SCRS 2017/188

ADDENDUM TO THE DETAILED REPORT OF THE 2017 BLUEFIN TUNA STOCK ASSESSMENT SESSION

UPDATES TO BLUEFIN TUNA STOCK ASSESSMENT MODELS ADOPTED DURING THE 2017 BLUEFIN TUNA SPECIES GROUP MEETING

Bluefin Tuna Species Group

SUMMARY

Several changes were made to the model specifications set forth in the report of the 2017 Bluefin Tuna Stock Assessment based on analyses conducted after the meeting. For the western stock, the major change was to combine the results from the VPA and Stock Synthesis models with equal weight given to each. For the eastern stock, the base VPA was modified by fixing the F-ratio for the last period to 1.0 and the projections were modified by replacing the last 4 recruitments estimated by the VPA with the average recruitment from 2006-2011.

KEYWORDS
stock assessment, Atlantic bluefin tuna,

Assessment of Western Atlantic Bluefin Tuna

Base VPA

The base case VPA configuration remains the same as specified during from the July assessment. The numbers and figures that appear in the Detailed report differ somewhat from those shown during the July assessment workshop, indicating slightly higher recruitments in recent years and resulting in somewhat higher projected catches at F0.1. It was explained that the results shown in July were provisional and based on only the few bootstraps that could be completed in the time available. Subsequently, the starting guesses and random number seeds were varied across a wider grid to better ensure that the model arrived at the lowest possible objective function value. The number of bootstraps was increased to 500.

Base Stock Synthesis model

The base SS model configurations remain largely unchanged since the July assessment with a few minor modifications documented in SCRS-2017-176. These modifications include incorporating the new ICCAT length weight relationship. After doing so, the original model evidenced some relatively minor instability in jitter performance due to the presence of several highly correlated selectivity parameters. To address this, several values were fixed at their previous (Runs 10 and 11) values. The parameters that were fixed were: SizeSel_3P_1_USA_CAN_PSFB, SizeSel_2P_1_USA_CAN_PSFS and SizeSel_1P_1_JAPAN_LL_BLK1-repl_1950 and L_at_Amin_Fem_GP_1. The results for biomass, recruitment and apical fishing mortality from the final configuration were almost indistinguishable from those shown in July.

Projections

The group considered the diagnostics and concluded that the results from the VPA and Stock Synthesis (SS) models should be considered equally plausible. Short-term projections (2018-2020) of bootstrap replicates were made for both models assuming recruitment would fluctuate (or, in SS, are constant) around the average of estimates over the six year period from 2007 to 2012 (as specified in the 2017 Detailed report). Inasmuch the results from the SS model varied somewhat with the spawning schedule assumed owing to its effect on the estimate of steepness, 250 bootstraps were generated for each case (younger and older spawning). The 500 bootstraps from the VPA and the 500 from stock synthesis were combined to generate a single Kobe matrix based on the probability of not overfishing. As explained below, the past practice of using the high and low recruitment potential scenarios to compute biomass-based reference points and the probability of being overfished was discontinued.

Assessment of Eastern Atlantic and Mediterranean Bluefin Tuna

Base VPA

The base case VPA from the July assessment workshop indicates that the 2004-2007 cohorts for Eastern Atlantic bluefin tuna were as strong as the large 2003 cohort. SCRS/2017/187 carried out a model-free exercise to inform on the relative strengths of the 2003-2007 year classes based on conversions to an age basis of selectivity-adjusted catch at length data distributions for the Japanese Northeast Atlantic longline fishery and the trap fishery. These results were compared to the output from the base case VPA and revealed inconsistencies, with the catch at length data suggesting that the 2003 cohort was certainly stronger than those for 2004-2007. In addition, this catch at length information was somewhat more compatible with alternative VPA runs that indicate lower recruitment and lower biomass in recent years than the base case VPA run does. However, the analysis did not allow a quantification of the extent of change in VPA specifications that would best reflect the available data as a whole.

In discussion it was suggested that the selectivity assumptions used for the trap fishery could be improved. However, the meeting agreed that the analysis of the Japanese longline data alone was sufficient to confirm that the July VPA base run was overestimating the strengths of the 2004-2007 cohorts relative to the 2003 cohort. This conclusion was supported by the pattern of recruitments estimated by the preliminary SS assessment, which inputs catch at length data directly.

The Group noted that the F-ratio estimate (ratio of the fishing mortality rate on age 10+ to the fishing mortality rate on age 9) for the last period exhibited a strong retrospective pattern, suggesting that it is not well-determined. It was noted that there is little reason to expect the F on age 9 to differ from older fish given the general shift toward large fish in the catch and the perception that eastern Bluefin fully participate in spawning by age 5. It was also pointed out the F-ratio estimated by the preliminary SS model was very close to 1.0 for the same period. Therefore, the Group elected to modify the base VPA by fixing the F-ratio for the last period to 1.0. Doing so resulted in only a small increase in the AIC (suggesting weak evidence for a value different than 1.0) and considerable improvement in the retrospective pattern of the recruitment estimates, and of the overall biomass in relative terms (**Figure 1**). However, the latter is achieved at the expense of the introduction of a pattern in overall biomass in absolute terms, and is especially evident .in a substantial increase with the addition of the last year of data (**Figure 2**). Nonetheless, the estimates of the 2004-2007 cohorts were substantially less than the 2003 year-class as indicated to be appropriate by SCRS/2017/187. The Group consequently agreed that the July VPA base case should be modified by fixing the F-ratio for the last period equal to 1.0.

Projections

The specifications for the VPA-based projections of the eastern stock were as specified in the detailed report except that the Group elected to replace the recruitment estimates from the last four years of the VPA with the average value from 2006 to 2011. Short-term projections of the bootstrap replicates were then made through 2022 assuming future recruitment would fluctuate about this same average. For illustrative purposes, the Group agreed to make deterministic projections under the high, medium and low recruitment levels specified in July. However, as explained below, the past practice of using these values to compute Kobe matrices was discontinued.

Kobe matrices and the choice of reference points

Recent assessments of both the eastern and western stocks have attempted to develop Kobe plots and matrices depicting the status of the stock relative to certain reference points, despite a general consensus that they did not adequately reflect the true range of uncertainties. The long-term recruitment potential in particular is unknown and probably changes over time. Mindful of the Commission's request for Kobe matrices, the WBFT Group has attempted to bracket the long-term recruitment potential with "high" and "low" scenarios based on two different spawner-recruit relationships fit to recruitment estimates from different periods of years. Similarly, the EBFT Group has attempted to bracket the range of possibilities with three different constant recruitment scenarios corresponding also to different periods. This bracketing approach has not proven especially helpful in either case because the range of possibilities is so large.

Despite considerable efforts to improve the historical data for both stocks, the Group has not gained any further insights into future recruitment potential. As any additional improvements to the historical data are likely to be rather modest in scope, the Group expects such insights to remain elusive. Moreover, the Convention objective of stabilizing the stock near the level that will produce the maximum sustainable catch by its very nature prevents the stock from reaching the high levels necessary to provide the needed contrast. Accordingly, the Group has elected to focus on fishing-mortality based reference points that do not require knowledge of long-term recruitment potential, but nevertheless can be implemented in a manner that will lead to rebuilding.

It is not possible to calculate F_{MSY} apart from the knowledge (or assumptions) about how future recruitment potential relates to spawning stock biomass. In the absence of such knowledge, several F reference points have been used in the past as proxies for F_{MSY}. The reference point of choice for the Eastern stock has been F0.1.

SCRS/2017/227 investigated the relationships between F0.1 and F_{MSY} values for North Atlantic bluefin assessments and their dependence on the Beverton-Holt stock-recruitment steepness parameter h. It found that F_{MSY} was higher than F0.1 at high values of h, but that the opposite was true at low values of h. The transition values for h for which the two were equal were 0.70 and 0.80 for the Western stock (for the younger and older spawning vectors respectively), and 0.68 for the Eastern stock (for which the young spawning vector is applied).

It was noted that F0.1 provided values in the right range for FMSY when stock-recruitment effects were taken into account, given estimates for h for similar species (e.g. southern bluefin tuna with h in the range of 0.6 to 0.8). Accordingly, the Group elected to adopt F0.1 as the stock status reference point for both stocks. The Kobe matrices were computed on the basis of the probability that overfishing does not occur (F<F0.1) and the Kobe plot is not given because the corresponding long-term biomass reference point (B0.1) cannot be reliably determined owing to the uncertainty about future recruitment. However, it is important to point out that, over the long term, fishing at F0.1 will cause the resource to fluctuate around B0.1 whatever the future recruitment level.

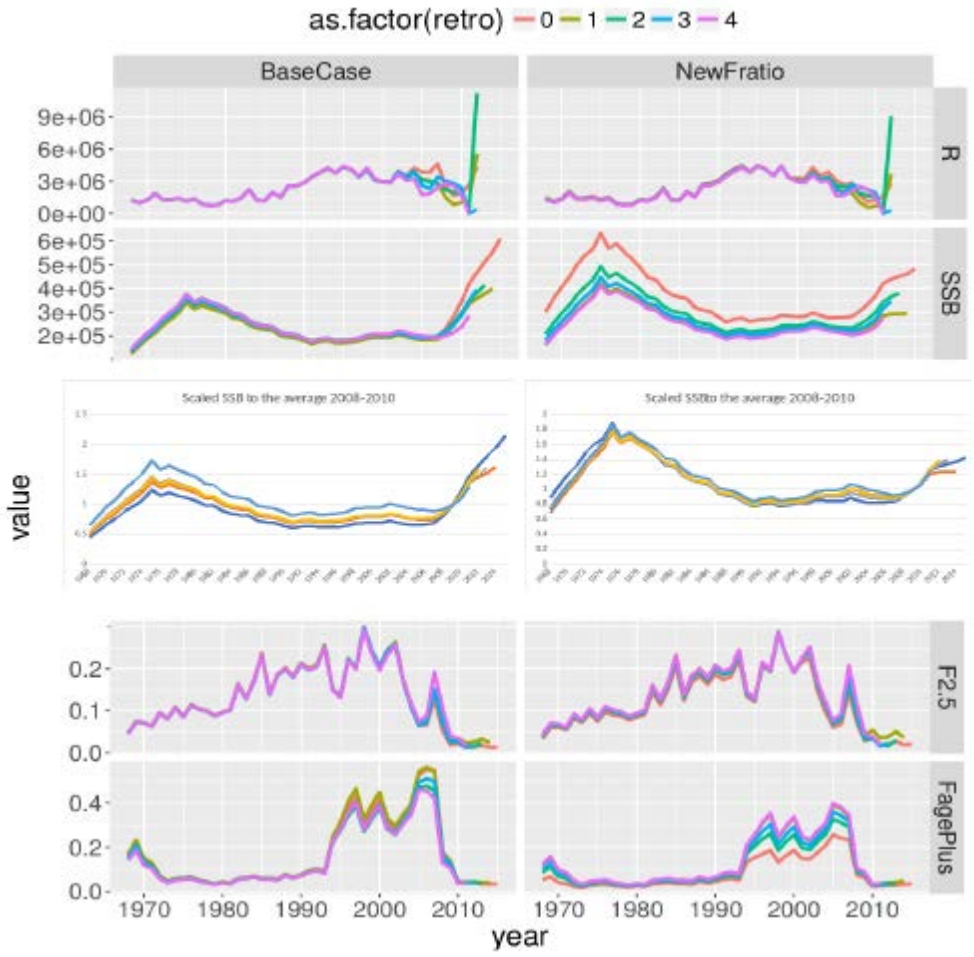

Figure 1. Retrospective estimates of recruitment (in millions), SSB, relative SSB and fishing mortality (average over ages 2 to 5, and 10+) from the revised VPA base run adopted during the species group meeting. The last four years recruitments (2012-2015) are not shown because they are poorly estimated.

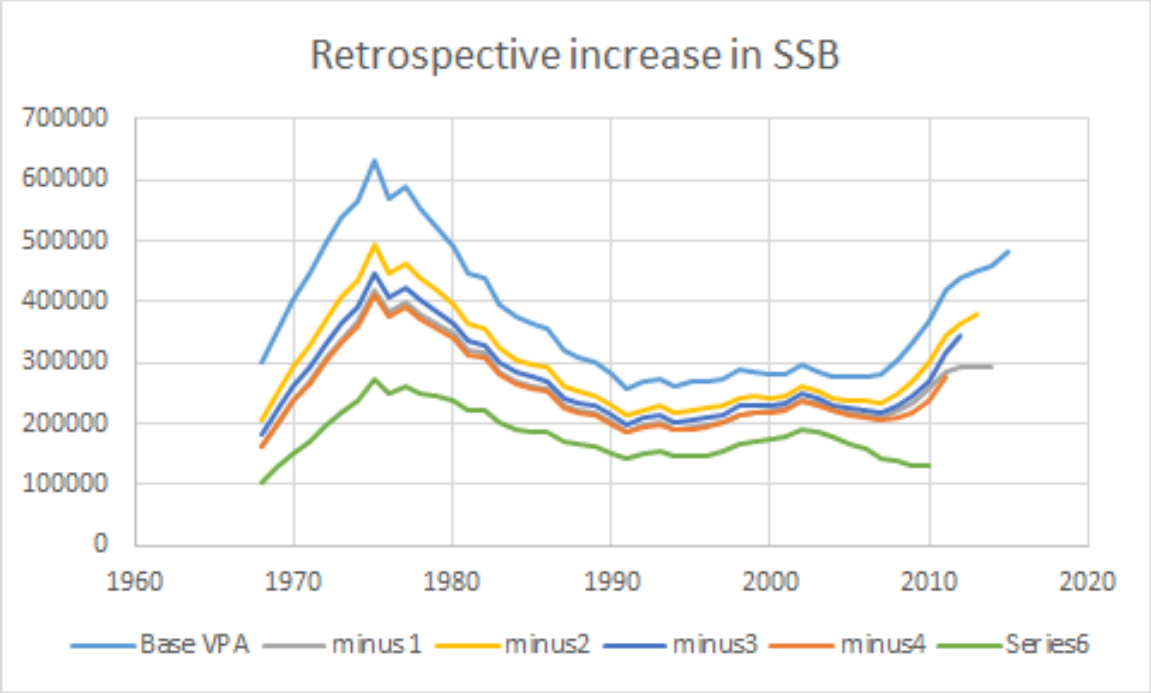

Figure 2. Retrospective estimates of SSB from the revised VPA base run adopted during the species group meeting.