UPDATE OF THE EASTERN AND MEDITERRANEAN ATLANTIC BLUEFIN TUNA STOCK

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SUMMARY

The update of the East and Mediterranean stock of Atlantic bluefin Tuna (ABFT) has been prepared during an inter-sessional meeting of the species group. The objective was to update the catch and abundance index data up to 2013 and use the same model specifications as in the 2012 stock assessment. The VPA2-Box was used to estimate the stock status. Due to major changes in fisheries harvest since the management plan has been set in 2007, alternative runs have been tested, including splitting the Northeast Atlantic Japanese longline index (NEATL JPLL), removing the last year of the Moroccan and Spanish trap index (2013; MorSpa Trap), and removing the last two years of the Spanish and French bait boat index. The run removing the last year of the MorSpa Trap index is chosen as the best case scenario ("Continuity run") for this E-MED ABFT updated stock assessment. This document will serve as a basis for 2014 update of ABFT stock assessment.

RESUME

La mise à jour de l'évaluation du stock de thon rouge de l'Atlantique (ABFT) a été préparée lors d'une réunion inter-session du groupe espèce. L'objective était de mettre à jour les données de captures et d'indices d'abondance jusqu'en 2013 et d'utiliser les mêmes spécifications pour le modèle que celle utilisées pour l'évaluation de stock de 2012. Le logiciel VPA-2BOX a été utilisé pour estimer l'état du stock. Etant donné les changements importants dans l'exploitation par les pêcheries dpeuis la mise en place du plan de gestion en 2007, des simulations alternatives ont été testées, incluant la séparation de l'indice des palangriers japonais dans l'Atlantique Nord-Est (NEATL JPLL), l'utilisation de l'indice de madragues marocaines et espagnols jusqu'en 2012 (MorSpa Trap), et en enlevant les deux dernières années de l'indice des canneurs espagnols et français. La simulation enlevant la dernière année de l'indice des madragues marocaines et espagnoles est choisi comme le meilleur scénario ("simulation de continuité") pour cette mise à jour de l'évaluation de stock E-MED ABFT. Ce document servira de base pour l'évaluation menée par le groupe thon rouge.

RESUMEN

La actualización de la evaluación del stock de atún rojo del Atlántico este y Mediterráneo (ABFT) se ha preparado durante una reunión intersesiones del Grupo de especies. El objetivo era actualizar los datos del índice de abundancia y de captura hasta 2013 y usar las mismas especificaciones del modelo que en la evaluación de stock de 2012. Se utilizó el VPA2-Box para estimar el estado del stock. Debido a grandes cambios en la captura de las pesquerías desde que en 2007 se estableció el plan de ordenación, se han probado ensayos alternativos, lo que incluye separar el índice de palangre japonés del Atlántico nororiental (NEATL JPLL), eliminar el último año del índice de almadrabas marroquíes y españolas (2013 MorSpa Trap) y eliminar los dos últimos años del índice de cebo vivo español y francés. El ensayo que

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eliminaba el último año del índice MorSpa Trap se ha elegido como el mejor caso base ("ensayo de continuidad") para esta evaluación de stock actualizada del atún rojo del Atlántico este y Mediterráneo. Este documento servirá como base para la actualización de la evaluación del stock de atún rojo del Atlántico de 2014.

KEYWORDS

Stock assessment, Update, Data preparatory group, Projections

1. Introduction

The update of the East and Mediterranean stock of Atlantic bluefin Tuna (ABFT) stock assessment has been prepared during an inter-sessional meeting in July-September 2014. This update includes updated catch data and abundance index values for 2012 and 2013. As proposed during the data preparatory group held in May 5-10 2014, a suite of different specifications have been investigated to test the sensitivity of the VPA to different technical assumptions and the choice of the CPUE series. Run 1 was used to assess the impact in historical changes to the data. The impact of each change in data (catch-at-age, weight-at-age, partial catch-at-age, and CPUEs) has been investigated and is reported below. Run 2 assessed the effect of the information contained in the last two years of data. Following discussions on the standardized CPUE series (see section 7), Runs 3, 4 and 5 investigated the effects of splitting the Japanese longline in the North East Atlantic index, leaving out the last 2 years of the Spanish baitboat index, and leaving out the last year of the Spanish-Moroccan trap index, respectively. Several additional runs were performed: Run 6 which included the abundance index for juvenile ABFT derived from aerial surveys in the Gulf of Lions. Run 7 which combined the splitting of the Japanese longline in the North East Atlantic index and the removal of the last year of the Spanish-Moroccan trap index. For Run 11, F-ratios were estimated instead of being fixed for the same period as defined for the 2012 stock assessment using specifications of Run 7. For Run 12, F-ratios were estimated over different periods estimated using a catch curve analysis (see Kell paper). In Run 13, the age plus group was fixed at 16 years to enable us to assume fixed F-ratios over the whole period and equal to 1. The trajectories of Run 5 was selected to provide the potential trajectories of the bluefin stock and fishing mortalities and their uncertainties. As major changes in the Japanese longline fishery have occurred since the management plan has been set in 2007 and due to substantial changes in the effort and data (no information from Spanish traps since 2012, released individuals accounted for in the trap index and individuals caught outside the fishing season are also included as released individuals now on), these runs were selected for this update assessment. A retrospective and bootstrap analysis was performed on these best-case runs.

2. Materials and methods

2.1 Data inputs

2.1.1 Catch at age

The updated catch-at-size takes into account only the new/revised series submitted before the deadline of May 31st 2014 (as for Task-I). Because this stock assessment is an update, only years 2011 to 2013 can be changed. The same substitution rules used for the 2012 assessment has been applied (see data preparatory group report). As in previous assessments, the relative differences between Task-I and the catch-at-size weight equivalent catches, mostly found in two Flags (Japan and USA) will not be addressed in this updated version. To examine the differences between the updated and previous catch-at-age, we show the age structure of the updated reported catch-at-age (**Figure 1**).

Here we show the comparison between the catch at age used in the 2012 ABFT stock assessment and the updated catch at age (**Figure 2**). As it can be seen, there is a substantial problem for 2000 with a very large number of young fish compared to other years. However, we have a potential solution for next assessments, i.e., using log-book for French purse seiners in the problematic years.

Here we show the age structure of the updated inflated catch-at-age (**Figure 3**). Since the catch are inflated over a period previous this update, the anomalies showed before are the same.

As it can be seen, there is a substantial problem for 2000, but potential solutions for pilot assessment will be explored for the species group in September 2015.

2.1.2 Catch per unit of efforts

There is no substantial changes in the catch per unit of efforts (CPUE). Here we show the comparison between the CPUEs in the 2012 ABFT stock assessment and the updated CPUEs (**Figure 4**).

2.1.3 Weight at age

The weight-at-age calculation have been performed as previous years by dividing the landings-at-age data by the catch-at-age data. There are substantial changes in the weight-at-age between this update and last assessment. Weight-at-age is estimated as the total yield by age divided by numbers at age (aggregated matrix). An alternative estimate weight-at-age for each record (yld / number), then estimated the mean values by year age. This version gives a different values than 2010/2012 stock assessment, and noticeable for the plus group in particular as well as for young ages. The reason is the issue of means of means, rather than the mean of aggregated values. Statistically it should be use the ver2, as it is more accurate, reflecting the variations of size within age and weighting by the number of observation within age. Here we show the comparison between the weight-at-age used in the 2012 ABFT stock assessment and the updated weight-at-age (**Figure 5**).

2.1.4 Partial catch

Partial catch are identical to last assessment. However, for 2011, small changes has occured as new catch data arrived in between. Here we show the comparison between the partial catch-at-age (PCAA) for each CPUE used in the 2012 ABFT stock assessment and the updated PCAAs (**Figure 6**).

2.2 Model used

2.2.1 VPA-2 Box and R

We used the VPA-2BOX software to run the simulations. A set of R scripts have been developed to automate the procedure and all outputs are stored on the ICCAT sever.

2.2.2 VPA specifications

The table of the specifications of the different model runs defined during the data preparatory group is given in **Table 1**.

3. Results

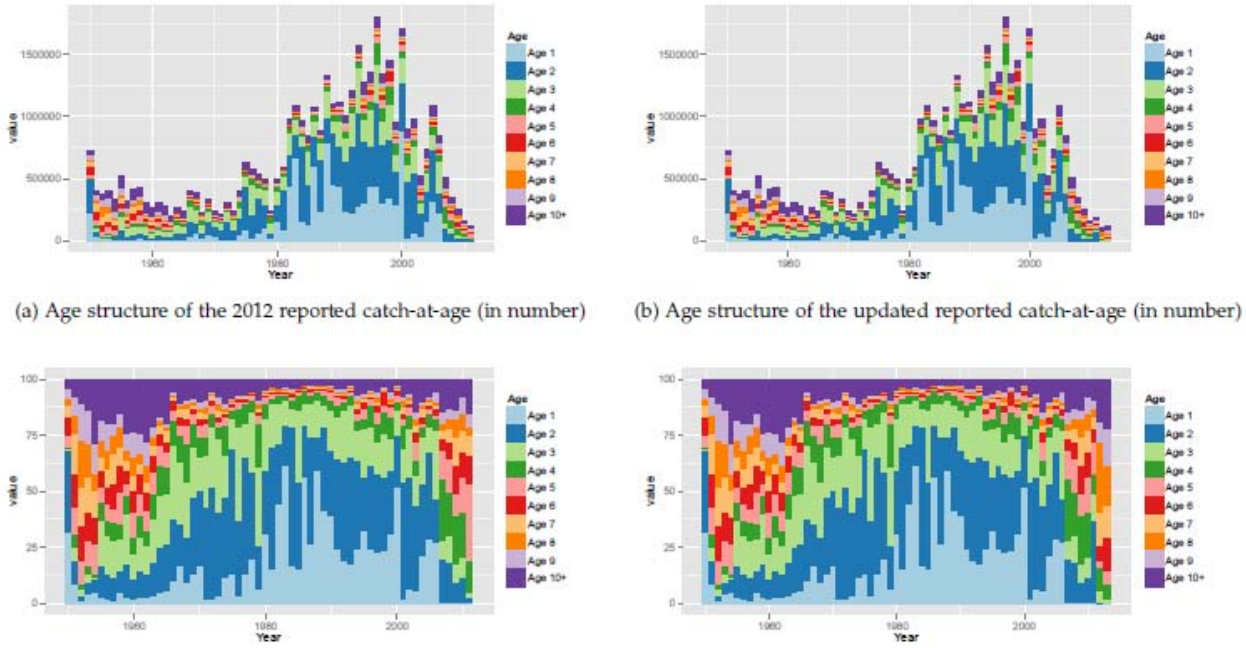
The update with new data (catch and abundance indices) is done using the same specifications as in the 2012 stock assessment (**Figure 7**). It reveals some issues with internal functioning of the VPA-2BOX (random seed numbers). To cope with this issue, 100 seed numbers have tested for each run and the one with the best likelihood was kept. The comparison of the seven simulations have been analyzed to estimate the sensitivity of the model to data and specifications (**Figure 8**). The retrospective analysis has been performed on Run 5 to see the robustness of the result (**Figure 9**). We also examine the fit of the model to the CPUEs (**Figure 10**). To compare with expert knowledge we also examined the fishing mortality at age over the period 1950-2013 (**Figure 11**). The continuity run was projected using the PRO-2BOX software. The Kobe plot and pie chart have been used to illustrate the results (**Figure 12**). All other sensitivity runs that have been tested are described below.

References

Kell, A. 2015. Catch-At-Size and Age Analyses For Atlantic Bluefin. Collect. Vol. Sci. Pap. ICCAT, 70. *In this Volume*.

Table 1. Technical specifications of the ADAPT-VPA runs investigated for the East Atlantic and Mediterranean bluefin tuna stock.

Period	*CPUE series*	*CAA and PCAA*	*F-ratios*	*Plus group*	*Name of the run*
1950-2011	Norwegian purse seine, Spain-Moroccan trap, Japanese longline North East Atlantic, Japanese longline East Atlantic & Mediterranean, and the Spanish bait boat indices	As in 2012	As in 2012	10+	Run_0
1950-2011	Same CPUEs as 2012, but updated	Updated	As in 2012	10+	Run_1
1950-2013	As 2012 Base case updated but update all indices	Updated	As in 2012	10+	Run_2
1950-2013	As Update1 but split Japanese longline North East Atlantic (1990-2009, 2010-2013)	Updated	As in 2012	10+	Run_3
1950-2013	As Update1 but remove last 2 years in Spanish bait boat index	Updated	As in 2012	10+	Run_4
1950-2013	As Update1 with aerial survey index	Updated	As in 2012	10+	Run_6
1950-2013	As Update1 but remove last 1 years in Spanish-Moroccan trap	Updated	As in 2012	10+	Run_5
1950-2013	As CR but split Japanese longline North East Atlantic (1990-2009, 2010-2013)	Updated	As in 2012	10+	Run_7
1950-2013	As CR but use Moroccan trap CPUE instead of Spanish-Moroccan trap	Updated	As in 2012	10+	Run_17
1950-2013	As CR	Updated	Estimated, but using the same period as run 5	10+	Run_14
1950-2013	As CR	Updated	Estimated, but with periods defined by the Catch curve analysis (Kell, 2015)	10+	Run_15
1950-2013	As CR	Updated	All=1	16+	Run_16
1950-2013	As CR	New CAA-PCAA coming from GBYP	As Run_5	10+	Run_5new



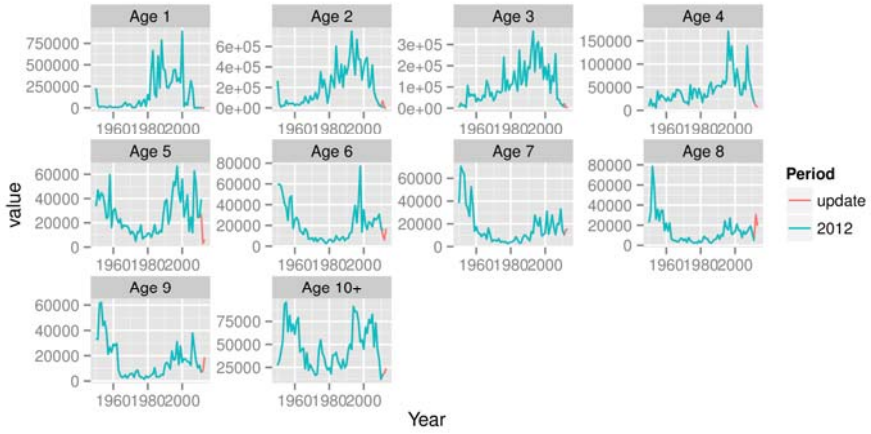
(a) Age structure of the 2012 reported catch-at-age (in number)

(b) Age structure of the updated reported catch-at-age (in number)

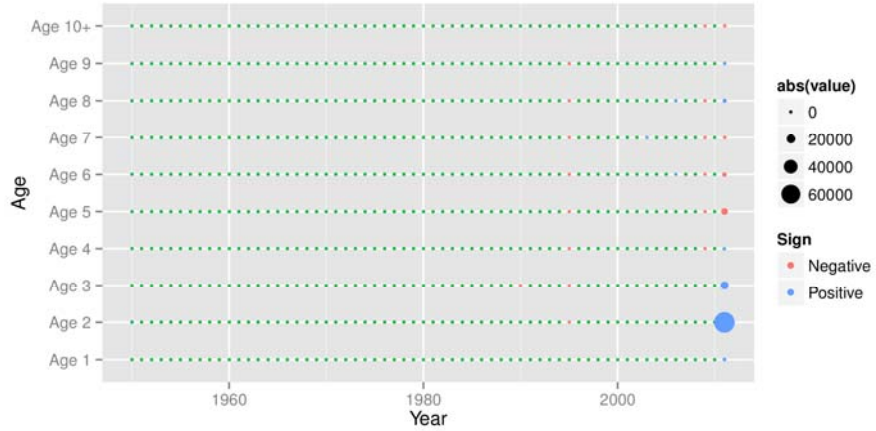
(c) Age structure of the 2012 reported catch-at-age (in %)

(d) Age structure of the updated reported catch-at-age (in %)

Figure 1. Main characteristics of the updated catch-at-age.

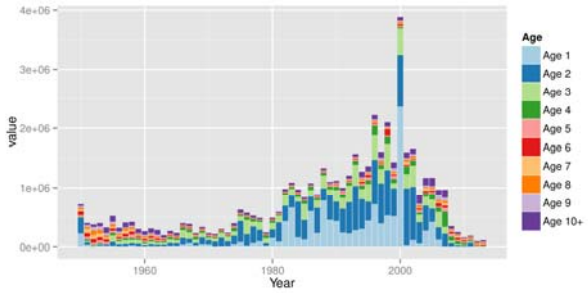


a) Comparison of catch for each age between the 2012 catch-at-age and the updated catch-at-age.

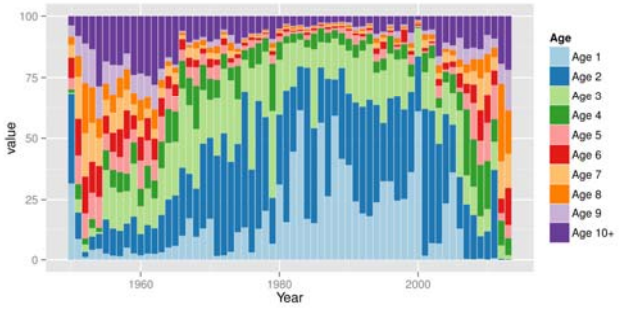


b) Anomalies between the 2012 catch-at-age and the updated catch-at-age (in numbers).

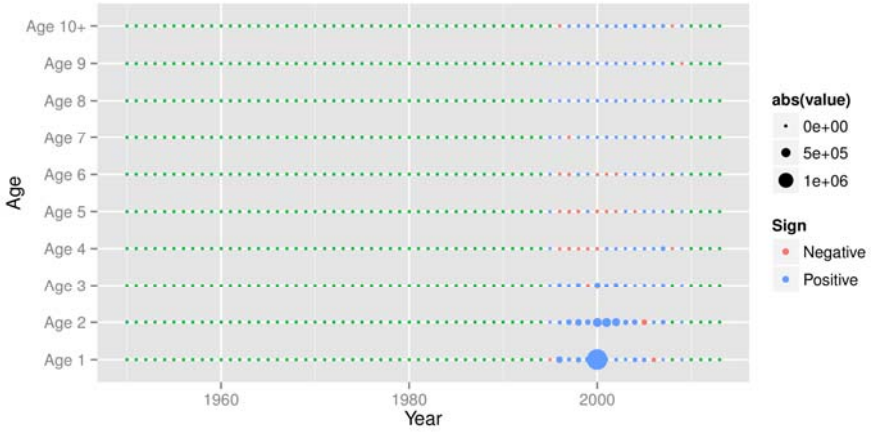
Figure 2. Comparison of the updated catch-at-age and the 2012 catch-at-age.



a) Age structure of the updated inflated catch-at-age (in number).



b) Age structure of the 2012 inflated catch-at-age (in %).



c) Anomalies between the updated inflated and reported catch-at-age (in numbers).

Figure 3. Main characteristics of the inflated updated catch-at-age and comparison with the reported one.

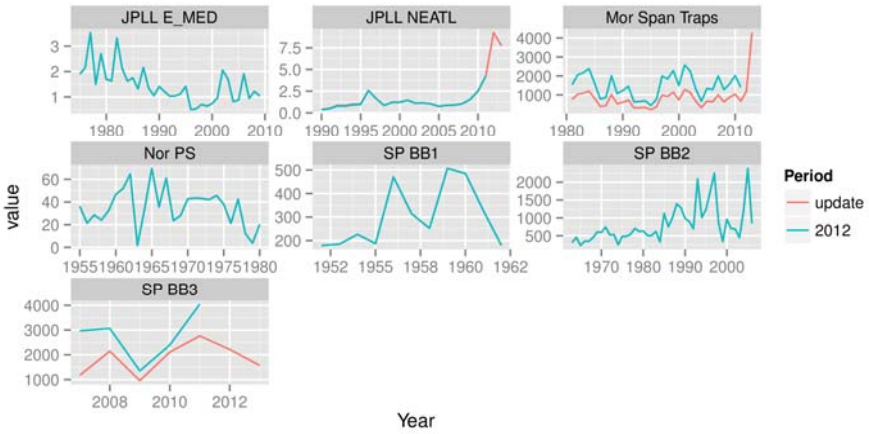
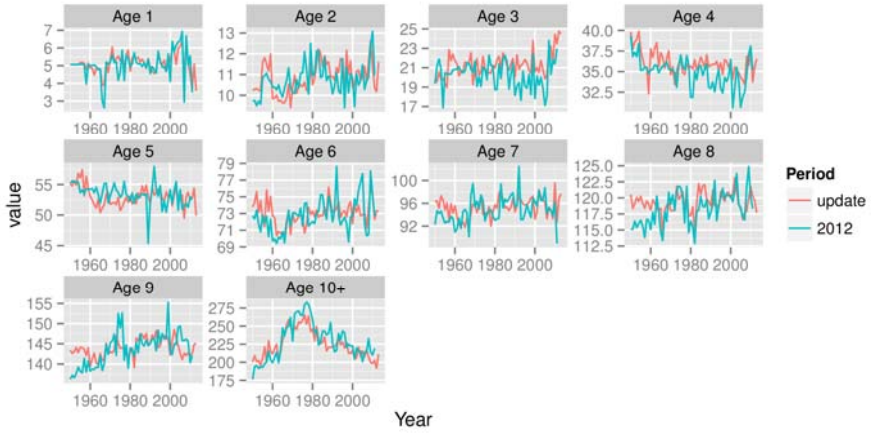
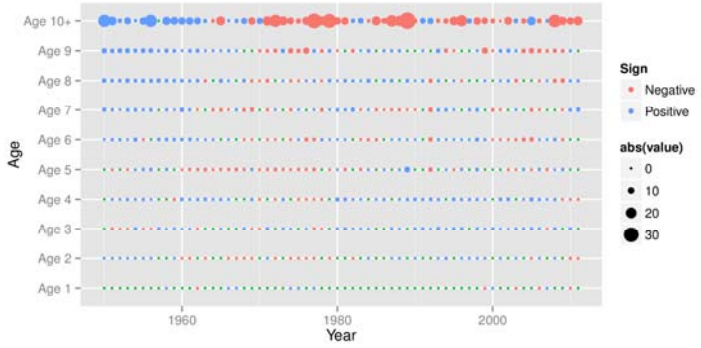


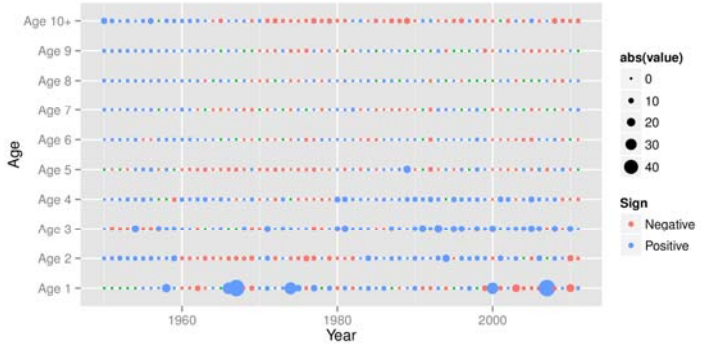
Figure 4. Comparison of the catch per unit of efforts (CPUEs) in the 2012 ABFT stock assessment and the updated CPUEs.



a) Comparison of weight for each age between the 2012 weight-at-age and the updated weight-at-age.

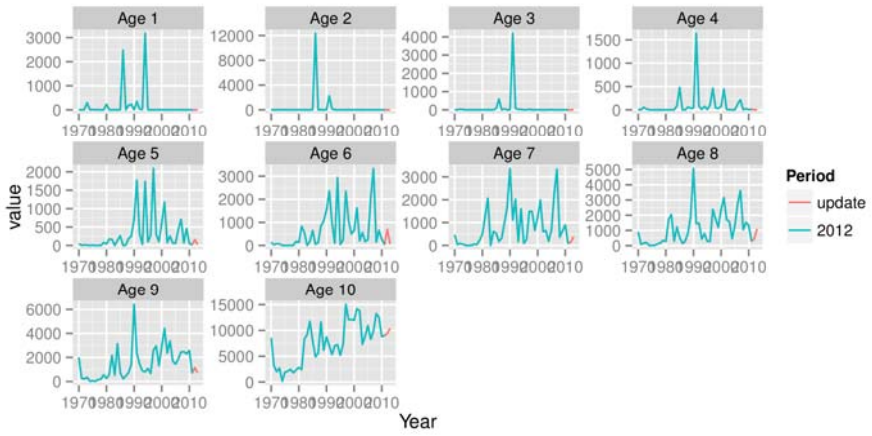


b) Anomalies between the 2012 weight-at-age and the updated weight-at-age (in numbers).

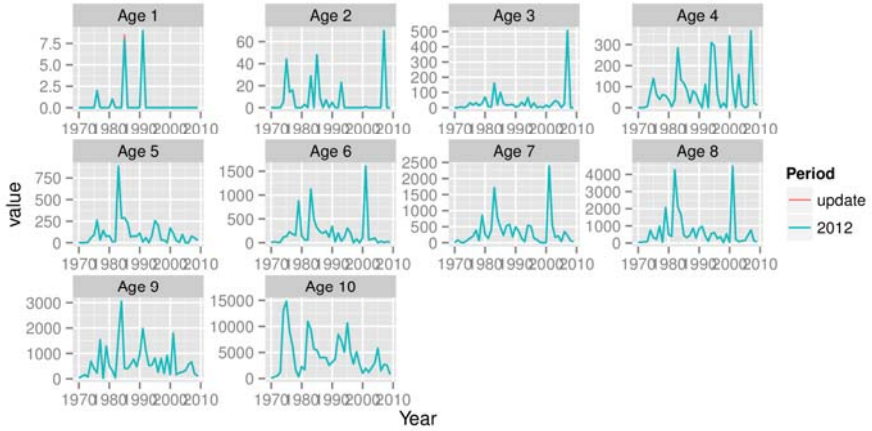


c) Anomalies between the 2012 weight-at-age and the updated weight-at-age (in %).

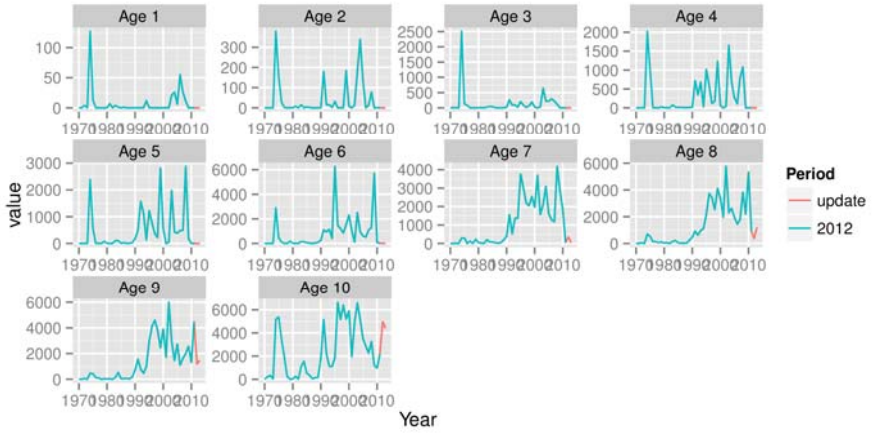
Figure 5. Comparison of the updated catch/weight-at-age and the 2012 catch/weight-at-age.



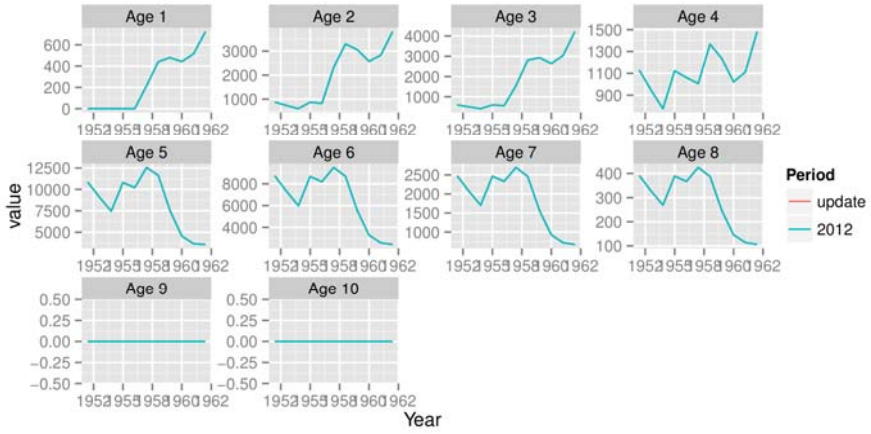
a) Partial catch-at-age for Moroccan and Spanish traps.



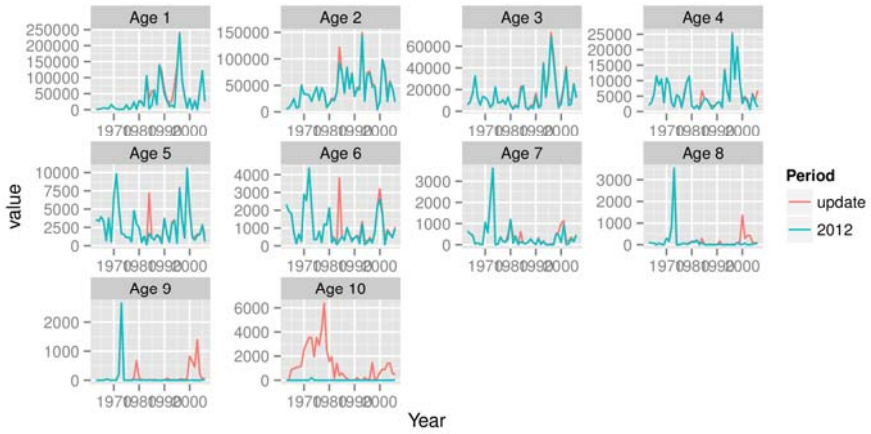
b) Partial catch-at-age for Japanese Longline East and Mediterranean Sea.



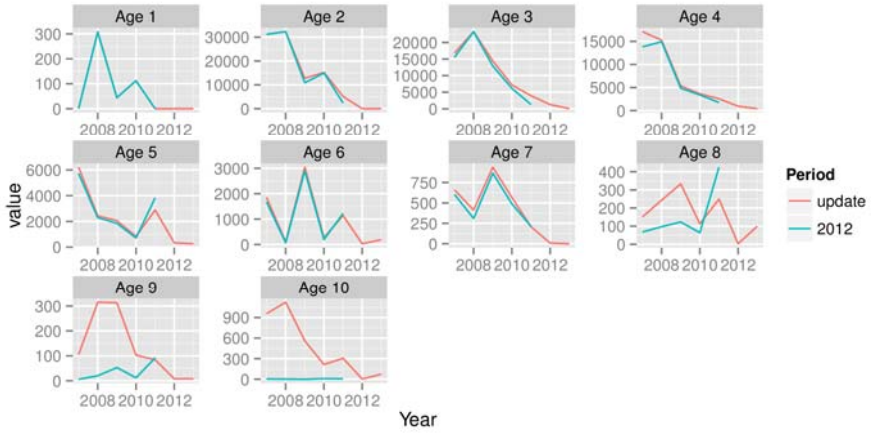
c) Partial catch-at-age for Japanese longline North East Atlantic.



d) Partial catch-at-age for Spanish baitboat 1.



e) Partial catch-at-age for Spanish baitboat 2.



f) Partial catch-at-age for Spanish baitboat 3.

Figure 6. Comparison of the updated partial catch-at-age and the 2012 partial catch-at-age.

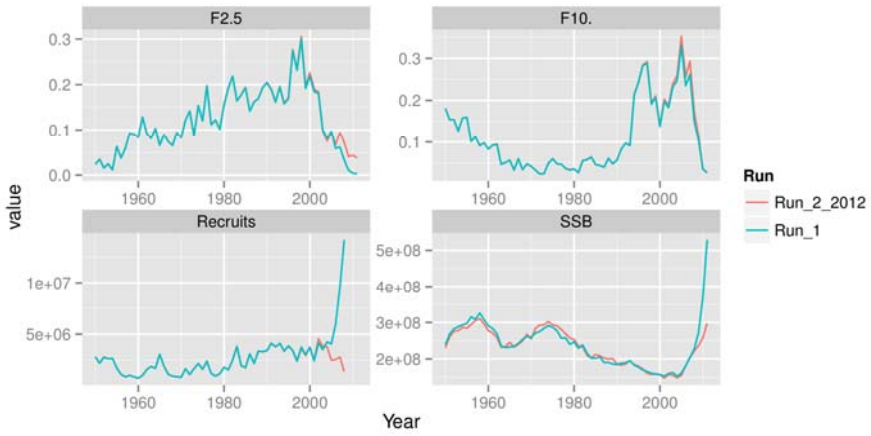


Figure 7. Run 0 (Run 2 in 2012) and 1: Evolution of fishing mortality at age 2-5, fishing mortality for the 10+ group, recruitment (last three years are removed), and spawning stock biomass.

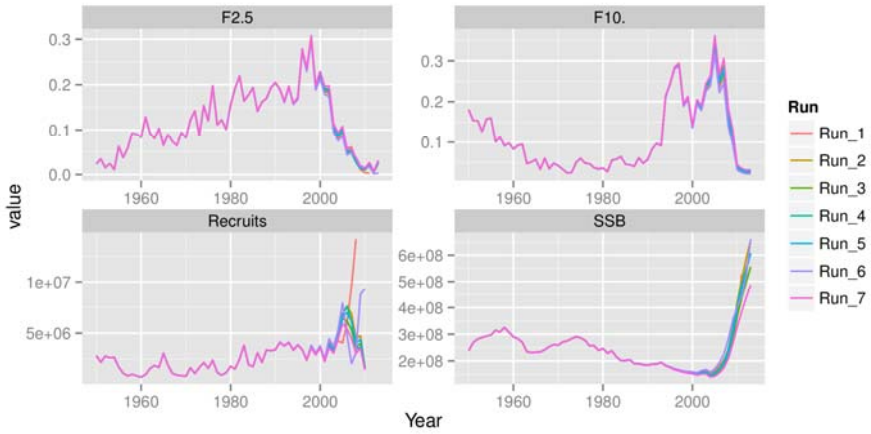


Figure 8. Run 1 to 7: Evolution of fishing mortality at age 2-5, fishing mortality for the 10+ group, recruitment (last three years are removed), and spawning stock biomass.

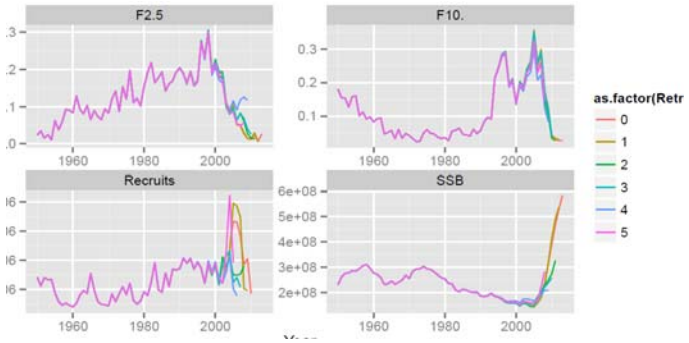


Figure 9. Retrospective analysis for Run 5: Evolution of fishing mortality at age 2-5, fishing mortality for the 10+ group, recruitment (last three years are removed), and spawning stock biomass when removing sequentially 5 years.

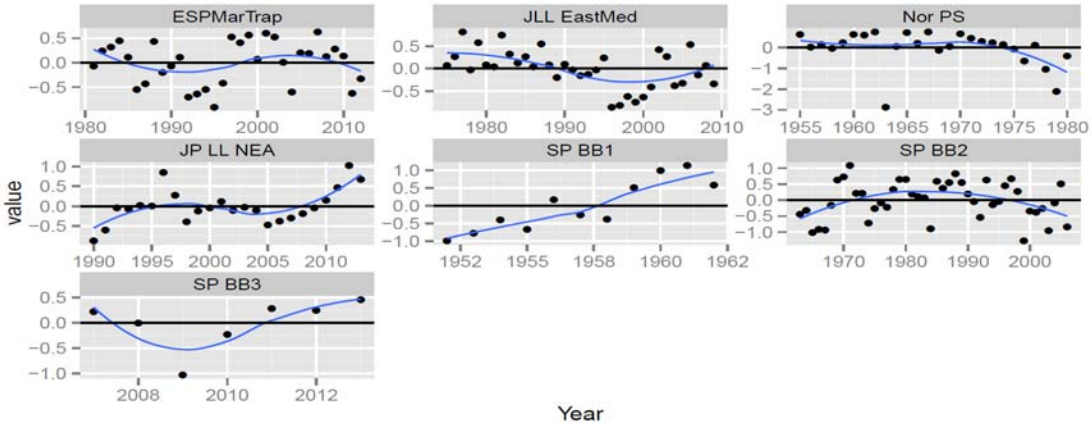


Figure 10. Eastern bluefin tuna. CPUE series (points) and fitted values (lines) resulting from the VPA of continuity run (Run 5) using reported catch.

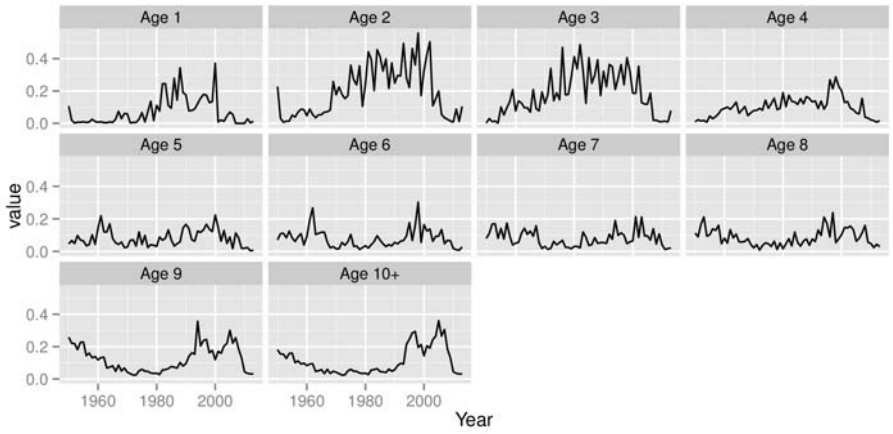


Figure 11. Estimate of fishing mortality-at-age for Run 5.

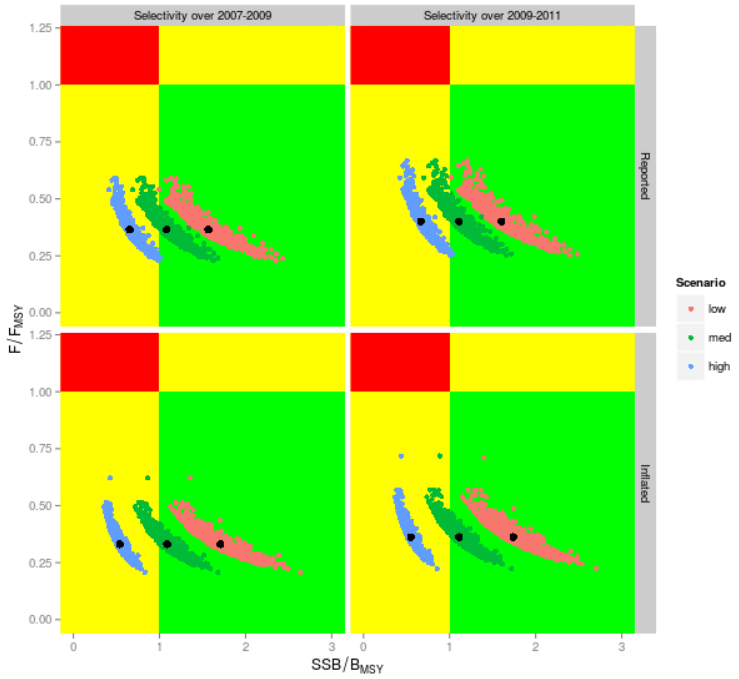


Figure 12. Stock status from 2011 to the terminal year (2013) estimated from VPA continuity run with reported and inflated catch (upper and lower panels) and considering low, medium and high recruitment levels (blue, green and red lines). Blue, green and red dots represent the distribution of the terminal year obtained through bootstrapping for the corresponding three recruitment levels. Left Panel (selectivity over 2007-2009): 2013 SSB and F relative to reference points calculated with the selectivity pattern over 2007-2009 which was same period as the 2010 stock assessment. Right Panel (selectivity over 2009-2011): 2013 SSB and F relative to the reference points with the selectivity pattern over 2009-2011 which was same period as the 2012 stock assessment.

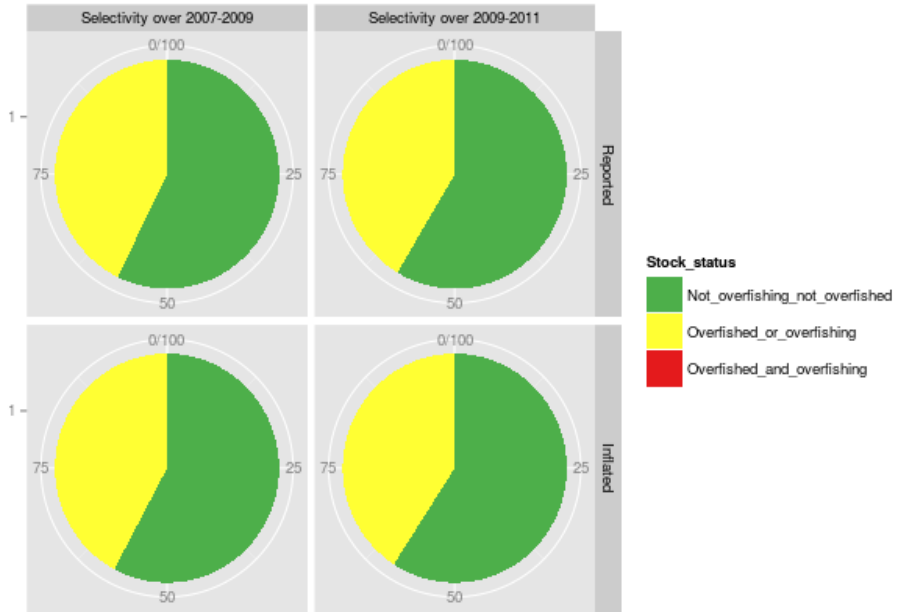


Figure 13. Pie chart showing the proportion of the VPA continuity run results for the terminal year (2013) that are within the green quadrant of the Kobe plot chart (not overfished, no overfishing), the yellow quadrant (overfished or overfishing), and the red quadrant (overfished and overfishing). Split by catch scenario (reported and inflated) and benchmark (selectivity patterns were estimated over 2007-2009 or over 2009-2011).

A 2012 run (1950-2011): Run 0

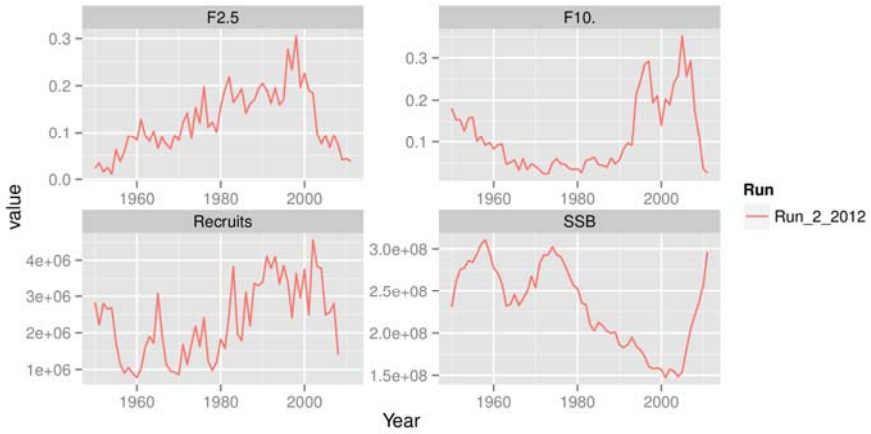


Figure 14. Run 0: Evolution of fishing mortality at age 2-5, fishing mortality for the 10+ group, recruitment (last three years are removed), and spawning stock biomass.

B Run 0_A, B, and C: update only CAA and/or partial catch

Here we keep everything the same and we only update the catch-at-age (Run_0_A), only partial catch (Run_0_B), and both (Run_0_C) (**Figure 15**). Major effects on the results. But partial catch do not change much the results.

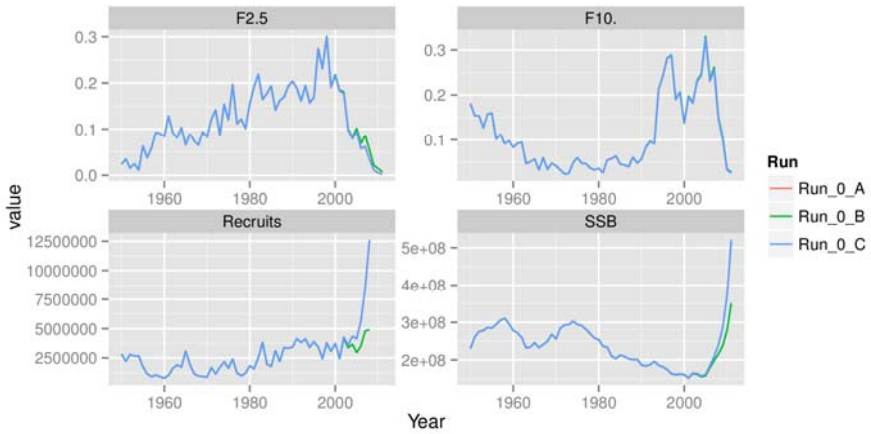


Figure 15. Run 0_A, B, and C: Evolution of fishing mortality at age 2-5, fishing mortality for the 10+ group, recruitment (last three years are removed), and spawning stock biomass.

C Run 0_D: Update only CPUEs

Here we keep everything the same and we only update the CPUEs (Run_D; **Figure 16**). Minor effects on the results, slightly larger values in 2011.

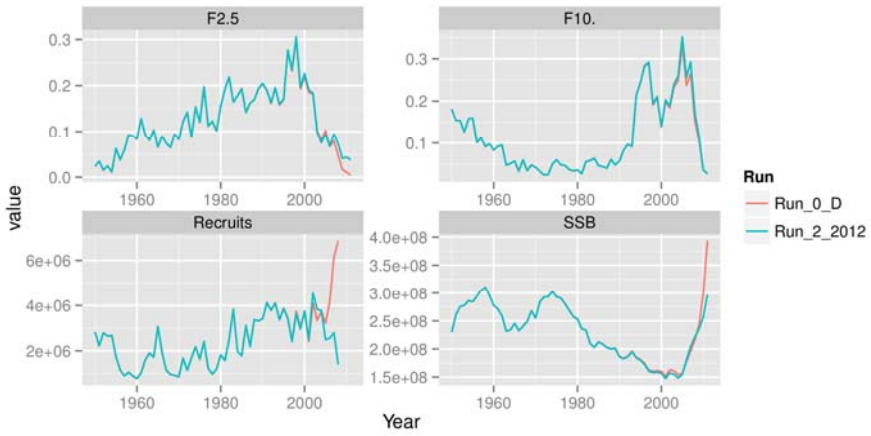


Figure 16. Run 0_D: Evolution of fishing mortality at age 2-5, fishing mortality for the 10+ group, recruitment (last three years are removed), and spawning stock biomass.

D Run 0_E, F, and G: Update only partial weight-at-age and/or weight-at-age

Here we keep everything the same and we only update the partial weight-at-age (run 0_E) and weight-at-age (run 0_F) or both (run 0_G; **Figure 17**). Minor effects on the results, slightly lower SSB (due to lower weight-at-age of big individuals than in 2012 assessment.

shadecolorrgb0.969, 0.969, 0.969

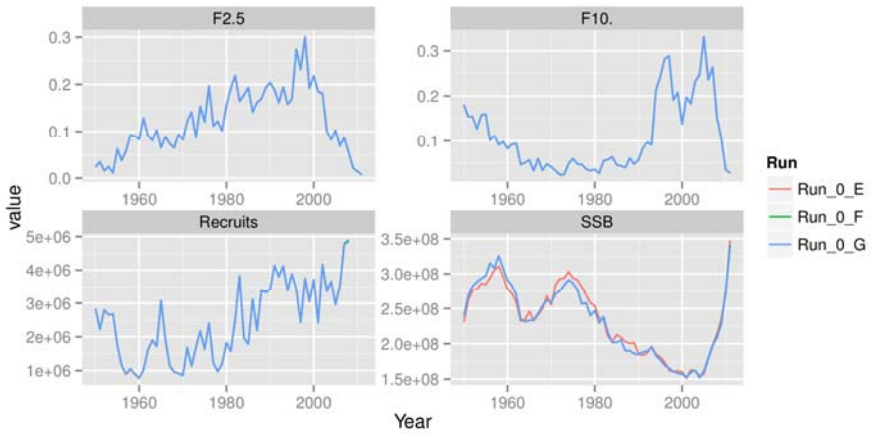


Figure 17. Run 0_E, F, and G: Evolution of fishing mortality at age 2-5, fishing mortality for the 10+ group, recruitment (last three years are removed), and spawning stock biomass.

E Run _A, H, I, and J: Update catch-at-age, partial weight-at-age, and weight-at-age

Here we update the catch-at-age, and the partial weight-at-age (Run_H) and weight-at-age (Run_I) and both PWAA and WAA (Run_J; **Figure 18**). Minor effects on the results.

shadecolorrgb0.969, 0.969, 0.969

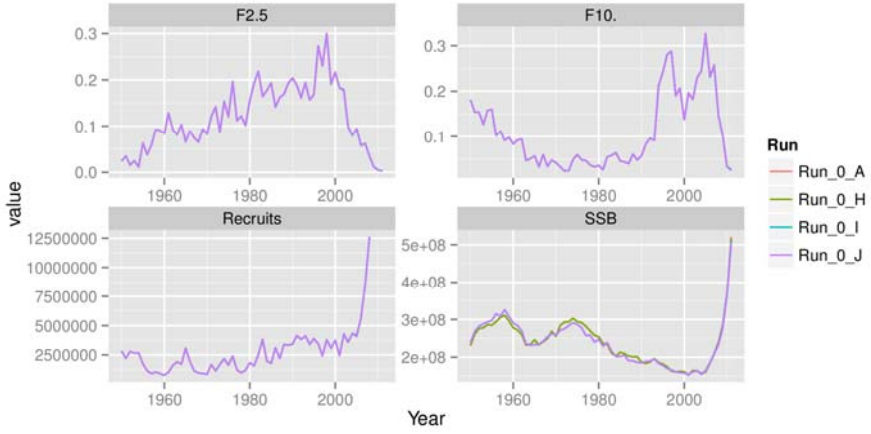


Figure 18. Run_A, H, I, and G: Evolution of fishing mortality at age 2-5, fishing mortality for the 10+ group, recruitment (last three years are removed), and spawning stock biomass.

F Run _J, K, L, and Run_1: Update everything but CPUE values

Here we update everything but the CPUES (Run_K), or but partial catch (Run_L) and full update until 2011 (Run_1; **Figure 19**).

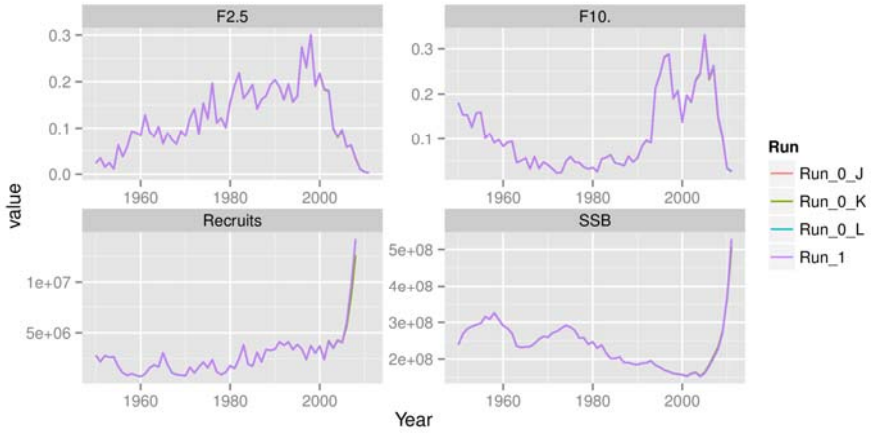


Figure 19. Run 0_J, K, L, and 1: Evolution of fishing mortality at age 2-5, fishing mortality for the 10+ group, recruitment (last three years are removed), and spawning stock biomass.