REPORT OF THE 2017 ICCAT ALBACORE SPECIES GROUP INTERSESSIONAL MEETING (INCLUDING ASSESSMENT OF MEDITERRANEAN ALBACORE)

(Madrid, Spain 5-9 June, 2017)

1. Opening, adoption of agenda and meeting arrangements

The meeting was held at the ICCAT Secretariat in Madrid 5 to 9 June, 2017. Dr Haritz Arrizabalaga (EU-Spain), the Species Group ("the Group") coordinator and meeting Chairman, opened the meeting and welcomed participants. Dr José María Ortiz de Urbina, rapporteur of the Mediterranean albacore, served as co-chair. Dr Miguel Neves dos Santos (ICCAT Assistant Executive Secretary) adressed the Group on behalf of the ICCAT Executive Secretary, welcomed the participants and highlighted the importance of the meeting due to the Commission's increasing interest in developing Management Strategy Evaluation and the assessment for the Mediterranenan stock which has not been assessed since 2011. The Chairman proceeded to review the Agenda which was adopted with minor changes (**Appendix 1**).

The List of Participants is included in **Appendix 2**. The List of Documents presented at the meeting is attached as **Appendix 3**. The abstracts of all SCRS documents presented at the meeting are included in **Appendix 4**. The following served as rapporteurs:

Sections	*Rapporteur*
Items 1, 9	M. Neves Santos
Item 2.1, 2.2	C. Palma
Item 2.3	D. Alvarez-Berastegui
Item 2.4	V. Ortiz de Zárate
Item 3	D. Macías
Item 4	R. Sharma, H. Winker
Item 5	J.M. Ortiz de Urbina
Item 6	P. de Bruyn, H. Arrizabalaga
Item 7	D. Parker
Item 8	H. Arrizabalaga, J.M. Ortiz de Urbina

2. Review of fishery statistics for Mediterranean and Atlantic albacore

The Secretariat presented the most up-to-date statistical information available in the ICCAT database system (ICCAT-DB) in relation to the albacore (*Thunnus alalunga*, ALB) Mediterranean stock (ALB-M). For ALB-M, both Task I nominal catches (T1NC) and Task II (T2CE: catch and effort, T2SZ: Task II size frequencies; T2CS: reported catch-at-size) were presented and revised by the Group. Statistics for 2016 are very incomplete and preliminary. The statistics of the two albacore Atlantic stocks were only marginally revisited by the Group, once the Secretariat informed that, with the exception of 2016 new data, no major updates were made since October 2016.

2.1 Task I (catches) data for Mediterranean albacore

The ALB summary table (T1NC catches of the three stocks) is presented in **Table 1** and **Figure 1**. The ALB-M cumulative catches by major gear are shown in **Figure 2**. Since the last ALB-M stock assessment (Anon, 2012) no major improvements were made to T1NC estimations, neither in terms of data recovery of historical catch series, nor in terms of corrections required to the existing data. The T1NC catches still have several of the same problems found in the past particularly for the older time series (incomplete series, poor gear discrimination, etc.). However, it is a fact that in recent years some improvements were made. For example, the ratio of unclassified gears (UNCL, SPOR, SURF) in the catches was reduced to levels below 20% (60% to 80% before 1991) as observed in **Figure 3**.

Overall, the lack of confidence the Group has in the total ALB-M biomass removals, a "key" element in the various models used by the SCRS, is very difficult to quantify in terms of the impact it can have on the results of the models. The Group reiterates once again the need to continue with the effort to improve ALB-M T1NC statistics especially to cover gaps for certain CPCs. This effort, must involve not only the major Mediterranean ALB-M fishing CPCs (EU.Italy, EU.Greece, EU.España, EU.Cyprus, and, Turkey) but also many other ICCAT CPCs (North African countries particularly are lacking catch information) in which some evidence of catches were found in other sources of information (GFCM, FAO, EUROSTAT, etc.).

During the meeting, the Group decided to adopt (and integrate in Task I, as preliminary estimations) the Turkish unclassified catches series (1957-1969) from EUROSTAT (used in the last stock assessment session), and, requested that the Secretariat informs Turkey about this decision. In addition, EU.Italy presented at the meeting a revision of T1NC catches covering various years (2003, 2007, 2009, 2011, 2014, and 2015). After a detailed comparison with the current catch series, only minor differences were found in the totals. However, at the gear level, the differences were large in particular because nearly 50% of the Italian catches were not associated to any gear. The adoption of these revisions, allowed the improvement of the gear discrimination for the Italian catches between 2003 and 2015.

The major ALB-M fishing CPCs have already reported T1NC preliminary statistics for the 2016 calendar year.

2.2 Task II (catch-effort and size samples) data for Mediterranean albacore

The availability of both T2CE and T2SZ datasets are presented in **Table 2** (the SCRS standard catalogue for ALB-M) for the period 1990 to 2016. The corresponding datasets were also prepared and made available (in various forms) to the Group. Nearly 95% of the total removals (period: 1990-2016) are concentrated in only 10 fisheries (see Rank in **Table 2**). In those 10 fisheries many T2CE and T2SZ datasets are still missing (or were not reported with the minimum detail required by the SCRS). For those cases in which both T2CE and T2SZ datasets were not reported with the required SCRS detail, the Secretariat will request a revision (now a general procedure used for all species) with the necessary details.

The Group considers that Task II information is still very poor and incomplete especially before 2003. Several highly aggregated (by year, without geographical discrimination, without gear differentiation, etc.) T2CE and T2SZ datasets still exist in the ICCAT-DB system. The Secretariat informed the Group that, all these “poor” datasets are bookmarked for future revision requests.

During the meeting, the Italian T2SZ revision of the 2003 ALB-M dataset presented to the Group, was adopted and replaced the incorrect dataset (mixed samples of albacore, bluefin and swordfish, ranging from 30 cm to 290 cm) identified during the last ALB-M stock assessment.

2.3 Evaluate relative indices of abundance for use in the Mediterranean stock assessment

During the meeting three indices of abundance were presented for the Mediterranean stock: the “western Mediterranean larval index”, the update of the “Spanish longline” index and the “Italian longline” index.

The following additional indices from the previous assessment are also available (Anon., 2012) (**Figure 3**):

- Nominal CPUE from Italian drifting longlines fishery in the southern Adriatic Sea from FAO-MiPAF document (Marano *et al*., 2005) covering years 1984 to 2000 (no data for 1988-89 and 1996-97);
- The Spanish sport fishery nominal CPUE from contests in the western Mediterranean Sea spanning years 2004 to 2009 (Macías *et al*., 2010);
- The Italian albacore nominal CPUE in the Tyrrhenian Sea and the south-central Mediterranean Sea including years 1999 and 2003 to 2006 (Di Natale *et al*., 2011);
- The standardized CPUE from the Greek longlines directed to albacore (Tserpes and Peristeraki, 2012);
- The standardized CPUE from the Greek longlines directed to swordfish (Tserpes and Peristeraki, 2012).

A larval index for albacore caught around the Balearic Sea was presented in document SCRS/2017/122. Larval abundance indices express standardized abundances of larval densities from ichthyoplankton surveys as proxy for spawning stock biomass. The index covered the period from 2001 to 2015 (9 years). Results show a decreasing trend in albacore larval abundance resulting in significant lower abundances in years 2013 to 2015 when compared to the previous years.

The Group discussed and agreed to use this index as proxy for spawning stock biomass in the Western Mediterranean. The Group confirmed that adult albacore in the Spanish coast with gonads in “spawning” state mainly appear around the Balearic archipelago and thus are representative. The Group also discussed about the habitat variables to be included in the model and the role of the local mesoscale oceanography on the retention/dispersion process.

Document SCRS/2017/115 presented standardized relative abundance indices of albacore caught by the Spanish surface longline in the western Mediterranean Sea. The indices cover the years from 2004 to 2015. The model accounted for fishing effort, time (quarter and month) and spatial area. The abundances time series derived was stable for the period 2004-2009, increased in year 2010 and then decreased until 2015 with 2015 being the lowest value ever.

Document SCRS/2017/117 presented standardized relative abundance indices of albacore caught by the Italian surface longlines in the Central Mediterranean Sea. The time series covers years 2011 to 2015. Annual standardized indices were estimated by means of Generalized Linear Modeling techniques including as predictors the year, month and area of fishing. Results highlight that Catch Per Unit Effort (CPUE) have been decreasing over time.

After the presentation of the three indices, the Group discussed similarities in their temporal trends. Both Spanish longlines and the Balearic larval indices showed no significant changes in abundance between 2001 and 2005, period for which no data from Italian longlines were available. For years 2011-2015, all indices exhibit negative trends, with the lowest values observed in year 2015 in all cases.

The information available regarding indices for their evaluation is included in **Table 3**. The same criteria as that proposed during the bluefin tuna data preparatory meeting in July 2016 were used. **Figure 4** present standardized values of all indices considered and standardized values for the selected indices for the assessment based on the summary table mentioned above.

The Group analyzed all the available indices in **Table 4** and decided to select the three new indices and the “Italian longline Adriatic” since 1990 for the assessment (**Figure 5**). The three indices were consistent among each other reinforcing the identified trends. The Group welcomed the new standardization methodologies applied and the new data as they improve the previous assessment where mainly nominal, discontinuous and conflicting fisheries dependent indices were available.

2.4 Progress on the available relative indices of abundance for the Atlantic stocks

Following the recommendations from the 2016 assessment of North and South stocks in 2016 (Anon., 2017) the Group reviewed and discussed the updated CPUE indices presented to the meeting.

2.4.1 North Atlantic

Document SCRS/2017/113 presented the first characterization of the catches and nominal CPUEs of albacore tuna (*Thunnus alalunga*) captured as a by-catch by the Portuguese pelagic longline fishery targeting swordfish in the North Atlantic. The percentage of the catch covered in the analysis as regards to the overall yearly albacore tuna catch in the North Atlantic was 0.6% and data covered the period from 1999 to 2015. The catches were particularly concentrated in the northeast areas of operation of the fleet, north of the Azores islands and also in areas closer to the Madeira, Canary and Cabo Verde Islands. Overall, 90.1% of the trips or sub-trips considered in this study had zero albacore tuna catches. Seasonal effects were noticed, with higher CPUEs mainly between November and February, and lower in the warmer period (from April to October). It was noticed a decreasing trend in the nominal CPUE from 2000 to 2013, which might be due to selectivity patterns related to the target species and longline setting.

Overall, the Group welcomed the work and recommended the authors to further standardize the time series.

Document SCRS/2017/118 presented the monthly spatial variation of albacore nominal catch rates in weight per unit of fishing effort (fishing days) derived from the Spanish baitboat and troll fisheries, based on trip port sampling of the catch during the 2015 and 2016 fishing seasons, in relation to the monthly SST distribution in the fishing area. The troll fleet operated in a continuous area in Northeast Atlantic offshore waters and in the Bay of Biscay, while the baitboat fleet was confined to the Bay of Biscay. Fishing activity concentrates in waters of SST ranging from 16°C to 22°C, characterized by different thermal features (lower SST range was observed for the North East Atlantic area, when compared to the Bay of Biscay).

The Group noted that a different fishing strategy by fleet was observed when analyzing the spatial distribution of the respective nominal CPUEs by fleet.

Document SCRS/2017/121 updated the standardized CPUE of Northern Atlantic albacore caught by Taiwanese longliners for the period 1967 to 2016. The novelty of this new analysis was the definition of a new core area for albacore sets, based on the distribution maps of albacore catch, effort, proportion of catch by species for decadal periods. Cluster analysis was used to distinguish sets targeting for four main species caught (albacore, bigeye, yellowfin and swordfish) and then designated the core albacore sampling area to determine the albacore fleet. The yearly standardized CPUE series continuously declined up to early1980s, highly fluctuated before late 1990s, thereafter, it increased since early 2000s and remained relative stable up to 2016.

The Group proposed this new core albacore sampling area to be considered in the future for minimizing the bias effect resulting from these non-albacore-targeting data.

2.4.2 South Atlantic

During the 2016 SCRS meeting, it was recommended to produce new, or improve existing standardized CPUE indices, for Japanese longline fleets to consider alternative ways to incorporate targeting effects (e.g. based on species composition) to try to recover the early periods. It was also requested to compare the indices for Brazil, Chinese Taipei, Japan and Uruguay and consider feasibility of a joint CPUE index for these longline fleets using fine scale, operational level data.

Document SCRS/2017/109 presented a revised method for the standardization of CPUEs of South Atlantic albacore caught by the Japanese longline fishery. Among the objectives of the new approach there were: selection of "core area", based on the proportion of high albacore catch and a certain amount of the fishing effort, which is still arbitrary, and therefore has room for improvement; 5 degree latitude and longitude blocks instead of subareas for the effect of fishing area; use of operational level logbook database; incorporation of effect of bait (only before 1993); and incorporation of additional effect of fishing gear (main and branch line materials, only after 1994). The operational (set-by-set) data extended 1959-2015 period, but the operations in the defined core area exist only from 1961. The model used for the standardization of CPUEs was highly significant. However, the effect of branch line during 1994-2015 was less significant. The effect of five degree latitude and longitude blocks was largest or second largest. The effect of quarter was also comparatively high. Standardized CPUE showed sharp declining trend during the 1960s and slight declining trend during the early 1970s. It was comparatively constant with fluctuations after that. It sharply increased after late 2000s. During late period (after 1994), the trend of CPUE is similar to that of nominal CPUE. The trend is also similar to the CPUE provided in the 2016 assessment with some small scale differences. It seems that in the early period there was a decreased targeting trend, whereas in recent years albacore targeting increased. Probably it is almost impossible to fully incorporate targeting issue in CPUE standardization. Therefore, it is relevant to specify the period and/or area in which CPUE appears to reflect abundance of the stock. For this purpose, it would be necessary to review in detail the fishery operation issues (i.e. changes in target species), including interviewing fishermen.

The Group noted that change in proportion of the bait (decrease in saury bait) is a part of the causes of decline in nominal CPUE during the early period. The Group also noted that it would be interesting to analyze the interaction between fishing gear (gear depth based on number of hooks per basket) and bait, although it may not be easy because of missing of interactions. Due to the high proportion of zero catch observations (around 60%) during the late 1970s to late 2000s, it was suggested the use of the Negative Binomial model.

Regarding joint CPUE analysis, a brief overview of the analysis conducted for Indian Ocean albacore was given. The Group thanked for providing the information, and recommended investigating this kind of analysis in the future.

Document SCRS/2017/120 updated the standardized CPUE of Southern Atlantic albacore caught by Taiwanese longliners for the period 1967 to 2016. The novelty of this new analysis was the definition of a new core area for albacore sets, based on the distribution maps of albacore catch, effort and proportion of catch by species for decadal periods. Cluster analysis was used to distinguish sets targeting for four main species caught (albacore, bigeye, yellowfin and swordfish) and then designated the core albacore sampling area to determine the albacore fleet. The yearly standardized CPUE series showed a continuous decline from the beginning of the Taiwanese longline fishery to 1990, then increased till mid-1990s, and leveled off since early 2000s up to 2016.

The Group proposed this new core albacore sampling area to be considered in the future for minimizing the bias effect resulting from these non-albacore-targeting data.

The Group revisited Winker *et al*., 2016, which presented the standardized CPUE index for South African pole and line fishery, for the period 2003 – 2015. A new approach was adopted using a Generalized Additive Mixed-Model (GAMM) with a *Tweedie* distributed error. The standardized CPUE mostly trails the nominal CPUE with no overall significant upward or downward trends. The analyses indicate that the CPUE for the South African baitboat fishery for albacore has been stable over the last decade.

The Group noted that this document presented a different methodology (GAMM, compared to normally used GLM/GLMM), and that seasonality was modelled with a spline function instead of as a factor. Thus, the Group recommended that the WGSAM provide some advice on the merits of the alternative procedures that can be used to standardize nominal CPUE series. It was also noted that an "early South baitboat" series exists, from 1975-1998. During the 2013 stock assessment, the "late South African baitboat" series started in 1999, while in this study it only starts in 2003. The authors explained to the Group that the years 1999-2003 were excluded because data reporting was more consistent after 2003.

The Group recommended that the above described model be used to standardize the CPUE of the South African baitboat fishery time series and these data be used as input data for the next South Atlantic albacore assessment.

3. Review of available and new information on biology and other life-history information

Within this item of the agenda, one presentation and two documents were presented.

Document SCRS/2017/112 presents a habitat model for Northeast Atlantic albacore based on albacore catches of the Basque trolling fleet (niche-ecological models). The main aim of the authors was to model the Northeast Atlantic albacore distribution changes and to identify possible causes of such variability associated to environmental changes. These environmental changes could affect relative availability of albacore to different fleets and explain the variability in abundance indices. In addition, projections to mid-century and end-of-the century allowed to describe the potential new distribution of this species in the future. Projections indicate a northward shift in albacore catches and an earlier feeding migration for the end-of-the-century, with a potential range contraction in some usual fishing areas around the Bay of Biscay.

The Group discussed how changes in the fleet dynamic could affect the results. The authors clarified on the nature of the troll fishery as probably the best available source of information, but that presence/absence data from other fleets can be assimilated in the future. The Group asked about the generation of pseudo-absences and discussed the possibility to use data from searching periods, or operations targeting other species as a source of real albacore absence data. Finally, the Group recommend to present this document to the Sub-committee of Ecosystems.

Presentation SCRS/P/2017/014 updates information about reproductive biology of albacore in the Western Mediterranean. The authors update information on size distributions, sex ratios, spawning season, minimum length at maturity, spawning fraction, and fecundity. As a conclusion albacore from the western Mediterranean Sea show lower minimum length at maturity, shorter spawning season, lower spawning interval, and higher relative batch fecundity in comparison with the oceanic albacore populations. This variation in expression of reproductive traits of Mediterranean albacore could represent an adaptive response to the environmental conditions in the Mediterranean.

The Group discussed about minimum size/age at maturity of the Mediterranean albacore from Arena *et al*., 1980 and Urbina *et al.*, 2011, and noted that their size estimates are really close.

Document SCRS/2017/128 presents age and growth parameters of Mediterranean albacore based on dorsal fin spine section readings of 379 specimen collected during the period 2003–2016 in Southern Ionian Sea and Ligurian Sea. The parameter estimated were like those of Quelle *et al.*, 2011 and differs substantially from those of Arena *et al.*, 1980 (obtained from scales).

The Group discussed the importance of using standardized methodologies so that the growth and age estimates can be comparable between areas. The Group recommend to analize all data available together.

Age-length data pairs from spine readings from Quelle *et al*., 2011 and SCRS/2017/128, and those provided by Italy and Cyprus as part of the European Data Collection Framework were combined into a single data set (**Table 5**). Such pairs from Megalofonou, 2000 were not available to the group. These four data sets represent a total of 1602 pairs and extend over a broader range of age groups and lengths than those available to Megalofonou, 2000. The mean lengths at age for age groups 1-9 from this combined data set are smaller than those observed by Megalofonou, 2000 (**Figure 6**). Note that in this analysis we assume that the absolute age of age group one is 2 years, as done by Megalofonou, 2000. Furthermore, we assume that the absolute age of age group zero samples from SCRS/2017/128 is 0.3 years, the difference between the time of collection (August) and the main spawning peak (June) in the central Mediterranean. We also assume that the age of age group zero collected by Arena *et al.*, 1980 is 0.6, the difference between the time of collection (December) and the main spawning peak (June) in the central Mediterranean. Note that Megalofonou fitted the von Bertalanffy equation to the mean length of each of the age groups rather than to the individual age-length pairs. The lengths at age predicted by such equation are close to the mean lengths of the age groups of the combined data set for ages 1 and 2 but are larger than for age groups 3-11 (see **Table 6**).

4. Mediterranean Albacore stock assessment

4.1 Catch-Based method Catch-MSY

For Mediterranean albacore (*Thunnus alalunga*), the data poor methods used in the past did not provide an estimate of MSY. Thus, in this case a catch based model was presented to estimate a range of Maximum Sustainable Yield in a probabilistic manner for Mediterranean albacore (SCRS/2017/114). This model was already presented two years ago in the species group meeting, but the SCRS suggested that this should be presented and approved during a stock assessment meeting before the MSY estimates could be incorporated in the executive summary table.

The model (Martell and Froese, 2013) uses the historical catch series with a prior on the resilience of fish stocks to generate a posterior distribution of MSY and the parameters of Schaefer model (Schaefer, 1954). The results produced with this model indicate that, since the 1980s, catch has been oscillating around the estimated MSY (**Figure 7**). The upper limit of the MSY was exceeded during the end of the 1990s and early 2000s, and remained below the lower limit during the last three years of the time series (**Figures 7**and **8**). The parameters of Schaefer surplus production model (intrinsic growth rate *r* and carrying capacity *K*) and the estimated MSY are also shown in **Table 7**.

4.2 Catch-based method CMSY

Similar to Catch-MSY (Martell and Froese, 2013), the CMSY method uses catch and productivity to estimate biomass, exploitation rate, MSY, and related fisheries reference points from catch data and resilience of the species to provide an alternative assessment tool for situations where CPUE indices are not available or potentially unreliable. Assuming underlying population dynamics of the Schaefer Model probable ranges of parameters *r* and *K* are filtered with a Monte-Carlo algorithm to detect 'viable' *r-K* pairs. A parameter pair is considered 'viable' if the corresponding biomass trajectories are compatible with the observed catches in the sense that predicted biomass does not become negative, and is compatible with prior estimates of relative biomass ranges for the beginning and the end of the respective time series.

The application of CMSY to Mediterranean albacore data was presented (SCRS/P/2017/015), including an application to data time series through 2015 (SCRS/P/2017/015). It was highlighted that the main improvement of CMSY compared with the Catch-MSY method of Martell and Froese, 2013 lies in overcoming the problems created by a triangular rather than ellipsoid distribution of the viable *r-K* pairs as a result of the Monte-Carlo filtering procedure. Other improvements include adding estimation of biomass and exploitation rates as standard CMSY output and the implementation of a Bayesian state-space Schaefer surplus production model (CMSY.BSM) as routine tool within the CMSY software (Froese *et al*., 2016). Froese *et al*., 2016 demonstrated that the tip of the triangle typically transverses the expected ellipsoid cloud of viable *r-K* pairs found by fitting an implemented Bayesian state-space Schaefer surplus production model to catch and abundance data.

For the purpose of ICCAT assessments, the CMSY_ICCAT R code (CMSY_ICCATv1.R) was made available to the Group. CMSY_ICCAT is designed to facilitate comparison with outputs of conventionally used Bayesian surplus models. Among the newly implemented features are: i) a plot comparing normalized trends of CMSY biomass projection to observed and predicted CPUE from the CMSY_BSM; ii) plots comparing CMSY distributions of *K*, *r*, B_{cur}/B_{MSY} and F_{cur}/F_{MSY} to the corresponding posteriors from the CMSY_BSM, as well as priors for *K* and *r*; and iii) a Kobe-type bi-plot that allows comparing the CMSY and CMSY_BSM trajectories of the ratios F/F_{MSY} (y-axis) over B/B_{MSY} (x-axis), with uncertainties for the assessment year final illustrated as kernel density plots denoting the 50%, 80% and 95% credibility intervals.

Figures 9 and **10** illustrate an example application using CMSY_ICCATv1.r for the updated Mediterranean albacore data comparing CMSY and CMSY_BSM fitted to CPUE data, excluding the 2015 CPUE data point (c.f. assessment below).

4.3 Catch Curve Analysis

Total instantaneous mortality (Z) rates were estimated for years where size information was available (1977-2016, with gaps). Yearly Z estimates (**Table 8**) were based on the value of the slope of a length-converted catch curve (regression of the number of fish in a given length-class on the average relative age of a fish in the length-class, corrected for nonlinearity in fish growth), based on length-converted catch curve analysis assuming Megalofonou, 2000 growth. The central solid black line (**Figure 11**) represents an M assumption of 0.3 with patterns resulting from an assumed M of 0.4 (lower dotted) and 0.2 (upper dotted) also depicted.

The Group noted that not much change had occurred in the stock from what was assessed in 2011 (showing population fluctuating around some mean level of F/M=0.25). The stock status is stable and does not show a decline. Other approaches to use size based indicators for the population (e.g. l_{opt}, l_{50}) were suggested. Growth and recruitment overfishing can be estimated using these methods.

4.4 Bayesian State-Space Surplus Production Model (BSPSP)

Stock assessment results from a JABBA (Just Another Bayesian Biomass Assessment) were presented to the Group using the R tool (BSPSP_ICCATv2.R). For further technical aspects of the model, refer to the Report of the 2017 ICCAT Shortfin Mako Meeting.

Issues of catches doubling in recent years, and contradictory to the low Biomass trends were discussed. The authors noted that this pattern is not biologically implausible, but if the observed CPUE trend is a real effect, there will be a severe problem in the stock status. Issues on retrospectives were asked to be examined, as the model performance is low.

A comparison of the Schaefer BSPSP and Fox BSPSP fitted to CPUE time series including 2015 CPUE data, produced slightly more pessimistic results with regards to F/F_{MSY} for the Schaefer BSPSP than for Fox BSPSP and similar pessimistic on biomass depletion B/B_{MSY} (**Table 9**). The analysts pointed out that this can be largely attributed to the inherent change in location of the B_{MSY} reference point relative to the unfished biomass (*K*), i.e. $B_{MSY} = 0.5K$ (Schaefer) and $B_{MSY} = 0.4K$ (Fox), but also suggested that the Fox model is generally more plausible for tuna species given their life history.

The fits to the observed CPUE time series (2001-2015) for the Fox Model are shown in **Figure 12**. Due to concerns regarding the potentially overly strong influence of the 2015 CPUE data point, It was suggested to assess other production functions where the shape parameter was fixed (**Table 9**, **Figure 13**), and assess model performance with retrospective and prediction diagnostics. Other issues discussed were prior sensitivity and how it influences the model. It was also noted that certain data were having a high influence on model performance.

To address the concerns, the following analyses were conducted; Jack-knife (**Figure 13**), retrospective (**Figure 14**) and prediction cross-validation (**Figure 15**). Jack-knife indicates that the stock status is highly dependent on the last point. Retrospective patterns are apparent as they indicate a better status until we have the last point. Finally, predictive skill is poor given the last point and whether it is an outlier or actual indicator of abundance remains an issue to resolve.

Based on the highly sensitive last 2015 CPUE point, the Group recommended that it is not really feasible to conduct projections using this model. Two CPUEs fishery based and one fishery-independent, all generally indicated a downward trend. Possible reasons for this could have been the potentially anomalously environmental conditions in the Mediterranean in 2015. Having updated information for 2016 would help to evaluate how the model may perform in the future.

The Group noted as to why things may have been occurring in the history of the fishery. In 2007 when catches were 6,566 t, the fleet moved into an area where they normally do not operate (spatial coverage of the fishery was larger than normal). Regardless, the Group noted that the 2007 catches were unsustainable, and it was recommended to not approach those fishing levels again.

4.5 Final Stock Status Advice

Finally, as the last point seems highly influential and possibly suspect, advice was based on using all catch data till 2015, and CPUE data till 2014 (**Figure 16**) and stock status advice is based on **Table 10**. However, it should be reiterated that the alternative fits including the 2015 CPUE data point are not biologically implausible, which poses the risk that there could be a severe problem in the stock status with current catches substantially exceeding sustainable fishing level (**Table 9**). **Table 11** shows times series with confidence intervals for F relative to F_{MSY} and B relative to B_{MSY}. In addition, issues on retrospectives were asked to be examined, as the model performance is low. The uncertainty in stock status indicates that the status is highly uncertain with respect to both fishing mortality and biomass (**Figure 17**).

5. Management recommendations for Mediterranean albacore

Unfortunately, limited quantitative information is available to the SCRS for use in conducting a robust quantitative characterization on biomass status relative to Convention objectives. Recent fishing mortality levels appear to be below F_{MSY}, and current biomass is aproximately at B_{MSY} level. However, there is considerable uncertainty about current stock status. For this reason, the Commission should institute management measures designed to avoid increases in catch and effort directed at Mediterranean albacore. The analyses suggest that catch levels as high as those in the years 2006-2007 (beyond 5900 t) proved to be clearly unsustainable. Moreover, recent catches for this stock are close to the estimated MSY. Considering the high uncertainty regarding the most recent abundance trends, the Committee recomends to maintain catches below MSY at least until these abundance trends are confirmed. The precise level of catch would depend on the level of risk the Commission would like to assume. If the downward abundance trends are confirmed, catch levels would need to be further reduced.

6. Evaluation of HCRs for North Atlantic albacore

An update of the MSE work conducted for northern albacore was presented in documents SCRS/2017/091, SCRS/2017/092 and SCRS/2017/093. These documents were first presented at the 2017 Working Group on Stock Assessment Methods inter-sessional meeting.

Rec. 16-06 states that "in 2017, the SCRS shall refine the testing of candidate reference points (e.g $SSB_{THRESHOLD}$, SSB_{LIM} and F_{TARGET}) and associated harvest control rules (HCRs) that would support the management objective", which is "(a) to maintain the stock in the green quadrant of the Kobe plot with at least a 60% of probability, while maximizing long-term yield from the fishery, and (b) where $SSB<SSB_{MSY}$, to rebuild SSB to or above SSB_{MSY}, with at least a 60% probability, and within as short time as possible, while maximizing average catch and minimizing inter-annual fluctuations in TAC levels". Based on this objective, the MSE used in SCRS/2017/093 was tailored specifically to support the process to discuss and eventually adopt a HCR for North Atlantic albacore in 2017. Compared to the work presented in 2016, the new MSE included many more OMs, an MP that simulated, to the extent possible, the last stock assessment for this stock conducted in Madeira in 2016, and bounded HCRs that limited the amount of TAC change between iterations (which has also been included as part of recently implemented HCRs such as for Indian Ocean skipjack).

This work was already presented in May to the Working Group on Stock Assessment Methods (WGSAM), that highlighted that authors incorporated all the suggestions made in the previous years, and that "MPs employed in the MSE framework are consistent with the current assessment approach, … thus taking management decisions and applying these HCRs to the outcome of the last northern albacore stock assessment would be appropriate". The evaluations indicated that all HCRs tested would enable achieving ICCAT's management objective, however, some differences were found between HCRs, expressed as trade-offs between the different performance statistics. The WGSAM noted the importance of improving the presentation of the results to make the trade-offs more obvious.

Thus, the Group went on to discuss the presentation of the MSE results. A table using grey-scale shading was suggested by the 2017 Working Group on Stock Assessment Methods (WGSAM). The Group discussed this table, providing suggestions for refining the presentation of results in this format. It was generally agreed that the grey-scale shading was desirable as it stayed away from the emotive colour scheme used in Kobe plots, while still differentiating different simulation outputs. It was generally agreed that, as in the Kobe strategy matrices, "relatively better" values should be darker, while "relatively poorer" values should be lighter and that the colours should be scaled according to the maximum and minimum values in each column. Regarding the probability of being in the green zone, although all HCRs meet the objective established by the Commission, the Group agreed to use a grey scale to reflect the relative differences in performance regarding this indicator. It was also suggested that the values in the table should be sorted according to the value of the Probability of the stock being in the green quadrant of the Kobe Plot, as this would allow to more easily visualize the main trade-offs between this and other indicators. The results in this agreed format, for a representative subset of 27 HCRs are included in **Table 12**, while **Table 13** includes the whole set of 45 HCR options tested.

Following a recommendation from the WGSAM, a simplified Spider plot was presented as a suggestion for graphically presenting the results of the **Table 12**. The Group agreed that these simplified plots were useful in characterizing the main trade-offs, essentially between the probability of being in the green zone and the long term yield. However, several suggestions were made to improve them. It was stressed that the plots should be comparable between scenarios (i.e. same scale on axes). In addition, the link between the different plots and their corresponding rows on the table need to be clearly identified. The spider plots were amended accordingly and are provided in **Figure 18**.

The authors agreed that the code used to conduct the MSE will be submitted to a github site. This will facilitate transparency and collaboration for validation of the process. The Secretariat provided a brief presentation of the current contents of the github site and how it can facilitate these types of collaborations particularly between tRFMOs. This tool would not be limited to the albacore MSE, but to all ICCAT and potentially all tRFMO MSE work. It was stressed that the site is being modified and is a work in progress. The Group noted that the procedures for data sharing that are being elaborated by the Sub-committee on Statistics (SC-STATS) will need to be followed on the github. The code used to run the MSE can be shared in real time, but the input data should only be provided openly once reviewed by the SCRS. It was thus recommended that the SC-STATS should specifically include github in their data sharing protocols. Github facilitates password protection and it was suggested that this could be used for portions of the process not yet reviewed by the SCRS, after which it can be passed to the open access section of github.

The authors stressed that although the results of the MSE work have been checked and have been presented to several SCRS working groups, as well as panels of the Commission, several additional diagnostic checks were still necessary for reassurance. The authors stated that a list of checks had been agreed and that these would be conducted inter-sessionally to ensure the correct functioning of the models. This list of diagnostic checks, as well as a brief summary of the current status is provided in https://github.com/laurieKell/albn/wiki, which is a living document reflecting the progress on these tasks. The Group agreed to present the MSE results to the SWGSM whilst acknowledging that diagnostic tests are still being run and that the work will only be considered to have been completely reviewed by the SCRS after the plenary meeting. Should the diagnostic checks show any major issues that require any modification of the conclusions reached by the MSE, the Group will inform the SCRS during the plenary meeting this year.

An important point raised, was that once a Harvest Control Rule is adopted, it will need to be applied to the outcome of the last stock assessment meeting so as to set the TAC. The authors agreed that this could be prepared in advance for the range of scenarios so that this would be available when a specific HCR is adopted. This outcome however should not be part of the presentation to the SWGSM but should be presented to the SCRS plenary for review and included as part of the executive summary.

Lastly it was acknowledged that the performance indices presented are those specifically requested by the Commission, however these may not include several key indicators that demonstrate the usefulness or limitations of each scenario. As such it was noted that the SCRS has the flexibility to suggest additional performance indicators useful to the SCRS and Commission. This can be done should additional important indicators be provided. The Group can use the work being conducted by the joint t-RFMO MSE working group for guidance on this issue.

7. Recommendations on research and statistics

For the Mediterranean stock, in principle, changes in mean size of the catch may reflect changes in the age/size distribution of the population and/or changes in the selectivity of the gear(s) or other factors indirectly affecting size selectivity. In order to evaluate annual trends of mean size it is necessary to identify the possible factor(s) that could explain variability on observed size frequency samples. The Group recommends that methods of standardizing length measurements be implemented. A method for standardizing length data has previously been submitted to the SCRS (Ortiz and Palma, 2012). In addition to length standardization, the Group recommended to conduct a review and collation of all the available data on age-length pairs available from the various studies that have estimated age from spines with the view to update the estimate of the growth curve for the species. It is also recommended that methods of accounting for selectivity in the year 1 cohort in von Bertalanffy growth function (VBGF) be explored to ensure accurate parameter estimation.

The Group recommended the continuing effort to standardize CPUE estimates from the swordfish directed Portuguese pelagic longline fishery in the Atlantic Ocean, which has a North Atlantic albacore bycatch component. The potential of these data as a relative index of abundance remains unknown, and can only be determined once targeting has been accounted for. Similar approaches are recommended for other swordfish oriented fisheries, e.g. the Spanish longline fishery that operates in a similar area.

The Group recommended that the feasibility of joint South Atlantic albacore CPUE analyses for longline fleets (Brazil, Chinese Taipei, Japan and Uruguay) using fine scale, operational level data be explored. Fleet specific CPUE has been found to be sensitive to targeting despite standardizing techniques. There is evidence that combining time series data from multiple fleets may be less sensitive to such bias (Hoyle *et al*., 2016).

The Group recognized the potential of the Balearic Sea larval index as a proxy for spawning biomass (SCRS/2017/122) to improve western Mediterranean albacore assessments where fisheries dependent data are limited. As such, the Group supports the continuation of larval index data collection in the Balearic Sea and other spawning areas, and recommends further research into the use of larval indices to supplement fisheries dependent data in stock assessments.

The Group recognized the lack of standardized CPUE data from the eastern Mediterranean as a potential source of uncertainty when assessing Mediterranean albacore. The Group recommended the CPCs predominantly fishing in this area (EU-Greece, EU-Cyprus and Turkey) make a concerted effort to generate, and submit, standardized CPUE data.

In an attempt to improve assessment transparency, the Group recommends that GitHub be considered as a platform for sharing information, in addition to ownCloud. GitHub lends itself to sharing and editing documents such as code. Access protocol for GitHub must align with the SCRS requirements and will follow that of ownCloud in that the password will be made available to attending delegates and, if requested, can be shared with non-delegates at the discretion of the SCRS chairman.

The Committee continues to recommend initiating an albacore research program for North Atlantic albacore. Over a four year period, the research will be focused on three main research areas: biology and ecology, monitoring of stock status, and management strategy evaluation. The requested funds to develop this research plan have been estimated at a cost of 1.2 million Euros for a 4 year work plan. More details of the proposed research and economic plan are provided in **Appendix 5.**

During the most recent series of scientific meetings of the Albacore Species Group, several countries with important albacore fisheries have not been represented at the meeting. This limited the ability of the Group to properly revise the basic fishery data and some standardized CPUEs that were submitted electronically. This continues to result in unquantified uncertainties which negatively affected successfully achieving the objectives of the meetings. To overcome this, the Group continues to recommend that CPCs make additional efforts to participate and be made aware of capacity building funds available for participation in and contributing to working group meetings.

Reliable evaluation of Mediterranean albacore stock status is hindered by the inexistence (or low quality) of catch, catch-effort and size statistics over time for some important fleets. As a prerequisite of successful assessments of the stock, a complete revision of Task I (aggregated catch, by gear/fleet) and Task II (catch-effort, size) data is recommended, specifically before the year 2000. The Committee believes that the total amount of removals is probably incomplete as some CPCs, particularly from North Africa might not be submitting Task I data.

The Group recommended that an independent peer-review of the MSE process and code used in setting the MP would be useful to get external approval on what has been done with the current (North Atlantic albacore and Atlantic bluefin tuna) and future MSEs being proposed (e.g. swordfish and tropical tunas). Possible candidate approaches would be the model used for CCSBT/IOTC with external reviewers from the field evaluating the procedure and technical modules used to design and evaluate the process. This would be of high priority for the albacore MSE and should be undertaken within the next few years. The Group recommends that the Secretariat approaches the ABNJ project to inquire about the possibility of financial assistance.

8. Other matters

8.1 Update of the species Executive Summaries

The Albacore Executive Summary was revised, updated and adopted by the Group. However, catch tables and figures by species will be updated by the Secretariat prior to the Species Groups meeting in September 2017.

8.2 Other

The Group agreed on indicators of biomass and fishing mortality for Mediterranean albacore and those are provided in section 4 (**Table 10**). These indicators are provided to be incorporated in the Ecosystem Report Card.

9. Adoption of the report and closure

The report was adopted by the Group and the meeting was adjourned.

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Table 1. Estimated catches (t) of Albacore (*Thunnus alalunga*) by area, gear and flag (as of June 8 2017).

			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
TOTAL			70088	69919	60095	61467	53378	57728	67407	48794	42320	41663	40857	48796	52788	45399	42728	43396	23841
	ATN		33124	26253	22741	25567	25960	35318	36989	21991	20483	15375	19509	20039	25680	24633	26651	25449	11483
	ATS		31387	38796	31746	28002	22543	18882	24453	20283	18867	22265	19225	24129	25061	19262	13677	15143	8921
	MED		5577	4870	5608	7898	4874	3529	5965	6520	2970	4024	2124	4628	2047	1503	2400	2804	3436
Landings	ATN	Bait boat	11072	6103	6638	7840	8128	10458	14273	8496	7931	4994	6026	5530	8816	4975	7341	9265	1061
		Longline	7321	7372	6180	7699	6917	6911	5223	3237	2647	2619	3913	3666	3759	6514	3091	4464	3557
		Other surf.	5971	2828	422	551	697	624	625	525	274	427	324	412	352	596	162	28	31
		Purse seine	191	264	118	211	348	99	188	198	70	84	74	0	167	7	35	115	44
		Trawl	3547	5374	5376	3846	2369	7001	6385	3429	4321	2811	2026	6852	6678	6558	9184	5771	6297
		Troll	5023	4312	4007	5419	7501	10224	10296	6105	5239	4440	7146	3578	5909	5891	6660	5596	192
	ATS	Bait boat	6873	10355	9712	6973	7475	5084	5876	3375	4350	7926	3748	5938	6710	4411	4741	4965	
		Longline	24398	28039	21671	20626	14735	12977	17740	15087	13218	12113	13471	16445	17846	13863	8886	9982	8916
		Other surf.	58	377	323	82	299	288	395	1762	1219	2066	1651	1538	66	897	7	66	
		Purse seine	58	25	39	309	16	534	442	58	81	160	355	208	437	91	42	129	5
		Trawl	0	0	0	12	18	0	0	0	0	0	0	0	0	0	0	0	
	MED	Bait boat	88	77	29	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Longline	2796	2597	3704	4248	2335	1997	3026	4101	2694	2160	1719	2327	1959	1392	2343	2485	3409
		Other surf.	2693	2196	1757	46	87	169	134	182	246	634	404	1408	8	18	27	58	0
		Purse seine	0	0	1	3557	2452	1362	2803	2237	24	1230	0	869	68	86	14	247	4
		Trawl	0	0	0	48	0	0	0	0	5	0	0	0	0	0	5	4	7
		Troll	0	0	117	0	0	0	1	0	1	0	1	0	6	0	3	0	0
Discards	ATN	Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	93	179	209	300
	ATS	Longline	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
	MED	Longline	0	0	0	0	0	0	0	0	0	0	0	25	6	7	8	10	16
Landings	ATN	Barbados	0	2	5	8	10	13	9	7	7	4	6	4	20	22	13	16	
		Belize	0	0	0	0	0	0	0	22	26	39	416	351	155	230	79	1	
		Brazil	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Canada	122	51	113	56	27	52	27	25	33	11	14	28	34	32	47	32	
		Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	
		China PR	16	57	196	155	32	112	202	59	24	27	142	101	21	81	35	21	
		Chinese Taipei	5299	4399	4330	4557	4278	2540	2357	1297	1107	863	1587	1367	1180	2394	947	2857	3134
		Cuba	0	0	1	322	435	424	527	0	0	0	0	0	0	0	0	0	
		Côte d'Ivoire	0	0	0	0	0	0	0	0	0	25	53	39	146	0	0	0	
		Dominican Republic	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.España	16000	9177	8952	12530	15379	20447	24538	14582	12725	9617	12961	8357	13719	10502	11607	14126	
		EU.France	5718	6006	4345	3456	2448	7266	6585	3179	3009	1122	1298	3348	3361	4592	6716	3441	4223
		EU.Ireland	3464	2093	1100	755	175	306	521	596	1517	1997	788	3597	3575	2231	2485	2390	2337
		EU.Netherlands	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	
		EU.Portugal	278	1175	1953	553	513	556	119	184	614	108	202	1046	1231	567	2609	929	1110
		EU.United Kingdom	15	0	0	0	0	6	19	30	50	67	118	57	50	133	136	31	0
		FR.St Pierre et Miquelon	0	0	4	0	7	2	0	3	0	0	0	0	0	0	0	0	
		Grenada	12	21	23	46	25	29	19	20	15	18	18	18	0	0	0	0	
		Guatemala	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	
		Iceland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Japan	688	1126	711	680	893	1336	781	288	402	288	525	336	400	1745	267	283	
		Korea Rep.	0	0	0	0	0	59	45	12	59	82	110	60	200	184	64	5	
		Maroc	0	0	55	81	120	178	98	96	99	130	0	0	0	0	0	0	20
		Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	
		NEI (Flag related)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Panama	0	0	0	0	0	0	96	298	113	45	154	103	0	246	126	103	
		Philippines	0	0	0	0	0	9	0	8	19	54	0	0	83	0	0	0	
		Sierra Leone	0	91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		St. Vincent and Grenadines	704	1370	300	1555	89	802	76	263	130	135	177	329	305	286	328	305	
		Sta. Lucia	1	3	2	10	0	2	2	2	2	0	130	2	3	2	0	0	
		Suriname	0	0	0	0	0	0	0	0	0	0	0	0	249	216	0	0	
		Trinidad and Tobago	2	11	9	12	12	9	12	18	32	17	17	23	47	67	71	95	71
		U.S.A.	406	322	480	444	646	488	400	532	257	189	315	422	418	599	458	247	
		U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		UK.Bermuda	2	2	0	0	1	1	0	0	0	0	0	1	0	0	1	0	1
		UK.Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	
		Vanuatu	0	0	0	0	414	507	235	95	20	140	187	196	172	228	195	0	
		Venezuela	299	348	162	346	457	175	321	375	222	398	288	247	312	181	285	351	287

Table 1. (continued).

			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
	ATS	Angola	0	0	0	0	0	0	0	0	0	0	0	0	168	0	5	0	
		Argentina	0	0	0	12	18	0	0	0	0	0	130	43	0	0	0	0	
		Belize	2	0	0	0	0	0	54	32	31	213	303	365	171	87	98	0	
		Brazil	4411	6862	3228	2647	522	556	361	535	487	202	271	1269	1857	1821	438	425	
		Cambodia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cape Verde	0	0	0	0	0	8	46	24	0	5	0	5	0	0	0	0	
		China PR	89	26	30	26	112	95	100	35	25	89	97	80	61	65	34	120	
		Chinese Taipei	17221	15833	17321	17351	13288	10730	12293	13146	9966	8678	10975	13032	12812	8519	6675	7157	8907
		Cuba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Curaçao	2	0	0	0	0	0	0	0	0	21	4	4	24	0	0	1	
		Côte d'Ivoire	0	0	0	0	0	0	0	0	0	47	43	45	50	0	0	0	
		EU.España	288	573	836	376	81	285	367	758	933	1061	294	314	351	369	259	418	
		EU.France	23	11	18	63	16	478	347	12	50	60	109	53	161	73	38	53	5
		EU.Portugal	486	41	433	415	9	43	8	13	49	254	84	44	11	1	3	1	9
		EU.United Kingdom	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
		Ghana	0	0	0	0	0	0	0	5	10	14	25	0	0	0	0	0	
		Guatemala	0	0	0	0	0	0	40	0	0	0	56	0	0	15	0	1	
		Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	
		Guinée Rep.	0	0	0	0	0	0	0	0	0	0	7	7	74	0	0	0	
		Honduras	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Japan	554	341	231	322	509	312	316	238	1370	921	973	1194	2903	3106	1129	1761	
		Korea Rep.	18	1	0	5	37	42	66	56	88	374	130	70	89	33	2	4	
		Maroc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (ETRO)	0	10	14	53	0	7	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Namibia	2418	3419	2962	3152	3328	2344	5100	1196	1958	4936	1320	3791	2420	848	1057	1062	
		Panama	0	0	0	0	0	17	0	87	5	6	1	0	12	3	0	6	
		Philippines	0	0	0	0	0	52	0	13	79	45	95	96	203	415	18	0	
		Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	
		Seychelles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		South Africa	3610	7236	6507	3469	4502	3198	3735	3797	3468	5043	4147	3380	3553	3510	3719	4030	
		St. Vincent and Grenadines	2116	4292	44	0	0	0	65	160	71	51	31	94	92	97	110	100	
		U.S.A.	1	2	8	2	1	0	0	0	0	0	0	0	0	0	0	0	
		U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		UK.Sta Helena	58	12	2	0	0	0	62	46	94	81	3	120	2	2	0	0	
		Uruguay	90	135	111	108	120	32	93	34	53	97	24	37	12	209	0	0	
		Vanuatu	0	0	0	0	0	684	1400	96	131	64	104	85	35	83	91	0	
	MED	EU.Croatia	0	0	0	0	0	0	0	0	0	0	2	7	12	20	30	11	
		EU.Cyprus	6	0	12	30	255	425	507	712	209	223	206	222	315	350	377	495	542
		EU.España	152	200	209	1	138	189	382	516	238	204	277	343	389	244	283	53	
		EU.France	0	0	1	0	0	0	0	2	1	0	1	2	0	0	1	1	
		EU.Greece	1786	1840	1352	950	773	623	402	448	191	116	125	126	126	165	287	541	1332
		EU.Italy	3630	2826	4032	6913	3671	2248	4584	3970	2104	2727	1109	2501	1117	615	1353	1602	1490
		EU.Malta	4	4	2	5	10	15	18	1	5	1	2	5	19	29	62	37	56
		EU.Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Korea Rep.	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	
		Maroc	0	0	0	0	0	0	0	0	0	120	0	0	0	0	0	0	
		NEI (MED)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Syria	0	0	0	0	0	0	0	19	14	0	0	0	1	1	0	0	
		Turkey	0	0	0	0	27	30	73	852	208	631	402	1396	62	71	0	53	
		Yugoslavia Fed.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Discards	ATN	Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Venezuela	0	0	0	0	0	0	0	0	0	0	0	0	0	93	179	209	300
	ATS	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	MED	EU.Cyprus	0	0	0	0	0	0	0	0	0	0	0	25	6	7	8	10	16
		EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Table 2. Mediterranean Albacore catalogue of Task I (t1, in tonnes) and Task II (t2 availability; where "a": t2ce only; b: t2sz only; "ab": t2ce & t2sz; “-1”: no data) between 1990 and 2016 (2016 is provisional).

Stock	Status	FlagName	GearGrp	DSet	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Rank	%	%cum
				T1 Total	1896	2379	2202	2138	1349	1587	3150	2541	2698	4856	5577	4870	5608	7897	4874	3529	5965	6567	2970	4021	2124	4621	2047	1503	2400	2774	3436			
MED	CP	EU.Italy	LL	t1	624	523	436	402	347	81	366	172	172	307	2712	2445	3631	3786	1555	1189	1995	2739	2083	919	1109	1625	1117	605	1342	1356	1480	1	36.7%	37%
MED	CP	EU.Italy	LL	t2	-1	-1	-1	b	a	-1	-1	-1	-1	-1	ab	b	-1	b	b	b	b	b	bc	abc	abc	abc	abc	abc	abc	abc	ab	1		
MED	CP	EU.Italy	GN	t1	565	668	1025	873	759	1027	1383	1222	1222	2254	916	379	397				2589	1220								0		2	17.3%	54%
MED	CP	EU.Italy	GN	t2	a	a	a	ab	a	-1	-1	-1	-1	-1	ab	b	-1	b		b	-1	-1								-1		2		
MED	CP	EU.Greece	UN	t1	500	500	500	1	1		952	741	1152	1950	1735	1786	1304															3	11.6%	66%
MED	CP	EU.Greece	UN	t2	-1	-1	-1	-1	-1		-1	-1	-1	-1	-1	-1	-1															3		
MED	CP	EU.Italy	UN	t1					1	1					2	2	4	3125	2115	1057			0	1780		837		0	4	201		4	9.6%	75%
MED	CP	EU.Italy	UN	t2					-1	-1					-1	-1	-1	b	b	b	b		-1	-1		-1		-1	-1	-1		4		
MED	CP	EU.Greece	LL	t1										35	33	40	36	445	427	323	242	257	191	116	125	126	126	165	287	541	1332	5	5.1%	80%
MED	CP	EU.Greece	LL	t2										-1	-1	-1	-1	a	a	ab	ab	-1	a	a	-1	-1	-1	b	b	a	-1	5		
MED	CP	EU.Cyprus	LL	t1														17	243	337	451	695	204	220	206	247	321	357	385	505	558	6	5.0%	85%
MED	CP	EU.Cyprus	LL	t2														a	a	a	ab	abc	abc	abc	abc	abc	ab	a	abc	abc	a	6		
MED	CP	EU.España	LL	t1		1	6	8	3	6	25	176	22	74	51	112	37	1	109	148	322	421	208	204	277	338	385	238	270	52		7	3.7%	89%
MED	CP	EU.España	LL	t2		ab	ab	ab	ab	ab	ab	ab	ac	ac	ab	ac	ac	-1	-1	a	a	a	abc	abc	abc	a	abc	ab	abc	abc		7		
MED	CP	Turkey	GN	t1																			208	631	402	1396						8	2.8%	92%
MED	CP	Turkey	GN	t2																			a	a	ab	ab						8		
MED	CP	EU.España	BB	t1	83	499	171	231	81	163	205		33	96	88	77	29			0		0										9	1.8%	93%
MED	CP	EU.España	BB	t2	ac	ac	ac	c	ac	ac	ac		ac	ac	a	-1	ac			-1		a										9		
MED	CP	EU.Greece	PS	t1														478	326	287	141	123										10	1.4%	95%
MED	CP	EU.Greece	PS	t2														-1	-1	-1	-1	-1										10		
MED	CP	EU.España	TR	t1		48	50	59	129	306	119	202	45	73			117										2					11	1.2%	96%
MED	CP	EU.España	TR	t2		abc	abc	abc	abc	abc	abc	abc	abc	abc			abc										a					11		
MED	CP	Turkey	PS	t1															27	30	73	852					62	71				12	1.2%	97%
MED	CP	Turkey	PS	t2															-1	-1	-1	-1					-1	-1				12		
MED	NCO	NEI (MED)	PS	t1				500																								13	0.5%	98%
MED	NCO	NEI (MED)	PS	t2				-1																								13		
MED	CP	EU.España	UN	t1							80	2	24	41	5	12	26		29	40	60	94	31	0		6	3	6	8	0		14	0.5%	98%
MED	CP	EU.España	UN	t2							a	a	a	a	a	a	a		-1	-1	a	a	a	a		a	a	a	a	a		14		

Table 3. Available abundance indices for Mediterranean albacore in 2017.

	Paper	SCRS/2017/122	SCRS/2017/115	SCRS/2017/117	SCRS/2009/137	SCRS/2010/089	Marano et al., 2005	SCRS/2011/104	SCRS/2011/104
	Index	West Med larval index	West Med Spanish Long lines	Italian Long lines Central Med	Spanish Sport Contest	Italy LL Tyrrhenian & South-Central	Italy LL South Adriatic Sea	Greek bycatch	Greek ALB
1	**Diagnostics**	Q-Qplots, residuals, real presence/absence histogram included	Q-Qplots, residuals, type III test included	Q-Qplots, residuals, type III test included. Tables of SE, CV missing	Nominal cpue	Nominal cpue	Nominal cpue	Type III test reported	Type III test reported
2	**Appropriateness of data exclusions and classifications (e.g. to identify targeted trips).**	(sampling designed and ata selection process described in the SCRS document)	Metier identification	no information	Data from sport fishing contest during 2 days in july	No data selection methods described	No data selection methods described	Metier identification (Swordfish)	Metier identification (Albacore)
3	**Geographical Coverage**	(covered the whole Balearic spawning ground in half of the sampling years, 3/4 in the remaining), not covering other spawning grounds in the Mediterranean	Covering the Spanish Mediterranean Coast	Covering the Italian Coast	Covering the Mallorca Island surroundings	TYRRHENIAN SEA AND IN THE SOUTH-CENTRAL MEDITERRANEAN	Southern Adriatic	Eastern Mediterranean	Eastern Mediterranean
4	**Catch Fraction**	Fisheries independent	substantial	substantial	minor	Substantial	Substantial	minor	substantial
5	**Length of time series relative to the history of exploitation.**	2001-2016	2004-2015	2011-2015	2004-2009	1999 and 2003-2006	1984-2000	1993-2010	2003-2006
6	**Are other indices available for the same time period?**	(Long lines) unique fishery independent	larval index	(Larval index, spanish long line)	Spanish longlines	Overlaping the spanish longlines indices	No overlap	Overlap with the spanish long line	Overlap with the spanish long line
7	**Does the index standardization account for known factors that influence catchability/selectivity?**	factors affecting catchability included, also environmental: hour of day, day of the year, residual temperature, salinity, year, gear catchability, larvae decay curves	Fishing effort, temporal and area factors	Fishing effort, temporal and area factors	CPUE nominal and fishing effort	Nominal cpue	Nominal cpue	Fishing effort and month	Fishing effort and month
9	**Is the interannual variability within plausible bounds (e.g. SCRS/2012/039)**								
11	**Assessment of data quality and adequacy for standardization purpose (e.g. sampling design, sample size, factors considered)**	Sampling specifically designed for collecting tuna species larvae, not covering the full spawning period of the specie	limited information	limited information	limited information	Applying EC Data Collection Programme (EC Reg. 1543/2000)	No specific assessment of data adequacy, metier combined with Swordfish	identification of metier, Albacore is bycatch of Swordfish	identification of metier, Albacore is target species
12	**Is this CPUE time series continuous?**	No (2006 to 2011 data missing)	Yes	Yes	Yes	No (continuous from 2003 to 2006)	Four years missing along the time series	Continuous from 2003 to 2010 (plus years 1993 and 1994)	Yes

Table 4. Standardized and nominal annual CPUEs considered in the assessment of the Mediterranean albacore stock.

	Greek bycatch		Greek LL ALB		Italy LL South Adriatic		Italy LL Tyrrhenian &south-central		Spain LL ALB		Spain Sport Contests		Western Med Larval index		Italian LL 2017	
	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV
1984	-	-	-	-	85,02	-	-	-	-	-	-	-	-	-	-	-
1985	-	-	-	-	105,59	-	-	-	-	-	-	-	-	-	-	-
1986	-	-	-	-	112,81	-	-	-	-	-	-	-	-	-	-	-
1987	-	-	-	-	248,77	-	-	-	-	-	-	-	-	-	-	-
1988	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1989	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1990	-	-	-	-	220,61	-	-	-	-	-	-	-	-	-	-	-
1991	-	-	-	-	181,67	-	-	-	-	-	-	-	-	-	-	-
1992	-	-	-	-	188,89	-	-	-	-	-	-	-	-	-	-	-
1993	0,1	-	-	-	124,44	-	-	-	-	-	-	-	-	-	-	-
1994	0,13	-	-	-	169,3	-	-	-	-	-	-	-	-	-	-	-
1995	-	-	-	-	136,44	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998	-	-	-	-	98,56	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	105,78	-	32,51	-	-	-	-	-	-	-	-	-
2000	-	-	-	-	133,64	-	-	-	-	-	-	-	-	-	-	-
2001	-	-	-	-	-	-	-	-	-	-	-	-	5,9	0,17	-	-
2002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003	1,73E-09	-	85,72	-	-	-	9,29	-	-	-	-	-	-	-	-	-
2004	1,42E-01	-	58,47	-	-	-	14,36	-	244,9	2,15	0,38	-	7,0	0,123	-	-
2005	1,12E-01	-	69,85	-	-	-	12,76	-	359,8	1,95	0,52	-	5,1	0,1183	-	-
2006	6,88E-02	-	81,79	-	-	-	68,81	-	321,2	2,11	0,96	-	-	-	-	-
2007	2,00E-09	-	-	-	-	-	-	-	226,6	1,83	0,61	-	-	-	-	-
2008	2,02E-09	-	-	-	-	-	-	-	307,8	2,38	1,51	-	-	-	-	-
2009	3,24E-09	-	-	-	-	-	-	-	294,9	1,86	1,97	-	-	-	-	-
2010	2,39E-09	-	-	-	-	-	-	-	638,8	2,13	-	-	-	-	-	-
2011	-	-	-	-	-	-	-	-	394,5	2,4	-	-	-	-	10,1	-
2012	-	-	-	-	-	-	-	-	296,2	1,62	-	-	4,5	0,1075	11,9	-
2013	-	-	-	-	-	-	-	-	382,3	1,25	-	-	1,6	0,175	6,4	-
2014	-	-	-	-	-	-	-	-	208,5	1,67	-	-	2,1	0,2012	7,9	-
2015	-	-	-	-	-	-	-	-	72,6	11,335	-	-	0,4	0,2432	2,6	-

Table 5. Number of age-length spine readings by age group available for Mediterranean albacore. Data sources are SCRS/2017/128, Quelle *et al*. (2011), Megalofonou (2000), and datasets from the European Data Collection Framework provided to the Working Group from Italy and Cyprus.

Age	Garibaldi	Quelle	Cyprus	Italy	Megalofonou	Total
0	8					8
1	61	22	2	7	2	94
2	70	49	11	37	280	447
3	40	32	70	142	520	804
4	52	31	134	141	195	553
5	32	39	144	79	72	366
6	11	32	118	31	13	205
7	18	18	51	15	4	106
8	7	15	34	6	1	63
9	5	13	4	2		24
10	3	7	2			12
11		1	3			4
12			1			1
13						0
14			1			1
15			1			1
Total	**307**	**259**	**576**	**460**	**1087**	**2689**

Table 6. Estimated mean lengths by age group from Megalofonou (2000) and combined dataset and predicted lengths from the von Bertalanffy equation from Megalofonou (2000).

Age group	Megalofonou (2000)		Combined
	Mean	**Predicted**	**Mean**
0		43.1	28.1
1	59.5	54.8	56.1
2	65.8	63.9	63
3	69.8	70.9	67.3
4	74.4	76.3	71.6
5	79.3	80.5	75
6	81.2	83.7	78.8
7	85.5	86.2	81.8
8	92	88.2	84.6
9		89.6	86.5
10		90.8	88.4
11		91.7	90.8
12		92.4	91
13		92.9	
14		93.3	98
15		93.6	98

Table 7. Output of the catch based model.

***MSY* (‘000 tonnes)**			***r***			***K* (‘000 tonnes)**		
Median	q05	q95	Median	q05	q95	Median	q05	q95
3.46	3.07	4.23	0.314	0.24	0.62	43.94	27.21	52.56

Table 8. Z estimates from length composition analysis for Mediterranean albacore.

year	slope	Z
1977	-0.20	0.20
1979	-0.27	0.27
1984	-0.40	0.40
1985	-0.26	0.26
1986	-0.36	0.36
1987	-0.32	0.32
1988	-0.27	0.27
1989	-0.35	0.35
1990	-0.29	0.29
1991	-0.29	0.29
1992	-0.27	0.27
1993	-0.35	0.35
1994	-0.24	0.24
1995	-0.28	0.28
1996	-0.28	0.28
1997	NA	NA
1998	NA	NA
1999	NA	NA

year	slope	Z
2000	-0.50	0.50
2001	-0.43	0.43
2002	-0.52	0.52
2003	-0.63	0.63
2004	-0.38	0.38
2005	-0.23	0.23
2006	-0.33	0.33
2007	-0.31	0.31
2008	-0.39	0.39
2009	-0.36	0.36
2010	-0.37	0.37
2011	-0.47	0.47
2012	-0.35	0.35
2013	-0.31	0.31
2014	-0.41	0.41
2015	-0.34	0.34
2016	-0.47	0.47

Table 9. Key reference points for Mediterranean albacore based on fits to CPUE data 2001-2015 for the Schaefer and the Fox BSPSP.

		Schaefer			**Fox**	
Estimates	**Median**	**2.50%**	**97.50%**	**Median**	**2.50%**	**97.50%**
H_{MSY}	0.106	0.065	0.173	0.105	0.065	0.166
B_{MSY}	27150.5	17660.0	52700.9	29519.7	19719.8	49402.2
MSY	2877.8	1884.5	5698.2	3106.9	2141.0	4769.1
B_{1950}/K	0.816	0.587	1.028	0.82	0.588	1.038
B_{2015}/K	0.204	0.093	0.464	0.204	0.1	0.425
B_{2015}/B_{MSY}	0.555	0.253	1.260	0.408	0.200	0.849
H_{2015}/H_{MSY}	1.804	0.447	4.119	2.263	0.800	4.528

Table 10. Key reference points for Mediterranean albacore based on fits to catch data 1980-2015 and CPUE data 2001-2014 (excl. 2015) for the Fox BSPSP put forward as final model.

	Fox		
Estimates	**Median**	**2.50%**	**97.50%**
H_{MSY}	0.119	0.072	0.192
B_{MSY}	29168.1	17939.7	65861.9
MSY	3419.3	2187.4	7842.2
B_{1950}/K	0.821	0.587	1.027
B_{2015}/K	0.369	0.168	0.648
$B_{2015}/B_{\mathrm{MSY}}$	1.002	0.456	1.760
$H_{2015}/H_{\mathrm{MSY}}$	0.830	0.223	2.194

Table 11. B/B_{MSY} and F/F_{MSY} values for the final model considered for the provision of advice.

Year	B / B_{MSY}				F / F_{MSY}			
	Estimate	95% CI's			Estimate	95% CI's		
1980	2.232	1.595	-	2.790	0.079	0.028	-	0.112
1981	2.216	1.583	-	2.741	0.240	0.085	-	0.342
1982	2.176	1.532	-	2.717	0.209	0.073	-	0.296
1983	2.161	1.509	-	2.704	0.205	0.072	-	0.293
1984	2.153	1.500	-	2.724	0.575	0.201	-	0.820
1985	2.081	1.421	-	2.680	0.718	0.241	-	1.042
1986	1.989	1.319	-	2.639	0.680	0.222	-	1.016
1987	1.935	1.252	-	2.616	0.760	0.243	-	1.158
1988	1.873	1.182	-	2.586	0.802	0.243	-	1.242
1989	1.810	1.114	-	2.555	0.837	0.246	-	1.314
1990	1.757	1.047	-	2.503	0.407	0.117	-	0.649
1991	1.788	1.074	-	2.535	0.506	0.145	-	0.795
1992	1.800	1.078	-	2.537	0.466	0.134	-	0.731
1993	1.814	1.082	-	2.554	0.450	0.130	-	0.707
1994	1.839	1.104	-	2.581	0.280	0.081	-	0.440
1995	1.893	1.149	-	2.622	0.322	0.094	-	0.496
1996	1.936	1.182	-	2.643	0.628	0.184	-	0.943
1997	1.927	1.176	-	2.624	0.516	0.148	-	0.771
1998	1.953	1.178	-	2.639	0.546	0.154	-	0.808
1999	1.971	1.173	-	2.666	0.986	0.269	-	1.450
2000	1.913	1.097	-	2.640	1.199	0.308	-	1.777
2001	1.841	1.015	-	2.621	1.130	0.264	-	1.669
2002	1.750	0.944	-	2.589	1.367	0.311	-	2.050
2003	1.646	0.863	-	2.499	1.309	0.283	-	1.965
2004	1.562	0.814	-	2.447	1.375	0.290	-	2.073
2005	1.482	0.772	-	2.355	1.065	0.213	-	1.599
2006	1.423	0.746	-	2.272	1.870	0.377	-	2.797
2007	1.306	0.679	-	2.127	2.268	0.435	-	3.414
2008	1.214	0.590	-	2.061	1.135	0.201	-	1.762
2009	1.241	0.608	-	2.096	1.503	0.271	-	2.303
2010	1.227	0.583	-	2.085	0.816	0.142	-	1.261
2011	1.214	0.588	-	2.009	1.808	0.324	-	2.760
2012	1.084	0.506	-	1.861	0.933	0.156	-	1.412
2013	0.995	0.467	-	1.712	0.771	0.124	-	1.122
2014	0.963	0.456	-	1.680	1.369	0.208	-	1.851
2015	1.002	0.456	-	1.760	1.804	0.223	-	2.194

Table 12. Performance of 27 HCRs, according to the performance statistics defined by Panel 2 (see key below). The combination of the target fishing mortality (F_{TAR}), Biomass threshold (B_{THRESH}) and the maximum percent change in TAC (δTAC) defines the HCR. Each HCR has a unique identification number in this table and in **Figure 18**. Each column is shaded with respect to its maximum and minimum values, and the table is ordered according to pGr% indicator.

HCR				Stock Status					Safety		Catch			Stability					
Number	Ftar	Bthresh	δTAC	Bmin	Bmean	Fmean	pGr%	pRed%	pBlim%	pBint%	ShortC (kt)	MidC (kt)	LongC (kt)	MAP (%)	sd	variance (M)	pshut	p10%	maxTACc (kt)
25	0.60	1.00	30%	0.56	2.07	0.51	93.6	1	100	5	21.1	19.9	29.2	6.5	6.2	38.0	0	21.4	11.1
16	0.60	1.00	25%	0.57	2.01	0.50	93.2	0	100	6	21.6	20.3	29.2	6.2	5.9	34.7	0	21.2	10.2
4	0.60	0.80	20%	0.63	2.04	0.51	93.1	0	100	5	23.2	21.1	28.3	5.1	4.9	23.8	0	19.9	8.7
1	0.60	0.60	20%	0.65	2.02	0.51	93.1	0	100	5	23.2	21.1	28.2	5.0	4.8	23.2	0	19.8	8.7
13	0.60	0.80	25%	0.60	2.04	0.50	92.5	1	100	6	21.7	20.9	29.1	5.8	5.6	30.9	0	20.7	10.0
7	0.60	1.00	20%	0.62	2.02	0.51	92.4	1	100	6	23.2	20.6	28.3	5.3	5.0	25.1	0	20.0	8.7
10	0.60	0.60	25%	0.58	2.03	0.51	92.3	0	100	6	21.5	21.1	29.1	5.9	5.6	31.5	0	20.7	10.1
22	0.60	0.80	30%	0.53	2.01	0.51	91.5	0	100	5	20.7	21.0	29.1	6.5	6.2	37.9	0	21.5	11.4
19	0.60	0.60	30%	0.51	2.01	0.52	90.8	1	100	7	21.0	21.1	29.3	6.5	6.1	37.1	0	21.2	11.3
5	0.80	0.80	20%	0.34	1.76	0.62	85.9	3	100	9	24.3	24.5	32.3	5.4	5.7	32.9	0	19.9	10.3
17	0.80	1.00	25%	0.30	1.81	0.62	84.4	3	100	9	22.6	22.8	33.4	6.6	7.3	52.6	0	21.8	12.6
8	0.80	1.00	20%	0.37	1.81	0.61	83.4	2	100	11	23.9	22.6	32.6	5.8	6.3	40.2	0	20.8	10.7
2	0.80	0.60	20%	0.28	1.76	0.65	83.3	3	100	10	24.3	24.8	32.5	5.2	5.8	33.4	0	19.6	10.3
23	0.80	0.80	30%	0.23	1.75	0.66	83.2	4	100	9	22.7	24.4	32.8	7.0	7.0	49.1	0	22.2	13.6
14	0.80	0.80	25%	0.19	1.72	0.68	82.3	4	100	10	23.1	24.6	33.1	6.4	6.7	45.1	0	21.5	12.2
26	0.80	1.00	30%	0.28	1.81	0.62	81.1	3	100	10	22.1	22.7	33.4	7.5	7.9	62.7	0	22.4	14.0
20	0.80	0.60	30%	0.22	1.73	0.67	80.5	4	100	13	23.1	25.3	32.6	6.8	6.8	46.9	0	21.8	13.2
11	0.80	0.60	25%	0.25	1.74	0.67	80.2	4	100	11	23.1	25.0	32.7	6.1	6.3	40.1	0	20.9	11.9
9	1.00	1.00	20%	0.19	1.62	0.73	76.4	7	99	13	24.5	24.5	35.3	6.1	7.1	50.3	0	21.4	11.9
18	1.00	1.00	25%	0.17	1.63	0.74	74.3	8	99	15	23.3	24.6	35.5	7.2	7.9	62.6	0	22.7	14.0
27	1.00	1.00	30%	0.19	1.67	0.73	73.9	8	99	14	22.3	24.3	34.7	8.1	8.6	73.3	0	23.4	15.7
6	1.00	0.80	20%	0.19	1.58	0.76	71.8	9	99	16	25.3	27.1	34.8	5.9	6.4	41.0	0	21.2	11.6
15	1.00	0.80	25%	0.17	1.61	0.78	70.3	11	98	16	24.6	27.3	34.6	6.9	7.1	50.8	0	22.6	13.8
12	1.00	0.60	25%	0.14	1.47	0.82	69.1	12	98	18	25.0	28.8	34.0	6.7	6.7	45.4	0	22.2	13.2
24	1.00	0.80	30%	0.13	1.51	0.81	69.0	11	98	18	23.4	27.1	34.6	8.0	8.0	64.2	0	23.4	15.5
21	1.00	0.60	30%	0.16	1.52	0.82	68.2	13	97	18	24.9	28.5	33.7	7.1	7.1	50.1	0	22.9	14.7
3	1.00	0.60	20%	0.12	1.44	0.87	66.1	13	98	19	25.5	28.7	34.5	5.8	6.3	39.1	0	21.0	11.7

	PERFORMANCE INDICATORS AND ASSOCIATED STATISTICS	**UNIT OF MEASUREMENT**	**TYPE OF METRICS**
	1 Status		
B_{min}	1.1 Minimum spawner biomass relative to B_{MSY}	B/ B_{MSY}	Minimum over [x] years
B_{mean}	1.2 Mean spawner biomass relative to B_{MSY}	B/ B_{MSY}	Geometric mean over [x] years
F_{mean}	1.3 Mean fishing mortality relative to F_{MSY}	F/ F_{MSY}	Geometric mean over [x] years
pGr%	1.4 Probability of being in the Kobe green quadrant	B, F	Proportion of years that $B \geq B_{MSY}$ & $F \leq F_{MSY}$
pRed%	1.5 Probability of being in the Kobe red quadrant	B, F	Proportion of years that $B \leq B_{MSY}$ & $F \geq F_{MSY}$
	2 Safety		
pB_{lim}%	2.1 Probability that spawner biomass is above B_{lim} ($0.4B_{MSY}$)	B/ B_{MSY}	Proportion of years that $B > B_{lim}$
pB_{int}%	2.2 Probability of $B_{lim} < B < B_{thresh}$	B/ B_{MSY}	Proportion of years that $B_{lim} < B < B_{thresh}$
	3 Yield		
Y1	3.1 Mean catch – short term	Catch	Mean over 1-3 years
Y2	3.2 Mean catch – medium term	Catch	Mean over 5-10 years
Y3	3.3 Mean catch – long term	Catch	Mean in 15 and 30 years
	4 Stability		
MAP	4.1 Mean absolute proportional change in catch	Catch (C)	Mean over [x] years of $(C_n - C_{n-1})/ C_{n-1}$
var	4.2 Variance in catch	Catch (C)	Variance over [x] years
Pshut	4.3 Probability of shutdown	TAC	Proportion of years that TAC=0
p10%	4.4 Probability of TAC change over a certain level	TAC	Proportion of management cycles when the ratio of change $(TAC_n - TAC_{n-1})/TAC_{n-1} > X\%$
maxTACc	4.5 Maximum amount of TAC change between management periods	TAC	Maximum ratio of change

Table 13. Performance of 45 HCRs, according to the performance statistics defined by Panel 2 (see key in **Table 12**). The combination of the target fishing mortality (F_{TAR}), Biomass threshold (B_{THRESH}) and the maximum percent change in TAC (δTAC) defines the HCR. Each column is shaded with respect to its maximum and minimum values, and the table is ordered according to pGr% indicator.

HCR			Stock Status					Safety		Catch			Stability					
Ftar	Bthresh	δTAC	Bmin	Bmean	Fmean	pGr%	pRed%	pBlim%	pBint%	ShortC (kt)	MidC (kt)	LongC (kt)	MAP (%)	sd	variance (M)	pshut	p10%	maxTACc (kt)
0.60	1.00	30%	0.56	2.07	0.51	93.6	1	100	5	21.1	19.9	29.2	6.5	6.2	38.0	0	21.4	11.1
0.60	1.00	25%	0.57	2.01	0.50	93.2	0	100	6	21.6	20.3	29.2	6.2	5.9	34.7	0	21.2	10.2
0.60	0.80	20%	0.63	2.04	0.51	93.1	0	100	5	23.2	21.1	28.3	5.1	4.9	23.8	0	19.9	8.7
0.60	0.60	20%	0.65	2.02	0.51	93.1	0	100	5	23.2	21.1	28.2	5.0	4.8	23.2	0	19.8	8.7
0.60	0.80	25%	0.60	2.04	0.50	92.5	1	100	6	21.7	20.9	29.1	5.8	5.6	30.9	0	20.7	10.0
0.60	1.00	20%	0.62	2.02	0.51	92.4	1	100	6	23.2	20.6	28.3	5.3	5.0	25.1	0	20.0	8.7
0.60	0.60	25%	0.58	2.03	0.51	92.3	0	100	6	21.5	21.1	29.1	5.9	5.6	31.5	0	20.7	10.1
0.70	1.00	20%	0.47	1.95	0.56	91.6	1	100	6	23.4	21.9	31.1	5.5	5.7	32.9	0	20.5	9.8
0.60	0.80	30%	0.53	2.01	0.51	91.5	0	100	5	20.7	21.0	29.1	6.5	6.2	37.9	0	21.5	11.4
0.60	0.60	30%	0.51	2.01	0.52	90.8	1	100	7	21.0	21.1	29.3	6.5	6.1	37.1	0	21.2	11.3
0.70	0.60	20%	0.45	1.91	0.58	89.6	2	100	7	23.6	23.1	30.8	5.0	5.4	29.3	0	19.3	9.4
0.70	0.60	25%	0.40	1.86	0.59	89.3	2	100	7	22.3	23.2	31.0	5.9	5.9	35.4	0	20.4	10.8
0.70	0.60	30%	0.39	1.94	0.57	88.5	2	100	8	22.2	23.4	30.9	6.6	6.4	41.4	0	21.2	12.4
0.70	0.80	20%	0.41	1.88	0.59	88.4	2	100	7	23.5	23.0	30.8	5.2	5.4	29.3	0	19.6	9.6
0.70	1.00	25%	0.39	1.90	0.58	88.4	2	100	8	21.9	21.6	31.3	6.3	6.5	41.9	0	21.4	11.4
0.70	0.80	25%	0.40	1.87	0.59	88.1	2	100	8	22.1	23.0	31.1	6.1	6.1	37.3	0	20.9	11.0
0.70	1.00	30%	0.39	1.93	0.56	88.0	1	100	7	21.5	21.5	31.4	7.1	7.2	51.2	0	21.9	12.6
0.80	0.80	20%	0.34	1.76	0.62	85.9	3	100	9	24.3	24.5	32.3	5.4	5.7	32.9	0	19.9	10.3
0.70	0.80	30%	0.37	1.89	0.57	85.5	2	100	11	21.7	22.5	31.1	6.7	6.7	45.4	0	21.5	12.4
0.80	1.00	25%	0.30	1.81	0.62	84.4	3	100	9	22.6	22.8	33.4	6.6	7.3	52.6	0	21.8	12.6
0.80	1.00	20%	0.37	1.81	0.61	83.4	2	100	11	23.9	22.6	32.6	5.8	6.3	40.2	0	20.8	10.7
0.80	0.60	20%	0.28	1.76	0.65	83.3	3	100	10	24.3	24.8	32.5	5.2	5.8	33.4	0	19.6	10.3
0.80	0.80	30%	0.23	1.75	0.66	83.2	4	100	9	22.7	24.4	32.8	7.0	7.0	49.1	0	22.2	13.6
0.80	0.80	25%	0.19	1.72	0.68	82.3	4	100	10	23.1	24.6	33.1	6.4	6.7	45.1	0	21.5	12.2
0.80	1.00	30%	0.28	1.81	0.62	81.1	3	100	10	22.1	22.7	33.4	7.5	7.9	62.7	0	22.4	14.0
0.90	0.60	20%	0.23	1.66	0.71	80.6	6	100	12	25.5	26.8	33.7	5.2	5.8	34.0	0	20.2	10.8
0.80	0.60	30%	0.22	1.73	0.67	80.5	4	100	13	23.1	25.3	32.6	6.8	6.8	46.9	0	21.8	13.2
0.80	0.60	25%	0.25	1.74	0.67	80.2	4	100	11	23.1	25.0	32.7	6.1	6.3	40.1	0	20.9	11.9
0.90	1.00	25%	0.23	1.72	0.68	80.0	5	99	11	23.6	23.5	34.9	6.9	7.6	58.0	0	22.1	13.3
0.90	1.00	20%	0.25	1.70	0.68	78.9	5	100	13	24.4	23.6	34.3	6.0	7.0	49.7	0	21.1	11.5
0.90	0.80	20%	0.23	1.65	0.70	78.3	6	99	14	24.8	26.2	33.4	5.6	6.1	37.6	0	20.9	10.8
0.90	1.00	30%	0.19	1.70	0.70	78.2	6	99	12	22.5	23.7	34.4	7.9	8.4	70.7	0	23.1	15.1
0.90	0.80	30%	0.19	1.63	0.73	76.9	7	99	14	23.7	25.7	34.0	7.4	7.8	61.6	0	22.2	14.5
0.90	0.80	25%	0.18	1.60	0.74	76.9	7	99	14	23.4	26.1	34.2	6.6	7.0	49.0	0	21.3	12.6
1.00	1.00	20%	0.19	1.62	0.73	76.4	7	99	13	24.5	24.5	35.3	6.1	7.1	50.3	0	21.4	11.9
1.00	1.00	25%	0.17	1.63	0.74	74.3	8	99	15	23.3	24.6	35.5	7.2	7.9	62.6	0	22.7	14.0
1.00	1.00	30%	0.19	1.67	0.73	73.9	8	99	14	22.3	24.3	34.7	8.1	8.6	73.3	0	23.4	15.7
0.90	0.60	25%	0.17	1.52	0.76	73.1	8	99	14	24.1	27.1	33.9	6.3	6.4	40.7	0	21.3	12.7
0.90	0.60	30%	0.17	1.59	0.73	73.0	8	99	14	24.3	27.2	33.6	7.2	7.2	51.5	0	22.5	14.5
1.00	0.80	20%	0.19	1.58	0.76	71.8	9	99	16	25.3	27.1	34.8	5.9	6.4	41.0	0	21.2	11.6
1.00	0.80	25%	0.17	1.61	0.78	70.3	11	98	16	24.6	27.3	34.6	6.9	7.1	50.8	0	22.6	13.8
1.00	0.60	25%	0.14	1.47	0.82	69.1	12	98	18	25.0	28.8	34.0	6.7	6.7	45.4	0	22.2	13.2
1.00	0.80	30%	0.13	1.51	0.81	69.0	11	98	18	23.4	27.1	34.6	8.0	8.0	64.2	0	23.4	15.5
1.00	0.60	30%	0.16	1.52	0.82	68.2	13	97	18	24.9	28.5	33.7	7.1	7.1	50.1	0	22.9	14.7
1.00	0.60	20%	0.12	1.44	0.87	66.1	13	98	19	25.5	28.7	34.5	5.8	6.3	39.1	0	21.0	11.7

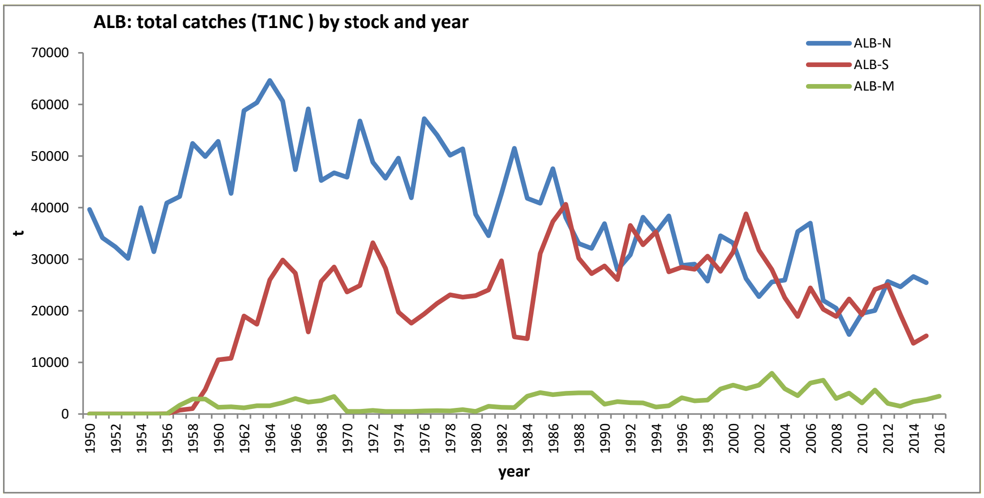

Figure 1. Total albacore catches (T1NC: landings and dead discards) by stock and year. ALB-N – North Atlantic; ALB-S – South Atlantic; ALB-M - Mediterranean.

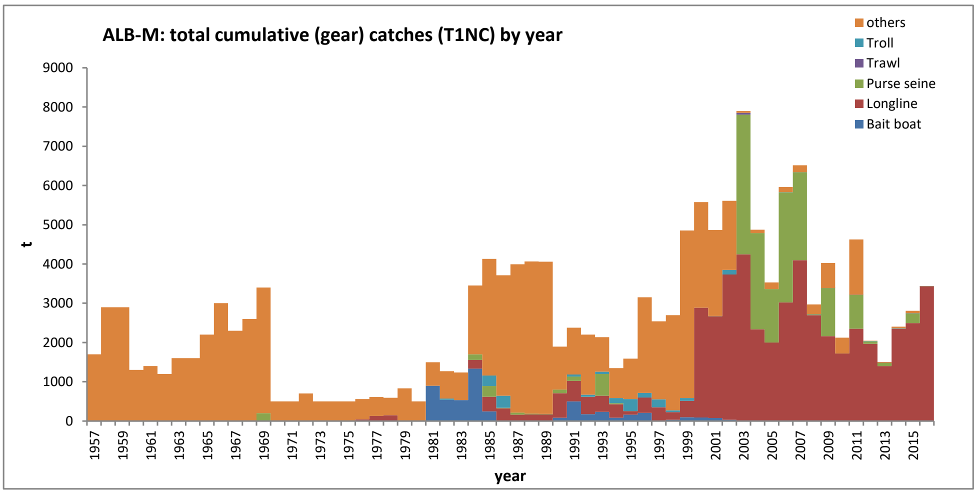

Figure 2. Mediterranean albacore total cumulative (by gear) catches (T1NC: landings + dead discards) by year.

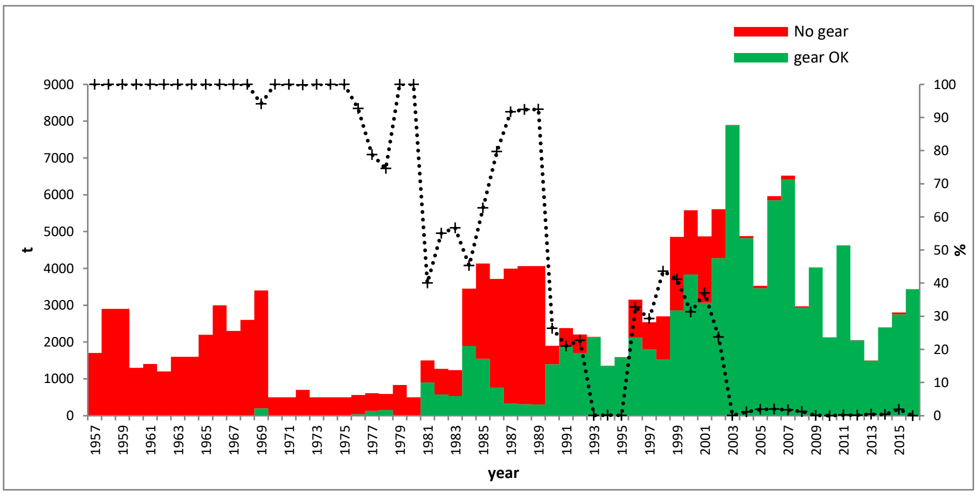

Figure 3. Mediterranean albacore total cumulative (with and without gear) catches (T1NC: landings + dead discards) by year, and the fraction (%, dotted line) without gear discrimination in each year.

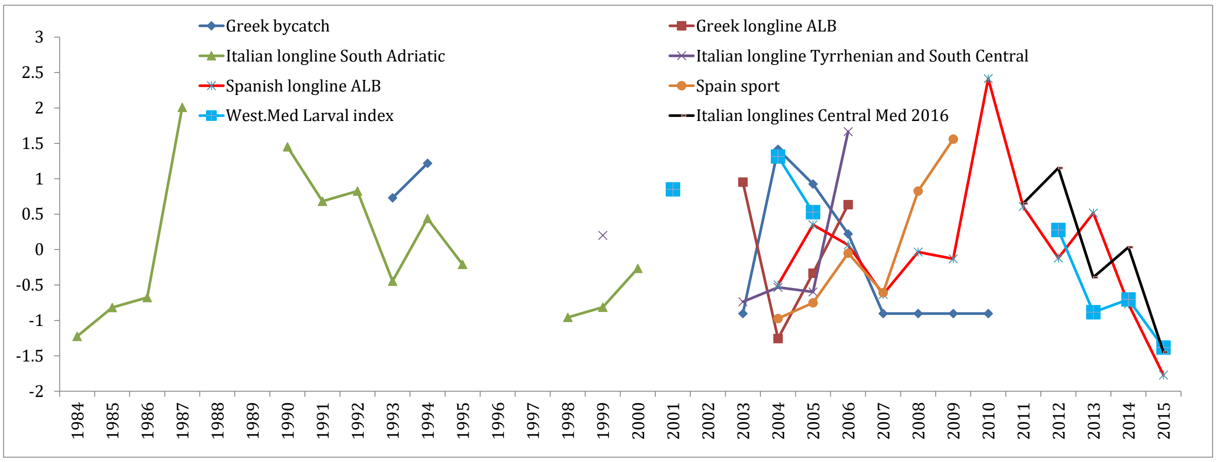

Figure 4. Available nominal and standardized CPUE indices for Mediterranean albacore.

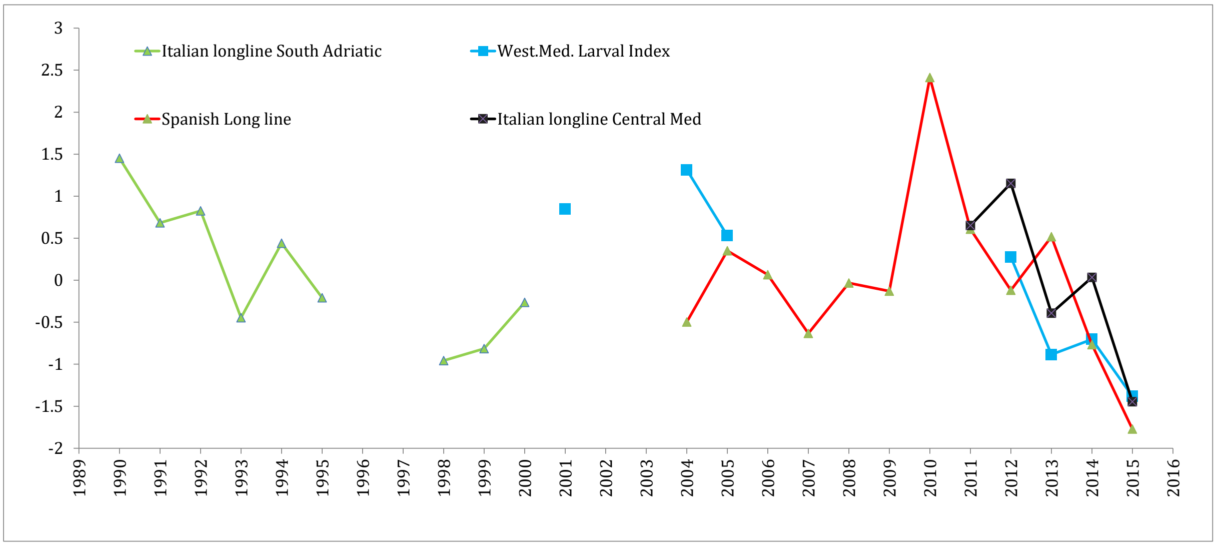

Figure 5. Selected standardized CPUE indices used in the Mediterranean stock assessment.

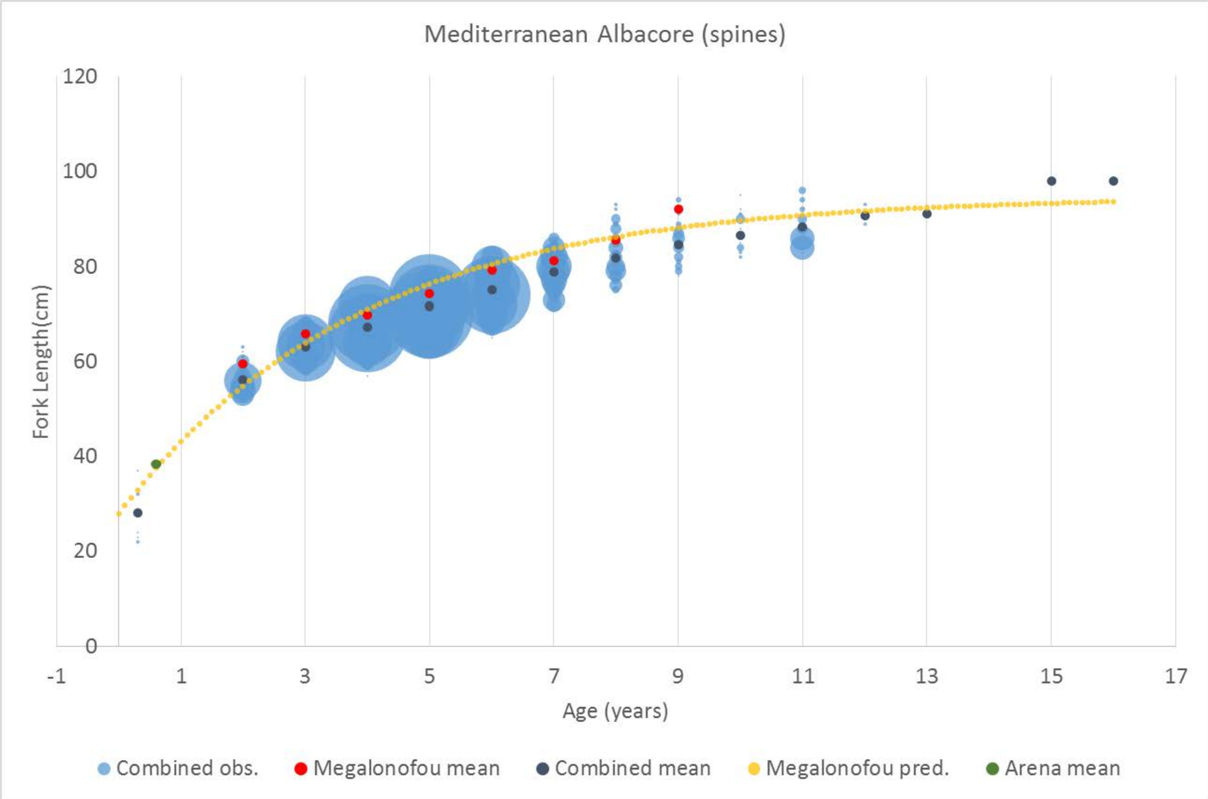

Figure 6. Growth of albacore tuna based on spine readings. Data corresponds to combined age-length observations from Quelle *et al*., 2011, SCRS/2017/128, and those provided by Italy and Cyprus as part of the European Data Collection Framework. Blue circles represent combined observations for each age group, circle diameter represents sample size. Small dark dots represent the average length for each age group of the combined data set and red dots the mean length from Megalofonou, 2000. Also shown is the mean length of age group zero (green dot) from Arena *et al*., 1980. Yellow dotted line represents the predicted lengths from the von Bertalanffy equation from Megalofonou, 2000.

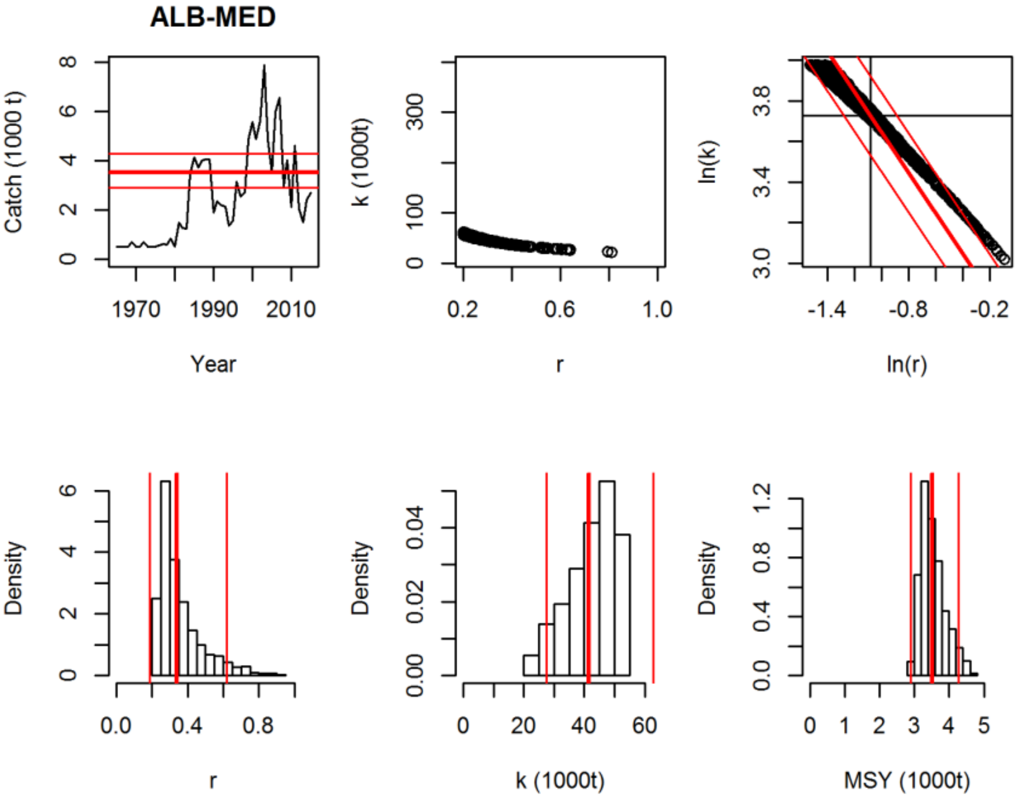

Figure 7. Graphical results of the catch only model. Red lines indicate median, upper and lower confidence intervals.

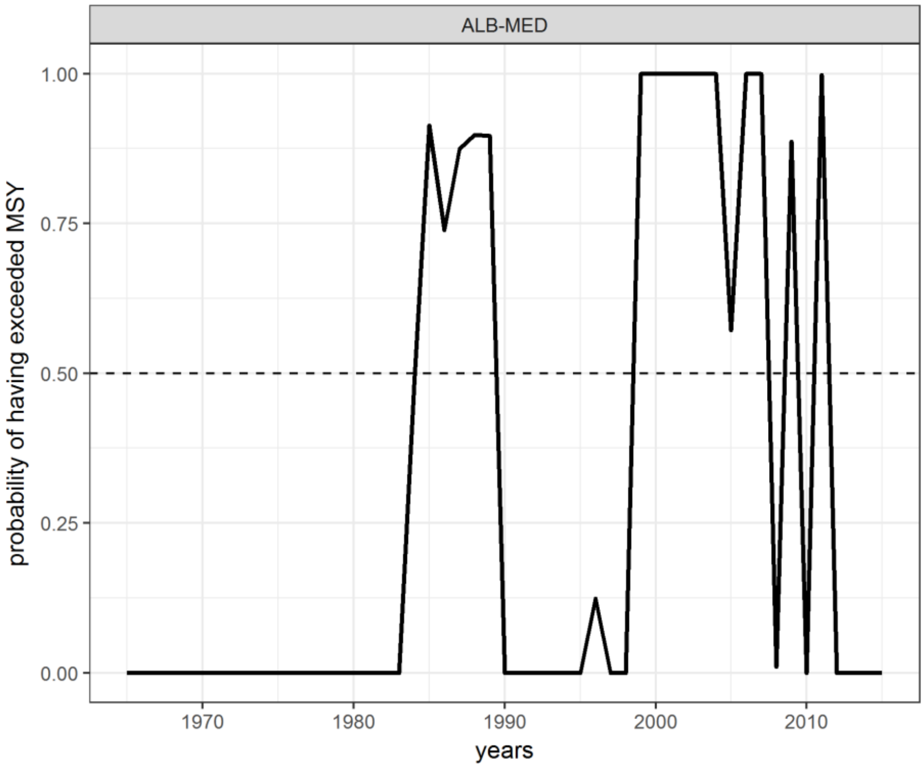

Figure 8. Historical probability of exceeding the estimated MSY for Mediterranean albacore.

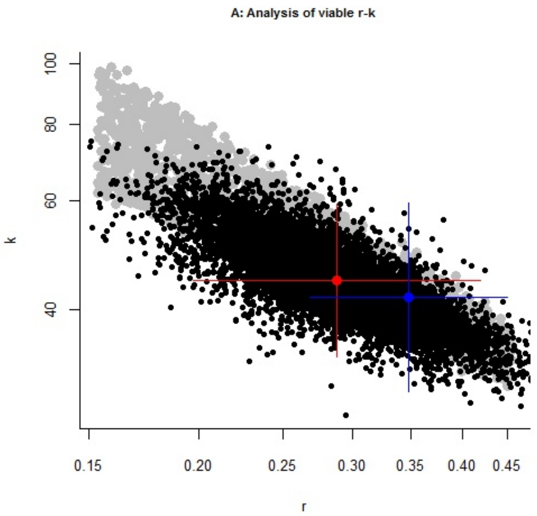

Figure 9. Comparison of CMSY and CMSY_BSM showing (**A**) viable *r-K* pairs from CMSY (grey dots) and *r-K* posterior values (black dots), with indication of approximate 95% credibility intervals denoted by the blue crosshair for CMSY and the red crosshair the CMSY.BSM model and (**B**) a comparison of the normalized projected biomass trend from CMSY with observed and predicted CPUE values fitted with CMSY.BSM to Mediterranean albacore CPUE.

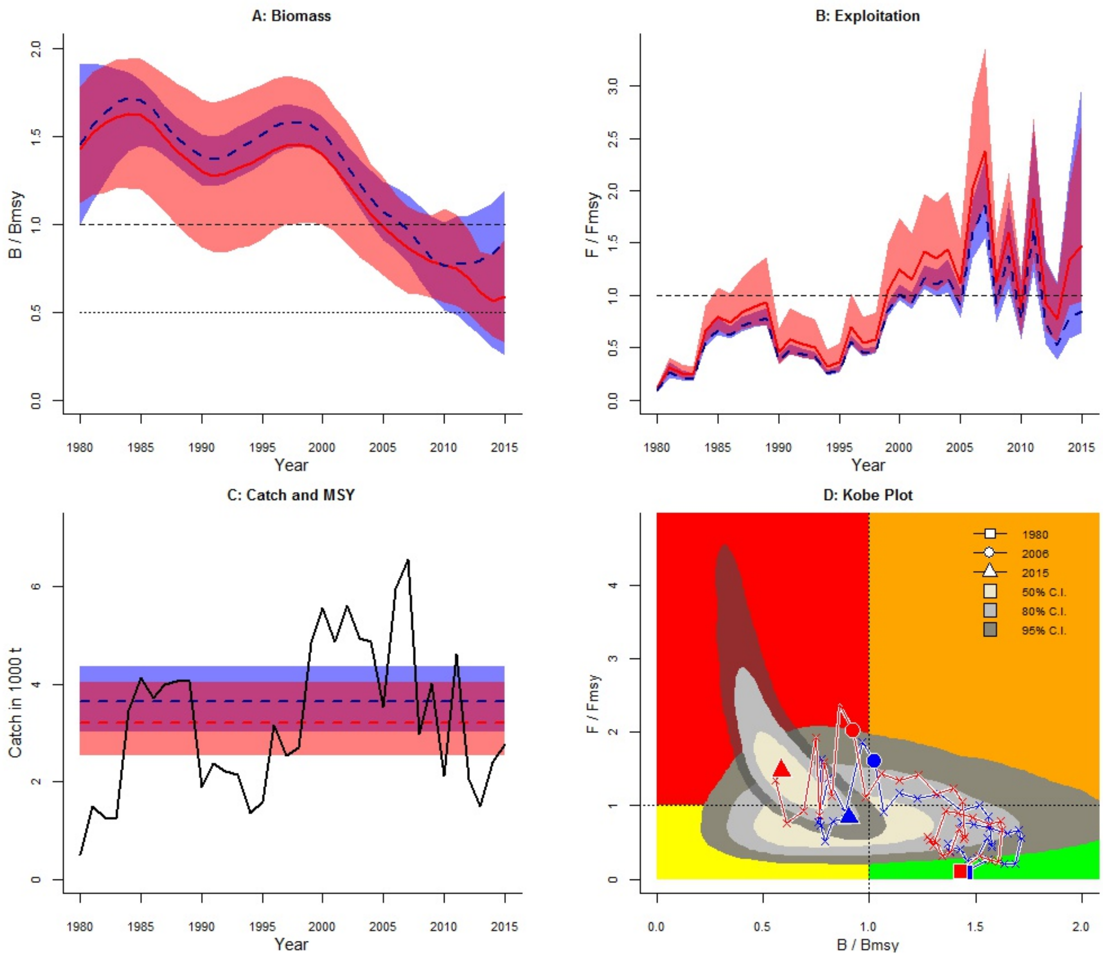

Figure 10. Comparison of CMSY (blue) and CMSY_BSM (red) showing the trajectories of (**A**) predicted B / B_{MSY} (**B**) predicted F / F_{MSY} (**C**) catches superimposing the MSY region (95% CIs) and (**D**) Kobe-type biplot with uncertainty for the final year illustrated by kernel densities.

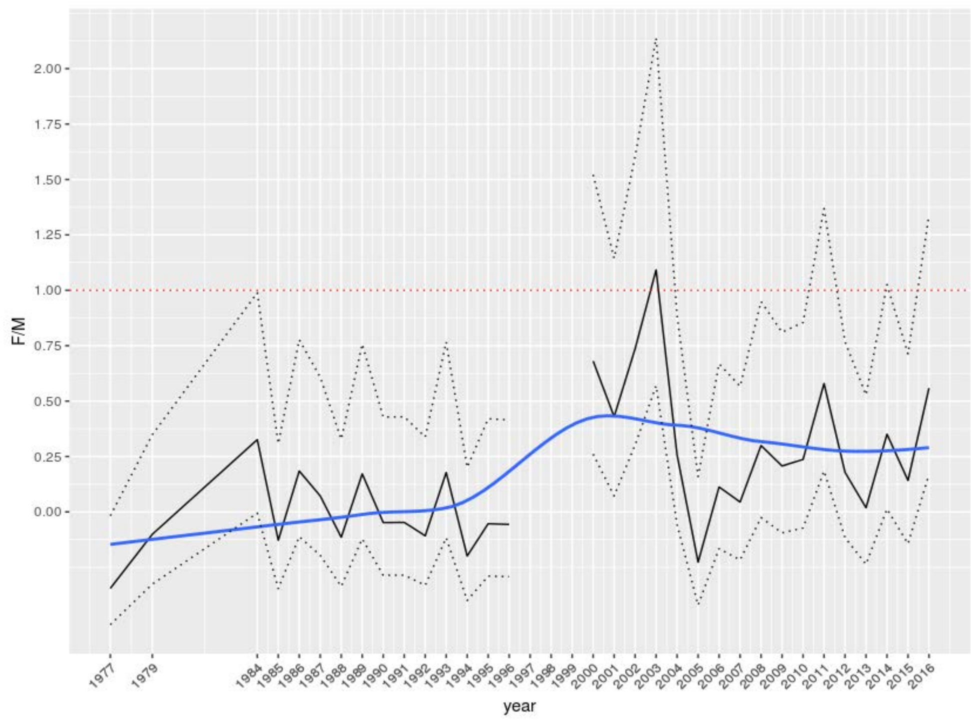

Figure 11. Length converted catch curve analysis results. Estimates of equilibrium fishing mortality rate relative to M as a proxy for F_{MSY}.

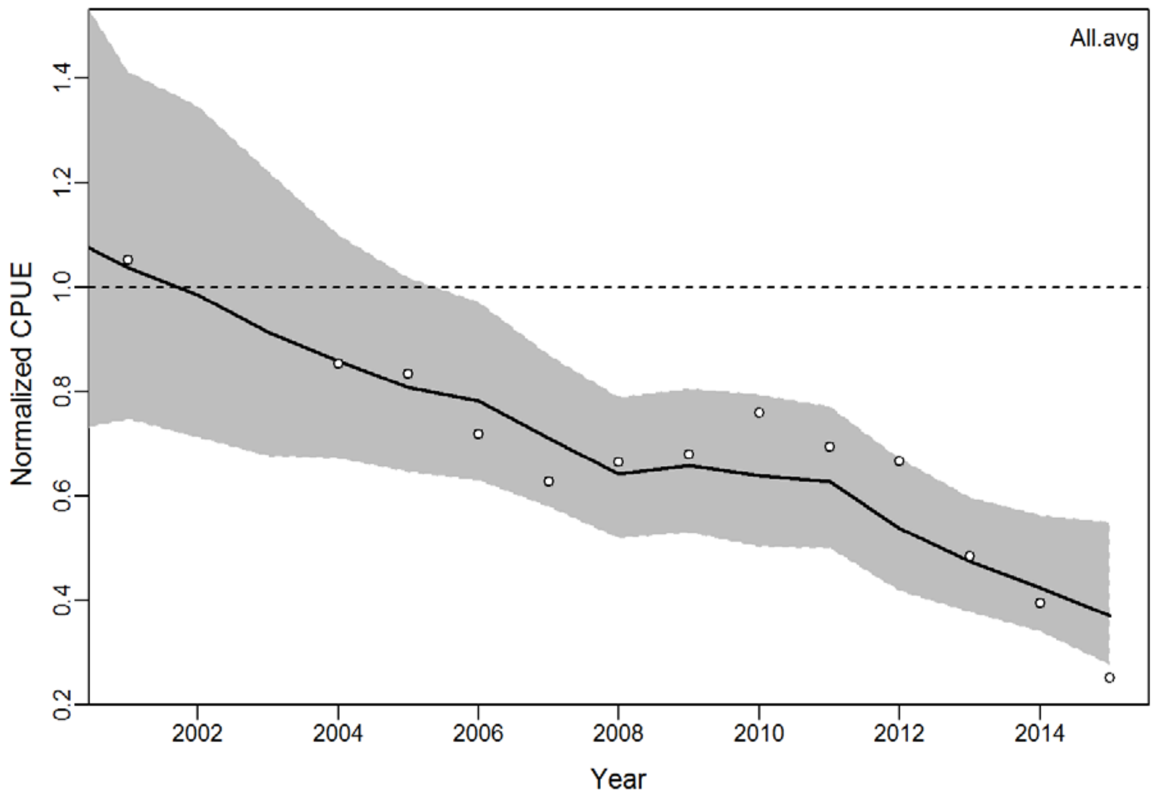

Figure 12. Fits to CPUE series 2001-2015 for Fox BSPSP (Note one CPUE series was estimated based on the 3 series by averaging them over the period 2001-2015, i.e. the two LL series from Spain and Italy, and the Balearic larval survey series). The dashed line corresponds to the mean predicted CPUE series from 80-15.

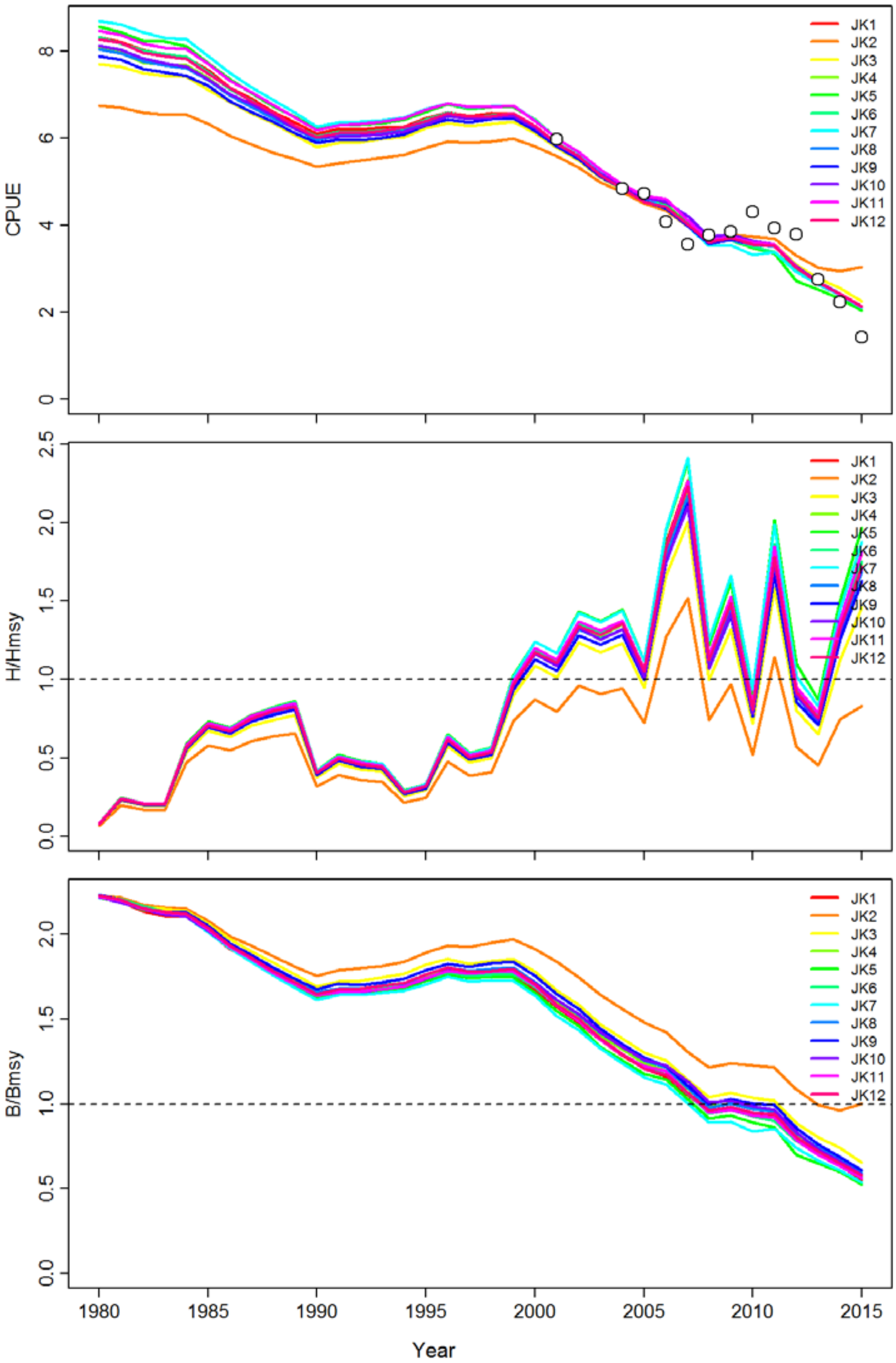

Figure 13. Jack-knife diagnostics with respect to the CPUE series, F/F_{MSY} and B/B_{MSY} over time.

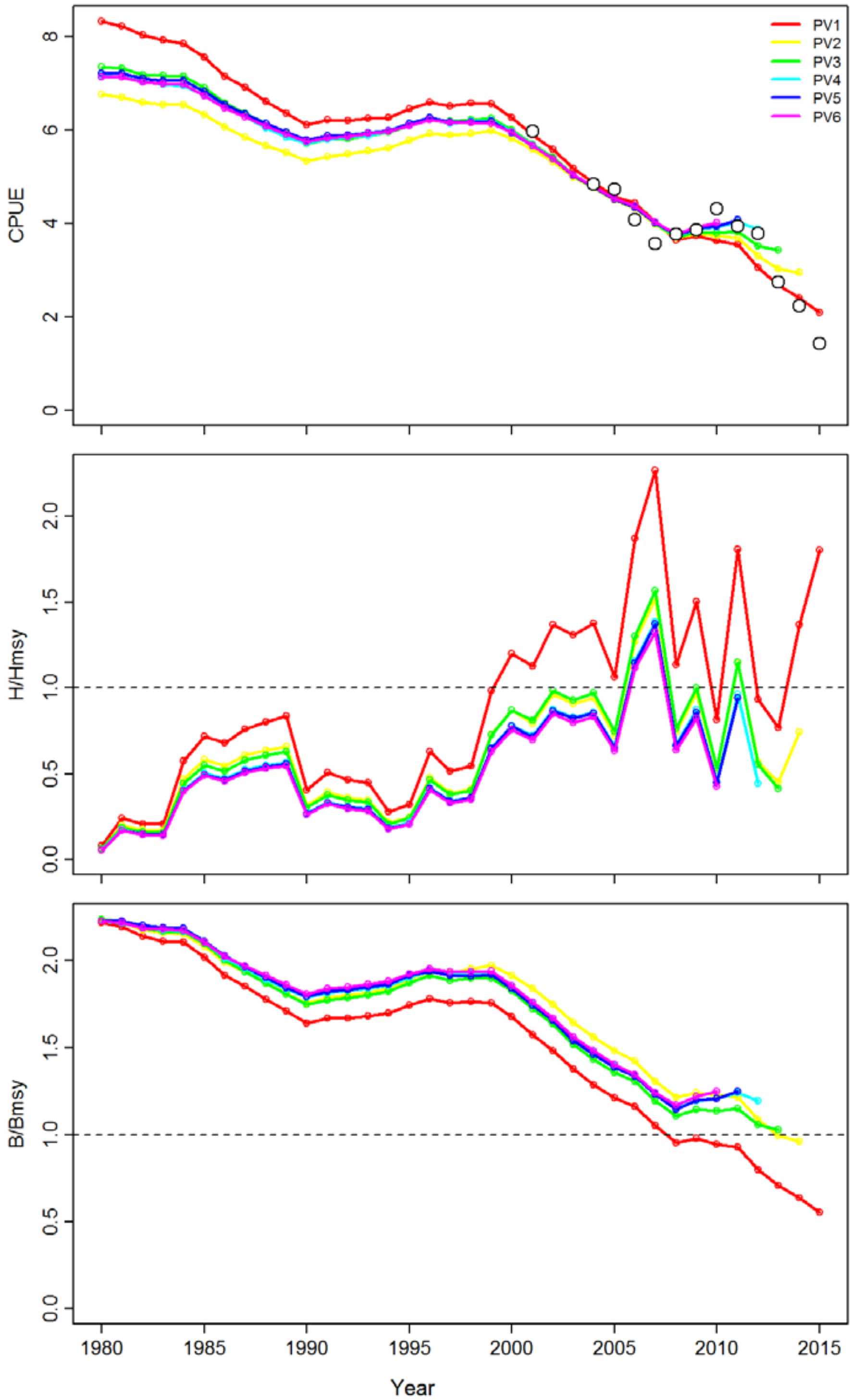

Figure 14. Retrospective diagnostics with respect to the CPUE series, F/F_{MSY} and B/B_{MSY} over time.

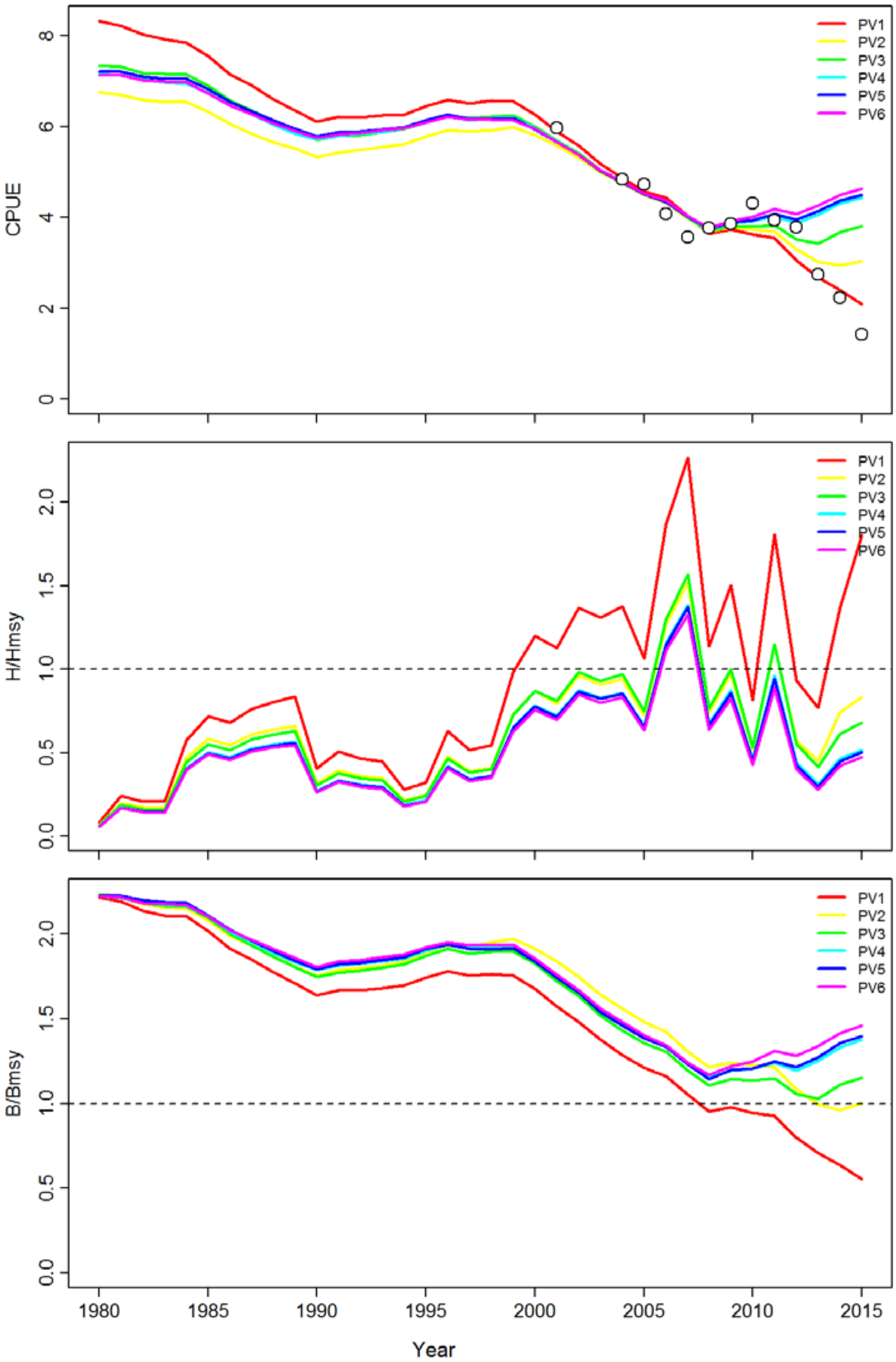

Figure 15. Cross-validation prediction diagnostics with respect to the CPUE series, F/F_{MSY} and B/B_{MSY} over time.

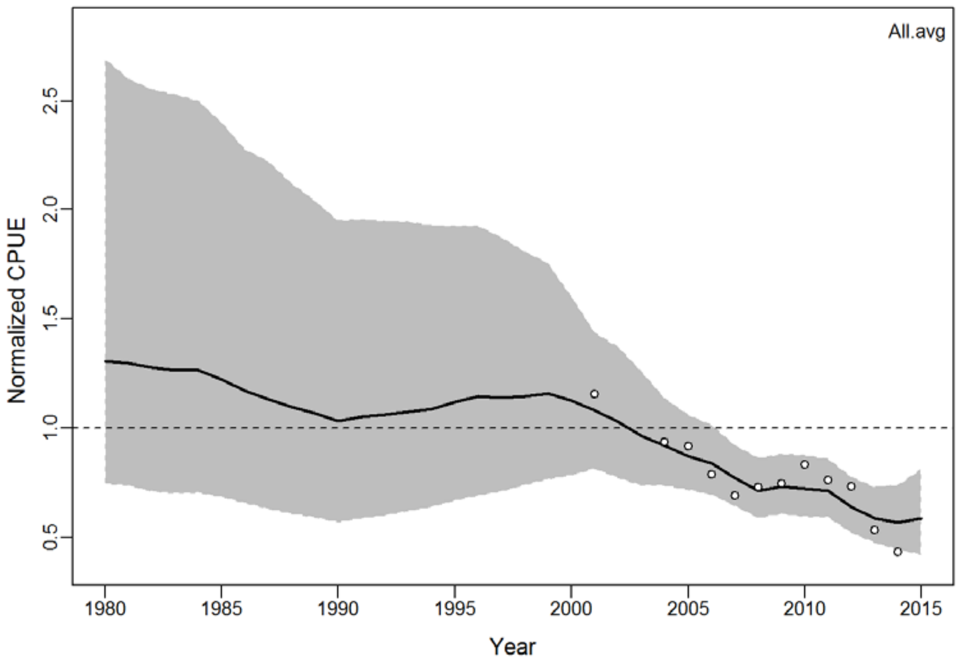

Figure 16. Fits to CPUE series for BSPSP using Fox Production function on CPUE data till 2014 projecting data till 2015.

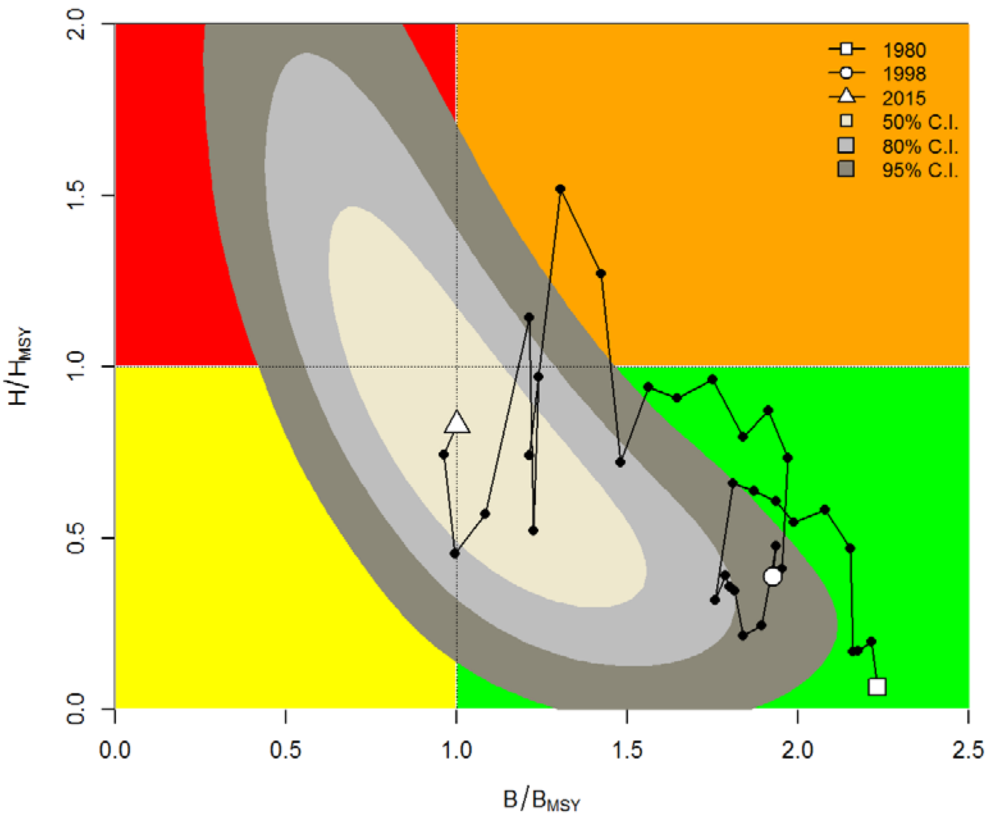

Figure 17. Kobe 2 phase plot with uncertainty using the CPUE data till 2014, and projecting till 2015 using observed catches in 2015.

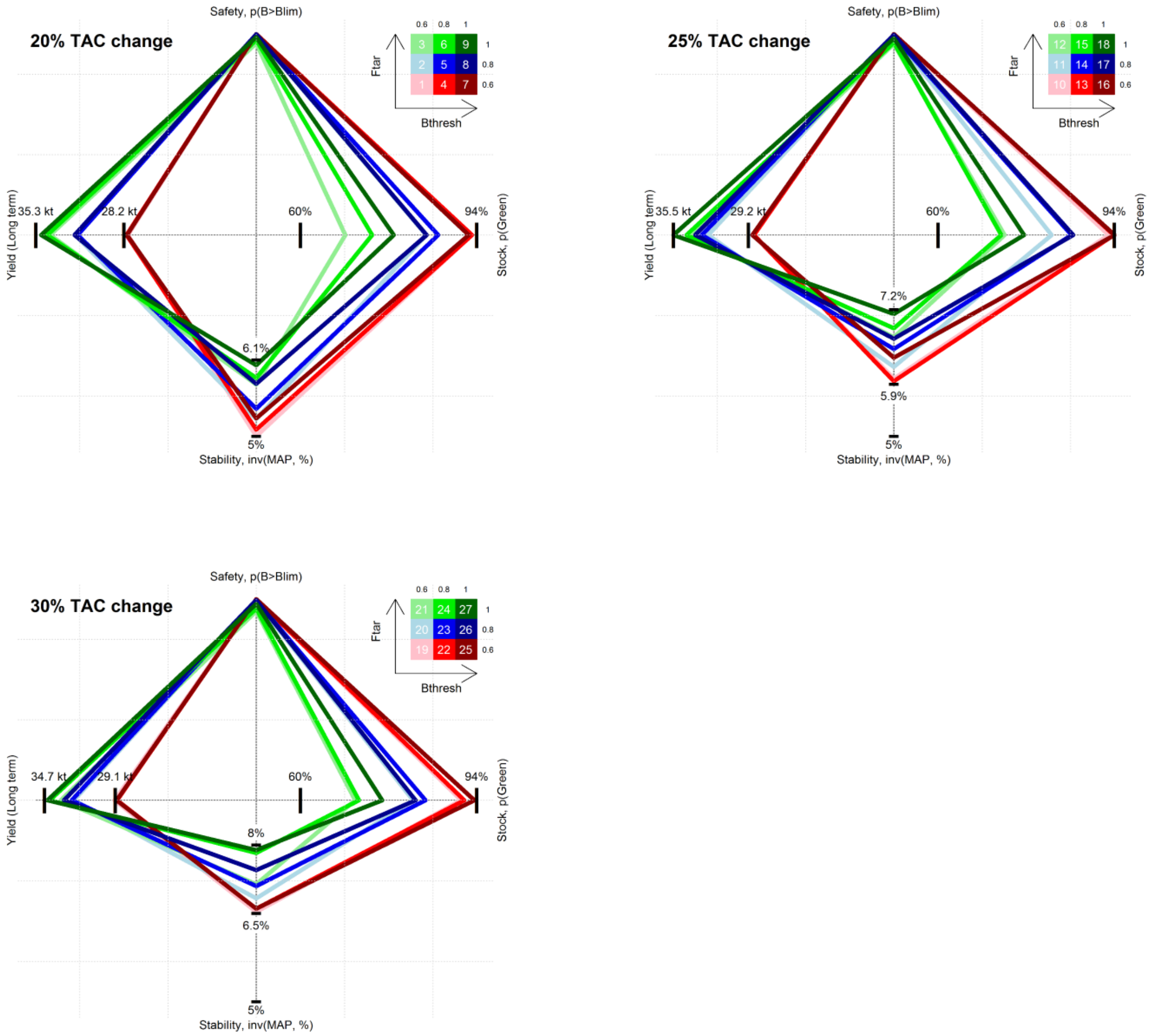

Figure 18. Spider plots representing the relative performance of HCRs with 20%, 25% and 30% maximum TAC change. Among the 15 performance statistics identified by Panel 2 (see key in **Table 12**), a single performance statistic per main group is represented in each of the axes. Each HCR has a unique identification number in this figure and **Table 12**. Different tick marks in the axes are included to inform about absolute values. The values for the whole set of indicators can be seen in **Table 12**.

Appendix 1

Agenda

1. Opening, adoption of Agenda and meeting arrangements
2. Review of fishery statistics for Mediterranean and Atlantic albacore
    2.1 Task I (catches) data for Mediterranean albacore
    2.2 Task II (catch-effort and size samples) data for Mediterranean albacore
    2.3 Evaluate relative indices of abundance for use in the Mediterranean stock assessment
    2.4 Progress on the available relative indices of abundance for the Atlantic stocks
3. Review of available and new information on biology and other life-history information
4. Mediterranean stock assessment
    4.1 Catch-Based method Catch-MSY
    4.2 Catch-based method CMSY
    4.3 Catch Curve Analysis
    4.4 Bayesian State-Space Surplus Production Model (BSPSP)
    4.5 Final Stock Status Advice
5. Management recommendations for Mediterranean albacore
6. Evaluation of HCRs for North Atlantic albacore
7. Recommendations on research and statistics
8. Other matters
    8.1 Update of the species Executive Summaries
    8.2 Other
9. Adoption of the report and closure

Appendix 2

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Appendix 3

List of Papers and Presentations

Reference	Title	Authors
SCRS/2017/091	Options for an Observation Error Model for North Atlantic albacore MSE	Merino G., Kell L.T., Arrizabalaga H., Santiago J., Sharma R., Ortiz de Zarate V. and De Bruyn P.
SCRS/2017/092	Uncertainty grid for North Atlantic albacore Management Strategy Evaluation: Conditioning Operating Models	Merino G., Kell L.T., Arrizabalaga H., Santiago J., Sharma R., Ortiz de Zarate V. and De Bruyn P.
SCRS/2017/093	Updated Evaluation of Harvest Control Rules for North Atlantic albacore through Management Strategy Evaluation	Merino G., Kell L.T., Arrizabalaga H., Santiago J., Sharma R., Ortiz de Zarate V. and De Bruyn P.
SCRS/2017/109	Standardization of CPUE for south Atlantic albacore by the Japanese longline fishery using revised method	Matsumoto T.
SCRS/2017/112	A habitat model for northeast Atlantic Albacore	Goikoetxea, Chust G., Ibaibarriaga L., Sagarminaga Y. and Arrizabalaga H.
SCRS/2017/113	Albacore tuna (*Thunnus alalunga*) catches by the Portuguese pelagic longline fleet targeting swordfish in the North Atlantic (1999-2015)	Coelho R. and Lino P.G.
SCRS/2017/114	Estimation of Mediterranean albacore fisheries' productivity using a Catch Based Method	Merino G., Arrizabalaga H., Restrepo V., Murua H., Santiago J., Ortiz de Urbina J. and Scott G.P.
SCRS/2017/115	Standardized CPUE of albacore (*Thunnus alalunga* Bonnaterre, 1788) caught by the Spanish surface longline fishery in the western Mediterranean, 2004-2015	Saber S., Macías D., Rioja P. and Ortiz de Urbina J.
SCRS/2017/116	Overview of the Italian fleet fishing albacore (*Thunnus alalunga*)	Mariani A., Camolese C. and Dell'Aquila M.
SCRS/2017/117	Standardization of albacore (*Thunnus alalunga*) CPUE rates from the Mediterranean Italian fisheries	Mariani A., Tserpes G., Camolese C. and Dell'Aquila M.
SCRS/2017/118	Spatial distribution of fishing ground of the Spanish albacore (*Thunnus alalunga*) surface fishery in the north eastern Atlantic in 2015 and 2016	Ortiz de Zárate V., Perez B. and Quelle P.
SCRS/2017/120	CPUE standardization on southern Atlantic albacore, dating from 1967 to 2016, based on catch statistics of Taiwanese longliners	Feng-Chen C. and Shean-Ya Y.
SCRS/2017/121	CPUE standardization on northern Atlantic albacore, dating from 1967 to 2016, based on catch statistics of Taiwanese longliners	Feng-Chen C. and Shean-Ya Y.
SCRS/2017/122	Albacore (*Thunnus alalunga*) larval index in the Western Mediterranean Sea, 2001-2015	Alvarez-Berastegui D., Ingram G.W., Reglero P., Macías D. and Alemany F.
SCRS/2017/128	Age and growth of Mediterranean albacore	Garibaldi F., Lanteri L., Valastro M. and Di Natale A.

SCRS/P/2017/014	Updated information on the reproductive biology of albacore in the Western Mediterranean Sea	Saber S., Ortiz de Urbina J., Gómez-Vives M.J. and Macías D.
SCRS/P/2017/015	Comparing CMSY and a Bayesian Surplus Production Model (BSM) fitted to average CPUE time series for Mediterranean Albacore	Winker H. and Parker D.
SCRS/P/2017/016	Data-poor assessments for small tunas, mackerels and bonitos in the Atlantic Ocean	Pons M., Kell L.T., Hilborn R. *et al*.

Appendix 4

SCRS Document Abstracts

SCRS/2016/077 - Albacore, *Thunnus alalunga*, is the main target of the South African tuna pole-line (baitboat) fleet operating along the west and south west coast of South Africa and the South African catch is the second largest in the region with annual landings of around 4000 t. A standardization of the CPUE of the South African baitboat fleet for the time series 2003-2015 was carried out with a Generalized Additive Mixed-Model (GAMM) with a Tweedie distributed error. Explanatory variables of the final model included year, month, geographic position, vessel power, included as a random effect, and targeting, included in form of clustered PCA loadings of the root-root transformed, normalized catch composition. The standardized CPUE mostly trails the nominal CPUE with no overall significant upward or downward trends. The analyses indicate that the CPUE for the South African baitboat fishery for albacore has been stable over the last decade.

SCRS/2017/091 - When conducting a Management Strategy Evaluation the Observation Error Model is the component of the Operating Model that generates fishery-dependent and/or fishery-independent resource monitoring data for input to a Management Procedure. In this paper we explore options for the Observation Error Model used to test the North Atlantic albacore Management Procedure. The options include (i) single indices derived from Operating Models abundance, catch per unit of effort and overall selectivity and (ii) multiple fleet specific indices for biased and unbiased CPUE. We recommend the unbiased multiple CPUE indices for the North Atlantic albacore evaluation of HCRs using MSE. Fleet specific CPUE and variability of the indices can explain the recent assessment of this stock.

SCRS/2017/092 - Management Strategy Evaluation (MSE) requires characterizing the main sources of uncertainty inherent to fisheries. The unknowns that challenge the interpretation of fish stock assessments include gaps on biological processes and fishery dynamics. The first are often dealt by imposing ranges of input biological parameters to stock assessment models; and the second with assumptions over the available datasets. The uncertainties explored in the North Atlantic albacore MSE so far include the range of stock assessment scenarios tested in 2013 with the statistical, size-based, age structured model Multican-CL. These explore the impacts of a range of data series combinations as the main source of uncertainty together with a natural mortality scenario. In this paper, we condition a grid of Operating Models by expanding the initial set of runs from 2013 using (a) alternatives for input biological parameters (natural mortality and steepness) and fishery dynamics (1% increase of catchability), and (b) projections using three scenarios for future recruitment. This work aims to expand the grid of OMs so that the tested HCRs are robust to a wider range of uncertainty.

SCRS/2017/093 - ICCAT's management objective is to maintain high long-term catch with a high probability of stocks not being overfished nor overfishing occurring and a high probability of not being outside biological limits. To achieve this, Harvest Control Rules (HCRs) can be used to determine annual catch limits. HCRs need to be agreed by policymakers and understood and accepted by stakeholders, which is often difficult due to the many uncertainties inherent to fisheries. For this, Management Strategy Evaluation (MSE) is used to estimate different levels of probability of achieving management objectives by alternative HCRs. Based on the feedback from ICCAT's WGSAM, Panel 2, albacore WG and SCRS, improvements have been made to the MSE framework presented in 2016 to provide updated evaluations of Harvest Control Rules: (i) extended grid of Operating Models, (ii) a modified Observation Error Model to generate CPUE series, and (iii) bounds to the TAC changes through HCRs. The results shown here indicate that all the HCRs evaluated would allow achieving the management objective of p(Green)>60% but would perform differently for other indicators. We show results in accordance with the performance statistics requested by the Commission, in order to support the potential adoption of a HCR for this stock.

SCRS/2017/109 - Standardization of CPUE of south Atlantic albacore (*Thunnus alalunga*) caught by Japanese longline fishery were conducted using negative binominal model, based on revised methods from the previous studies. CPUE series were separated into two periods (before and after 1993) due to availability of logbook database. Core area (main fishing ground for albacore) was selected and used. Effects of quarter, five degree latitude and longitude blocks, fishing gear (number of hooks between floats), branch and main line materials, bait, and one interaction were incorporated, although effect of bait can be used only before 1993. The effect of five degree latitude and longitude blocks was greatest except for the effect of year in one model. Standardized CPUE sharply declined during the 1960s, slightly decreased or was comparatively constant after that. CPUE sharply increased in recent years. It seems that the trend of CPUE is affected by albacore targeting.

SCRS/2017/112 - Albacore is a highly migratory temperate species. At the end of spring, juveniles start a trophic migration from central Atlantic waters to Northeast Atlantic area, heading to the productive waters of the Bay of Biscay and south Ireland. During this migration, they follow an optimal thermal window. In addition, factors such as depth, water column structure or primary production have been also seen to be influential for this commercially important species. The environmental preferences of albacores suggest that oceanographic changes could influence the spatial and temporal distribution of the stock. The aim of this work was to analyse the Northeast Atlantic albacore distribution changes and to identify possible causes of such variability associated to recent climatic changes. Further, future projections to mid-century and end-of-the century allowed to describe the potential new distribution of this species in the following decades. To do so, albacore catches of the Basque trolling fleet were studied by means of niche-ecological models. Results showed a northward shift in albacore catches during the period 1981-2006. This shift could be partly linked to the recent warming of the sea. In contrast, we detected significant westward shifts which are not explained by environmental changes. Future projections indicate a northward shift in albacore catches and an earlier feeding migration for the end-of-the-century, with the potential local extinction of some usual fishing areas of the Bay of Biscay.

SCRS/2017/113 - This working document presents the first overview on the catch, effort and nominal CPUE trends for the albacore tuna (*Thunnus alalunga*) captured as bycatch by the Portuguese pelagic longline fleet targeting swordfish in the North Atlantic. The analysis was based on data collected from fishery observers, port sampling and skippers logbooks (self-sampling), collected between 1999 and 2015. Overall, 90.1% of the trips or sub-trips considered in the study had zero albacore tuna catches in the North Atlantic. The area with the higher CPUEs was the northwest area of the operation of the fleet, northwest of the Azores Islands. In general there was a large variability in the nominal CPUE time series and no major noticeable trends during the period. The results presented in this document should be considered preliminary as this is the first overview of the bycatch of this tuna species by this fleet. Future work and analysis can be programmed as needed.

SCRS/2017/114 – Fisheries are managed using biological information of fish stocks, historical catch data and complex numerical models. However, the availability of reliable and complete information of both biological characteristics and fisheries yield is often incomplete, inaccurate or non-available. Therefore, there is a need for simple methods that allow estimating fish stocks productivity using limited data. In this study we use a simple method to investigate the productivity and historical harvest rates applied to Mediterranean albacore, a species exploited by several nations and a diversity of gears and managed by the International Commission for the Conservation of Atlantic Tunas (ICCAT). Our results suggest that current and recent catch is within the estimated limits of the capacities of this stock to replace the amount of biomass harvested and that catches exceeded this limit at the end of the 1990s and early 2000s. We discuss that these results need to be supported by more in-depth studies and new data due to the limitations of catch based methods.

SCRS/2017/115 – Standardized relative abundance indices of albacore (*Thunnus alalunga*, Bonnaterre, 1788) caught by the Spanish surface longline in the western Mediterranean Sea were estimated for the period 2004-2015. Standardized CPUEs were estimated through a General Linear Modelling (GLM) approach under a negative binomial error distribution assumption. Following a relatively stable trend for the period 2004-2008 and an increase between 2005 and 2010, the index seems to have declined since 2011.

SCRS/2017/116 – Italian fishing fleet targeting albacore was investigated during 2015. The survey was carried out in the framework of an Italian Ministry Project. Fleet size, distribution and fishing strategies were investigated through specific surveys. The main features characterize Italian albacore fleet as a drifting surface longline fishery, mainly carried out by the Sicilian fleet, in terms of tons. Different fishing strategies were identified.

SCRS/2017/117 - Indices of abundance of albacore from the Italian long-line fisheries operating in the central Mediterranean Sea are presented for the period 2011-2015. Annual standardized indices were estimated by means of Generalized Linear Modelling techniques including as predictor variables the Year, Month and Area of fishing. Results indicated that Catch Per Unit Effort (CPUE) rates, expressed either in terms of weight or number, were decreasing over time.

SCRS/2017/118 - Albacore (*Thunnus alalunga*) nominal catch rates were estimated from the monitored trips of the Spanish surface fishery during 2015 and 2016. The baitboat and troll fleet targeted albacore during summer and autumn seasons. Their spatial distributions were compared in relation to Sea Surface Temperature (SST) measured in the North East Atlantic off shore waters and the Bay of Biscay area. Range of the Sea Surface Temperature where catches were located, was estimated from SST satellite maps and the distribution of CPUEs by trip for both fleets and month for the two years respectively. In summer, there are two distinct regions according to range of SST and CPUEs by fleet, one warmer area in the Bay of Biscay and more temperate area in the off shore waters of NE Atlantic. Two distinct distribution areas were observed concerning fleet strategy. Baitboat catches were located in the Bay of Biscay, while troll catches were spread through the Bay of Biscay and NE Atlantic off shore waters. Likewise, SST range observed in 2015 and 2016 in the fishing areas was similar.

SCRS/2017/120 - Logbooks since 1981 and the Task II data since 1967 from Taiwanese longliners were scrutinized, by decadal period and 5º-square block, for the geographical distribution characters of four major tuna species (albacore, bigeye tuna, yellowfin tuna, and swordfish) to determine the core area for albacore. Datasets within the proposed core sampling area were standardized with the Generalized Linear Model (GLM) for minimizing most noises of non-albacore-targeting data. The albacore core sampling area comprised 10°S to 45°S and from 55°W to 20°E, yet excluding the small block of 10°S-15°S/10°W-15°E. 10°N to 50°N and 20°W to 75°W, for the period 1967-2016. The log-normal error distribution was used to standardize both yearly and quarterly nominal CPUEs. Year, quarter and subareas by 5° latitude x 5° longitude were included in the model. Factors of quarter-series and subareas by 5° latitude x 5° longitude were also fitted to obtain quarterly standardized abundance index. Annual index trend declined from late 1960s to 1990, then increased till mid-1990s, and leveled off since early 2000s up to 2016. Quarterly trend, as compared to its respective yearly trend, often appeared a significant peak per year implied a consistent recruitment pattern of this resource. New fishing management strategy, if applied, will then inevitably affect the long-standing-understood status of the stock, because no such factor has ever put into the model consideration.

SCRS/2017/121 - Logbooks since 1981 and the task2 data since 1967 from Taiwanese longliners were scrutinized, by decadal period and 5º-square block, for the geographical distribution characters of four major tuna species (albacore, bigeye tuna, yellowfin tuna, and swordfish) to determine the core area for albacore. Data sets within the proposed core sampling area were standardized with the Generalized Linear Model (GLM) for minimizing most noises of non-albacore-targeting data. The albacore core sampling area comprised 10°N to 50°N and 20°W to 75°W, for the period 1967-2016. The log-normal error distribution was used to standardize both yearly and quarterly nominal CPUEs. Year, quarter and subareas by 5° latitude x 5° longitude were included in the model. Factors of quarter-series and subareas by 5° latitude x 5° longitude were also fitted to obtain quarterly standardized abundance index. Annual index trend declined until early 1980s, it highly fluctuated before late 1990s, showed an upward trend since early 2000s, and remained relative stable up to 2016. Similar trends were also observed for quarterly standardized CPUE index. New fishing management strategy, if applied, will then inevitably affect the long-standing-understood status of the stock, because no such factor has ever put into the model consideration.

SCRS/2017/122 - Larval abundance indices express standardized abundances of larval densities from ichthyoplankton surveys. For more than two decades these indices have been used to assess the trends of the spawning stock biomass of various species in the Gulf of Mexico, being incorporated into the population models applied by ICCAT. Recently, the delta-lognormal models used for the calculation of the indices have been improved to incorporate the environmental variability and have been applied in the Balearic Sea to obtain a larval index for bluefin tuna (*Thunnus thynnus*). Here we apply the same methodological approach to calculate a larval index of albacore (*T. alalunga*) from surveys conducted from 2001 to 2015 in the Balearic Sea, the most relevant spawning ground of this species in the Western Mediterranean. Results show a decreasing trend on albacore larval abundances and significant lower abundances from 2013 to 2015. This larval index, standardized for gears, sampling coverage, hour, salinity, date and sea surface temperature, attempt to provide information on the dynamic of the western Mediterranean stock of albacore, for which not much information available for assessment is available.

SCRS/2017/128 - This study presents age and growth parameters of albacore *Thunnus alalunga* from the Mediterranean Sea, derived on the basis of dorsal fin spine section readings. 379 specimens were collected during the period 2003 – 2016 in Southern Ionian Sea and Ligurian Sea in the framework of different research programs funded by the EU and Italian Government. The albacore length ranged between 22 cm FL and 99 cm FL. New growth parameters estimates were compared with other studies carried out in the past on Mediterranean albacore.

Appendix 5

North Atlantic albacore tuna research program (2018-2021)

The Albacore Species Group proposes to initiate a coordinated, comprehensive 4 yearlong research program on North Atlantic albacore to advance knowledge of this stock and be able to provide more accurate scientific advice to the Commission. This plan is based on the plan presented in 2010, which was based on document SCRS/2010/155, that has been revised according to new knowledge, reconsidering the new most important priorities and reducing the total cost.

The research plan will be focused on three main research areas: biology and ecology, monitoring stock status and management strategy evaluation, during a four-year period.

Biology and Ecology

The estimation of comprehensive biological parameters is considered a priority as part of the process of evaluating northern albacore stock capacity for rebounding from limit reference points. Additional biological knowledge would help to establish priors for the intrinsic rate of increase of the population as well as the steepness of the stock recruitment relationship, which would facilitate the assessment. Among the key biological parameters are ones related to the reproductive capacity of the northern albacore stock, which include sex-specific maturity schedules (L50) and egg production (size/age related fecundity). In order to estimate comprehensive biological parameters related to the reproductive capacity of the northern albacore stock, an enhanced collection of sex-specific gonad samples need to be implemented throughout the fishing area where known and potential spawning areas have been generally identified. The collection of samples need to be pursued by national scientists from those fleets known to fish in the identified areas and willing to collaborate in the collection of samples for the analysis. Potential CPCs that could collaborate with the sampling program may include (but not limited to): Japan, Chinese Taipei, USA and Venezuela. Expected results will include a comprehensive definition of sex-specific maturity development for albacore, spatial and temporal spawning grounds for northern albacore, estimate of L50 and size/age related fecundity.

The Group also recommended further studies on the effect of environmental variables on CPUE trends of surface fisheries. The understanding of the relationship between albacore horizontal and vertical distribution with the environment will help disentangle abundance signals from anomalies in the availability of albacore to surface fleets in the North East Atlantic.

It is also proposed to conduct an electronic tagging experiment to know more about the spatial and vertical distribution of albacore throughout the year. Given the typically high cost of this kind of experiment, and the difficulties to tag albacore with electronic tags, it is proposed to deploy 50 small size pop up tags in different parts of the Atlantic where albacore is available to surface fisheries (to guarantee good condition and improve survival), namely the Sargasso Sea and off Guyana, off USA/Canada, Azores-Madeira-Canaries, and the Northeast Atlantic.

Last, the existence of potential subpopulations in the north Atlantic has been largely discussed in the literature. While recent genetic studies suggest genetic homogeneity (Laconcha *et al.,* 2015), otolith chemistry analyses (Fraile *et al.,* 2016) suggested the potential existence of different contingents, which could also have important management implications. Thus, in order to clarify the existence of potential contingents, we propose to expand the limited study area in Fraile *et al.*, 2016 to the entire north Atlantic, as well as to address interannual variability through multiyear sampling and analysis of otolith chemistry.

Monitoring of stock status

The Group recommends the joint analysis of operational catch and effort data from multiple fleets be undertaken, following the example of other species working groups. This would provide a more consistent view of population trends, compared to partial views offered by different fleets operating in different areas. The analysis is suggested for both longline fleets operating in the central and western Atlantic, and surface fleets operating in the Northeast Atlantic.

Finally, given the limitations of the available fishery dependent indicators, the Group mentioned the need to investigate fishery independent abundance indices. Although the Group is aware that, in the case of albacore, there are not many options to develop such fishery independent indices of abundance, it is proposed to conduct a feasibility test using acoustics during baitboat fishery operations to improve the currently available indices. A fine scale analysis for surface fisheries catch of albacore recruits (Age 1) is suggested to analyse the feasibility of designing some transect based approach for a recruitment index.

Management Strategy Evaluation

The Group recommends that further elaboration of the MSE framework be developed for albacore, considering the recommendations by the Working Group on Stock Assessment Methods and the Albacore Species Group as well as the guidance of the ICCAT Panel 2 meeting in Sapporo (July 2016) and the t-RFMO initiative. Among other things, work should be promoted towards exploring additional operation models (e.g. considering auto-correlated recruitment or regime shifts), improving observation error models (e.g. considering changes in catchability over time), considering alternative management procedures (e.g. harvest control rules that consider bounds to the management action, alternative stock assessment models, and CPUEs with different characteristics, such as very noisy CPUEs or CPUEs that track only some age classes), and considering implementation error (or systematic bias). Following the Panel 2 meeting in Sapporo, there is also a need to discuss the performance indicators and find better ways to communicate results.

The requested funds to develop this research plan have been estimated at 1,192,000 Euros. The research program will be an opportunity to join efforts from an international multidisciplinary group of scientists currently involved in specific topics and fisheries.

Budget

Research aim	***Priority***	Approximate 4 year Cost (€)
Biology and Ecology		
Reproductive biology (spawning area, season, maturity, fecundity)	High	200000
Environmental influence on NE Atlantic surface CPUE	High	50000
Distribution throughout the Atlantic (e-tags)	Medium	350000
Population structure: contingents	Low	120000
Monitoring stock status		
Joint Atlantic longline CPUE	High	30000
Joint NE Atlantic surface CPUE	High	12000
Feasibility of fisheries independent survey	low	180000
Management Strategy Evaluation		
Development of MSE framework	High	250000
	TOTAL	**1192000**

Timeline

Research aim	Year 1	Year 2	Year 3	Year 4
Biology and Ecology				
Reproductive biology (spawning area, season, maturity, fecundity)	x	x	x	
Environmental influence on NE Atlantic surface CPUE	x	x		
Distribution throughout the Atlantic (e-tags)	x	x	x	x
Population structure: contingents	x	x	x	x
Monitoring stock status				
Joint Atlantic longline CPUE	x	x		
Joint NE Atlantic surface CPUE	x	x		
Feasibility of fisheries independent survey		x	x	x
Management Strategy Evaluation				
Observation error: CPUE error structures and age classes	x			
Management Procedure: delay difference models	x			
Operating models: regime shifts	x			
Management Procedure: HCRs with bounded TACs	x	x		
Observation error: changes in catchability over time		x	x	
Implementation error		x	x	
Operating models: changes in selectivity		x	x	
Operating models: autocorrelated recruitment		x	x	
Operating models: broader scenarios using MFCL or SS			x	x
Communication: performance indicators and plotting	x	x	x	x

References

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