CONTRIBUTIONS TO THE SAW62 BLACK SEA BASS STOCK ASSESSMENT

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Summary – SCeMFiS funded the finfish stock assessment team to contribute to the 62nd Northeast Regional Stock Assessment Workshop as members of the Black Sea Bass Stock Assessment Working Group. The team participated in all Working Group meetings, calls and correspondence during 2015 and 2016; contributed technical reports on data-limited stock assessment approaches, integrated modeling, and simulation testing; contributed to the consensus Working Group Report; and participated in the Stock Assessment Review Committee. An analytical stock assessment that accounts for spatial structure was accepted as a basis for fishery management. The stock assessment concluded that the stock is well above the rebuilding target (not overfished), and overfishing is not occurring (Figure 1). The SAW62 assessment is a major scientific advancement for improving black sea bass fishery management.

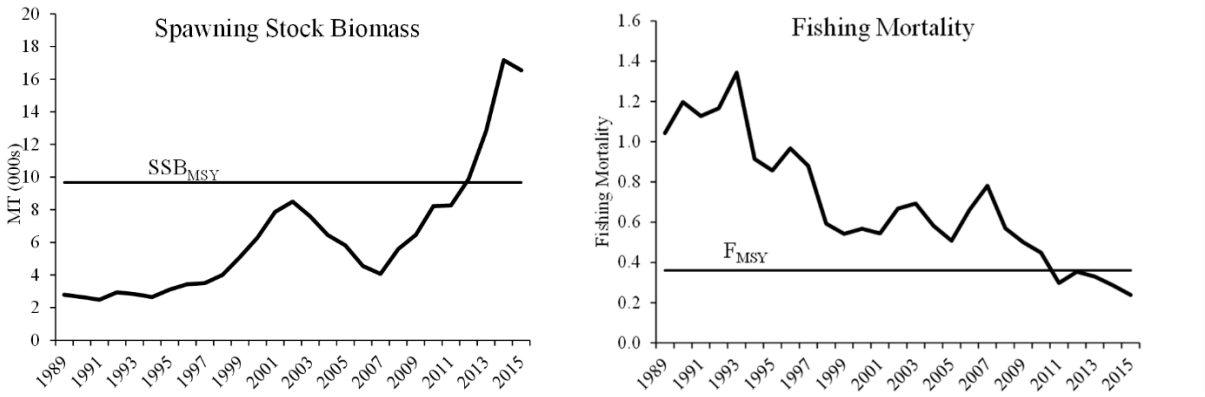

Figure 1. Estimates of black sea bass spawning stock biomass and fishing mortality rates relative to maximum sustainable yield reference points (from SAW62 summary report).

Notes:

1. ***This report presents the perspectives of the authors - not necessarily the black sea bass working group, the stock assessment review committee, or SCeMFiS.***
2. ***This summary includes information developed by the SAW62 Black Sea Bass Working Group, with substantial contributions from Gary Shepherd (NEFSC), Gavin Fay (UMass Dartmouth) and Jason McNamee (RIDEM), with matching funding from MAFMC.***

Background - Recent stock assessments of black sea bass were based on fishery catch and survey trends, because attempts to develop analytical stock assessment models have been rejected. The previous assessment of black sea bass (SARC 53, NEFSC 2012) was rejected because "*The Panel identified substantial concerns over the potential for spatial structure and incomplete mixing within the stock area that compromised the ability of the forward projecting catch at age model to index abundance and fishing mortality reliably based on the data available*." The Mid Atlantic Fishery Management Council's control rule for Acceptable Biological Catch (ABC) has a tiered approach, in which catch limits are based on catch history or some other ad hoc approach when no reliable assessment exists (Carmichael & Fenske 2011). ABC recommendations for black sea bass were based on catch history (Figure 2).

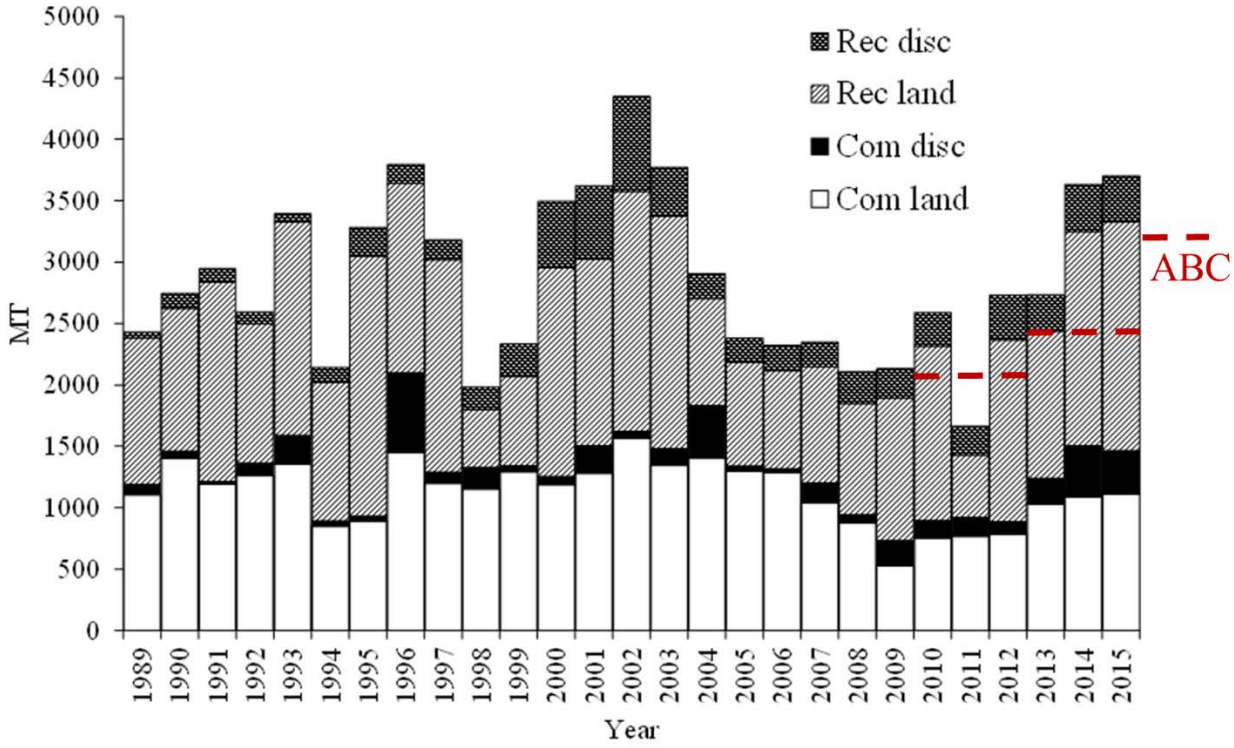

Figure 2. Black sea bass catch and Acceptable Biological Catch (ABC: red dashed lines; modified from SAW62 summary report).

Commercial landings have been within or slightly greater than the commercial quota (e.g., 95% to 106% of quota since 2010), but despite increasingly restrictive regulations, recreational landings have greatly exceeded the recreational quota in most recent years (e.g., 170% of quota in 2015). Commercial and recreational fishermen report increasing availability of black sea bass in recent years, particularly in northern areas. In response to the uncertain scientific basis for catch limits and the challenges of limiting fisheries when availability is increasing, the Atlantic States Marine Fisheries Commission and Mid Atlantic Fishery Management Council requested a new benchmark stock assessment of black sea bass for the 62nd Northeast Regional Stock Assessment Workshop.

Data-Limited Catch Advice - An analysis was presented to the Mid Atlantic Council's Scientific & Statistical Committee (SSC) in September 2015 to provide a more analytical basis for catch recommendations in the interim of a benchmark stock assessment for black sea bass (McNamee et al. 2015). The DLMtool analytical software (Carruthers et al. 2014)) was used to evaluate fishery management procedures using simulations from an operating model which was parameterized to represent the black sea bass fishery. The SSC formed a peer review panel that concluded that four methods used to estimate reference points provide a reasonable basis for ABC recommendations. Three methods use the magnitude of recent catch and the recent stock trends in stock abundance to derive an ABC recommendation. The fourth method is based on constant catch, the method currently applied by the SSC. The SSC used the four data-limited approaches to revise the 2016 and 2017 ABC recommendation to 3,024 mt.

Spatial Stock Structure - An initial term of reference for the benchmark assessment was to "*evaluate the distribution, movement and potential for spatial structure of the stock, the ability of existing data to support alternative spatial structure, and their consequences for the stock assessment*." The SAW62 Black Sea Bass Working Group met in December 2015 to review the information available on spatial structure and determine how to proceed with the development of a spatially-explicit stock assessment. The consensus was that the most reasonable approach was to consider a spatial boundary near Hudson Canyon for assessment model development and simulation testing, which reflects a natural discontinuity in spatial processes in the black sea bass resource. A SSC Review Panel concluded that "this separation is reasonable and appropriate to use as a starting point for developing stock assessment models."

Stock Synthesis Application – The Mid Atlantic Fisheries Management Council solicited research for "Development of a Quantitative Stock Assessment for Black Sea Bass", specifically to participate in the development of a new quantitative stock assessment for which addresses the concerns raised about the stock assessment model developed for review at SARC53 and to work collaboratively with stock assessment scientists at the NEFSC and the ASMFC Technical Committee to facilitate the development of a stock assessment model which will ultimately form the basis for setting annual catch limits for BSB, including forward projecting statistical catch-at-age and catch-at-length models. With matching funds from SCeMFiS, SMAST was funded by the Council to collaborate with stock assessment scientists at NEFSC, ASMFC and MAFMC SSC to develop and test the performance of a set of alternative configurations of statistical catch at age estimation models for black sea bass.

Stock Synthesis (SS, Methot & Wetzel 2013) was applied to the fishery and survey as specified by the SAW62 Black Sea Bass Working Group as well as the available tagging data to estimate stock size and fishing mortality. The SS model was structured spatially (north and south of a boundary near Hudson Canyon), seasonally, by fleet and demographically by length, age, and sex. The model fits available fishery, survey and tagging data relatively well. Results suggest that the stock has increased in the last decade from strong recruitment (Figure 3), fishing mortality decreased to relatively low values in the last decade, selectivity of all fleets shifted to older ages after the 1997 management actions, and seasonal movement rates between regions is relatively low. Sensitivity analyses indicate that these results are robust to alternative model configurations.

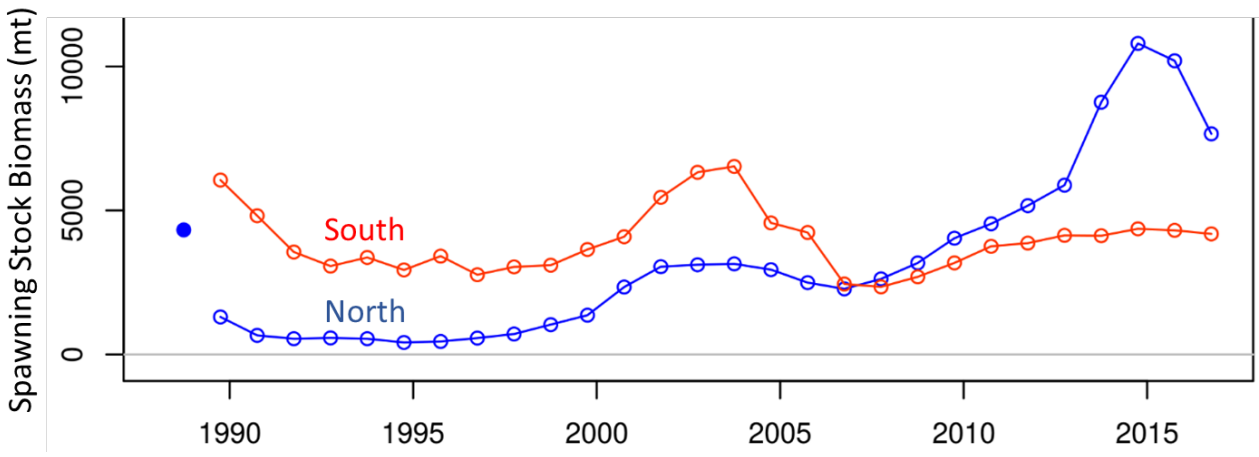

Figure 3. Estimated spawning stock biomass (mt, males and females) from the Stock Synthesis model.

Simulation Testing – Alternative configurations of SS, including spatially-explicit models with a boundary near Hudson Canyon, were developed for the data available for assessing black sea bass. Alternative SS configurations were tested through simulation analyses. A complex operating model including spatial, seasonal, age, length, sex, and fleet structure was developed to produce pseudo-datasets that were characteristic of the information available for assessment, and the alternative SS configurations were fitted to the pseudo-datasets. Results suggest that a 1-area assessment model ('1-area') did not perform as well as spatially-explicit assessment models, and models that did not allow for seasonal movement ('no move') and did not account for hermaphroditism ('no hermaph') performed nearly as well as the most complex model with seasonal movement and hermaphroditism (Figure 4).

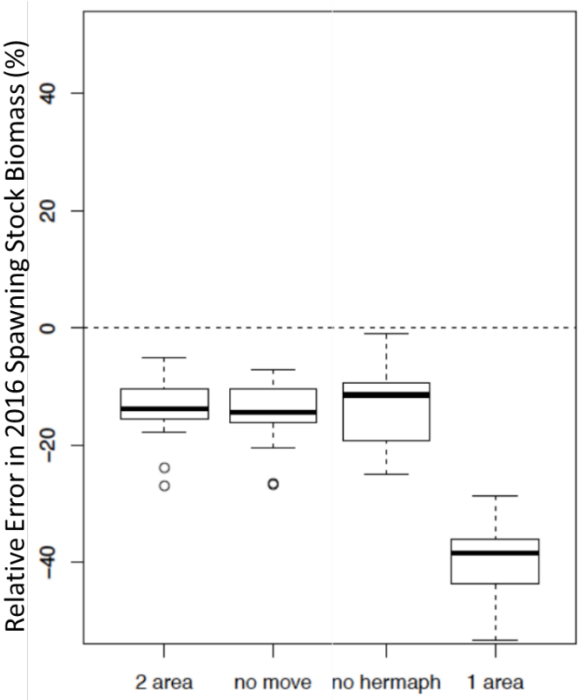

Figure 4. Relative error of 2016 spawning biomass estimates, for estimation models fit to pseudo-data generated from the 2 area operating model.

Stock Assessment Workshop – Based on the simulation testing and the available expertise, the Black Sea Bass Working Group presented multiple modeling approaches, and proposed a spatially explicit statistical catch-at-age models (ASAP, Legault & Restrepo 1998) as the preferred approach. The resource and fisheries were modeled using ASAP as two separate areas within the stock area. The fisheries were modeled as trawl and non-trawl fleets with indices of stock abundance from NEFSC winter and spring surveys, NEAMAP surveys, recreational catch per effort, as well as state survey indices from MA,RI,CT,NY,NJ, DE,MD and VA. The average of the north and south F and the sum of the north and south biomass were used to determine stock status.

The Stock Assessment Review Committee requested a comparison of SS and ASAP results. The comparison shows similar general results from two modeling approaches with considerable differences (Figure 5). The approach of applying ASAP to sub-units was accepted as the best scientific information available for determining stock status for black sea bass.

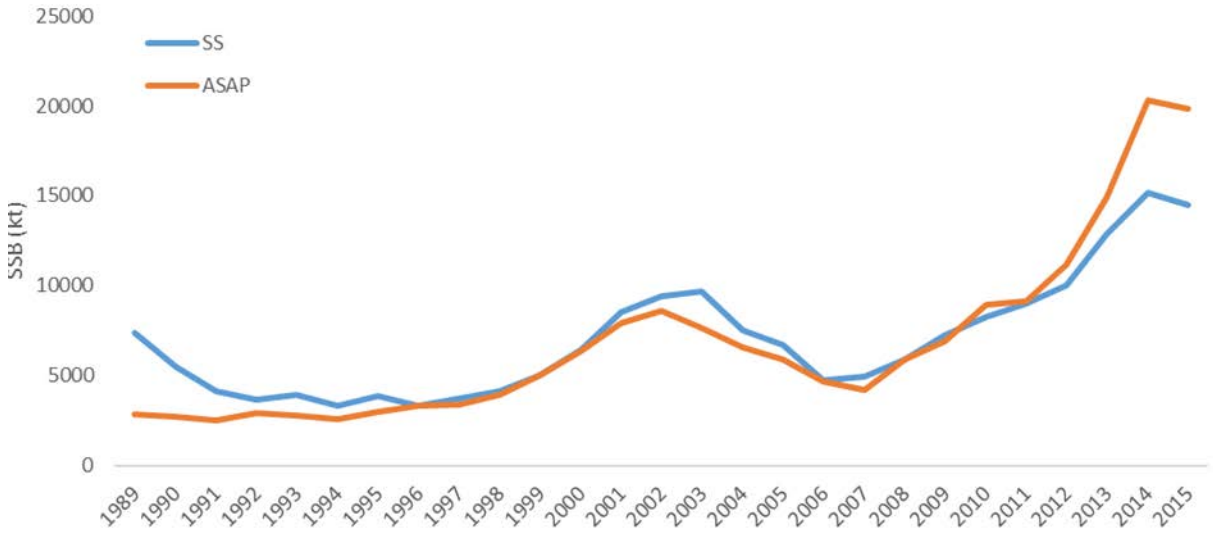

Figure 5. Estimates of spawning stock biomas from Stock Synthesis (SS) and Age-Structured Assessment Program (ASAP).

ASAP model results indicate that the black sea bass stock is not overfished and overfishing is not occurring (Figure 1). Spawning stock biomass in 2015 was estimated to be 130% of the SSB_{MSY} proxy, and 2015 fishing mortality was estimated to be 75% of the F_{MSY} proxy (Figure 1). Preliminary projections suggest that catch recommendations should be based on overfishing limits of 5,490 mt in 2017, 4,517 in 2018, and 3,918 mt in 2019.

References

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