**Final Report**

# Summary Report of the 66th Northeast Regional Stock Assessment Review Committee (SARC 66)


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# 1. Introduction

## 1.1 Background

The 66th Stock Assessment Review Committee (SARC) met in Woods Hole, MA from 27 November – 30 November, 2018 to review the most recent stock assessments for summer flounder, *Paralichthys dentatus*, and striped bass, *Morone saxatilis* (Attachment 1). The review committee was composed of Robert J. Latour (MAFMC SSC and Virginia Institute of Marine Science, SARC Chair) and three scientists affiliated with the Center for Independent Experts: John Casey (Consultant), Robin Cook (University of Strathclyde), and Yan Jiao (Virginia Polytechnic Institute and State University).

The SARC was assisted by the Stock Assessment Workshop (SAW) Chairman, James Weinberg (NEFSC). Supporting documentation for the summer flounder assessment was prepared by the NEFSC Summer Flounder Working Group (SFWG) and presentation of the assessment was made by Mark Terceiro (lead analyst) with support from Jessica Coakley (MAFMC, Chair SFWG). Technical documents for the striped bass assessment were prepared by the Striped Bass Working Group (SBWG) and presentations were made by Katie Drew (ASMFC), Gary Nelson (MADMF), and Michael Celestino (NJDFW, Chair SBWG). Tony Wood, Toni Chute, Alicia Miller, Brian Linton, and Chris Legault (all NEFSC) served as rapporteurs. A total of 39 individuals attended the SARC 66 meeting, representing NEFSC, MAFMC, ASMFC, MADMF, NJDFW, DEFW, RIDMF, various academic institutions, non-governmental organizations, and fisheries stakeholder organizations (Attachment 2). The contributions of all associated with the SARC 66 process are gratefully acknowledged.

## 1.2 Review of Activities

Approximately two weeks before the meeting, assessment documents and supporting materials were made available to the SARC Panel electronically. On the morning of 27 November, the Panel met with James Weinberg and Russell Brown to discuss the meeting agenda, reporting requirements, and meeting logistics. The meeting opened on the morning of 27 November with welcoming remarks by James Weinberg and Robert Latour. Following introductions, the remainder of day was devoted to presentations of the summer flounder assessment. Most all of 28 November was spent on presentations of the striped bass assessment, with the latter part of the day dedicated to follow-up discussion of the summer flounder assessment and editing of the summer flounder Assessment Summary Report. Virtually all of 29 November focused on discussion associated with the striped bass assessment and editing of the striped bass Assessment Summary Report. The final day of the meeting was restricted to only the SARC Panelists for report writing.

The presentations given during the meeting for each assessment followed the Terms of Reference (ToRs) which allowed the Panel to gain a deeper understanding of each assessment. The Panel asked each working group for additional model runs to explore sensitivities and alternative model configurations, and the efforts by working group members to quickly generate those model runs were greatly appreciated. The tone of the meeting was collegial, and considerable time was devoted to facilitate dialog among Panelists, working group members, and MAFMC and ASMFC staff. The SARC Panel was able to conduct a thorough review of both assessments.

The assessments were effective in providing current stock status information and the SARC Panel was able to reach consensus on both assessments, although the accepted model configuration for striped bass differed considerably from the base model put forth by the SBWG. Since the last peer-reviewed assessments of each species (2013 SAW/SARC 57 for both species), considerable research advancements have been made for each assessment. The assessments conducted by the SFWG and SBWG were very thorough, and it was apparent that each working group devoted significant time and effort to data analysis, model fitting, evaluation of uncertainty, and report preparation.

Special Comment, summer flounder: The SARC Panel acknowledged the public comment submitted by Save the Summer Flounder Fishery Fund regarding past efforts and future plans to develop a sex-structured assessment model for summer flounder. This comment was read into the record by Patrick Sullivan.

## 2. Review of Summer Flounder

### 2.1 General Comments

The SFWG considered several different models as the basis for the summer flounder assessment, including a sex-at-length model (developed by Patrick Sullivan, Cornell University), an SS3 model (developed by Mark Maunder, IATTC), a state-space model (develop by Timothy Miller, NEFSC), a sex-specific ASAP model (developed by Mark Terceiro, NEFSC), and a sexes combined ASAP model (developed by Mark Terceiro, NEFSC). Although results were not presented from all models, working papers for each were supplied to the SARC Panel for evaluation. After considerable vetting of the available models, the SFWG selected the sexes combined ASAP model for the summer flounder assessment, which was similar to the assessment model developed in 2013 (SAW/SARC 57) and updated in 2016. Given that some of alternative models required additional refinement and testing, the SARC Panel agreed with this decision. All ToRs were met and the SARC Panel accepted the sexes combined ASAP model for use as the basis for summer flounder management advice.

### 2.2 Evaluation of the Terms of Reference for Summer Flounder

ToR 1. *Estimate catch from all sources, including landings and discards. Describe the spatial and temporal distribution of landings, discards, and fishing effort. Characterize the* *uncertainty in these sources of data. Compare previous recreational data to re-estimated Marine Recreational Information Program (MRIP) data (if available*).

This ToR was met. Commercial landings (directed, primarily trawl) extend from Massachusetts to North Carolina and eastward to the shelf edge. Harvest statistics showed that directed commercial landings in 2017 were the lowest on record since 1943. Since the directed landings are taken to be a census, precision is considered good with coefficients of variation (CV) assumed to be approximately 0.1. The full time-series (1982 – 2017) of directed commercial catch-at-age landings was re-estimated by the SFWG to make use of the most recent version of reported landings and sample data (newest BIOSTAT program). Relative to previously estimated directed commercial catch-at-age, this re-estimation created minor changes (< 1%) in most years with a maximum change of +/- 8-9% in a few years. The magnitude of estimated commercial discards (1994 – 2017) was fairly small compared to directed landings and discard estimation procedures included a new data source, namely information from the extra-large mesh monkfish gillnet fishery. Relative to directed commercial landings, estimated discards were less precise with a mean CV of 0.32 and a range of 0.11 (2012) to 0.77 (1995). Estimates of recreational catch (1982 – 2017) came from newly calibrated MRIP time-series that reflected a revision of both the intercept (creel sampling) and effort (mail) surveys. Relative to previous MRIP recreational catch estimates, the calibrated MRIP time-series created roughly a six-fold increase in shore-based effort and a three-fold increase in private/rental boat effort. Comparable increases were evident in landed (catch type A + B1) and live discard (B2) summer flounder statistics, particularly in NY and NJ. Qualitative examination of spatial patterns in catch data from both commercial and recreational fisheries showed that a northward and offshore trend has developed in recent years (see ToR 3 for more details on spatial fisheries patterns). The SARC Panel concluded that the SFWG adequately characterized summer flounder removals from all sources.

ToR 2. *Present the survey data available, and describe the basis for inclusion or exclusion of those data in the assessment (e.g., indices of relative or absolute abundance, recruitment, state surveys, age-length data, etc.). Investigate the utility of commercial or recreational LPUE as a measure of relative abundance. Characterize the uncertainty and any bias in these sources of data.*

This ToR was met. Relative abundance data from roughly two dozen research surveys operated by federal (NEFSC) and state (MA, RI, CT, NY, NJ, DE, MD, VA, and NC) entities were incorporated into the assessment. Most of the available survey information pertained to adult fish, although a few datasets contained information on young-of-the-year (YOY) individuals. Several survey datasets also provided age-specific relative abundance and length composition information. When data were tabulated as aggregate counts of summer flounder sampled, nearly all surveys showed a decrease in relative abundance from the late 2000s (roughly 2009-2012) to 2017, with the exception of the MA and DE surveys. Larval data were analyzed to provide and index of spawning stock biomass (SSB).

The SFWG relied on representatives from each survey program to summarize relative abundance information and provide annual indices. This decision led to a somewhat heterogeneous treatment of the survey data such that some indices were generated as nominal catch-per-unit-effort (CPUE), while others utilized design-based methods or, in the case of the composite index, model-based approaches. CVs were not estimated for all survey indices which made it difficult to comprehensively judge uncertainty, although indices from several surveys showed fairly good precision (NEFSC and various states; CVs ≈ 0.1 – 0.5). The SARC Panel recommended that the SFWG develop a standardized framework for analysis of survey data (to the degree possible) in future assessments to ensure consistent treatment of all datasets.

It was clear that the SFWG thoughtfully evaluated several fisheries-dependent CPUE datasets for potential use in the assessment. Generalized linear models were used to estimate indices of relative abundance from various data sources including dealer reports, vessel trip reports (VTR), observer programs, and MRFSS/MRIP. The SFWG ultimately concluded that calculation of directed effort from the fisheries-dependent data was problematic and subject to a variety of inaccuracies. The SARC Panel agreed with the SFWG's conclusion that fisheries-dependent indices were subject to an unknown but likely negative bias, and given the availability of a large number of fisheries-independent data sources, supported the decision to not use fisheries-dependent information in the assessment.

ToR 3. *Describe life history characteristics and the stock's spatial distribution (for both juveniles and adults), including any changes over time. Describe factors related to productivity of the stock and any ecosystem factors influencing recruitment. If possible, integrate the results into the stock assessment.*

This ToR was met. Summer flounder life history information summarized for the assessment was based exclusively on fishery-dependent samples and NEFSC survey data, despite availability of substantial biological data from state operated surveys. Although the sampling frame of the NEFSC survey is expansive, near coastal and estuarine areas represent important habitats for summer flounder and data from those areas could prove informative, especially given that much of the recreational fishery is prosecuted in the coastal zone. The SARC Panel recommends that the SFWG consider approaches to integrate life history data from state sampling programs in future assessments in an effort to gain a more comprehensive characterization of biological and life history indicators.

Temporal summaries (yearly indicators) of biological data over the last decade showed both positive and negative trends. On the positive front, NEFSC survey information showed increasing relative abundance of older fish and an expanding age structure (current maximum ages of 18 for males and 19 for females). However, some 'red flags' were evident in the form of decreasing average length and weight for both sexes and slower growth (smaller observed and predicted length- and weight-at-age). The decreasing trend in weight-at-age derived from the survey data was also apparent in the commercial landings data.

Analyses of summer flounder spatial distribution showed a general shift northward and eastward since 1976. This conclusion was based on results of a vector-autoregressive spatio-temporal (VAST) model applied to the NEFSC and NEAMAP survey data. Results of the VAST model were somewhat equivocal in that only a small portion of the change in center-of-gravity of the population could be explained by variation in abundance, fishing, or environmental covariates. No factor was identified as strongly influencing the spatial shift in spawner biomass or the level of recruitment. The SARC Panel acknowledged that application of the VAST model was quite novel and was supportive of continued future work in this area.

ToR 4. *Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and estimate their uncertainty. Include retrospective analyses (both historical and within-model) to allow a comparison with previous assessment results and projections, and to examine model fit. Examine sensitivity of model results to changes in re-estimated recreational data.*

This ToR was met. Relative to the sexes combined ASAP model configuration developed in 2013 and updated in 2016, the most significant structural changes for the 2018 assessment involved changing from two fleets (landings and discards) to a four fleets (commercial landings, commercial discards, recreational landings, recreational discards) and treating the survey data from the *FSV Henry B. Bigelow* separately from the historic *FSV Albatross IV* survey data. Likelihood weights favored fitting the age-composition data, but a sensitivity analysis that explored different weighting schemes among age-composition and survey data showed robust model output. Some concern was raised by the SARC Panel regarding the choice to model discards as separate fleets rather than as offsets of the true fleets (i.e., application of discard ogives for commercial and recreational capture). The four fleet structure allows for independence among directed landings and discards and thus decouples the internal consistency of the capture-then-discard process, which has the potential to affect selectivity. Sensitivity runs (e.g., dropping area limited surveys) tended to affect the degree of doming in the estimated selection pattern where more pronounced doming resulted in higher SSB estimates. This issue is important in view of the artificial way selectivity is modeled in this assessment. However, the SARC Panel recognized that the commercial fleet was a combination of several gear types such that many more commercial fleets would need to be created if discards were to be modeled as they occur naturally. The four fleet structure also provides a direct link to management in terms of allocation of Allowable Biological Catch (ABC). The SARC Panel recommended that the SFWG give deeper consideration to fleet structure and the possibility of disaggregating commercial landings to constituent components in future assessments.

Estimates of fishing mortality (F) on fully selected age-4 fish were variable over time but relatively high during 1982-1996, followed by a consistent decrease to 2007, and then a slight increase to 2017. The 90% confidence interval for fishing mortality in 2017 was fairly narrow and indicative of reasonably good precision. Estimates of SSB intuitively tracked the pattern of fishing mortality with decreasing values in the 1980s-1990s followed by indications of recovery during the 2000s. Precision of the estimated SSB value for 2017 was reasonable. Estimates of recruitment showed consistent below average production since 2011.

A retrospective analysis was conducted to examine model stability. Data were removed sequentially for terminals years dating back to 2010 and results showed remarkable consistency in model output. This result is in direct contrast to previous assessments where configurations of a sexes combined ASAP model for summer flounder showed notable patterns of underestimation of F and overestimation of SSB. Although inclusion of the calibrated MRIP landings and discards data increased 1982-2017 total catch by an average of almost 30%, these additional removals had little impact on the magnitude of estimates of F but strongly increased estimates of stock size (model scaling) relative to output from previous assessments.

ToR 5. *State the existing stock status definitions for "overfished" and "overfishing". Then update or redefine biological reference points (BRPs; point estimates or proxies for $B_{MSY}$, $B_{THRESHOLD}$, $F_{MSY}$ and MSY) and provide estimates of their uncertainty. If analytic model-based estimates are unavailable, consider recommending alternative measurable proxies for BRPs. Comment on the scientific adequacy of existing BRPs and the "new" (i.e., updated, redefined, or alternative) BRPs.*

This ToR was met. The biological reference points (BRPs) associated with the 2013 summer flounder assessment (SAW/SARC 57) were based on stochastic yield, SSB-per-recruit, and stochastic projections. The fishing mortality threshold reference point was defined as $F_{35\%}$ = 0.309 (CV = 0.15) and taken as a proxy for $F_{MSY}$. Estimation of associated biomass reference point proxies, that is $SSB_{MSY}$ and the biomass threshold of ½ $SSB_{MSY}$, were based on projecting the Jan 1, 2013 stock size forward 100 years at $F_{35\%}$ assuming stochastic annual recruitment around the median estimated value from 1982-2012. Point estimates and uncertainties were as follows: $SSB_{MSY}$ = 62,394 mt (CV = 0.13), ½ $SSB_{MSY}$ = 31,197 mt (CV = 0.13), and MSY proxy = 12,945 mt (CV = 0.13).

The SFWG followed a similar approach for defining reference points for the 2018 assessment. The new fishing mortality threshold reference point was estimated as $F_{35\%}$ = 0.448 (CV = 0.15) and the new biomass threshold reference point was ½ $SSB_{MSY}$ = 28,580 mt (CV = 0.15). The SARC Panel accepted these reference point definitions, but noted an inconsistency in the approach used to estimate the threshold biomass reference point, namely, basing the projection on the most recent weights-at-age but the median recruitment value from the full time-series (1982-2017). This inconsistency was address through a sensitivity projection based on the median annual recruitment from the more recent time period (2011-2017, apparent lower productivity period). The lack of an identified causal mechanism for the lower recruitment in recent years supported basing the projection on the full time-series. Relative to the 2013 BRPs, the threshold F and biomass reference point estimates were higher and lower, respectively, and due primarily to observed lower mean weight-at-age for older fish (mainly age-6 and age-7+ individuals during 2010-2012).

ToR 6. *Make a recommendation[1] about what stock status appears to be, based on the existing model (i.e., model from previous peer reviewed accepted assessment) and with respect to a new modeling approach(-es) developed for this peer review.*

*a. Update the existing model with new data and make a stock status recommendation (about overfished and overfishing) with respect to the existing BRP estimates.*

This ToR was met. The SFWG developed a continuity run using the 2013 ASAP model (SAW/SARC 57) with the addition of the most recent years of fisheries data (2012-2017). For this model run, the uncalibrated (historic) MRIP data were used along with the 2103 point estimates of the threshold reference points. Stock status recommendation was not overfishing and not overfished. These continuity stock status recommendations were accepted by the SARC Panel.

*b. Then use the newly proposed modeling approach(-es) and make a stock status recommendation with respect to "new" BRPs and their estimates (from TOR-5).*

This ToR was met. Recommended stock status information from the newly configured 2018 ASAP model that included the calibrated MRIP data and the updated reference point estimates based on stochastic recruitment around the median estimate from the full time-series (preferred BRPs by the SFWG) was not overfishing and not overfished. As a sensitivity, an alternative model run was developed using the more recent median recruitment estimate (2011-2017) also yielded a Stock status recommendation of not overfishing and not overfished. These updated stock status recommendations were accepted by the SARC Panel.

*c. Include descriptions of stock status based on simple indicators/metrics (e.g., age- and size-structure, temporal trends in population size or recruitment indices, etc).*

This ToR was met. The SFWG developed time-series of several indicators/metrics for the

[1]NOAA Fisheries has final responsibility for making the stock status determination for this stock based on best available scientific information.

summer flounder stock: mean length- and weight-at-age, survey age-composition, and aggregate indices of relative abundance and biomass for both adults and juveniles. Some discussion was also directed at evaluation of ecosystem characteristics and processes in recent years, most notably patterns in sea surface and bottom temperature, salinity, chorophyll-*a* concentrations, and zooplankton density. Several aspects of the northwest Atlantic shelf ecosystem appear to be changing and these changes have likely impacted the biology and ecology of summer flounder. Of particular concern are the recent declining trends in aggregate indices of abundance, slower growth and reduced size-at-age, and below average recruitment. The SARC Panel recommended continued investigations into quantifying ecosystem effects on summer flounder stock dynamics.

ToR 7. *Develop approaches and apply them to conduct stock projections.*

*a. Provide numerical annual projections (5 years) and the statistical distribution (i.e., probability density function) of the catch at FMSY or an FMSY proxy (i.e. the overfishing level, OFL) (see Appendix to the SAW TORs). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. Use a sensitivity analysis approach in which a range of assumptions about the most important uncertainties in the assessment are considered (e.g., terminal year abundance, variability in recruitment).*

This ToR was met. Five-year (2019-2023) stock projections were configured in much the same manner as those used to estimation biomass reference points. Recent (2013-2017) patterns in fisheries selectivity, discarding, maturity-at-age, and average weight-at-age were assumed to continue over the time period of the projection. Also, the full 2018 ABC was assumed to be caught. Two sets of projections were made where the first was based on the estimated median recruitment from 1982-2017 and the second was based on the more recent lower estimated median recruitment from 2011-2017. For each set of projections, results indicated a 0% chance of exceeding the fishing mortality threshold and a 0% chance of falling below the biomass threshold. The SFWG noted that these projections were 'placeholders' pending availability of calibrated MRIP 2018 recreational catch statistics, and that the 2018 ABC is likely an underestimate of the final 2018 catch. The projection analysis was accepted by the SARC Panel.

*b. Comment on which projections seem most realistic. Consider the major uncertainties in the assessment as well as sensitivity of the projections to various assumptions. Identify reasonable projection parameters (recruitment, weight-at-age, retrospective adjustments, etc.) to use when setting specifications.*

This ToR was met. The SFWG recommended that projections based on estimated median recruitment from 1982-2017 be considered as most realistic. The SARC Panel accepted this recommendation (see ToR 5 for discussion on the lack of an identified causal mechanism for the lower recruitment in recent years).

c. *Describe this stock's vulnerability (see "Appendix to the SAW TORs") to becoming overfished, and how this could affect the choice of ABC.*

This ToR was met. Based on the projection results, the SARC Panel concurred with the SFWG that summer flounder stock has a low vulnerability to becoming overfished in the near term.

ToR 8. *Review, evaluate and report on the status of the SARC and Working Group research recommendations listed in most recent SARC reviewed assessment and review panel reports and MAFMC SSC reports. Identify new research recommendations.*

This ToR was met. Progress has been made on several of the research recommendations stemming from the 2013 assessment (SAW/SARC 57) and MAFMC SSC deliberations from 2013-2018. The SARC Panel recommended continued efforts on high priority research topics from this list. The SFWG also developed three new research recommendations:

- Continue to explore changes in the distribution of recruitment. Develop studies, sampling programs, or analyses to better understand how and why these changes are occurring, and the implications to stock productivity.

- The reference points are internally consistent with the current assessment. It may be useful to carry uncertainty estimates through all the components of the assessment, BRPs, and projections.

- Explore the potential mechanisms for recent slower growth that is observed in both sexes.

The SARC Panel agreed with the above new research recommendations and suggested one more be added to the list:

- Explore modeling discards as offsets of the true fleets (i.e., application of discard ogives for commercial and recreational capture; see ToR 4 for details).

# 3. Review of Striped Bass

## 3.1 General Comments

The stock assessment model for striped bass was last peer-reviewed in 2013 (SAW/SARC 57) and the model put forth by the SBWG at that time was a fairly traditional single-stock statistical catch-age-age model (referred herein as the 'SCA model'). However, it has been well documented in the primary literature that the coastal striped bass population is of mixed stock origin, and that striped bass exhibit differential habitat utilization among estuarine and coastal areas based on season of the year and ontogeny. Therefore, in an effort to build a stock assessment model that more closely represented the biology and ecology of striped bass, the SBWG introduced new assessment model formulation in 2018 that was stock-specific (two-stocks: Chesapeake Bay and Delaware/Hudson), seasonally-explicit (three periods: Jan-Feb, Mar-Jun, Jul-Dec), and spatially-explicit (two regions: Chesapeake Bay, coastal ocean). The SARC Panel was supportive of this very innovative modeling effort (referred herein as the '2SCA model'), but ultimately did not accept this model as a tool for the basis of striped bass management. Several technical issues regarding configuration of the 2SCA model were raised by the SARC Panel (see ToR 3 for more details) along with a conceptual concern pertaining to BRPs. Historically, the BRPs for striped bass were based on the estimated female SSB for 1995 ($SSB_{Threshold}$ = $SSB_{1995}$), which was regarded as the biomass achieved when the stock had recovered from a period of being overfished. Associated fishing mortality reference points were estimated from long-term stochastic projections by finding F values that corresponded to the median $SSB_{Threshold}$ and $SSB_{Target}$ values (see ToR 5 for more details). In developing the 2SCA model, the SBWG attempted to redefine the BRPs to be both stock- and area-specific, which resulted in two SSB reference points (one for the Chesapeake Bay stock and one for the Delaware/Hudson stock) and three F reference points (two for the Chesapeake Bay stock and one for the Delaware/Hudson stock). Specific to the Chesapeake Bay stock, this structure yielded a bay F reference point and a coastal F reference point. If accepted, this would imply that the Chesapeake Bay stock could be, for example, experiencing overfishing in the ocean but not experiencing overfishing in the bay. The SARC Panel regarded this as not biologically meaningful since the cumulative F on a stock should determine status as opposed to a single spatially-specific component. Imposing the constraint of a single, stock-wide F reference point is necessary to ensure a unique solution because there is an infinite number of ways of partitioning F between fleets or areas. Despite these concerns, the SARC Panel strongly recommended continued development of the 2SCA model and was optimistic that the model could become the basis for management in the future following more extensive testing and refinement.

In light of the SARC Panel's decision to not accept the 2SCA model, the SBWG brought forward an updated configuration of the SCA model (2013 assessment model – SAW/SARC 57). Available time for the SARC Panel to evaluation this model was abbreviated due to discussions associated with the 2SCA model, but the SBWG was able to present the key elements of the model structure, data inputs, model diagnostics with some sensitivity runs, results, and recommended stock status information. The SARC Panel accepted the SCA model for management, concluded that all ToRs were met for that model, and noted that the aforementioned discussion of area-specific reference points (e.g., bay vs. coastal ocean, Section 3.1) also pertains to the SCA model.

## 3.2 Evaluation of the Terms of Reference for Striped Bass

### ToR 1. Investigate all fisheries independent and dependent data sets, including life history, indices of abundance, and tagging data. Discuss strengths and weaknesses of the data sources.

This ToR was met. The SBWG provided detailed summaries of the available fisheries-independent and fisheries-dependent data. Rich datasets supported estimation of life history parameters such as growth and maturity. Published literature provided insight into potential population effects of mycobacteriosis, particularly disease-associated mortality. In total, over a dozen research survey datasets were analyzed to generate estimates of relative abundance. Indices were estimated for YOY and aggregated age-1+ fish. Age-specific indices were available from a few sampling programs. A wealth of tag-return data were available from producer areas (stock-specific tagged fish on/near spawning grounds) and coastal areas (mixed stock fish tagged in coastal zone). These data were used to aid fit and scaling of the SCA model, support estimation of natural mortality (M), and provide information on stock composition of the coastal population (needed only for the 2SCA model). The SARC Panel concluded that the SBWG satisfactorily assembled the necessary life history and relative abundance information needed for the SCA model.

### ToR 2. Estimate commercial and recreational landings and discards. Characterize the uncertainty in the data and spatial distribution of the fisheries. Review new MRIP estimates of catch, effort and the calibration method, if available.

This ToR was met. Strict quota monitoring is conducted by individual states through various state and federal reporting systems, and annual landings are compiled by state biologists. Directed commercial landings were assumed to be a census. The 2013 SCA model was structured to include three fleets: Chesapeake Bay, coastal ocean, and commercial discards. However, for the 2018 SCA model, commercial discards were separated regionally (Chesapeake Bay, coastal ocean) such that only two regional fleets were needed. Although some empirical estimates of commercial discards were available (e.g., Delaware Bay), discard estimation was largely based on tagging data. Specifically, a ratio approach was used that involved the ratio of tags report from discarded (or released) fish in the commercial fishery to tags reported from discarded fish in the recreational fishery, scaled by total recreational releases/discards. Corrections were made for differences among tag-reporting rates between sectors and gear-specific release mortality rates were applied to total discards to estimate dead discards. Directed commercial landings have generally exceeded discards since the 1990s with discards comprising roughly 15% of the total commercial removals from 2015-2017. Commercial catch-at-age summaries were based on regional age-length keys.

Estimates of annual recreational harvest and total catch (harvested+released) came from the newly calibrated MRIP, and were 140% and 160% higher than previous estimates, respectively. A 9% release mortality rate was applied to live releases (catch type B2). Temporal trends of catch and harvest statistics were similar among uncalibrated and calibrated MRIP data despite significant differences in magnitude. Recreational catch-at-age was based on state-specific age-length keys developed from fisheries-dependent (MRIP, state logbook programs, volunteer angler surveys, creel sampling, and the American Littoral Society volunteer angler tagging program) and fisheries-independent sources. The SARC Panel concluded that the assembled landings and discard data were suitable for the assessment.

ToR 3. Use an age-based model to estimate annual fishing mortality, recruitment, total abundance and stock biomass (total and spawning stock) for the time series and estimate their uncertainty. Provide retrospective analysis of the model results and historical retrospective. Provide estimates of exploitation by stock component and sex, where possible, and for total stock complex.

This ToR was met. As noted above (section 3.1), the SARC Panel did not accept the 2SCA model for use as the basis of striped bass management. Specific research needs raised by the SARC Panel for the 2SCA model are as follows:

- More extensive simulation testing
    - Exploration of parameter estimability
    - Testing of the effects of various emigration rate assumptions
    - Alternative methods (e.g., multi-state tagging models) to estimate emigration rates from existing tagging data
    - Development of a method to estimate numbers-at-age for the first year
- Further examination of tagging data after 1995 (including developing ways of assigning ages to NY data) to examine potential time-varying emigration rates
- Further exploration of appropriate BRPs for a two-stock population with mixing
    - Can the model detect changes in stock status with different emigration rates/exploitation patterns/etc?
- Evaluation of why model output for the two stocks show such similar patterns over time
- Further exploration of the assumption of constant selectivity across periods within a region & year
- Identify weaknesses in the existing data that can be improved to support the further development of this model

- Develop more robust estimates of stock composition

However, as noted above (section 3.1) the updated and slightly modified SCA model was accepted by the SARC Panel for striped bass management. The SCA model included two fleets (Chesapeake Bay, coastal ocean), four selectivity blocks in each area that corresponded to notable changes in management, and the aforementioned YOY and aggregated age 1+ indices of relative abundance. Likelihood weights favored the age-composition data which led to poor model fits to some survey indices.

Estimates of fully-recruited instantaneous fishing mortality (F) in Chesapeake Bay were low (≈ 0.05-0.10) across the time-series with comparably higher values estimated for the coastal ocean (≈ 0.03-0.26). CVs associated with estimates of fishing mortality in both areas were low and indicative of good precision (≈ 0.10-0.37). Estimates of female SSB were low in the 1980s (as expected given the depressed condition of the stock at the time) but increased through the 1990s to a peak in 2003. Since 2010, estimated female SSB has declined steadily such that the 2017 SSB estimate is commensurate to that of 1991-1992.

A retrospective analysis of the SCA model (seven year peels) showed very little trend (+/- 2%) in the more recent estimates of fully-recruited total fishing mortality, female SSB, and age-8+ abundance. Notable patterns did not emerge until five years of data were peeled (> 10% change). The SBWG indicated that fishing mortality is likely slightly overestimated with female SSB being slightly underestimated. The retrospective analysis of age-1 recruits indicated that the terminal year estimate of age-1 abundance was most uncertain.

### ToR 4. Use tagging data to estimate mortality and abundance, and provide suggestions for further development.

This ToR was met. Tagging data are available for striped bass from both coastal areas (MA, NY, NJ, and NC) and producer/spawning areas (Hudson, DE/PA, MD upper Chesapeake Bay, and VA Rappahannock River). These tagging data represent a rich source of information since most all programs have been operating continuously since the late 1980s. Age-invariant instantaneous rates catch and release models that allow for the release of tagged fish were applied to provide estimates of survival (S), instantaneous total mortality (Z), F and M for two size-classes of fish (≥ 457 mm and ≥ 711 mm). For each tagging dataset, a suite of candidate model parameterizations was fitted and information theoretic approaches were used to obtain final weighted parameter estimates across the hypothesized models (multi-model inference). Stock sizes were estimated using the annual exploitation rates averaged across all tagging program in concert with total catch (recreational and commercial harvest and dead discards; average stock size = catch/exploitation).

The SARC Panel accepted the analyses of the tagging data for comparative purposes to the mortality rates and stock sizes derived from the SCA model. As noted above (ToR 3), the

SBWG did make use of the tagging data to make inferences about stock composition of the coastal population and emigration rates, both of which were needed for the 2SCA model. The SARC Panel recommended continued work in this area for future assessments.

### ToR 5. Update or redefine biological reference points (BRPs; point estimates or proxies for $B_{MSY}$, $SSB_{MSY}$, $F_{MSY}$, MSY) for each stock component where possible and for the total stock complex. Make a stock status determination based on BRPs by stock component, where possible, and for the total stock complex.

SPR-based reference points were explored with the SCA model but ultimately not used for recommendations of stock status because estimates of SSB associated with various SPR fishing mortality rates were unrealistic. For example, long term (100 yr) projections at $F_{40\%}$ resulted in an equilibrium female SSB value that was approximately twice the highest estimated female SSB value in the time-series. Although the SBWG was unable to fully explain the stock dynamics associated with SPR-based reference points, it is possible that the SCA model did not adequately capture sex-specific dynamics associated with regional fisheries, particularly those operating in Chesapeake Bay. Sex ratio data from the bay showed high proportions of males, which is consistent with the notion that young females migrate to coastal areas earlier than males. Lower fisheries selectivity of young fish in coastal areas compared to that in the bay implies that female SSB could be elevated due differential habitat utilization among sexes.

For stock status determination from the SCA model, the SBWG put forth the empirical reference points used in previous assessments. Specifically, the $SSB_{Threshold}$ was defined as the estimated female SSB for 1995 ($SSB_{1995}$) and the $SSB_{Target}$ was defined as 125% of the female $SSB_{1995}$ value. Fishing mortality reference points associated with the $SSB_{Threshold}$ and $SSB_{Target}$ were generated using projections based on randomly selected 2017 estimates of January 1 abundance-at-age from a normal distribution, and geometric means of recent (2013-2017) selectivity, spawning stock weights-at-age, and age-1 recruitment stochastically obtained from the 'hockey-stick' approach (Beverton-Holt stock-recruitment up to median female SSB followed by the median recruitment thereafter). As a sensitivity run, projections were also generated where recruitment was 'empirical' and simply obtained as random selections from estimates spanning 1990-2017. In both cases, the input F was manually adjusted to obtain the median female SSB values closest to the female $SSB_{Threshold}$ and $SSB_{Target}$ in year 100.

The SCA model yielded the following stock status output: $SSB_{Threshold}$ = 91,436 mt, $SSB_{2017}$ = 68,476 mt; $F_{Threshold\text{-}HockeyStick}$ = 0.240, $F_{Threshold\text{-}Empirical}$ = 0.248, $F_{2017}$ = 0.307. Thus, the recommended stock status is overfished with overfishing occurring. Fleet-specific F reference points indicated the Chesapeake Bay fleet was equal to its $F_{Threshold}$ while the ocean fleet was above its $F_{Threshold}$. The BRPs and recommended stock status determination were accepted by the SARC Panel.

ToR 6. Provide annual projections of catch and biomass under alternative harvest scenarios. Projections should estimate and report annual probabilities of exceeding threshold BRPs for F and probabilities of falling below threshold BRPs for biomass.

This ToR was met. Short-term, six-year projections of the SCA model (2018-2023) were configured similarly to the projections used to estimate fishing mortality reference points (see ToR 5 for more details). Four scenarios were examined: (i) constant catch equal to 2017 catch, (ii) constant F equal to 2017 F, (iii) constant F equal to $F_{Threshold}$ ($F_{1995}$), (iv) and constant F equal to $F_{1993}$. Recruitment was modeled using both the 'hockey-stick' and 'empirical' approaches. Projection results showed very high probabilities (≈0.95-1.0) of remaining overfished and for overfishing to continue (≈0.6-1.0) assuming 'hockey-stick' recruitment. For 'empirical' recruitment, the probabilities of staying overfished in the short term were similar to the 'hockey-stick' projection results, but the probabilities of maintaining overfishing were lower (≈0.4-1.0). The SARC Panel accepted the projection analysis conducted by the SBWG for the SCA model.

ToR 7. Review and evaluate the status of the Technical Committee research recommendations listed in the most recent SARC report. Identify new research recommendations. Recommend timing and frequency of future assessment updates and benchmark assessments.

This ToR was met. Progress has been made on several of the research recommendations stemming from the 2013 assessment (SAW/SARC 57). The SARC Panel recommended continued efforts on high priority research topics from this list along with advancements associated with testing and refining the 2SCA model (see ToR 3 for details).

## 4. Description of SAW Supporting Materials

### References

| Working paper | Title | Author(s)/Publisher |
|---|---|---|
| **Summer Flounder** | | |
| A1 | The effect of ocean environmental conditions on the relative abundance of summer flounder (*Paralichthys dentatus*): spatio-temporal analysis and model comparison using R-INLA | S. Deen et al. |
| A2 | Summer flounder CPUE derived from cooperative research study fleet self-reported data | B.J. Gervelis |
| A3 | Evaluating summer flounder (*Paralichthys dentatus)* spatial sex-segregation in a southern New England estuary | Langan et al. |
| A4 | Stock Synthesis Implementation of a Sex-Structured Virtual Population Analysis Applied to Summer Flounder | M.N. Maunder |
| A5 | Dynamic reference points for summer flounder | M.N. Maunder |
| A6 | Developing an aggregated summer flounder fishery independent index from multiple noisy indices using a Bayesian hierarchical modeling approach | J.E. McNamee |
| A7 | Spatial distribution of summer flounder captured in the commercial and recreational fisheries | A. Miller & M. Terceiro |
| A8 | Spatial distribution of summer flounder sampled by the NEFSC trawl survey | A. Miller & M. Terceiro |
| A9 | Accounting for sex in equilibrium per-recruit biological reference points for summer flounder | T.J. Miller |
| A10 | A state-space, sex-specific, age-structured assessment model for summer flounder | T.J. Miller & M. Terceiro |
| A11 | Even more state-space, sex-specific, age-structured assessment models for summer flounder | T.J. Miller & M. Terceiro |
| A12 | An analysis of summer flounder (*Paralichthys dentatus*) distribution on the Northeast U.S. Shelf using a spatio-temporal model | C.T. Perretti |
| A13 | A sex-age-length based fisheries stock assessment model with analysis and application to summer flounder (*Paralichthys dentatus*) in the mid-Atlantic | P.J. Sullivan |
| A14 | 57$^{th}$ SAW/SARC Summer Flounder Assessment Report | Summer Flounder Working Group |

| | | |
|---|---|---|
| A15 | Stock Assessment of Summer Flounder for 2016 | M. Terceiro |
| A16 | The summer flounder ASAP statistical catch at age model by sex | M. Terceiro |
| B1 | Amendment 6 to the Interstate Fishery Management Plan for Atlantic Striped Bass | ASMFC |
| B2 | 57th SAW/SARC Striped Bass Assessment Report | Striped Bass Working Group |
| B3 | 57th SAW/SARC Striped Bass Assessment Report Appendices | Striped Bass Working Group |
| B4 | 57th SAW/SARC Striped Bass Assessment Summary Report | SARC 57 Panel |
| B5 | Summary Report of the 57th Northeast Regional Stock Assessment Review Committee (SARC 57) | C.M. Jones |
| B6 | Tag recovery estimates of migration of striped bass from spawning areas of the Chesapeake Bay | R. Dorazio et al. |
| B7 | Tag return models allowing for harvest and catch and release: evidence of environmental and management impacts on striped bass fishing and natural mortality rates | H. Jiang et al. |
| B8 | Movement patterns and stock composition of adult striped bass tagged in Massachusetts coastal waters | J. Kneebone et al. |
| B9 | Chronicle of striped bass population restoration and conservation in the northwest Atlantic, 1979-2016 | G. Shepherd et al. |

# 5. Appendices

## Performance Work Statement

**Performance Work Statement (PWS)**
**National Oceanic and Atmospheric Administration (NOAA)**
**National Marine Fisheries Service (NMFS)**
**Center for Independent Experts (CIE) Program**
**External Independent Peer Review**

***66th Stock Assessment Workshop/Stock Assessment Review Committee (SAW/SARC)***
***Benchmark stock assessment for Summer flounder and Striped bass***

**Background**

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer reviews of highly influential and controversial science before dissemination, and that peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards[1]. Further information on the Center for Independent Experts (CIE) program may be obtained from www.ciereviews.org.

**Scope**

The Northeast Regional Stock Assessment Review Committee (SARC) meeting is a formal, multiple-day meeting of stock assessment experts who serve as a panel to peer-review tabled

[1] http://www.cio.noaa.gov/services_programs/pdfs/OMB_Peer_Review_Bulletin_m05-03.pdf

stock assessments and models. The SARC peer review is the cornerstone of the Northeast Stock Assessment Workshop (SAW) process, which includes assessment development, and report preparation (which is done by SAW Working Groups or Atlantic States Marine Fisheries Commission (ASMFC) technical committees), assessment peer review (by the SARC), public presentations, and document publication. This review determines whether or not the scientific assessments are adequate to serve as a basis for developing fishery management advice. Results provide the scientific basis for fisheries within the jurisdiction of NOAA's Greater Atlantic Regional Fisheries Office (GARFO).

The purpose of this meeting will be to provide an external peer review of a benchmark stock assessment **Summer flounder and Striped bass**. The requirements for the peer review follow. This Statement of Work (PWS) also includes: **Appendix 1**: TORs for the stock assessment, which are the responsibility of the analysts; **Appendix 2:** a draft meeting agenda; **Appendix 3:** Individual Independent Review Report Requirements; and **Appendix 4:** SARC Summary Report Requirements.

**Requirements**
NMFS requires three reviewers under this contract (i.e. subject to CIE standards for reviewers) to participate in the panel review. The SARC chair, who is in addition to the three reviewers, will be provided by either the New England or Mid-Atlantic Fishery Management Council's Science and Statistical Committee; although the SARC chair will be participating in this review, the chair's participation (i.e. labor and travel) is not covered by this contract.

Each reviewer will write an individual review report in accordance with the PWS, OMB Guidelines, and the TORs below. All TORs must be addressed in each reviewer's report. No more than one of the reviewers selected for this review is permitted to have served on a SARC panel that reviewed this same species in the past. The reviewers shall have working knowledge and recent experience in the application of modern fishery stock assessment models. Expertise should include forward projecting statistical catch-at-age (SCAA) models. Reviewers should also have experience in evaluating measures of model fit, identification, uncertainty, and forecasting. Reviewers should have experience in development of Biological Reference Points (BRPs) that includes an appreciation for the varying quality and quantity of data available to support estimation of BRPs. For summer flounder, knowledge of flatfish biology and population dynamics would be useful. For striped bass, knowledge of anadromous species and SCAA models with spatial considerations would be useful.

**Tasks for Reviewers**

- Review the background materials and reports prior to the review meeting
- Attend and participate in the panel review meeting
    - The meeting will consist of presentations by NOAA and other scientists, stock assessment authors and others to facilitate the review, to provide any additional

information required by the reviewers, and to answer any questions from reviewers

- Reviewers shall conduct an independent peer review in accordance with the requirements specified in this PWS and TORs, in adherence with the required formatting and content guidelines; reviewers are not required to reach a consensus.
- Each reviewer shall assist the SARC Chair with contributions to the SARC Summary Report
- Deliver individual Independent Review Reports to the Government according to the specified milestone dates
- This report should explain whether each stock assessment Term of Reference of the SAW was or was not completed successfully during the SARC meeting, using the criteria specified below in the "Tasks for SARC panel."
- If any existing Biological Reference Points (BRP) or their proxies are considered inappropriate, the Independent Report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing BRPs are the best available at this time.
- During the meeting, additional questions that were not in the Terms of Reference but that are directly related to the assessments may be raised. Comments on these questions should be included in a separate section at the end of the Independent Report produced by each reviewer.
- The Independent Report can also be used to provide greater detail than the SARC Summary Report on specific stock assessment Terms of Reference or on additional questions raised during the meeting.

**Tasks for SARC panel**

- During the SARC meeting, the panel is to determine whether each stock assessment Term of Reference (TOR) of the SAW was or was not completed successfully. To make this determination, panelists should consider whether the work provides a scientifically credible basis for developing fishery management advice. Criteria to consider include: whether the data were adequate and used properly, the analyses and models were carried out correctly, and the conclusions are correct/reasonable. If alternative assessment models and model assumptions are presented, evaluate their strengths and weaknesses and then recommend which, if any, scientific approach should be adopted. Where possible, the SARC chair shall identify or facilitate agreement among the reviewers for each stock assessment TOR of the SAW.
- If the panel rejects any of the current BRP or BRP proxies (for BMSY and FMSY and MSY), the panel should explain why those particular BRPs or proxies are not suitable, and the panel should recommend suitable alternatives. If such alternatives cannot be identified, then the panel should indicate that the existing BRPs or BRP proxies are the best available at this time.
- Each reviewer shall complete the tasks in accordance with the PWS and Schedule of Milestones and Deliverables below.

**Tasks for SARC chair and reviewers combined:**
Review both the Assessment Report and the draft Assessment Summary Report. The draft Assessment Summary Report is reviewed and edited to assure that it is consistent with the outcome of the peer review, particularly statements about stock status recommendations and descriptions of assessment uncertainty.

The SARC Chair, with the assistance from the reviewers, will write the SARC Summary Report. Each reviewer and the chair will discuss whether they hold similar views on each stock assessment Term of Reference and whether their opinions can be summarized into a single conclusion for all or only for some of the Terms of Reference of the SAW. For terms where a similar view can be reached, the SARC Summary Report will contain a summary of such opinions. In cases where multiple and/or differing views exist on a given Term of Reference, the SARC Summary Report will note that there is no agreement and will specify - in a summary manner – what the different opinions are and the reason(s) for the difference in opinions.

The chair's objective during this SARC Summary Report development process will be to identify or facilitate the finding of an agreement rather than forcing the panel to reach an agreement. The chair will take the lead in editing and completing this report. The chair may express the chair's opinion on each Term of Reference of the SAW, either as part of the group opinion, or as a separate minority opinion. The SARC Summary Report will not be submitted, reviewed, or approved by the Contractor.

If any existing Biological Reference Points (BRP) or BRP proxies are considered inappropriate, the SARC Summary Report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing BRP proxies are the best available at this time.

**Foreign National Security Clearance**
When reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for reviewers who are non-US citizens. For this reason, the reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, country of birth, country of citizenship, country of permanent residence, country of current residence, dual citizenship (yes, no), passport number, country of passport, travel dates.) to the NEFSC SAW Chair for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website:
http://deemedexports.noaa.gov/ and
http://deemedexports.noaa.gov/compliance_access_control_procedures/noaa-foreignnational-

registration-system.html. The contractor is required to use all appropriate methods to safeguard Personally Identifiable Information (PII).

**Place of Performance**
The place of performance shall be at the contractor's facilities, and at the Northeast Fisheries Science Center in Woods Hole, Massachusetts.

**Period of Performance**
The period of performance shall be from the time of award through January 31, 2019. Each reviewer's duties shall not exceed **16** days to complete all required tasks.

**Schedule of Milestones and Deliverables:** The contractor shall complete the tasks and deliverables in accordance with the following schedule.

| | |
|---|---|
| No later than Oct. 26, 2018 | Contractor selects and confirms reviewers |
| No later than Nov. 13, 2018 | NMFS Project Contact will provide reviewers the pre-review documents |
| Nov. 27-30, 2018 | Each reviewer participates and conducts an independent peer review during the panel review meeting in Woods Hole, MA |
| Nov. 30, 2018 | SARC Chair and reviewers work at drafting reports during meeting at Woods Hole, MA, USA |
| Dec. 14, 2018 | Reviewers submit draft independent peer review reports to the contractor's technical team for review |
| Dec. 14, 2018 | Draft of SARC Summary Report, reviewed by all reviewers, due to the SARC Chair * |
| Dec. 21, 2018 | SARC Chair sends Final SARC Summary Report, approved by reviewers, to NMFS Project contact (i.e., SAW Chairman) |
| Jan. 2, 2019 | Contractor submits independent peer review reports to Government |
| Jan. 9, 2019 | The COR and/or technical POC distributes the final reports to the NMFS Project Contact the NMFS Project Contact |

* The SARC Summary Report will not be submitted to, reviewed, or approved by the Contractor.

**Applicable Performance Standards**
The acceptance of the contract deliverables shall be based on three performance standards: (1) The reports shall be completed in accordance with the required formatting and content (2) The reports shall address each TOR as specified (3) The reports shall be delivered as specified in the schedule of milestones and deliverables.

**Travel**
All travel expenses shall be reimbursable in accordance with Federal Travel Regulations (http://www.gsa.gov/portal/content/104790). International travel is authorized for this contract. Travel is not to exceed $12,000.

**Restricted or Limited Use of Data**
The contractors may be required to sign and adhere to a non-disclosure agreement.

**NMFS Project Contact**
Dr. James Weinberg, NEFSC SAW Chair
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## Appendix 1: Stock Assessment Terms of Reference for SAW/SARC-66

**Appendix 1.**

*The SARC Review Panel shall assess whether or not the SAW Working Group has reasonably and satisfactorily completed the following actions.*

The stock assessments for SAW/SARC66 require new calibrated catch and effort data from the Marine Recreational Information Program (MRIP). For these assessments to happen, the assessment scientists need the new MRIP data in a form ready for analysis by July 1, 2018.

**A. Summer flounder**

1. Estimate catch from all sources, including landings and discards. Describe the spatial and temporal distribution of landings, discards, and fishing effort. Characterize the uncertainty in these sources of data. Compare previous recreational data to re-estimated Marine Recreational Information Program (MRIP) data (if available).

2. Present the survey data available, and describe the basis for inclusion or exclusion of those data in the assessment (e.g., indices of relative or absolute abundance, recruitment, state surveys, age-length data, etc.). Investigate the utility of commercial or recreational LPUE as a measure of relative abundance. Characterize the uncertainty and any bias in these sources of data.

3. Describe life history characteristics and the stock's spatial distribution (for both juveniles and adults), including any changes over time. Describe factors related to productivity of the stock and any ecosystem factors influencing recruitment. If possible, integrate the results into the stock assessment.

4. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and estimate their uncertainty. Include retrospective analyses (both historical and within-model) to allow a comparison with previous assessment results and projections, and to examine model fit. Examine sensitivity of model results to changes in re-estimated recreational data.

5. State the existing stock status definitions for "overfished" and "overfishing". Then update or redefine biological reference points (BRPs; point estimates or proxies for $B_{MSY}$, $B_{THRESHOLD}$, $F_{MSY}$ and MSY) and provide estimates of their uncertainty. If analytic model-based estimates are unavailable, consider recommending alternative measurable proxies for BRPs. Comment on the scientific adequacy of existing BRPs and the "new" (i.e., updated, redefined, or alternative) BRPs.

6. Make a recommendation[1] about what stock status appears to be, based on the existing model (i.e., model from previous peer reviewed accepted assessment) and with respect to a new modeling approach(-es) developed for this peer review.

    a. Update the existing model with new data and make a stock status recommendation (about overfished and overfishing) with respect to the existing BRP estimates.
    b. Then use the newly proposed modeling approach(-es) and make a stock status recommendation with respect to "new" BRPs and their estimates (from TOR-5).
    c. Include descriptions of stock status based on simple indicators/metrics (e.g., age-and size-structure, temporal trends in population size or recruitment indices, etc).

7. Develop approaches and apply them to conduct stock projections.

    a. Provide numerical annual projections (5 years) and the statistical distribution (i.e., probability density function) of the catch at FMSY or an FMSY proxy (i.e. the overfishing level, OFL) (see Appendix to the SAW TORs). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. Use a sensitivity analysis approach in which a range of assumptions about the most important uncertainties in the assessment are considered (e.g., terminal year abundance, variability in recruitment).
    b. Comment on which projections seem most realistic. Consider the major uncertainties in the assessment as well as sensitivity of the projections to various assumptions. Identify reasonable projection parameters (recruitment, weight-at-age, retrospective adjustments, etc.) to use when setting specifications.
    c. Describe this stock's vulnerability (see "Appendix to the SAW TORs") to becoming overfished, and how this could affect the choice of ABC.

8. Review, evaluate and report on the status of the SARC and Working Group research recommendations listed in most recent SARC reviewed assessment and review panel reports and MAFMC SSC reports. Identify new research recommendations.

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[1]NOAA Fisheries has final responsibility for making the stock status determination for this stock based on best available scientific information.

**B. Striped bass**

1. Investigate all fisheries independent and dependent data sets, including life history, indices of abundance, and tagging data. Discuss strengths and weaknesses of the data sources.

2. Estimate commercial and recreational landings and discards. Characterize the uncertainty in the data and spatial distribution of the fisheries. Review new MRIP estimates of catch, effort and the calibration method, if available.

3. Use an age-based model to estimate annual fishing mortality, recruitment, total abundance and stock biomass (total and spawning stock) for the time series and estimate their uncertainty. Provide retrospective analysis of the model results and historical retrospective. Provide estimates of exploitation by stock component and sex, where possible, and for total stock complex.

4. Use tagging data to estimate mortality and abundance, and provide suggestions for further development.

5. Update or redefine biological reference points (BRPs; point estimates or proxies for $B_{MSY}$, $SSB_{MSY}$, $F_{MSY}$, MSY) for each stock component where possible and for the total stock complex. Make a stock status determination based on BRPs by stock component, where possible, and for the total stock complex.

6. Provide annual projections of catch and biomass under alternative harvest scenarios. Projections should estimate and report annual probabilities of exceeding threshold BRPs for F and probabilities of falling below threshold BRPs for biomass.

7. Review and evaluate the status of the Technical Committee research recommendations listed in the most recent SARC report. Identify new research recommendations. Recommend timing and frequency of future assessment updates and benchmark assessments.

***SAW Assessment TORs:***

**Clarification of Terms**
**used in the Stock Assessment Terms of Reference**

**Guidance to SAW Working Group about "Number of Models to include in the Assessment Report":**

In general, for any TOR in which one or more models are explored by the Working Group, give a detailed presentation of the "best" model, including inputs, outputs, diagnostics of model adequacy, and sensitivity analyses that evaluate robustness of model results to the assumptions. In less detail, describe other models that were evaluated by the Working Group and explain their strengths, weaknesses and results in relation to the "best" model. If selection of a "best" model is not possible, present alternative models in detail, and summarize the relative utility each model, including a comparison of results. It should be highlighted whether any models represent a minority opinion.

**On "Acceptable Biological Catch" (DOC Nat. Stand. Guidelines. Fed. Reg., v. 74, no. 11, 1-16- 2009):**

*Acceptable biological catch (ABC)* is a level of a stock or stock complex's annual catch that accounts for the scientific uncertainty in the estimate of Overfishing Limit (OFL) and any other scientific uncertainty..." (p. 3208) [In other words, OFL ≥ ABC.]

*ABC for overfished stocks.* For overfished stocks and stock complexes, a rebuilding ABC must be set to reflect the annual catch that is consistent with the schedule of fishing mortality rates in the rebuilding plan. (p. 3209)

NMFS expects that in most cases ABC will be reduced from OFL to reduce the probability that overfishing might occur in a year. (p. 3180)

ABC refers to a level of ''catch'' that is ''acceptable'' given the ''biological'' characteristics of the stock or stock complex. As such, Optimal Yield (OY) does not equate with ABC. The specification of OY is required to consider a variety of factors, including social and economic factors, and the protection of marine ecosystems, which are not part of the ABC concept. (p. 3189)

**On "Vulnerability" (DOC Natl. Stand. Guidelines. Fed. Reg., v. 74, no. 11, 1-16-2009):**

*"Vulnerability.* A stock's vulnerability is a combination of its productivity, which depends upon its life history characteristics, and its susceptibility to the fishery. Productivity refers to the capacity of the stock to produce Maximum Sustainable Yield

(MSY) and to recover if the population is depleted, and susceptibility is the potential for the stock to be impacted by the fishery, which includes direct captures, as well as indirect impacts to the fishery (e.g., loss of habitat quality).” (p. 3205)

**Participation among members of a Stock Assessment Working Group:**

Anyone participating in SAW meetings that will be running or presenting results from an assessment model is expected to supply the source code, a compiled executable, an input file with the proposed configuration, and a detailed model description in advance of the model meeting. Source code for NOAA Toolbox programs is available on request. These measures allow transparency and a fair evaluation of differences that emerge between models.

## Appendix 2. Draft Review Meeting Agenda

**Appendix 2.**

**66th Stock Assessment Workshop/Stock Assessment Review Committee (SAW/SARC)**
**Benchmark stock assessment for A. Summer flounder and B. Striped bass**

**November 27-30, 2018**

Stephen H. Clark Conference Room – Northeast Fisheries Science Center
Woods Hole, Massachusetts

**DRAFT AGENDA*** (version: Oct. 9, 2018)

| TOPIC | PRESENTER(S) | RAPPORTEUR |
|---|---|---|

**Tuesday, Nov. 27**

**10 – 10:45 AM**

| | | |
|---|---|---|
| Welcome/Description of Review Process<br>Introductions/Agenda<br>Conduct of Meeting | **James Weinberg**, SAW Chair<br>**Robert Latour**, SARC Chair | |
| **10:45 – 12:45 PM** | Assessment Presentation (A. Summer flounder)<br>**Mark Terceiro** | **TBD** |
| **12:45 – 1:45 PM** | Lunch | |
| **1:45 – 3:45 PM** | Assesssment Presentation (A. Summer flounder)<br>**Mark Terceiro** | **TBD** |
| **3:45 – 4 PM** | Break | |
| **4 – 5:45 PM** | SARC Discussion w/ Presenters (A. Summer flounder)<br>**Robert Latour,** SARC Chair | **TBD** |
| **5:45 – 6 PM** | Public Comments | |

| TOPIC | PRESENTER(S) | RAPPORTEUR |
|---|---|---|

**Wednesday, Nov. 28**

| | | |
|---|---|---|
| **8:30 – 10:30 AM** | Assessment Presentation (B. Striped bass)<br>**Katie Drew, Gary Nelson, Mike Celestino** | **TBD** |
| **10:30 – 10:45 AM** | Break | |
| **10:45 – 12:30 PM** | Assessment Presentation (B. Striped bass)<br>**Katie Drew, Gary Nelson, Mike Celestino** | **TBD** |
| **12:30 – 1:30 PM** | Lunch | |
| **1:30 – 3:30 PM** | SARC Discussion w/presenters (B. Striped bass)<br>**Robert Latour,** SARC Chair | **TBD** |
| **3:30 – 3:45 PM** | Public Comments | |
| **3:45 -4 PM** | Break | |
| **4 – 6 PM** | Revisit with Presenters (A. Summer flounder )<br>**Robert Latour,** SARC Chair | **TBD** |
| **7 PM** | **(**Social Gathering**)** | |

| TOPIC | PRESENTER(S) | RAPPORTEUR |
|---|---|---|

**Thursday, Nov. 29**

| | | |
|---|---|---|
| **8:30 – 10:30** | Revisit with Presenters (B. Striped bass)<br>**Robert Latour,** SARC Chair | **TBD** |
| **10:30 – 10:45** | Break | |
| **10:45 – 12:15** | Review/Edit Assessment Summary Report (A. Summer | |

| | | |
|---|---|---|
| | flounder)<br>**Robert Latour,** SARC Chair | **TBD** |
| **12:15 – 1:15 PM** | Lunch | |
| **1:15 – 2:45 PM** | (cont.) Edit Assessment Summary Report (A. Summer flounder)<br>**Robert Latour,** SARC Chair | **TBD** |
| **2:45 – 3 PM** | Break | |
| **3 – 6 PM** | Review/edit Assessment Summary Report (B. Striped bass)<br>**Robert Latour,** SARC Chair | **TBD** |

**<u>Friday, Nov. 30</u>**

| | |
|---|---|
| **9:00 AM – 5:00 PM** | SARC Report writing |

*All times are approximate, and may be changed at the discretion of the SARC chair. The meeting is open to the public; however, during the Report Writing sessions we ask that the public refrain from engaging in discussion with the SARC.

## Appendix 3. Individual Independent Peer Review Report Requirements

**Appendix 3.**

1. The independent peer review report shall be prefaced with an Executive Summary providing a concise summary of whether they accept or reject the work that they reviewed, with an explanation of their decision (strengths, weaknesses of the analyses, etc.).

2. The report must contain a background section, description of the individual reviewers' role in the review activities, summary of findings for each TOR in which the weaknesses and strengths are described, and conclusions and recommendations in accordance with the TORs. The independent report shall be an independent peer review, and shall not simply repeat the contents of the SARC Summary Report.

    a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including a concise summary of whether they accept or reject the work that they reviewed, and explain their decisions (strengths, weaknesses of the analyses, etc.), conclusions, and recommendations.

    b. Reviewers should discuss their independent views on each TOR even if these were consistent with those of other panelists, but especially where there were divergent views.

    c. Reviewers should elaborate on any points raised in the SARC Summary Report that they believe might require further clarification.

    d. The report may include recommendations on how to improve future assessments.

3. The report shall include the following appendices:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of this Statement of Work
   Appendix 3: Panel membership or other pertinent information from the panel review meeting.

## Appendix 4. SARC Summary Report Requirements

**Appendix 4.**

1. The main body of the report shall consist of an introduction prepared by the SARC chair that will include the background and a review of activities and comments on the appropriateness of the process in reaching the goals of the SARC. Following the introduction, for each assessment reviewed, the report should address whether or not each Term of Reference of the SAW Working Group was completed successfully. For each Term of Reference, the SARC Summary Report should state why that Term of Reference was or was not completed successfully.

   To make this determination, the SARC chair and reviewers should consider whether or not the work provides a scientifically credible basis for developing fishery management advice. If the reviewers and SARC chair do not reach an agreement on a Term of Reference, the report should explain why. It is permissible to express majority as well as minority opinions. The report may include recommendations on how to improve future assessments.

2. If any existing Biological Reference Points (BRPs) or BRP proxies are considered inappropriate, include recommendations and justification for alternatives. If such alternatives cannot be identified, then indicate that the existing BRPs or BRP proxies are the best available at this time.

3. The report shall also include the bibliography of all materials provided during the SAW, and relevant papers cited in the SARC Summary Report, along with a copy of the CIE Statement of Work.

   The report shall also include as a separate appendix the assessment Terms of Reference used for the SAW, including any changes to the Terms of Reference or specific topics/issues directly related to the assessments and requiring Panel advice.