**Recreation Demand Model Overview**

December 2023

During the December 2023 meeting of the Mid-Atlantic Fishery Management Council (Council) and the Atlantic States Marine Fisheries Commission's Summer Flounder, Scup, and Black Sea Bass Management Board (Board), staff from the Northeast Fisheries Science Center (NEFSC) will provide a brief overview of the Recreation Demand Model (RDM). Although the RDM has been discussed at several meetings over the past two years,[1] it is still a relatively new tool for management of these species. After this presentation and discussion, the Council and the Board will consider specific recommendations from the Monitoring Committee, informed by the RDM, for recreational measures for these species in upcoming years.

## Background

The RDM was developed by the Northeast Fisheries Science Center (NEFSC) to predict the effect of proposed recreational measures on angler satisfaction, fishing effort, and recreational harvest and discards of summer flounder, scup, and black sea bass. The RDM was first used to set 2023 recreational measures for scup and black sea bass.

The RDM represents a major improvement over prior methods for setting recreational measures in that it accounts for angler responses to alternative management measures (i.e., shifts in effort) and the projected length distribution of the fish stock. These factors were not explicitly considered under the previous methods, which relied largely on Marine Recreational Information Program (MRIP) data and the expert judgment of the Monitoring and Technical Committees. The RDM is based on peer-reviewed models for other species (Carr-Harris and Steinback 2020, Holzer and McConnell 2017, Lee et al. 2017) and was reviewed by the Scientific and Statistical Committee (SSC) in September 2021.[2] Several improvements have been made since the SSC review. The Monitoring and Technical Committees have also discussed the RDM multiple times over the past few years and additional improvements have been made based on their feedback.[3]

## RDM overview

The RDM consists of two main components: a discrete choice model of fishing decisions and a fishery simulation model.

The **discrete choice model** is used to predict the probability that an angler would choose to take a fishing trip based on the expected catch and cost of that trip. This component of the

[1] Recent in-depth discussions include the June 2022 Council meeting as part of the Summer Flounder Management Strategy Evaluation update and the October 2023 Monitoring/Technical Committee meeting.

[2] Briefing materials and the SSC report are available at https://www.mafmc.org/council-events/2021/ssc-peer-review-panel-sept20.

[3] For example, see https://asmfc.org/uploads/file/64dbc727SFSBSB_TC_Report_May2023.pdf and https://www.mafmc.org/s/Monitoring-Committee-9-20-23-Summary.pdf.

model is based on random utility theory,[4] in which it is assumed that a decision maker, when faced with a decision between a discrete number of alternatives, will choose the alternative that maximizes their utility. The utility provided by each alternative varies and can depend on characteristics of the alternative (e.g., trip costs, how many of each species can be kept vs. discarded), characteristics of the decision maker (e.g., age, gender, income, education, fishing avidity), and unobserved characteristics of both the alternative and the decision maker. The RDM models the relationship between the observable characteristics of the alternative/decision maker and utility. From this relationship the model is able to compute the probability that, given a choice between not fishing and taking a fishing trip with outcomes that are based on fishery data and proposed management measures, an angler will choose to fish. These individual decisions in aggregate constitute the total demand for recreational fishing and directly impact the estimated number of fish removed from the stock.

Data for the discrete choice model come from a 2022 mail and web-based survey of anglers from Maine through Virginia. This survey was sent to 6,000 saltwater fishing license holders. 2,317 completed surveys were returned, representing a 38.7% response rate. The survey collected demographic and fishing-related information, as well as angler choice data from a "discrete choice experiment". A sample of this survey is available at https://www.mafmc.org/s/survey-sample_version12.pdf.

The second major component of the RDM is a **fishery simulation model**, which calculates changes in angler fishing effort (demand), harvest, discards, and angler welfare[5] under alternative management measures relative to a baseline year. It uses results from the discrete choice model described above combined with recent historical and projected fishery data to predict trip-level outcomes. The model incorporates projected numbers-at-age from the stock assessments to allow projected changes in the size distribution of the stock to influence the size of fish anglers are expected to encounter in the upcoming year. The simulation is repeated 100 times to account for statistical uncertainty in the input data, including the MRIP data and the projected numbers-at-age from the assessments. Output of the simulations includes harvest and discards in numbers of fish and weight, number of expected trips, and angler welfare at the state level, as well as percent changes in harvest weight relative to a status-quo scenario where next year's regulations are held constant at current year values. Outputs used in management under the Percent Change Approach for setting measures include the median value of the distribution of model outcomes from the 100 simulations, and confidence intervals based on the percentiles of this distribution to capture uncertainty in the model input data. Results are provided at the state and fishing-mode level and can be aggregated to higher levels (e.g., state, region, or coastwide).

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[4] More details on random utility theory and modeling can be found in Train (2003) - Discrete Choice Methods with Simulation, available free at https://eml.berkeley.edu/books/choice2.html.

[5] Angler welfare is computed as the consumer surplus generated from a change in trip outcomes between a baseline year and a future year in which expected harvest and discards on that trip are manipulated to reflect management and stock changes. Consumer surplus is the maximum dollar value an individual would pay for a fishing trip with specified attributes (e.g., a given number of kept vs. discarded summer flounder, scup, and black sea bass), over and above the amount actually paid.

An important step in developing the simulation model is generating estimates of recreational catch-at-length and catch-per-trip in the future (in this case, 2024). The most recent complete year of input data is 2022. Therefore, the data used to generate baseline estimates of 2024 catch-at-length came from 2022 MRIP and state volunteer angler survey data. These baseline estimates were subsequently adjusted to account for the projected 2024 size distribution of the stock. Based on the advice of the Monitoring and Technical Committees, 2024 catch-per-trip by state/wave/mode is computed using the most recent two years of MRIP data (i.e., 2022 and preliminary 2023 data for waves 1-4; 2021 and 2022 for waves 5-6) with data from each year weighted equally. This method is intended to capture variation in the MRIP data across years while reflecting recent conditions and avoiding too much emphasis on years heavily impacted by COVID-19 (e.g., a three year average would have included 2020, which the Monitoring and Technical Committees did not support). The Monitoring and Technical Committees may revisit these data decisions in the future and recommend alternative approaches when setting measures for 2025 and beyond. Nonetheless, the data used to generate estimates of both recreational catch-at-length and catch-per-trip in 2024 represent the MSE modelers and Monitoring and Technical Committees' most informed beliefs about future fishing conditions.

**Ongoing improvements to the RDM**

As noted above, several improvements have been made to the RDM in recent years. The Monitoring and Technical Committees will have additional opportunities to work with the RDM modelers to ensure the model is configured appropriately for each specifications cycle.

A near-term major improvement is development of a cloud-based user interface to allow Monitoring and Technical Committee members to run the model on their own. Cloud computing will also increase the speed of running the 100 model simulations and will allow multiple users to run the model simultaneously. A beta version of the user interface has been shared with Monitoring and Technical Committee members for testing. A final version for use in setting 2024 state measures is anticipated to be available in the near future. In this first year for use of this cloud-based user interface, users will be limited to Monitoring and Technical Committee members (including Council and Commission staff) due to costs associated with adding additional users.

**References**

Carr-Harris, Andrew, and Scott Steinback. 2020. “Expected Economic and Biological Impacts of Recreational Atlantic Striped Bass Fishing Policy.” *Frontiers in Marine Science* 6 (January): 1–20.

Holzer, J., and K. McConnell. 2017. “Risk Preferences and Compliance in Recreational Fisheries.” *Journal of the Association of Environmental and Resource Economists* 4 (S1): S1–43.

Lee, M., S. Steinback, and K. Wallmo. 2017. “Applying a Bioeconomic Model to Recreational Fisheries Management: Groundfish in the Northeast United States.” *Marine Resource Economics* 32 (2): 191–216.