A check of operating model predictions from the viewpoint of metarule invocation and technical details for computing future TACs

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This paper checks whether exceptional circumstances exist at this time and examines the need to invoke metarules by comparing projection results that were obtained from operating models last year to the latest observations for the scientific aerial survey index, LL1 CPUE and catch-at-age compositions. Strictly an unexpected event has occurred in that the value of the aerial survey index in 2012 is outside the 95% probability interval predicted using the base case operating model last year. However the "severity" of this occurrence in the context of resource conservation is considered relatively low, because some of the robustness trials considered have projections whose 95% probability intervals cover the 2012 observation, and the agreed Bali procedure was confirmed to be robust to the associated uncertainties. Therefore, there does not seem to be any urgency to invoke a metarule and take immediate action by recommending a modified TAC. However, the ESC does need to monitor and review the scientific aerial survey results carefully at the next few ESC meetings. Technical details which need to be finalized for computing the next TAC for 2015-2017 are also listed.

メタルール発動の観点から見た OM 予測の現実性チェックおよび次回の TAC を計算するに当たっての留意点

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昨年得られた OM による予測と最新の観測データを比較することで、想定外のことが起こっていないか検討し、メタルール発動の必要性について吟味した。航空機目視指数、CPUE、漁獲物の年齢構成を検討の対象とした。ベースケースにおいて、航空機目視指数の観測値が予測の範囲から外れていたため、この指標について想定外の出来事が起きたと考えた。しかし、資源保護の観点からの深刻度は低いとみなした。その理由はいくつかの頑健性テストがその不確実性の範囲をカバーし、また合意された管理方式がその不確実性に対して頑健であることが確認されたからである。そのため、緊急にメタル

ールを発動し、TACを変更するための手続きを取る必要はないであろう。しかし、拡大科学委員会は航空機目視指数について今後も注意深く監視し検討する必要がある。また 2015–2017 年の TAC を計算するために最終化しなければならない技術的な点についてまとめた。

1. Introduction

Metarules are "rules" which prespecify what should happen in unlikely exceptional circumstances when application of the total allowable catch (TAC) generated by the management procedure (MP) is considered to be highly risky or highly inappropriate (*4. Metarule Process* in CCSBT 2012). A process for determining whether exceptional circumstances exist is illustrated in the document, and the ESC is required as an annual task to (1) review stock and fishery indicators, and any other relevant data or information on the stock and fishery; and (2) on the basis of this, determine whether there is evidence for exceptional circumstances. If the ESC agrees that exceptional circumstances exist, then the ESC needs to (1) determine the severity of the exceptional circumstances, and (2) on the base of the severity, formulate advice to the Extended Commission (EC) on the action to be taken.

Examples of what might constitute an exceptional circumstance are also listed in the document (CCSBT 2012). One of them is "a scientific aerial survey (AS) or CPUE result outside the range for which the MP was tested". As a guideline in an associated footnote, the "range" is defined as the "95% probability intervals for projections for the index in question made using the reference set of the operating models during the testing of the MP".

In this document, OM projections that were computed last year are compared with the latest observations for the AS index, CPUE and catch-at-age compositions. In addition, as a related topic, technical details to be further discussed and finalized for computing next TAC for 2015-2017 are listed. A general review of stock and fishery indicators is reported in Takahashi and Itoh (2012).

2. Methods

Projection results that were made in 2011 using the latest projection program (sbtprojv120), which were updated by the ESC after the Special Meeting of the EC in

August 2011 (CCSBT 2011), are compared to the most recent observations that have been reported to the 2012 ESC. The focus here is on three indices: (1) the scientific AS index for 2012, (2) LL1 (mainly consisting of Japanese longline) CPUE for 2011 and (3) catch-at-age composition in 2011 for the LL1 and purse seine (PS) fisheries. The AS index and LL1 CPUE are particularly important indices for MP implementation, because they are used in the Bali procedure as input data for computing TACs.

These comparisons are made using existing results for the "MP3_2035_3000_1000inc" scenario, which are projection results using MP3 (the Bali procedure) under the specifications of a tuning year of 2035 and a maximum TAC change of 3000t, with a specific rule allowing a 1000t increase in the first TAC setting period. This scenario is one of those for which results are currently available and has specifications close to the actual TAC decision made by the EC in October 2011. The EC determined to increase TACs gradually by 1000t, 1500t and 3000t over 2012-2014 from the 2011 TAC of 9449t.

The AS index observed, which is an indicator of juvenile abundance, has decreased considerably in 2012 compared to 2011 (Eveson et al. 2012). Thus the possibility that unexpected exceptional events have occurred in regard to recruitment and/or the AS index itself needs to be considered in the context of whether "exceptional circumstances" should be declared to exist. Because the criterion for such a declaration relates to observations outside the range considered when the MP was evaluated under simulation testing, the results of two robustness trials that can result in low AS index are examined in addition to the base case (reference set): (1) "high_aerial_cv", which assumes higher variation (cv=0.5) for the AS index (CCSBT 2010) and (2) "low_r", which assumes 50% lower recruitment for 4 years (from 2011) than predicted from SSB and the stock-recruitment relationship, are also pertinent. The following table summarizes the scenarios and indices considered in this document.

Scenario/indices	2012 AS index	2011 LL1 CPUE	2011 catch-at-age of LL1 and PS
base (reference set)	X	X	X
high_aerial_cv	X		
low_r	X		

3. Results and Discussion

3.1. Scientific aerial survey index

The first point to note is that the OM projections made in 2011 predicted that (in median terms) the AS index would decline for several years after 2011 (Fig. 1). This is due to the fact that the observed AS index in 2011 was much higher than that expected from abundance estimates for ages 2-4, which are the main contributors to this index, and (in median terms) the projected trajectory converges gradually to its expected level as a result of serial correlation effects. Were it not for the high positive residual associated with the 2011 aerial survey index together with the highish serial correlation assumed in projecting forward, the projection fan shown in Fig. 1 would be considerably lower and readily seen to be consistent with the 2012 observation.

The observed AS index in 2012, which was standardized by GLMs, showed a substantial decrease from 2011 and the point estimate is the second lowest of all survey years since 1993 (Eveson et al. 2012). The unscaled, observed index is 102 (AU_AerialSurvey_93_12.xls of 2012 data exchange), while the OM prediction made in 2011 for the 2012 index for the base case is 256 [with probability intervals of 118-547 and 100-620 for 2.5-97.5% and 1-99% ranges, respectively] (Fig. 1). In other words, the observed value corresponds to about the lower one percentile in the prediction. If the definition of "range" to declare exceptional circumstances is applied strictly, it would be appropriate to regard the 2012 AS index as outside the 95% range for the base case, which suggests that unlikely exceptional circumstances exist.

For the high_aerial_cv scenario, however, the observed value in 2012 is located within the 95% probability interval for the prediction [85-727] (Fig. 2). Also, for the low_r scenario, median predicted AS index values as low as the 2012 observation are evident around 2015 (corresponding to four years after low recruitment starts) (Fig. 3). At this point, it is difficult to provide reasons for the observed low index (which could equally be considered rather as a reflection of an unusually high index in the previous year), though unusual environmental conditions during the survey such as sea shadow and haze and/or shift of fish spatial distribution might have had an influence on the index (Eveson et al. 2012). In any case though, it is evident that these two robustness trials covered the possibility that the AS index would drop to as low a level as observed in 2012 in the short term.

Fortunately, the Bali procedure showed satisfactory performance for these two robustness trials in addition to the base case, as previously confirmed in the MP development process (Figs 4 and 5). In particular, the MP behavior (in terms of catch and SSB) for the high_aerial_cv scenario was almost identical to that of the base case. This indicates that the Bali procedure is very robust to higher observation errors for the AS index.

To summarize the points above, it appears that the AS index in 2012 reflects an unexpected event in that it falls outside the predicted 95% probability interval for the base case, but the level of concern ("severity") to be associated with this is relatively low, because some robustness trials reflect results within which this observation falls, and the agreed MP was confirmed to be robust to the uncertainties associated with those trials. Therefore, it seems unnecessary to invoke a metarule at this time and to take immediate action regarding the TAC such as adjustment of the MP-derived TACs agreed in 2011. However, the ESC needs to monitor and review the scientific aerial survey carefully over the next few ESC meetings.

3.2. LL1 longline CPUE

Both of observed LL1 CPUE series (w0.8 and w0.5) for 2011 and their average (JP_CoreVesselCPUE_6911.xls of 2012 data exchange) are within the 95-probability interval [0.42-1.27] for the base case OM prediction made in 2011 (Fig. 6). Accordingly the most recent LL1 CPUE value provides no justification for declaring that exceptional circumstances exist.

3.3. Age composition of LL1 and PS fisheries

The OM can also provide future projections of the catch-at-age composition for each fishery from the numbers-at-age of the population and the fishing selectivity vectors, although the program code needs to be slightly modified to output this age composition. This information would be helpful for clarifying the validity of model predictions regarding the CPUE and the AS index as well. In this analysis, the adjusted composition based on the 20% overcatch of surface fishery as applied in the conventional stock assessment was used to provide the observed age composition of the PS fishery (CCSBT 2006; SEC_ManagementProcedureData_52_11.xls of 2012 data exchange).

In general, the comparisons showed that observed age compositions of the LL1 (SEC_ManagementProcedureData_52_11.xls of 2012 data exchange) and PS fisheries in

2011 fell within projection ranges (Figs 7 and 8). Accordingly the conclusion follows that there are no indications that exceptional circumstances exist from the catch-at-age data for 2011.

4. Lists of technical details of MP specification to be finalized

4.1. Tuning issue

In terms of the requests from the Special Meeting of the EC in August 2011, the ESC showed results for 12 tuning options regarding (1) tuning year (2030 or 2035), (2) maximum TAC change (3000t or 5000t) and (3) restriction of first TAC increase (0t, 1000t, none) (CCSBT 2011). Based on these results, the EC at its meeting in October 2011 selected 2035 as the tuning year and 3000t as the maximum TAC change, and finally determined to increase TACs over 2012-2014 by 1000t, 1500t and 3000t from the 2011 TAC of 9449t.

Currently, however, the ESC does not have a tuning result for the Bali procedure under this agreed but somewhat complicated TAC increase pattern over 2012-2014. Although the ESC needs eventually to ask advice from the EC on how to deal with this matter, there are perhaps three options that the ESC can take in computing the next TAC for 2015-2017: use a tuning parameter value under a scenario of (1) 1000t and (2) 3000t as first TAC increase, which are already available, and (3) re-evaluate the tuning parameter under the agreed TACs over 2012-2014. Option 3 might be the most straightforward interpretation in terms of consistency of approach, but option 2 might be more appropriate if the EC in fact intended to increase the probability of stock rebuilding as much as possible when they made their TAC decisions in 2011.

4.2. Longline CPUE

In 2011 ESC, the CPUE working group determined that standardized CPUE series for core vessels is used as input data for the MP (*2. Specification of Standardised CPUE for the MP* in CCSBT 2012). However, this “base case” still includes two variants reflecting differences of area weighting: w0.5 and w0.8 (B-ratio and geostat proxies), and it has not been documented explicitly how to integrate these two series for input to the MP. A simple solution could be to use the arithmetic mean of the two, as was applied to past CPUEs in the MP development.

4.3. AS index

Eveson et al. (2012) slightly changed their analysis method for standardizing the AS index by adding a new environmental covariate to the original one in Eveson et al. (2011). It is important to try to further improve analysis methods for the AS index as well as the longline CPUE rather than sticking to old methods. However, it should be noted that it is necessary to fully discuss the application of new methods when characteristics and trends of indices used to provide inputs to the MP are changed substantially by introducing new methods.

5. References

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Eveson, P., Farley, J. and Bravington, M. 2011. The aerial survey index of abundance: updated analysis methods and results for the 2010/11 fishing season. CCSBT-ESC/1107/15.

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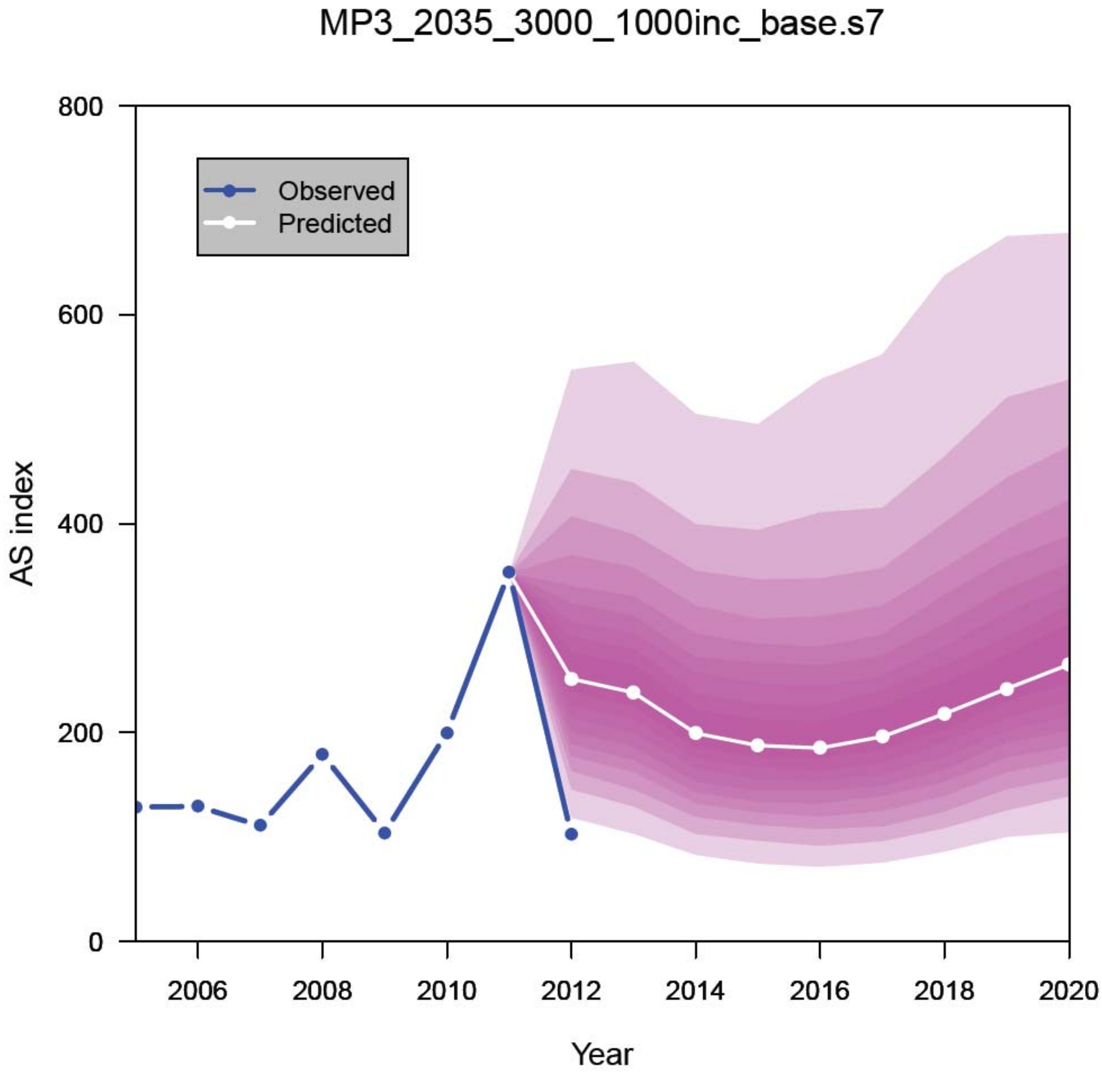

Figure 1. The past scientific aerial survey (AS) index (blue line; 2005-2012) and the future index as projected in 2011 for 2012 to 2020 for the ***base case*** scenario (reference set), where the white line with its points is the median projected AS index, and the shades of purple represent percentiles from 2.5% to 97.5% in increments of 5%.

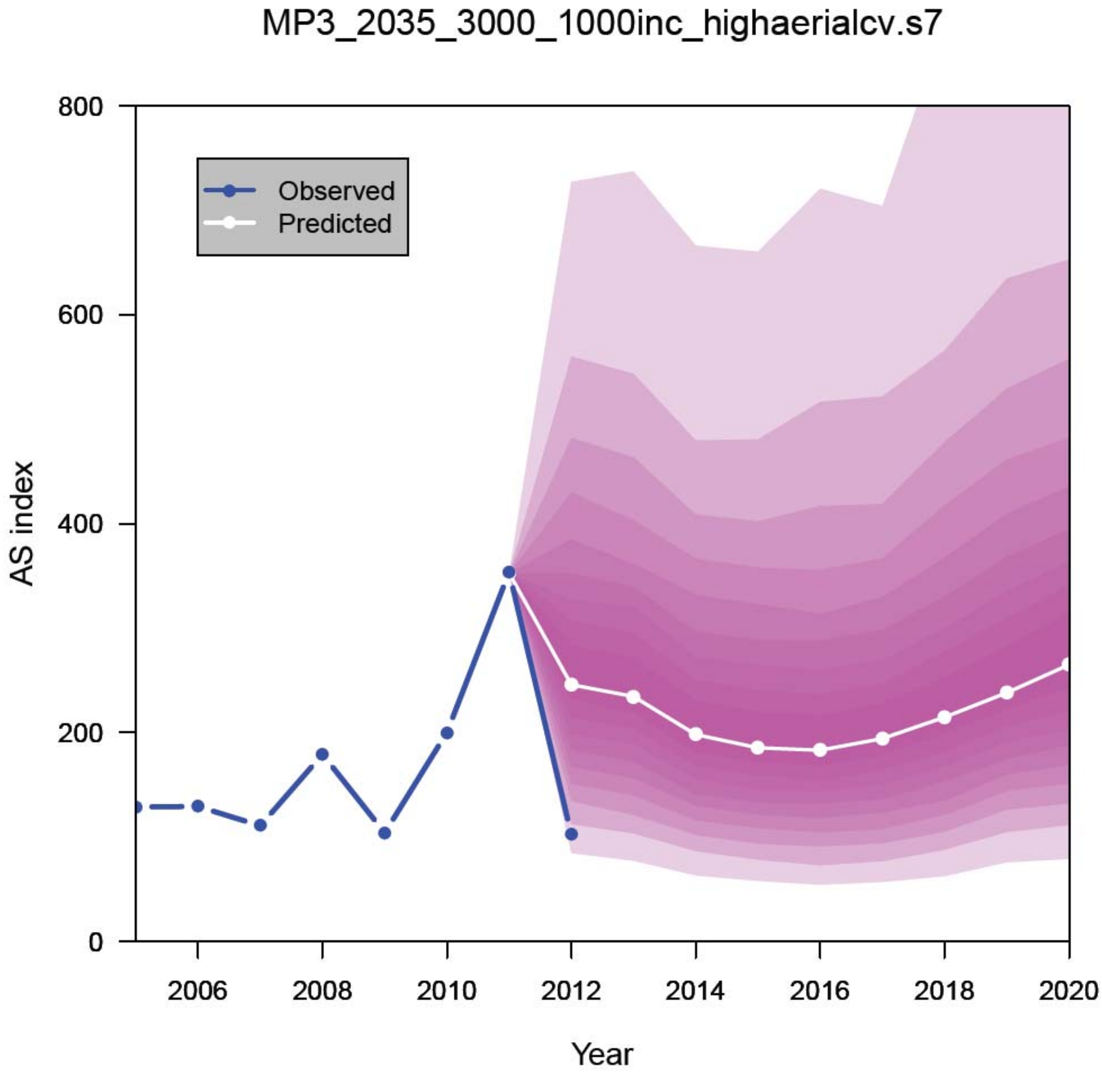

Figure 2. The past scientific aerial survey (AS) index (blue line; 2005-2012) and the future index as projected in 2011 for 2012 to 2020 for the "***high aerial cv***" scenario, where the white line with its points is the median projected AS index, and the shades of purple represent percentiles from 2.5% to 97.5% in increments of 5%.

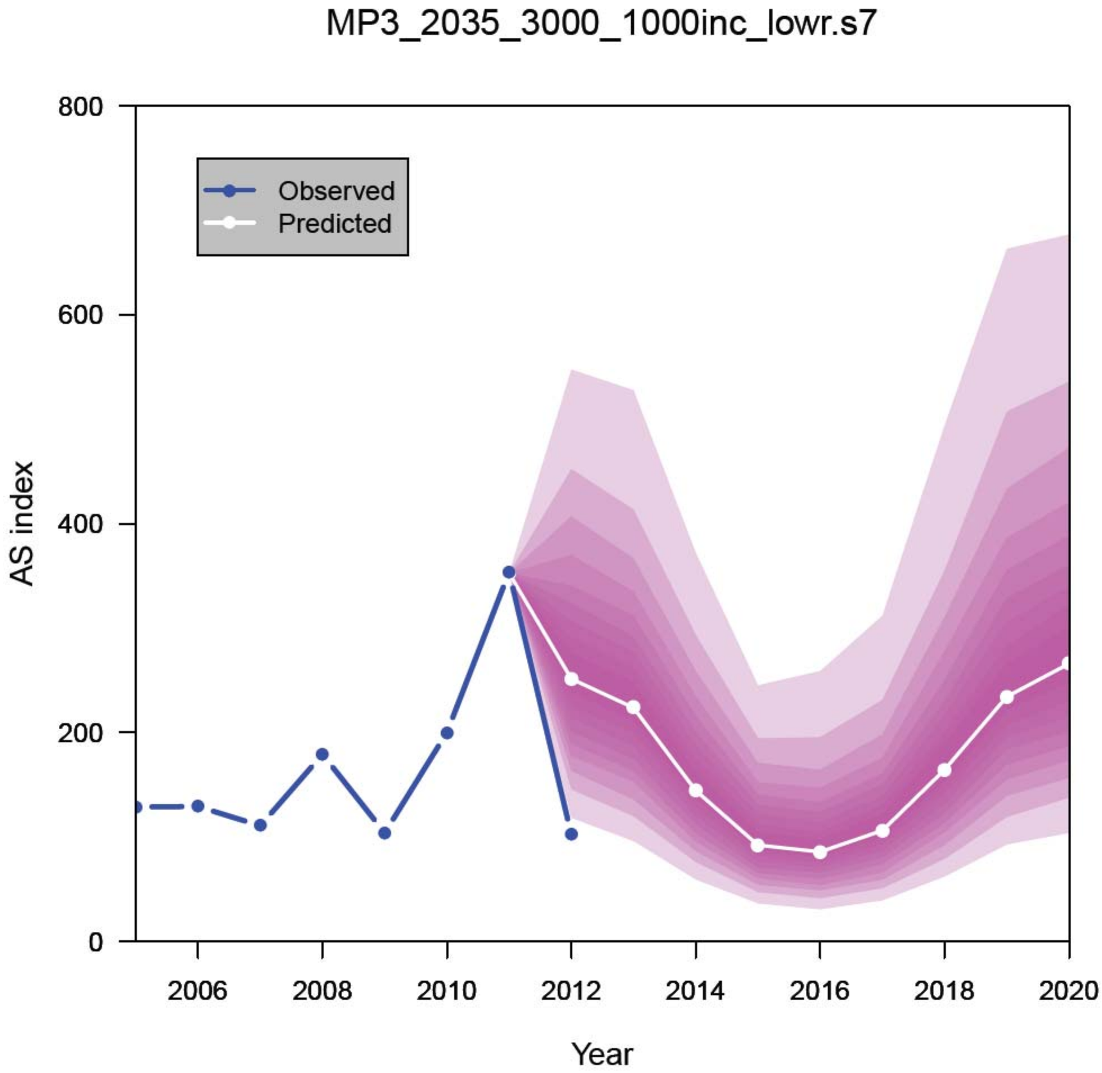

Figure 3. The past scientific aerial survey (AS) index (blue line; 2005-2012) and the future index as projected in 2011 for 2012 to 2020 for the "***low r***" scenario, where the white line with its points is the median projected AS index, and the shades of purple represent percentiles from 2.5% to 97.5% in increments of 5%.

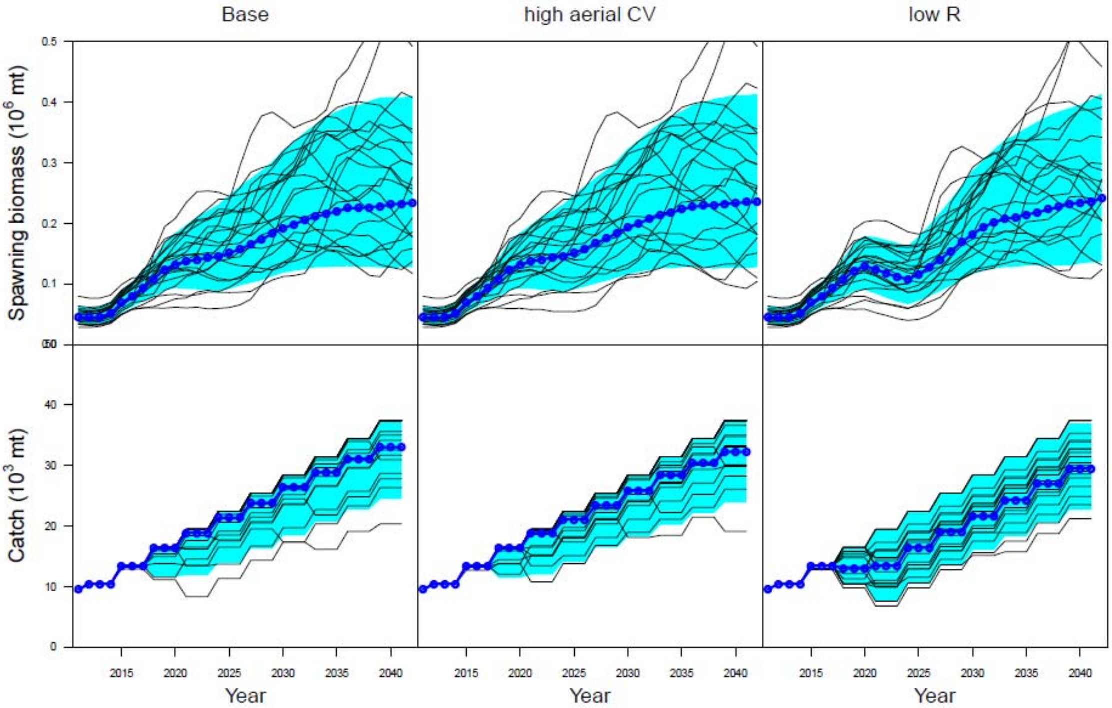

Figure 4. Worm plots (SSB and catch) for the Bali procedure for the base case (1000t increase in the first year) and two robustness trials. The dark blue circles represent the median, the light blue shading covers the range from the 10th to the 90th percentiles, and the 20 black lines a random sample of 20 trajectories.

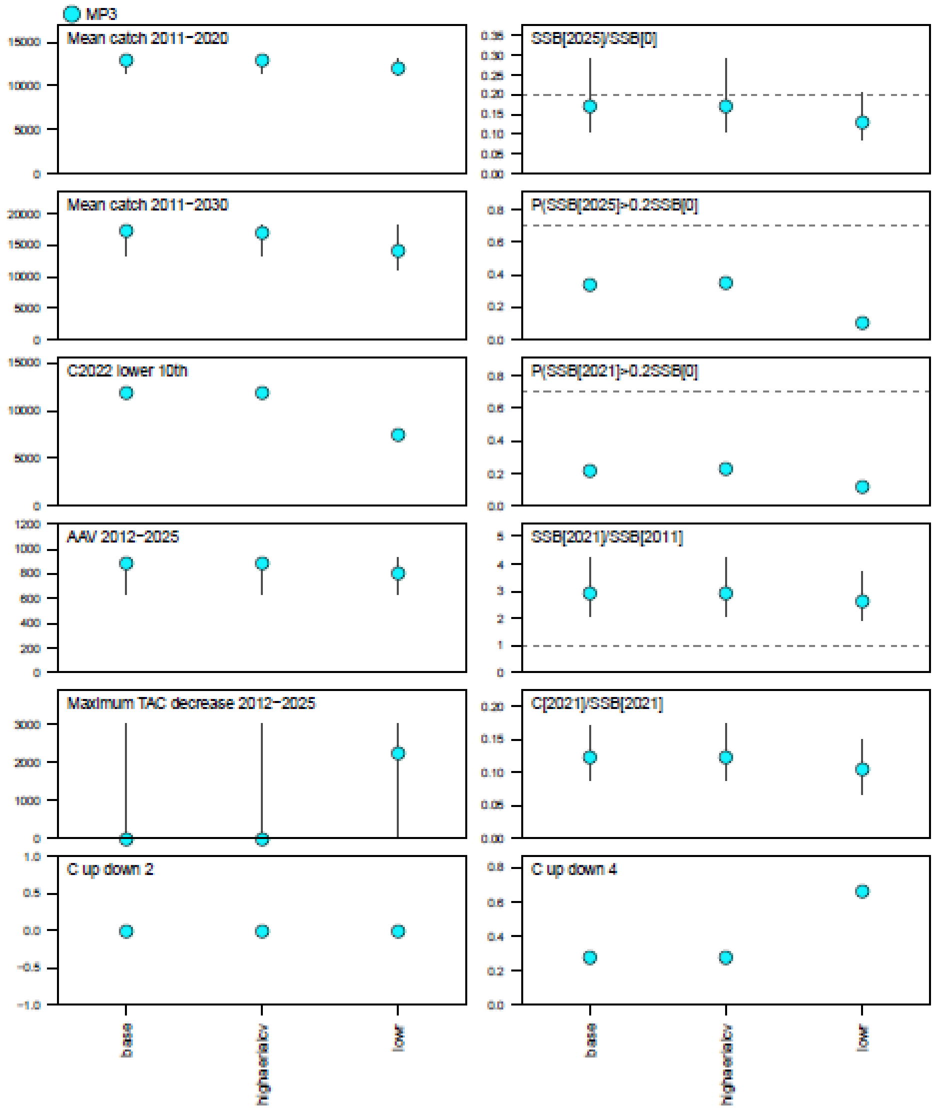

Figure 5. Summary statistics plot for the Bali procedure for the base case (1000t increase in the first year) and two robustness trials. The error bars show the 10th and 90th percentiles.

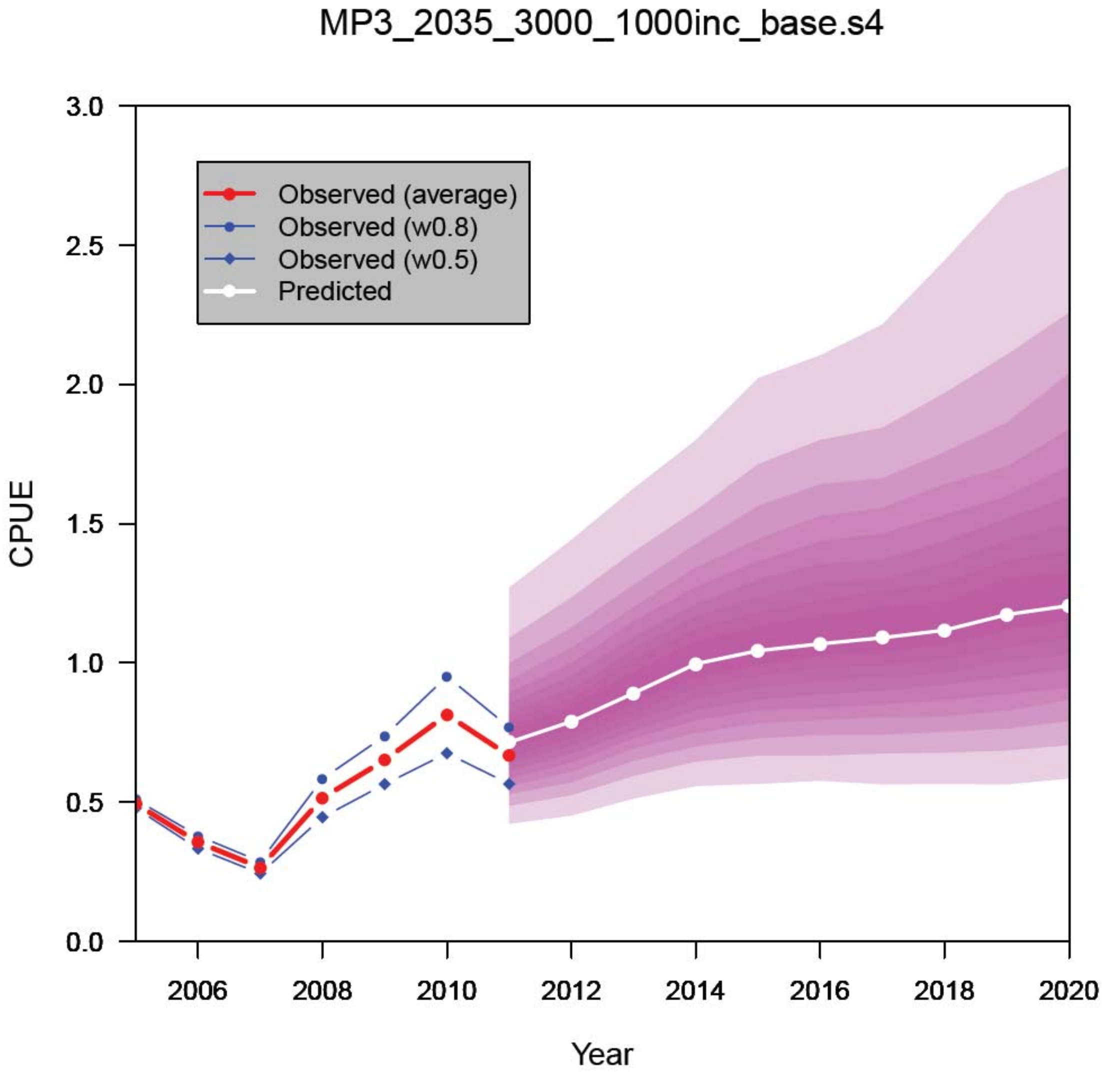

Figure 6. Historical CPUE series (2005-2011) of w0.5 and w0.8 (blue lines), the average of the two (thick red line) and the future index as projected in 2011 for 2011 to 2020 for the ***base case*** scenario (reference set), where the white line with its points is the median projected CPUE, and the shades of purple represent percentiles from 2.5% to 97.5% in increments of 5%.

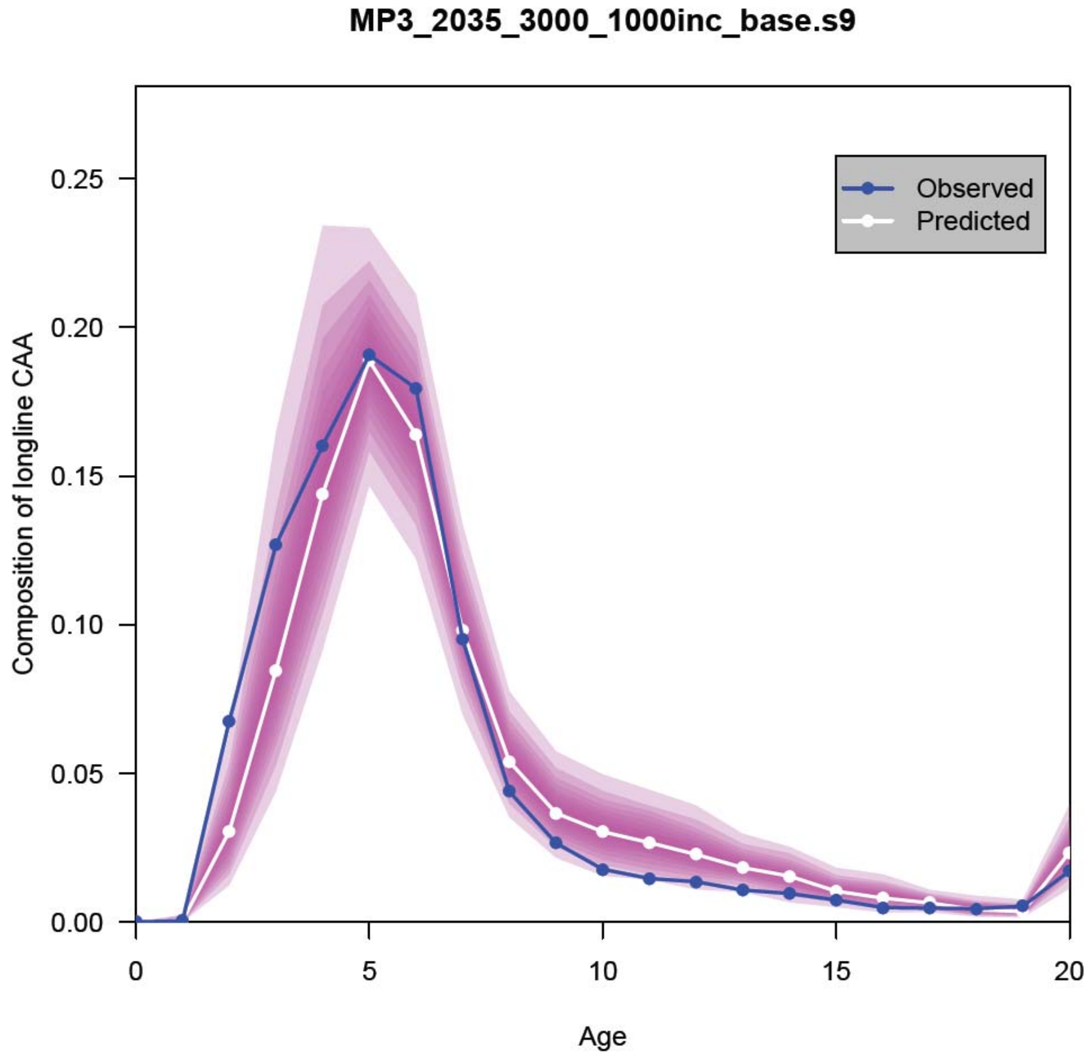

Figure 7. Observed catch-at-age composition of longline (LL1) fishery in 2011 (blue line) and composition as projected in 2011 for the ***base case*** scenario (reference set), where the white line with its points is the median projected composition, and the shades of purple represent percentiles from 2.5% to 97.5% in increments of 5%. Age 20 is a plus group.

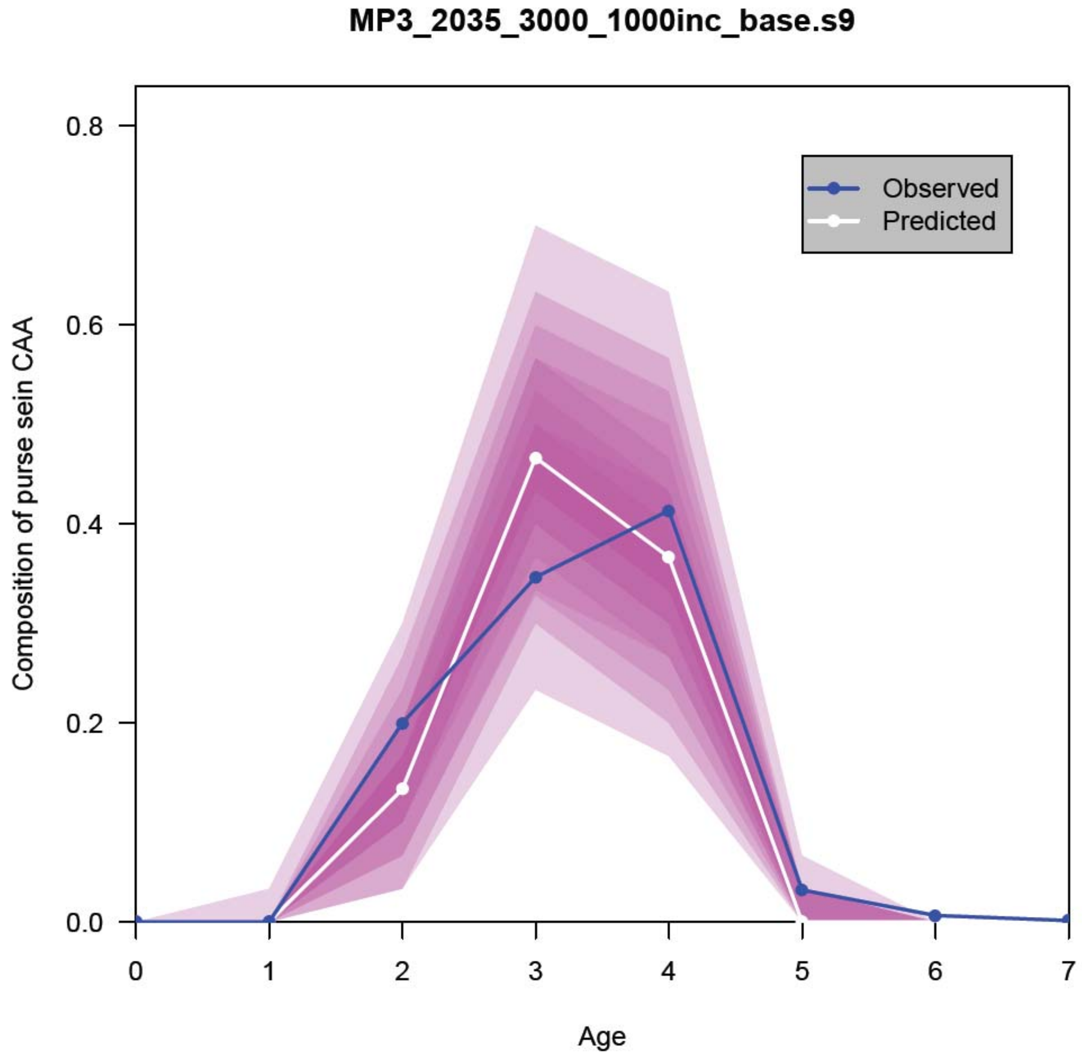

Figure 8. Observed catch-at-age composition of purse seine fishery in 2011 (blue line) and the composition as projected in 2011 for the ***base case*** scenario (reference set), where the white line with its points is the median projected composition, and the shades of purple represent percentiles from 2.5% to 97.5% in increments of 5%.