**United States Department of Commerce**
**National Oceanic and Atmospheric Administration**
National Marine Fisheries Service
Southeast Fisheries Science Center
3500 Delwood Beach Rd
Panama City, FL   32408

# SEDAR 77
# HMS Atlantic Hammerhead Sharks
# Terms of Reference for the Operational Assessment

The following Terms of Reference apply to each individual stock as determined in the SEDAR 77 Research Track Assessment process. The Operational Assessment should be completed by December 31, 2024.

1. As needed and appropriate, update and provide the life history information for the base model of each stock being assessed. Provide justification for any deviations in life history information from the SEDAR 77 Research Track Assessment Review Process (RP) base model recommendations.

2. Update and provide appropriate commercial catch statistics in both HMS and non-HMS fisheries through 2022 for the base model of each stock being assessed.
   a. Provide the list of fisheries investigated to estimate the catch statistics.
   b. Considering species identification issues between hammerhead shark species -- describe the process for determining the species and correct for these instances as appropriate.
   c. For each fishery (HMS and non-HMS), provide the estimates of landings, dead discards, live discards, and potential post-release mortality in both weight (dressed weight) and number.
   d. Provide justification for any deviations in the methods used to update commercial catch statistics from the SEDAR 77 RP base model recommendations.

3. Update and provide the appropriate recreational catch statistics through 2022 for the base model of each stock being assessed, including landings, dead discards, live discards, and potential post-release mortality in both pounds weight (dressed weight) and number. Consider species identification issues between hammerhead shark species -- describe the process for determining the species and correct for these instances as appropriate. Provide justification for any deviations in the methods used to update recreational catch statistics from the SEDAR 77 RP base model recommendations.

4. Update the appropriate  indices of abundance through 2022, for the base model of each stock being assessed. Provide justification for any deviations in the methods used to

update indices of abundance from SEDAR 77 RP base model recommendations.

5. Considering the information in the SEDAR 77 Research Track Assessment, describe any changes to the information or knowledge provided at that time regarding ecosystem, climate, species interactions, habitat considerations, and/or episodic event for the base model of each stock being assessed.

6. Using the updated information as provided above and considering relevant recommendations from the SEDAR 77 RP, implement the appropriate population assessment base model for each stock being assessed as described in the SEDAR 77 Research Track assessment. Provide justification for any deviations from SEDAR 77 RP base model recommendations.

7. 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.

8. Provide estimates of population benchmarks or management criteria (e.g., MSY, $F_{MSY}$, $B_{MSY}$, $B_{MSST}$, MSST, OY) consistent with available FMPs and amendments, proposed FMPs and amendments, other ongoing or proposed management programs, and National Standards.
   a. Evaluate existing or proposed management criteria as specified in the management summary.
   b. Recommend and define proxy values when necessary, and provide appropriate justification.

9. Recommend stock status relative to management benchmarks or alternative data-poor approaches if necessary.

10. Provide uncertainty distributions of 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.

11. As appropriate, project future stock conditions and develop rebuilding schedules, if warranted. All estimates should provide results for probabilities (e.g., probability of rebuilding, probability of ending overfishing) ranging between 50 and 70%. Provide the estimated generation time for the stock. Stock projections shall be developed in accordance with the following:
    a. If the stock status is overfished, then utilize projections to determine:
       - Year in which F=0 results in a X% probability of rebuilding (Year $F=0_{pX}$).
       - Target rebuilding year ($Year_{rebuild}$).
         - Year $F=0_{pX}$ if Year $F=0_{pX} \leq$ 10 years, or
         - Year $F=0_{pX} + 1$ generation time if Year $F=0_{pX} > 10$ years.
       - F resulting in a X% probability of rebuilding by $Year_{rebuild}$.
       - Fixed level of removals allowing rebuilding of stock with X% probability.

b. If the stock status is determined to be undergoing overfishing, then utilize projections to determine:
- $F=F_{reduce}$ (different reductions in F that should end overfishing with X% probability).

c. If the stock status is determined to be neither overfished nor undergoing overfishing, then utilize projections to determine:
- The F needed and corresponding removals associated with the appropriate probability (analogous to a P*) based on the resulting tier of the species and stock assessment, and/or
- The constant catch associated with the appropriate level of overfishing not occurring and the stock not being overfished based on the resulting tier of the species and stock assessment.

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

12. Provide the resulting tier of the species and stock assessment along with the overfishing level (OFL) and the acceptable biological catch (ABC) or appropriate proxies as described in Amendment 14 to 2006 Consolidated Highly Migratory Species FMP.

13. As appropriate, provide recommendations for future research and data collection.

14. Develop a stock assessment report to address these terms of reference and fully document the input data, methods, and results of the analyses.