values for stock status criteria (if possible).*

The base-case assessment model provided the best estimates for these values, which indicated that the stock was not overfished, and that there was no overfishing. The estimate of  $F_{msy}$  was 0.2. All model variations produced comparable results. A proper continuity analysis was not possible, because the previous assessment assumed a single stock and indices that were standardized differently. Nevertheless, the estimate of stock status in 2002 was similar: not overfished with no overfishing occurring, albeit with a lower  $F_{msy}$  of 0.06.

Although a number of key reference points were provided ( $B/B_{msy}$ ,  $SPR_{msy}$ ,  $F/F_{msy}$ ), they were not well estimated owing to the shortness of the time-series, conflicting trends from all the abundance indices, and the non-response of the indices to changes in catch. Precision of the estimates was provided, but distributions of the posteriors were not provided. The Panel accepted that the stock is not overfished and that overfishing is not taking place, but did not accept the absolute estimates of stock status. Consequently, there is no scientific basis for advising an increase in catches at this time.

*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.*

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

*7. Recommend probable values for future population condition and status (if possible).*

The uncertainty surrounding the estimates of key reference points and current stock status made population projections problematic. On the basis of the three abundance indices believed to be most representative of the Gulf blacktip stock, population numbers have remained stable or increased over the past 10 years during a period of declining catches. These observations are consistent with each other, and suggest that the current population is reasonably healthy. If the stock is indeed at a biomass above that of  $B_{msy}$  and being fished at a fishing mortality below  $F_{msy}$ , current management guidelines indicate that a rebuilding strategy is not required.

*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.*

All desired and necessary assessment results are clearly and accurately presented in the Assessment Report. The 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.*

The Data and Assessment workshops fulfilled their Terms of Reference.

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

The Review Panel offers the following comments regarding research needs in terms of data and assessment of blacktip sharks in the Gulf of Mexico.

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

Issue: The life history parameters recommended at the Data Workshop 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 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. Although 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

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

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

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

### Conclusions

- The Panel accepted that the stock is not overfished and that overfishing is not taking place, but 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.
- Based on life history characteristics, blacktip sharks are a relatively productive shark species.
- A combination of life history characteristics and recent increases in the most representative abundance indices suggests that the blacktip stock is relatively healthy. However, there is no scientific basis for advising an increase in catches at this time.

## ***D. Blacktip Shark – Atlantic***

### Terms of reference

*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.*

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:

- 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 recommended at the Data Workshop 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 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.*

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.

*3. Recommend appropriate or best-estimated values of population parameters such as abundance, biomass, and exploitation (if possible).*

The Review Panel noted that depending on the models used, the assessed status of Atlantic blacktip ranged from not overfished with no overfishing occurring, to overfished with overfishing taking place. The Panel agreed that there were no objective criteria to judge which, if any, of the results represents true stock status, so no confidence can be placed in the assessment results. In addition to the conflicting signals arising from the catch-rate series, estimates of population parameters varied widely between different models. Taking each of these issues into account, the status of the stock remains uncertain.

*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.*

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.

*5. Recommend appropriate values for stock status criteria (if possible).*

For the reasons outlined in (4) above, the Panel concluded that no reliable estimates of stock status for Atlantic blacktip can be recommended at this time.

*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.*

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

*7. Recommend probable values for future population condition and status (if possible).*

No reliable population projections were possible, so no probable values for future population condition and status of Atlantic blacktip can be given.

*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.*

All desired and necessary assessment results are clearly and accurately presented in the Assessment Report for the species, but they are currently uninformative on stock status. These 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.*

The Data Workshop fulfilled its Terms of Reference. The Assessment Workshop fulfilled its Terms of Reference to the extent possible, given the limitations of the data and the model outputs.

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

With regard to future assessments of blacktip shark in the Atlantic, the Panel makes the following recommendations:

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

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

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

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

Issue: Life history parameters for Atlantic blacktip.

- The life history parameters recommended at the Data Workshop 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.

### Conclusions

- The Review Panel concluded that the data used for the analyses were treated appropriately. However, it was unclear whether catch estimates prior to 1991 adequately represent historical removals of blacktip shark from the Atlantic stock component. Moreover, the Panel was unable to judge the extent to which each of the standardized catch-rate series reflected real trends in the abundance of the stock.
- The Panel concluded that given the widely differing results arising from the different models, the status of the stock of Atlantic blacktip shark is uncertain, so no reliable estimates of abundance, biomass or exploitation rate can be advanced at the current time.
- Further, in the absence of any reliable estimates of abundance, biomass and exploitation rates, no reliable estimates of stock status for Atlantic blacktip can be suggested.
- Given that the current status of Atlantic blacktip is unknown, no reliable population projections were possible, so no probable values for future population condition and status of Atlantic blacktip can be provided. Furthermore, there is no scientific basis for advising a change in catch levels at this time.

### **2.3 Additional General Recommendations**

In addition to the recommendations and proposals contained in the sections for each stock above, the Panel endorses the following research recommendations proposed by the 11<sup>th</sup> SEDAR Data and Assessment Workshop reports:

#### Recommendations from the Data Workshop report

- Biological data should be collected on the illegal Mexican shark catch confiscated in US waters, including species, sex, and length.
- Gear-related information, including effort and gear used for each species, should be collected on the interdicted Mexican vessels.
- One central electronic database for biological and gear data should be created to keep information regarding the confiscated sharks and vessels.
- Scientists should help the Coast Guard create the database and teach the agents how to identify the species and to collect gear information.

- The Atlantic menhaden fishery data should be examined to determine shark bycatch estimates, if available.
- Historical data should be re-examined to determine if the “unreported catch” from Mr Brannon is or is not already included in the commercial landings.
- Better landings information on number of species, by weight, from the dealers should be sought.
- Dockside sampling information would be helpful to verify landings information, such as species composition.
- Determine whether port-sampler information for large coastal sharks is available, and if so, how to access it.

#### Recommendations from the Assessment Workshop report

- Data Workshop participants need to bring raw data to workshop to enable additional analysis to be conducted and reviewed during the workshop when practical.
- Length frequency data should be provided when available, with particular reference to the Virginia Institute of Marine Science longline data set.
- Examination and analysis of pelagic longline observer data should be included.
- Identify nursery areas for sandbars in the northern Gulf of Mexico.
- Additional life history research into sandbar sharks to supplement or replace the available data from the mid 1990s.
- Additional life history studies for all species of the shark complex should be carried out to allow for additional species-specific assessments.
- Incorporation of the University of North Carolina data set collected by Frank Schwartz in the next LCS assessment, with recognition that it may also contain valuable information useful for the Small Coastal Shark assessment to be conducted in 2007.
- Examination of methods to incorporate tagging data information into the assessment.
- Attempt to recover and quantify information on historical catch, with special emphasis prior to the 1993 Fisheries Management Plan.
- Additional length sampling and age composition collection to improve information for developing selectivities.
- Initiation or expansion of dockside sampling for sharks.
- Ensure that existing independent sampling programmes be continued.
- Ensure that funding for the 2002 pelagic survey being conducted by the Pascagoula laboratory of the SEFSC be continued.

#### **2.4 Stakeholder Opinion**

Stakeholder opinion is in many cases encompassed in the text above, because views were willingly offered, often solicited, and enthusiastically given by those stakeholders present throughout the discussions. However, before the meeting

was closed, a final opportunity was afforded stakeholders to express concise views on both the process and discussion output, so that they could be used to add value to this report. It is stressed that the views do not necessarily mirror those of either the assessment team or the Review Panel.

### ***Large Coastal Shark (LCS) complex***

The Directed Shark Fisheries (DSF) stakeholders give a positive response to the 2006 9-species grouping assessment results. The results for the 11 and 22 species assessments appear more optimistic than the highly questionable negative sandbar shark assessment results (concerns detailed below).

Seven of the nine allowable LCS species are commonly caught as part of the annual 5–10% LCS secondary market “landings” component feature, compared with the two target species of commercial LCS landings, sandbars and blacktips, schooling sharks by nature. The common LCS species plus the nurse shark should be individually assessed in the future, in the opinion of DSF.

- (1) Bull shark populations mostly stay in nearshore proximity to southern US waters where commercial shark fishing effort has been limited or eliminated for more than a decade, which has helped to maintain a large biomass.
- (2) Tiger sharks, particularly juveniles, have been very abundant for nearly two decades, based on tagging data, NMFS observer information and fishing reports. They appear to mature rapidly compared with other sharks, and some adults travel great distances around the Atlantic basin, while mature females have large numbers of pups.
- (3) Spinner sharks, mostly adults, have been caught as bycatch by the offshore pelagic longline fleet for decades. They have often been misidentified as blacktip sharks. Both juveniles and adults are commonly caught nearshore.
- (4) Scalloped hammerhead, another schooling shark, is caught nearshore and/or offshore by both bottom and pelagic longlines, sometimes in large numbers per set. Incidental catch is common. They reproduce annually.
- (5) Great hammerheads are seen routinely, but usually as loners instead of in schools. DSF fishers have encountered several large specimens annually for decades.
- (6) Smooth hammerheads have never been a significant component of the shark bycatch. The species is occasionally confused with scalloped hammerheads.
- (7) Silky sharks, both juveniles and adults, are a common component of the offshore pelagic longline fleet.
- (8) Lemon sharks are common in Florida waters, but have been a minor bycatch for decades.
- (9) Nurse sharks are encountered off Florida routinely, but are never marketed and can be successfully released alive most of the time. Currently, they seem to be more common than they used to be.

### ***Sandbar shark***

The DSF disagrees with the sudden change in perception from the near-positive 2002 assessment results of being “not overfished” to the current super-negative assessment of severely overfished. DSF also disagrees with the use of extreme demographics such as the 2006 maturity ogive of 19.5 years to 50% maturity compared with the 2002 ogive of 13 years to 50% maturity. VIMS ageing data need to be provided for the VIMS longline series also to be used in age-structured modelling.

The best way to illustrate the problem with the NMFS 2006 sandbar shark assessment results is to show how the 2006 final estimate of 96 600 adult sandbars alive during 2004, or the estimate of 103 000+ adult sandbars alive during 2001, are fundamentally flawed! At a conservative 50-pounds dressed weight per mature sandbar, the number of adults for both years equates to ~5 million pounds dressed weight. If this number (~100 000 adults) is deemed “accurate”, then DSF asks the scientists to consider that the US Atlantic and Gulf of Mexico directed shark fleet has annually landed more than a million pounds of dressed weight adult sandbars every year since 1997, equating to annual total removals of some 20 000 adult sandbars. By simple arithmetic, there should be ~60 000 mature sandbars left by the end of 2006 using the 2004 estimate, and nearly none left at the end of 2006 using the 2001 benchmark. This also does not account for Mexican removals, to which waters many adult sandbars migrate for winter.

The recent abundance indices do not support the rapid decline in stock size that would be expected if the NMFS numbers of adult sandbar sharks are correct. In the opinion of DSF, NMFS should redo the 2006 sandbar shark assessment. The LCS quota is too small for the current fleet of fishing vessels; the DSF fleet could catch more than 5 million pounds annually of adult sandbars if allowed to do so. DSF believes that the current population of adult sandbars probably numbers millions of animals instead of up to 100 000, and rebuilding to ~350 000 in 60+ years. The juvenile population has increased markedly since the early 1990s, further indicating the continued presence of mature sandbars.

### ***Blacktip shark, Gulf of Mexico***

DSF endorses the positive results of the assessment, but does feel that geographical catch trends are indicative of some mixing in the Florida Keys region, i.e. a shared population with Atlantic blacktip. It is DSF’s opinion that sensitivity runs for the 2006 one-population blacktip indicate that the total stock is not overfished and that overfishing is not occurring.

The assessment’s impact needs to be better understood in terms of the mixing of the western blacktip shark population of the US and Mexico, especially with regard to total removals and nursery grounds.

## ***Blacktip shark, Atlantic***

DSF is troubled by the paucity of Atlantic blacktip landings, especially during the period 1985–1989. These were peak fishing years for the shark gillnetting fleet on the Florida east coast, where millions of pounds dressed weight of blacktip were landed then, alongside some significant longline effort.

### ***Overall Recommendations***

NMFS needs to get the LCS database and biological parameters in order to use in the next LCS assessment. It should also maintain *status quo* of the 2002 sandbar results rather than take the controversial results for 2006 into future sandbar management choices. NMFS should re-run the 2006 sandbar modelling exercise with a fresh approach to gain realistic outputs of the number of adults existing.

- (1) The VIMS age index for the standardized longline series needs to be provided for the 2006 assessment.
- (2) The maturity ogive for sandbars needs to be re-examined for accuracy owing to length-to-age conversion bias. All measurements, vertebrae and reproductive organ samples need to be from the same animals, and taken throughout the species' range.
- (3) The Gulf of Mexico blacktip reproductive cycle of annual or biennial needs to be resolved.
- (4) The millions of pounds dressed weight of Atlantic blacktip catch landed in Florida from the shark gillnet fleet in the 1980s needs to be found.
- (5) Sampling of sandbars and other common species of the large coastal shark complex needs to be enhanced to allow assimilation of better age, biological, conversion and ratio information, as well as genetic sampling from all regions.

### **2.5 Recommendations for future SEDAR assessments**

In terms of the terms of reference provided to the Review Workshop, participants and the Review Panel commented throughout the week on the SEDAR assessment process. What follows is a non-prioritized list of the main points made.

- Enhanced communication between stakeholders, analysts and customers about the management value of the SEDAR process would be useful.
- Acronyms abound in the literature provided. Expert reviewers (generally coming from outside the area) and stakeholders would benefit from these being defined throughout texts, either each time they are used or in terms of a Glossary.
- Continuity of personnel in the workshops is crucial to ensuring both acceptance and enhanced understanding of the dynamics of the resources.

- The information collated and created and the results in terms of management action need to be broadly disseminated, perhaps electronically, but also through making fishers more aware of the process and the output.
- Effort should be made to maximize the time allocated to preparation of data series, carrying out of assessments, and review material. The SEDAR three-part process involving as many participants as possible was considered to be of great value to this specific shark management process, and was suggested as the way to proceed for future initiatives of like nature. There is also clearly a very strong case for incorporating fisher knowledge into the assessment and management process, as done here.
- The Review Panel requires the presence of scientists who have not been involved in the Data and/or Assessment Workshops. While understanding and wholeheartedly endorsing the need for independent peer review, a strong case can be made for Panel meetings to remain open to stakeholders, biologists knowledgeable about the species, and stock assessment scientists who may not have been involved in the immediate assessments. It was felt unlikely that such people would be able to participate in the discussions at the current enthusiastic level unless they were formally invited to participate.
- The independence of the Review Panel chair and a small number of reviewers (currently appointed by the CIE) is deemed paramount and supporting the objective of independence.
- Given the volume of documentation associated with such reviews and the shortage of time often available to assimilate it, a clear executive summary to all substantive documents would be of great value.