SEDAR 101 HMS Sandbar Shark
Assessment Terms of Reference
December 2024

Overall, conduct a stock assessment of Sandbar Shark (*Carcharhinus plumbeus*) using the appropriate model with data through 2023. Provide catch information, estimates of population benchmarks and needed management criteria, and projections of stock status in the future.

Data Workshop Terms of Reference

1. Review, discuss, and tabulate available life history information.
   a. Evaluate and update as appropriate the stock definition, age, growth, natural mortality, and reproductive characteristics.
   b. As needed, provide appropriate models to describe population growth, maturation, and fecundity by age, sex, or length as applicable.
   c. As appropriate, evaluate the adequacy of available life history information for conducting stock assessments and recommend life history information for use in population modeling.
   d. As appropriate, evaluate and discuss the sources of uncertainty and error and data limitations (such as temporal and spatial coverage) for each data source. Provide estimates or ranges of uncertainty for all life history information, where applicable.
2. Review and update measures of population relative abundance.
   a. Consider all available and relevant fishery-dependent and fishery-independent data sources, including those used in previous assessments and any new ones.
   b. Document all programs evaluated; address program objectives, methods, coverage, sampling intensity, and other relevant characteristics.
   c. Provide maps of fishery-dependent and fishery independent survey coverage.
   d. Develop fishery and survey catch-per-unit-effort (CPUE) indices by appropriate strata (e.g., age, size, area, and fishery) and include measures of precision and accuracy.
   e. Document pros and cons of available indices regarding their ability to represent abundance.
   f. Categorize the available indices into Recommended and Not Recommended; provide justifications for the categorization.
   g. For recommended indices, document any known or suspected spatial or temporal patterns not accounted for by standardization.

     h. Provide appropriate measures of uncertainty for the abundance indices to be used in stock assessment models.

3. Provide commercial catch statistics for each stock being assessed, including landings, dead discards, live discards, and potential post-release mortality in both weight and number. Consider species identification issues and correct for these instances as appropriate.
   a. Evaluate and discuss the adequacy of available data for accurately characterizing landings and discards by fishery sector or gear.
   b. Provide length and age distributions for both landings and discards if feasible.
   c. Provide maps of fishery effort and harvest by fishery sector or gear.
   d. Provide estimates of uncertainty around each set of commercial landings (if possible) and discard estimates.
   e. Provide estimates of discard mortality rate by gear.

4. Provide recreational catch statistics for each stock being assessed, including landings, dead discards, live discards, and potential post-release mortality in both weight and number. Consider species identification issues and correct for these instances as appropriate.
   a. Evaluate and discuss the adequacy of available data for accurately characterizing landings and discards by fishery sector or gear.
   b. Provide length and age distributions for both landings and discards if feasible.
   c. Provide maps of fishery effort and harvest by fishery sector or gear.
   d. Provide estimates of uncertainty around each set of recreational landings and discard estimates.
   e. Provide estimates of discard mortality rate by gear.

5. If concluded at the data scoping webinar that there is sufficient data identified and available on ecosystem, climate, species interactions, habitat considerations, and/or episodic events that would be reasonably expected to affect population dynamics, then these should be provided as appropriate.

6. Collate recommendations for future research in areas such as biological sampling, fishery monitoring, and stock assessment resulting from the data and assessment processes. Include specific guidance on sampling intensity (number of length samples) and appropriate strata and coverage.

7. Prepare a Data Workshop report providing complete documentation of workshop actions and decisions in accordance with project schedule deadlines.

Assessment Process Terms of Reference

1. Review any changes in data or analyses following the Data Workshop. Summarize data as used in each assessment model. Provide justification for any deviations from Data Workshop recommendations.

2. Develop population assessment models that are compatible with available data and document input data, model assumptions and configuration, and equations (if necessary) for each model considered.

3. Identify preferred model approach and explain why the model is preferred and any relevant assumptions.

4. Provide estimates of stock population parameters:

    a. Include fishing mortality, abundance, biomass, selectivity, stock-recruitment relationship (if applicable), and other parameters as necessary to describe the population.

    b. Include appropriate measures of precision for parameter estimates.

5. Characterize uncertainty in the assessment and estimated values, if possible.

    a. Consider uncertainty in input data, modeling approach, and model configuration.

    b. Consider and include other sources of uncertainty as appropriate for this assessment.

    c. Provide appropriate measures of model performance, reliability, and 'goodness of fit'.

6. Provide estimates of population benchmarks and management criteria consistent with the 2006 Consolidated Atlantic Highly Migratory Species (HMS) Fishery Management Plan (FMP), its amendments, and the National Standards.

    a. Recommend the tier level as defined in Amendment 14 to the HMS FMP.

    b. Provide estimates of the appropriate population benchmarks including at a minimum the overfishing limit (OFL), the maximum sustainable yield (MSY), biomass as it relates to MSY (BMSY), the minimum stock size threshold (MSST), the maximum fishing mortality threshold (MFMT), the acceptable biological catch (ABC), or their proxies and provide appropriate justification.

    c. Evaluate management criteria as specified in the management summary.

7. Provide uncertainty distributions of proposed reference points and stock status metrics that provide the values indicated in the management specifications. Include probability density functions for reference point estimates and population metrics (e.g., biomass and exploitation) used to evaluate stock status.

8. Project future stock conditions and develop rebuilding schedules, if warranted, for a range of values between 50% - 70%. Provide the estimated generation time for the stock. Stock projections shall be developed in accordance with the following:

    a. If the preliminary stock status is overfished, then utilize projections to determine:

        i. Year in which F=0 results in a X% probability of rebuilding (Year F=0pX%).

        ii. Target rebuilding year (Year-rebuild).

            1. Year F=0pX% if Year F=0pX% ≤ 10 years, or

            2. Year F=0pX% + 1 generation time if Year F=0pX% > 10 years.

        iii. F resulting in X% probability of rebuilding by Year-rebuild.

        iv. Fixed level of removals allowing rebuilding of stock with X% probability.

    b. If the preliminary stock status is determined to be undergoing overfishing, then utilize projections to determine:

          i. $F=F_{reduce}$ (different reductions in F that should end overfishing with X% probability).

  c. If the preliminary stock status is determined to be neither overfished nor undergoing overfishing, then utilize projections to determine:

          i.   The F needed and corresponding removals associated with a X% probability of overfishing not occurring (analogous to a $P* = 1-X\%$ approach), and/or

         ii. The constant catch associated with a X% probability of overfishing not occurring and the stock not being overfished.

  d. If data limitations and/or model limitations preclude classic projections (i.e. a, b, and c above), explore alternate projection models.

9. Collate recommendations for future research and data collection. Emphasize items that will improve future assessment capabilities and reliability. Consider data, monitoring, and assessment needs.

10. Complete an Assessment Workshop Report in accordance with project schedule deadlines.

Desk Review Terms of Reference

1. Evaluate the data used in the assessment, including discussion of the strengths and weaknesses of data sources and decisions. Consider the following:
   a. Are data decisions made by the Data and Assessment workshops justified?
   b. Are data uncertainties acknowledged, reported, and within normal or expected levels?
   c. Is the appropriate model applied properly to the available data?
   d. Are input data series sufficient to support the assessment approach?
2. Evaluate and discuss the strengths and weaknesses of the methods used to assess the stock, considering the available data. Consider the following:
   a. Are methods scientifically sound and robust?
   b. Are the methods appropriate for the available data?
   c. Are assessment models configured properly and used in a manner consistent with standard practices?
3. Consider how uncertainties in the assessment, and their potential consequences, are addressed.
   a. Comment on the degree to which methods used to evaluate uncertainty reflect and capture the significant sources of uncertainty in the population, data sources, and assessment methods.
   b. Ensure that the implications of uncertainty in technical conclusions are clearly stated.
4. Evaluate the provisional assessment findings and consider the following:
   a. Are abundance, exploitation, and biomass estimates reliable, consistent with input data and population biological characteristics, and useful to support status inferences?
   b. Are the provisional stock status determination methods for each stock or stock complex appropriate? If not, are there other indicators that may be used to inform managers about stock trends and conditions?

5. Evaluate the stock projection methods, including discussing strengths and weaknesses, and consider the following:

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

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

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

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

6. Provide, or comment on, recommendations to improve the assessment:

    a. Consider the research recommendations provided by the Data and Assessment workshops in the context of overall improvement to the assessments, and make any additional long-term research recommendations warranted.

    b. Provide suggestions on key improvements in data analysis or modeling approaches that should be considered when scheduling the subsequent operational assessment. These recommendations should be described in sufficient detail for application in the subsequent operational assessment, and consequently should be practical for short-term implementation (i.e., achievable within ~6 months).

    c. Comment on the degree of environmental and climate linkage(s) incorporated in the stock assessments and make recommendations for improvements in the future.

7. Prepare a Review Workshop Summary Report describing the Panel's evaluation of the sandbar shark stock assessment and addressing each Term of Reference.