REPORT OF THE 2018 ICCAT BLUE MARLIN DATA PREPARATORY MEETING
(Madrid, Spain 12-16 March, 2018)

"The results, conclusions and recommendations contained in this Report only reflect the view of the Species/Working Group/Sub-Committee. Therefore, these should be considered preliminary until the SCRS adopts them at its annual Plenary meeting and the Commission revise them at its Annual meeting.

Accordingly, ICCAT reserves the right to comment, object and endorse this Report, until it is finally adopted by the Commission."

1. Opening, adoption of agenda and meeting arrangements

The meeting was held at the ICCAT Secretariat in Madrid March 12 to 16, 2018. Mrs. Fambaye Ngom (Senegal), the Species Group ("the Group") rapporteur and meeting Chairman, opened the meeting and welcomed participants. Dr. Miguel Neves dos Santos (Assistant Executive Secretary) adressed the Group on behalf of the ICCAT Executive Secretary, welcomed the participants and thanked Mrs. Ngom for having assumed the new responsabilities as Group rapporteur. The Chair proceeded to review the Agenda, which was adopted with a few 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 abstarcts of all SCRS documents presented at the meeting are included in **Appendix 4**. The following served as rapporteurs:

Sections	*Rapporteur*
Items 1, 8	M. Neves dos Santos
Item 2	C. Palma, J. Hoolihan, M. Ortiz,
Item 3	M. Schirripa, B. Morato ,P. De Bruyn
Item 4	M. Schirripa, F. Forrestal, M. Ortiz
Item 5	J. Hoolihan, D.Die, M. Neves dos Santos
Item 6	F. Ngom
Item 7	D. Die, F. Ngom

2. Review of data held by the Secretariat

2.1 Biology data

Age and growth studies

A progress report (SCRS/P/2018/001) on age and growth analysis was presented for blue marlin sampled during 2003-2005 from the Venezuelan longline fishery. Transverse sections of the second anal fin spine from 694 males, 273 females, and 36 of unknown sex were scored for observed growth bands and back-calculated bands lost to vascular erosion of the spine core. Males ranged in size from 153 to 289 cm LJFL and exhibited a maximum age of 31.3 yrs for observed bands, and 37.3 yrs when including back-calculated lost bands. Females ranged in size from 156 to 289 cm LJFL and exhibited a maximum age of 29.7 yrs for observed bands, and 36.7 yrs when including back-calculated lost bands. Growth rates were estimated using the von Bertalanffy growth function (**Figure 1**). Notably, this project is ongoing and at this time lacks specimens larger than 300 cm LJFL. A revised analysis that includes larger individuals is expected prior to the 2018 blue marlin stock assessment. Assuming a maximum age of 37 yrs, a value of 0.122 for M (**Figure 2**) is attained using the equation of Hewitt and Hoenig (2005), in contrast to the M (0.139, 30 yrs.) used in the previous assessment.

Biological Parameters considered for stock assessment

The Group considered constant rates of natural mortality vs age dependent rates (e.g., Lorenzen method), and agreed that a constant rate of M would be used for the 2018 assessment. The Group discussed the variation in M rates. An M value of 0.139 was used in the previous assessment. The Group agreed that for the 2018 assessment three scenarios would be considered. 1) M = 0.139 (30 yrs) for continuity testing with 2011 assessment (Hoenig, 1983); 2) M = 0.122 (37 yrs) to account for new findings (above); and, 3) M = 0.100 (45 yrs) for sensitivity testing (Hewitt and Hoenig, 2005) (**Table 1**).

The Group discussed the need to consider various biological parameters pertinent to the 2018 assessment. These included length, size, length-weight relationships (**Table 2**), maturity at length (**Table 3**), and coefficient of variation for size at age from recent aging work (**Table 4**). A value of 0.5 was assumed for the sex ratio at recruitment.

2.2 Task I and II catch data

The Secretariat presented to the Group the most up-to-date Task I nominal catches (T1NC) of blue marlin (BUM) together with a list of possible improvements (already identified/discussed in recent meetings), namely catch series with gaps in some years, catches series with unknown gear (UNCL, representing about 5 to 10% of the total BUM catches in various years), list of carry overs (and other SCRS corrections/estimations made in the past) used as preliminary estimations to cover unavailable official statistics. These problematic BUM T1NC catch series were revised and corrected in its majority (some will require further work) by the Group. The detailed list of revisions made (affecting about 250 records, adopted by this Group) was registered in the ICCAT-DB system (available whenever required).

In addition, the new estimations presented by São Tomé and Príncipe (TROL 2009 to 2017) and Côte d'Ivoire (GILL 1988 to 2016), the historical revisions presented in document SCRS/2018/012 for Grenada (drift longline 1988 to 2014) and Dominican Republic (hand line 2000 to 2016), and, the preliminary estimates made by the Group for Liberia (described below) and the European ("MIX-FR+ES") PS tropical by-catch estimations of BUM (described below) allowed to greatly improve the overall BUM biomass removals (landings and dead discards) estimates for the entire period (**Table 5**). The comparison of the T1NC BUM catches before (similar to the BUM estimations presented at the 2017 SCRS meeting) and after this revision is shown in **Figure 3**. The increase in more than 20% the total catches observed after 2011 (always near and above 2,000 t), are mostly due to the inclusion of the catch series of PS MIX-ES+FR, Liberia estimations, and, the Brazilian LL preliminary updates provided at the meeting. The total T1NC catches by major gear (UNCL gear now represents less than 5% in weight, on average) and year are shown in **Figure 4**.

Despite this improvement in T1NC, the Group considers that some large scale LL catch series still incomplete (Belize, China (People's Rep.), Korea Rep., Panama, and Philippines) and will require future revisions. Similar doubts exist on the recreational/sport fisheries component (various flags) in both Atlantic and Mediterranean Sea. Efforts should be made by the ICCAT CPCs to recover those missing/incomplete catch series in the future.

During the meeting preliminary estimates of catch (Task I) for Liberia artisanal fisheries for the 2004-2016 period were calculated. Liberia reported catches of blue marlin (Task I) for the period 1995-2003 ranging from 87 to 712 tons with an average of 302 tons per year. However, after 2004 catches of blue marlin and other billfishes have not been reported. In 2017 a Liberian scientist submitted size distribution data for blue marlin from the sampling program for the years 2013, 2014 and 2016. The monitoring program of artisanal fleets and catches included the visit twice a week, and sampling of all landed catch for 2 vessels of the main fishing group vessels (Fanti and Mixed) through the year in 5 regions of the country covering the main landing ports through the coast. This program has also provided estimates of the number of vessels in each group/fleet category and average number of fishing days per vessel per year (fishing effort). From the size sampling annual data it was possible to estimate an average catch per vessel group per fishing day (**Table 6**). With this estimate for each year, it is possible to estimate the total annual catch as the average catch per fishing day per fishing group times the number of total fishing days for each vessel group for 2013, 2014 and 2016. These estimates ranged from 196 to 234 tons of blue marlin catches. For the period 2004-2012 (and 2015), a comparable fishery fleet-gear type was selected; Ghana artisanal catches and an average ratio of catches was estimated for the overlapping years when both Ghana and Liberia had reported Task I (**Table 5**) to ICCAT. On average Ghana catches are 2.5 times the catches of Liberia, which roughly agree with their respective artisanal fleet sizes. Thus, the catches for Liberia 2004-2012 were estimated as the product of this ratio times the annual catch of Ghana. **Table 6a and 6b** and **Figure 5** present the estimated catch series for 2004 to 2016.

At the meeting, it was noted that BUM by-catches from the PS tropical and tuna FAD fishery (EU-Spain, EU-France and NEI-ETRO) have not been reported since 2010 (except for EU-France PS in 2017). However, during the 2000's the monitoring of by-catch from this important fishery reported on average 470 t of billfish, of which 150 t were blue marlin. The Working Group decided to estimate the unreported catches for the period 2011 to 2016 and to be included in the best estimates of total removal for blue marlin stock evaluation. The estimates were calculated using the ratio BUM/(SKJ+YFT+BET) from the 2000-2010 period (0.166%) when an observer program was in place for the by-catch and "faux poisson" monitoring of the tropical purse seine fisheries. **Table 7** shows the estimated BUM catch for the PS tropical tunas fishery 2011-2016.

The billfishes unclassified (BIL) catches have increased over the last decade (**Table 8**). These catches were revised by the Group. The BIL catches of São Tomé and Príncipe (2011-2016) and Chinese Taipei (2012-2014), were eliminated from T1NC, because these amounts were afterwards officially submitted disaggregated by species. In two cases (EU-Italy LL 2015-2016: BIL reclassified as MSP; Namibia LL 2002-2009: BIL reclassified as BUM) the species was recoded. Only in one case (EU-Portugal LL 2011 BIL) the catches were split by species (ratios of 2011 for LL EU-Portugal-Mainland: BUM 29%, SAI 56%, SPF 5%, and, WHM 10%) and the estimations recorded under the flag “NEI-BIL” (standard procedure adopted by this Group in the past). The BIL overall revision reduced substantially the unclassified BIL catches in all the T1NC time series (1970 to 2016).

Three scientific documents presented revisions to Task I nominal catches of billfish species, all related to artisanal fisheries. All these T1NC revisions were acknowledged and adopted by the Group.

Document SCRS/2018/012 presented the interim report on the advances of the comprehensive study of strategic investments related to artisanal fisheries data collection in ICCAT fisheries of the Caribbean/Central American region, which included a detailed description of the work plan that will follow a three step process including a questionnaire to be completed by the selected countries in the study, a comprehensive review of the available literature, and on-site visits to countries identified as of high interest. The document presented preliminary results from two selected countries, Grenada (ICCAT CPC) and Dominican Republic (non-ICCAT CPC), which showed the contrast between target species, modes of fishing, data limitations and areas for strategic investments. It also provided time series of historical catches of blue marlin for each of the countries that would contribute to fill the gaps in the ICCAT Task I data base. In addition, total catches of blue marlin and effort from the artisanal drift-gillnet fishery of Venezuela were recovered for 2015 and 2016 and reported in the document.

Document SCRS/2018/021 presented a complete revision of the fisheries statistics (T1NC) of the Côte d’Ivoire multi specific artisanal fishery (canoes using gillnets near coastal waters). Billfishes (including BUM) were monitored (counted and measured) at the main landing sites in Abidjan. This study presents a revision of the data collected from 1988 to 2016. The results indicate that the species occurs throughout the year. The nominal catch oscillated significantly over the years (as also the fishing effort and the nominal CPUE). Catches were, however, slightly higher in the warmer season and dominated by smaller specimens. In contrast, larger Blue Marlin dominated the catches during the cooler season.

The presentation SCRS/P/2018/05 described the São Tomé and Príncipe artisanal fisheries and the associated data collection system in place since 2015, with the financial/technical support of the ICCAT-JCAP-EPBR Programmes. A revision of the billfish catches (BUM, SAI, and WHM) and SWO (trolling as the major fishing gear, but also minor catches of drifting longlines) was presented covering the period 2009 to 2017. The new estimations officially reported to ICCAT) substantially improved the billfish catches for São Tomé and Príncipe.

2.3 Task II effort and size data

The SCRS catalogue of BUM (T1NC *vs* availability of T2CE [Task II catch & effort] and T2SZ [Task II size samples], with the fisheries ranked by order of importance of total catches) covering the period 1996 to 2016, was updated and presented (**Table 9**) to the Group. It shows that the improvements made to T1NC, was not followed by similar improvements in any of the two Task II datasets (T2CE, T2SZ).

Important T2CE (yearly and quarterly datasets are not shown) and T2SZ datasets (yearly datasets now shown) are still missing or require revisions (**Table 10** shows the T2CE datasets requiring revisions, and, **Table 11** shows the T2SZ datasets requiring revisions) in the future. The Secretariat should explicitly request these datasets (in conformity with the current SCRS quality standards) to the respective CPCs as soon as possible.

The Secretariat presented a summary and preliminary review of the size data (Task II) available at the Secretariat for blue marlin.

A total of over 130 thousand samples are available since 1970. **Figure 6** shows the available size samples by main gear type and compared to the total catch of blue marlin. All size data was standardised to LJFL size bins using current weight/length conversion factors. Overall there is good size sampling from 1980's forward and in particular in the 1990's. However, size sampling has substantially decreased in recent years, with the reductions of catches. It was noted that most size sampling were collected from the South Atlantic, and the Caribbean region. The overall size frequency distributions shows catches of blue marlin between 130 and 350 LJFL cm (95% quartile), with a median at about 205 cm (**Figure 7**). By main type gear, longline shows the wider size distribution, while the rod and reel catches larger size fish. **Figure 8** shows the annual trends of mean size by main gear type, in general indicating a reduction in the mean size since 1970 for the longline and gillnet components. In contrast, the mean size of the rod and reel fisheries seems to increase in the 1980's, although with larger variations. It was also noted that in the last decade, the mean size trends shows larger variations that in prior periods, further analyses indicated that these variations respond mostly to differences in reporting between CPCs/feets, rather than trends of population. In 2017 size sampling data was provided by Liberia scientist from their artisanal fisheries for 2013, 2014 and 2016 years. The size frequency of this fleet is small compared to similar fisheries in the area, after discussion it was recommended to confirm species identification of the landings for blue marlin. At the meeting preliminary size data was also presented from the artisanal fisheries of São Tomé and Príncipe for 2016 and 2017 (preliminary datasets provided to the Secretariat).

As the blue marlin size frequency data will be used in the assessment model (Stock Synthesis), it was agreed that a quality control and minimum size sample be applied prior to the input in the model in collaboration between the modeller scientist and the Secretariat.

2.4 Tagging data

The BUM conventional tagging data available in the ICCAT database is presented in **Table 13**. There are a total of 47,155 BUM individuals released between 1940 and 2015. The total number of individuals recovered is 716, which represents on average a recovery ratio of about 1.5%. The apparent movement (straight displacements between release and recovery positions) shown in **Figure 9** (complemented by the release and recovery density maps of **Figure 10**) indicates that the largest number of releases have occurred in the western Atlantic and Caribbean. Tag recaptures are also concentrated in the western Atlantic and Caribbean.

It was noted that there has been a large reduction in the number of tags deployed since 2000, and particularly since 2008. It was suggested that the reduction in tagging since 2000 was due to a reduction in distribution of conventional tags by the Billfish foundation, who had been extremely active in the late 1990s. In addition, the global economic crisis in 2008 resulted in less recreational fishing, further reducing the number of tag deployments over this time period. It was noted that the number of deployments in recent years appears extremely low. The Secretariat subsequently received several tagging files from the US scientists. It was agreed that the secretariat will investigate why these data do not appear in the conventional tagging database if they have previously been submitted.

SCRS/2018/014 provided information on catch rates based on Brazilian sport fishing tournaments (1996-2018). In this presentation it was noted that many of the fish in the study are tagged and released alive. The Group noted that data for recent years (after 2014) have been collected but not submitted to the ICCAT Secretariat. As such the Group strongly urged the author to provide the tagging information to the Secretariat in the future.

2.5 Other relevant data

No other relevant data was made available for the assessment.

3. Review of relative indices of abundance (CPUEs)

Document SCRS/2018/014 provided information on how daily radio logbook records from recreational tournaments of yacht clubs from São Paulo, Rio de Janeiro, Espírito Santo and Bahia, including 289 tournament days, from 1996 to 2018, were used to generate a standardized CPUE series, by a GLM, using the tweedie distribution.

The author noted that only values up to and including 2014 are worth including in assessment models as after this period, there is an increasing trend, resulting in unusually high blue marlin catches due to a change in the fishing ground, with the boats operating much closer to the oil platforms in recent years in front of the State of Rio de Janeiro. Also, the variance becomes very large and thus the catch rates can be considered unreliable. The author also discussed that there is interesting catch data presented in the document which could be provided for ICCAT Task I recreational fisheries, noting that the information is just a sample of the total catch. The Group, however, observed that it is difficult to get an estimation of total catch from the available data and therefore is not suitable for Task I. Of greater use is the information regarding tagging, as mentioned in the previous section.

In SCRS/2018/015, catch and effort data from 99,376 sets done by the Brazilian tuna longline fleet, including both national and chartered vessels, in the equatorial and southwestern Atlantic Ocean, from 1978 to 2016, were analyzed to develop a standardized CPUE series for the Brazilian pelagic longline fleet.

The author noted the last years in the series are not suitable for use. In this case, the information becomes unreliable after 2005. This drop in catches may be due to the implementation of management regulations in 2005. As such, the Group agreed that the data after 2005 should not be included in the assessment models.

Document SCRS/2018/016 describes how logbook and observer effort data from the US pelagic longline fishery were used in a longline simulator (LLSIM) to simulate catch datasets from a known population of blue marlin. The CPUE index obtained from the logbook data provided a better estimate of the true population as compared to the observer CPUE index, however, both data sources were able to capture the overall true population trend.

The Group noted that the trends for observer and logbook simulated series are very different for the last few years (after 2010). It was noted that this may be due to several factors including the low percentage of observed sets as well as non-random distribution of observers across the fishing area. Thus, the observers are to some degree a non-random subset of the logbook recorded sets. It is generally considered that observer data is more reliable than logbook data, particularly with regard to species identification, reporting and fate, but other Groups have concluded that the low sample size and non-random distribution of sampling may offset these benefits. It was also concluded that despite changes in effort and distribution, the inclusion of environmental variables appears to allow the series to track the population trend sufficiently.

In document SCRS/2018/017 the Group was presented with a paper that introduced a theoretical method of incorporation of habitat information into the standardization of CPUE information. This work was in direct response to the same topic being worked on by the Working Group on stock Assessment Methods (WGSAM). Including the habitat coefficient into the standardization improved the fit of the estimated trend in abundance to that of the simulated population trend. The authors let it be known that this habitat information (by lat, lon, depth, month and year) is available since 1950 from the authors for any scientist to use in their own standardization purposes.

A continuation of the above presentation revisited the corrections made to the historical Japanese series as was done after the 2011 assessment. Based on a reduced log likelihood the author concluded that the model that allowed for time varying catchability was superior to the model that did not. The Group agreed with the authors' conclusions that the ratio of YFT/BET could be a suitable proxy for depth (and therefore habitat) and so would be a good factor to include in the correction of the Japanese CPUE which does not contain information on hooks per basket for the entire time series. YFT is considered to be more appropriate, as YFT habitat is more similar to BUM habitat.

Catch and effort data of blue marlin for the Chinese Taipei distant-water tuna longline fishery in the Atlantic Ocean were standardized in document SCRS/2018/022 for the whole period (1968-2016) and by period using a generalized linear model (GLM). Four periods of 1968-2016, 1968-1990, 1990-2016 and 1998-2016 and information on operation type (the number of hooks per basket, HPB, for the model of 1998-2016) were considered in the CPUE (catch per unit effort) standardization to address the issue of targeting change in this fishery.

The Group discussed the time blocks considered by the authors and agreed these periods follow shifts in targeting from albacore to tropical tunas, particularly between the first and second blocks. The third block is justified by the inclusion of hooks per basket information, not available for the previous two time-series. The Group suggested possibly using the correction factor described for the Japanese CPUE series (above), but also concluded that there was no simple switch in targeting as was the case with Japan, but rather an expansion from targeting albacore to include targeting of tropical species. Therefore, a simple correction using a proxy may not be appropriate and that maintaining the split in the series would be preferable. The Group did however request that the authors rerun the analysis using the zero catch information, using an appropriate model to incorporate this information in the standardisation, due to the fact that the proportion positive sets was below 70%. The authors promptly responded with a revised analysis, using a delta log-normal model to account for the zero catch sets. The Group thanked the authors for their rapid response and collaboration, despite not being able to attend the meeting and agreed that the revised values should be used in the assessment.

Updated standardized CPUE for Atlantic blue marlin caught by Japanese longliners was submitted in document SCRS/2018/019. The same standardization procedure as Kimoto and Yokawa, 2011 that was agreed by billfish species group was used for the period 2010 to 2016 and the standardized period between 2001 and 2016.

Firstly the Group noted that the series only updates the data from 2001 and so does not affect the historic Japanese time series that will continue to be used as was presented in 2011. The Group stressed that the paper did not include any diagnostics for evaluating the series. The basic information required for filling in the standard CPUE evaluation table was not available. Although the author noted that the analysis included comments from the Group made in 2011, it is not clear how these were taken into account in the new estimations. This lack of diagnostics was acknowledged by the author in the self-evaluation of the CPUE series sent using the CPUE evaluation table. As such the Group concluded that this series is not suitable for use in the assessment models. Suggestions for future improvement include compensating for the lack of hooks per basket information by using a proxy such as that suggested above for the historic series or similar habitat descriptive factor.

A brief presentation was provided in document SCRS/2018/018 that applied the theory presented in the paper SCRS/2018/017 to real logbook data from the US fishery. The finding here is important because the two approaches used, either a habitat effect or an area effect, provided the same answer with high precision. That is evidence for using the habitat coefficient elsewhere. The resulting CPUE was presented for consideration for use the in the stock assessment.

It was noted that the variables presented in this study appear to be a reasonable proxy for habitat implying the area classification overlaps closely with changes in habitat. The authors noted too, that using environmental data may allow the dropping of the factors area and month as they appear to provide the same information. Using environmental data may be more beneficial, as areas may be incorrectly classified, negatively impacting the standardization process. The Group noted that neither habitat nor the area and month information appear to have much explanatory value in this case, but both were found to be significant in the model fitting despite the gear information having far more effect on the standardized series.

The Group did note that some diagnostic information is missing from this paper, and no model selection was conducted. As such, it was not considered to be a full standardization procedure. In addition, this standardization overlaps with the standardization conducted in document SCRS/2018/020 (below) which includes additional information. As such, the Group decided not to use this series in the assessment and the authors agreed it is still largely a study in its conceptual phase. The Group suggested that the series may be improved by considering interaction terms in the future.

Standardized indices of relative abundance for blue marlin in the northwest Atlantic Ocean are presented in document SCRS/2018/020 for two U.S. fisheries, the pelagic longline by-catch fishery and the recreational billfish tournament fishery. The longline index is based on scientific observer reported catch and effort for individual longline sets; the tournament index is based on records of catch and effort aggregated by tournament.

The authors subsequently provided a revised document (SCRS/2018/020 revised) in response to several questions by the Group. The revisions were based on recommendations to remove the first year of data in which the US pelagic longline observer program was developed as sampling intensity was lower compared to the rest of the time series. Additionally, a more appropriate treatment of spatial areas was included using the National Marine Fisheries Service defined biological areas rather than ICCAT areas. The Group acknowledged that several of the uncertainties raised regarding the initial document were addressed by this revised manuscript. The Group noted with interest that in 2007 observer coverage increased, and this coincides with CPUE increase in the revised estimations.

With regards to the recreational series, it was explained that the inclusion of at tournament effect factor and rodeo tournament data (tournaments over extended periods), which were not included in the 2011 assessment, explain the clear difference in the revised CPUE when compared to the past CPUE series.

Updated indices for Venezuelan rod and reel and gillnet were not provided during the meeting. CPC scientists from Venezuela communicated during the meeting that the series presented in 2011 were updated in Babcock and Arocha 2015 and that the revised values in that document should be used in the assessment. The Group agreed with this communication and therefore these values were adopted for use.

Summary of CPUEs

Based on the revisions of the CPUE documents presented above, the Group discussed the CPUE evaluation tables completed for each series. The agreed information for each series is provided in **Table 13**. A discussion was also held regarding which historic CPUE series (those presented in 2011) will be carried forward into the current assessment. **Table 14** provides the final list of CPUEs available for inclusion in the assessment models. **Figure 11** depicts all CPUE series plotted together and **Figure 12** shows each CPUE independently, including a loess smooth fitting regression to visualize trends among them.

4. Discussion on models to be used during the assessment and their assumptions and remaining issues in preparation for the June stock assessment meeting

4.1 CPUE Selection

The available historical and current CPUE time series were discussed and included the Japanese LL, Chinese Taipei LL, USA LL, USA Rec, Brazilian LL and recreational, Venezuelan LL and Ghanaian gillnet (**Table 13**). It was decided that the Japanese historic longline would be used as in the 2011 assessment, but that the catchability of the fishery will be allowed to vary in time according to the YFT/BET ratio as proxy for the historic shifting of targeting species of this fishery. Regarding the current Japanese longline, the Group was in agreement with the author's diagnosis and comments, and the Group concluded that this time series should not be used for the 2018 stock assessment session. The Group decided to use the current Chinese Taipei longline, the USA longline observer, and the USA recreational time series as presented.

The Group discussed the Venezuelan longline time series, noting that there is now new information on the series. The Group noted that a revision of the Venezuelan gillnet and rod and reel (Babcock and Arocha, 2015) had been presented at the 2014 Intersessional meeting of the Billfish Species Group (Anon. 2015). Based on the authors concerns and advice the continuous time CPUE time series will not be used, but rather the time series (including the additional years) broken into two sets (gillnet and rod & reel) will be used in the current assessment.

The Ghanaian gillnet time series from the previous assessment will also be used in the 2018 assessment. It was noted that this series was not updated. The Group discussed that this time series and others used in the 2011 assessment were not evaluated in the same format the time series presented at this meeting. The reason being that the CPUE evaluation tools utilized were implemented after 2011. However, the historic time series were subjected to evaluation at the 2011 assessment, thus the Group decided it was reasonable to retain for the 2018 assessment.

4.2 Model Selection

The Group discussed the three models that were used in the 2011 assessment, ASPIC, a Bayesian surplus production model and Stock Synthesis. While three models were run, only the Stock Synthesis model was used for management advice and the two production models were used for sensitivity explorations. It was noted that in the 2011 assessment ASPIC had problems converging when all parameters were estimated. It was proposed that three models should be presented again at the 2018 blue marlin stock assessment, Stock Synthesis, ASPIC and a Bayesian production model. A length-model (NZ50, Goodyear 2015) was proposed that would provide qualitative information using length-composition data. This model can provide an estimated trend of total mortality which could be used to compare the estimates of F from the other models utilized in the assessment. It was noted that this method has been approved by WGSAM and has been published in a peer-reviewed journal. The evaluated indices from Section 3 and the approved historical indices will be included in the models (**Table 14**); the Group set a deadline (30 March 2018) to receive the indices that need to be updated before they can be included. It was noted that the Group encouraged alternative assessment models that promote involvement by maximizing the participation of other scientists.

4.3 Steepness

As in all previous assessments, during the 2011 blue marlin stock assessment (Anon. 2012), it was reported that there is little information on steepness for this species. During such assessment steepness was allowed to be estimated by SS3 with an information prior of 0.5 (SD 0.05) resulting in an estimate of 0.411 (SD 0.062). The assessment team acknowledged, however, that the estimate of steepness was influenced by the bounds placed in recruitment deviations and that without such bounds the model had difficulties converging.

The SCRS has often noted that steepness is difficult to estimate for most of the ICCAT stocks as the data has little information that allows for estimation of this parameter without major assumptions. However, this is not unusual for pelagic stocks. In a scientific review, Harley (2011) fitted Beverton and Holt and Ricker Stock recruitment relationships to several data on tuna stock assessment results compiled by ISSF (2011) to empirically estimate the steepness parameter. Point estimates of steepness from Beverton and Holt S/R curves ranged from 0.45-1.0 and from Ricker S/R curves from 0.37-0.94. Excluding the results for the southern Pacific albacore the ranges were much narrower, 0.64-1.0 for Beverton and Holt S/R and 0.60-0.94 for Ricker S/R.

Mangel *et al.* (2010) developed a method to estimate steepness through a population model applied by simulation to southern bluefin tuna. This method relies on biological parameters of the early and adult life history of the species, including maturity, longevity, but notably also survival of early life history stages. Survival estimates were obtained from the empirical relationship for estimating daily mortality rates during the early life history of McGurk's (1986). Brodziak and Mangel (2011) used this method to estimate steepness for North Pacific striped marlin, obtaining a mean value of 0.87 (S.D. 0.05). Such estimate was contingent on the assumption that survival of larvae and juveniles of striped marlin were similar to those of southern bluefin tuna. The authors investigated how sensitive steepness was to values of reproductive parameters and found values of steepness ranging from 0.73 to 0.92. Davies *et al.* (2012) fixed steepness to 0.8 in their assessment of southwest Pacific striped marlin even though in the 2006 assessment of the same stock, steepness had been estimated to be 0.51. ISC (2013, 2016) used a value for steepness of 0.87 estimated for striped marlin by Brodziak and Mangel (2011) in their assessment of Pacific striped marlin but conducted sensitivity runs for values of (h=0.65, 0.75, and 0.95).

For Atlantic stocks Simon *et al.* (2012) used a similar procedure to that of Mangel *et al.* (2010) and applied it to Atlantic bluefin tuna obtaining a median estimate of steepness of 0.99 with 95% confidence interval of (0.38 and 0.99). These authors highlight that the most important parameter affecting estimates of steepness is the survival of young of the year, and again argued that estimates from McGurk (1986) were the best available for such survival. ICCAT (2013) estimated steepness to be 0.654 within SS3 for white marlin. ICCAT (2015) fixed steepness at 0.9 during the 2014 assessment of skipjack tuna on the basis of the use of that same value in the assessment of western Pacific skipjack and yellowfin tuna. ICCAT (2016) used values of steepness of 0.7, 0.8 and 0.9 in the 2015 assessment of bigeye tuna. ICCAT (2017) used values of steepness of 0.75, 0.85 and 0.95 for production models and fixed it to 0.9 for SS3 in the 2016 assessment of yellowfin tuna. ICCAT 2017, estimated a steepness of 0.8 for the western stock of sailfish from a Bayesian production model. Recently, Sharma and Arocha (2017) estimated the resilience of the north Atlantic swordfish stock by applying through the population model of Mangel *et al.* (2010) to different values of steepness ranging from 0.6 to 1.0, but assuming a base value of 0.8. The swordfish species group agreed to initially fix steepness (0.7, 0.8 and 0.9) for the assessment of northern Atlantic SWO conducted with SS3. When an informative prior was provided for steepness in SS3, steepness of NSWO was able to be estimated resulting on a value of 0.88 (S.D. 0.03).

In summary, as reported by Harley (2011) it is often argued that fishery data used in stock assessments are not informative enough to estimate steepness, so it is difficult to argue that the metadata analysis he conducted on empirically estimated steepness values should be considered reliable. Moreover, it is unclear how many of the assessments from which the data compiled by ISSF (2011) used priors or fixed steepness in the assessment process. Alternative methods based on population models such as those proposed by Mangel and Brodziak (2010) and Simon et al (2012) depend on survival estimates of early life history stages which are very hard to obtain. In fact, almost all authors use the single study on survival young fish by McGurk 1986 in their steepness calculations. The ICCAT SCRS has usually preferred to fix steepness in their recent assessments of tunas and used values of between 0.8 and 0.9 for their base case and use ranges (between 0.7 and 0.95) for sensitivity analyses. In the last assessments of Atlantic billfish, however, steepness was estimated through Bayesian production models or SS3, obtaining values of 0.411 for BUM, 0.65 for WHM and 0.8 for sailfish. For billfishes in the Pacific Ocean, the most common value of steepness used, as a fixed parameter was 0.87 (Brodziak *et al*., 2011).

The discussions of the Group concluded that the values of steepness based on simulation studies (approximately 0.87) do not necessarily represent the best prior for Atlantic blue marlin. Based on these discussions the Group decided to use the three possible values for steepness of 0.4, 0.5 and 0.6. The lower bound was selected based on the value estimated in the last blue marlin assessment. The upper bound was based on the informed decision that white marlin are more productive than blue marlin. The ICCAT estimated value of steepness for white marlin is approximately 0.6. A 0.5 steepness value was adopted as the base case value.

5. Enhanced Program for Billfish Research (EPBR)

The SCRS Chair and the Secretariat provided detailed explanation on the decisions taken by the Commission in November 2017 regarding the Enhanced Program for Billfish Research (EPBR) and the science budget for 2018 and 2019. In doing so, the ERPB and its dedicated budget line created in 1986 was ended.

The science budget proposed for 2018 includes new ICCAT funds provided by the Commission (€50,000), and the leftover funds that had been previously committed to EPBR. The funds allocated for 2018, however, were not sufficient to cover all the research requests proposed by the SCRS in September 2017. As a result the ICCAT Secretariat took the initiative to approach a willing CPC for additional funding. This funding was obtained recently from the EU, for strengthening the scientific basis for decision-making in ICCAT. These additional funds have been provided for a specific list of activities that was developed on the basis of the SCRS Sub-Committees and Working Group work plans for 2018.

In order to access these funds in 2018, working groups will have to define specific research activities that require funding. The Secretariat will then liaise with the SCRS Chair and the Species Groups rapporteurs to define terms of reference (TORs) required for developing call for tenders that will subsequently be advertised by ICCAT. In a few, very specific cases, funds can be allocated for activities that had been initiated prior to 2018, without a call for tenders. TORs should contain specific milestones and deliverables to be achieved as part of all funded activity. Contracts issued through call for tenders have the advantage that initial partial payments can be provided shortly after the contract is signed.

Additionally, the Group was informed of other available funding (i.e. Data Fund; Capacity building) that could be used for enhancing the collection of data on billfishes. Since in the past EPBR contained activities aimed at improving the basic fishery data (e.g. catch, effort, sizes) that cannot be funded from the new ICCAT research budget, scientists from developing country CPCs were encouraged to create regional consortia to propose such data improvement projects to the Secretariat. The Group agreed to prepare and submit to the Secretariat before the end of March 2018, proposal(s) requesting financial support for such activities through the ICCAT Data Fund.

The Group stressed the importance of continuing such support activities to improve the quality of data on billfish collected from artisanal fisheries [Rec. 15-05, Paragraph 10] and the difficulty to achieve such goals without a multi-annual program, as these activities have to be carried out over a period exceeding the bi-annual timeframe of the ICCAT science budget. It was also stressed that such support could be aimed at expanding data collection, improving the design of collection activities and recovering data sets, but that the funds could not be considered as a permanent source of support for data collection because that is a responsibility of the CPCs.

For 2018 activities, such project proposals should be aimed at the ICCAT data improvement fund. For 2019 activities, proposals could also be aimed at ICCAT/Japan Capacity-Building Assistance Project (JCAP). The Group agreed to also develop a proposal to the JCAP to support these activities in 2019. Such proposals should be developed prior to the June stock assessment meeting, so that they can be reviewed and submitted to JCAP in preparation for the October 2018 Steering Committee meeting that will evaluate submitted proposals.

The new research funding structure in place for 2018, has designated specific amounts be applied to billfish genetics and age/growth studies during 2018, as well as to the project titled *Comprehensive study of strategic investments related to artisanal fisheries data collection in ICCAT fisheries of the Caribbean/ Central American region* (details provided in SCRS/2018/012).

The genetics study, which was designed to delineate the ranges and catch ratios of white marlin to roundscale spearfish, has had a low return rate of DNA samples. The Group concluded that the best use for 2018 allocated funds would be to purchase additional DNA sampling kits for distribution in order to obtain an adequate sample size. The Group nominated Dr. John Hoolihan (USA) as leader of this research activity.

The original objective for the EPBR age and growth study was to collect anal fin spines from billfish captured in the eastern Atlantic, because no previous billfish aging studies have been conducted in this region. For that purpose, the SCRS Chair and the Species Group rapporteur will develop TORs, including a more comprehensive sampling protocol that includes age and growth as well as other biological parameters.

Under the new research funding system, the Group was urged to form a research consortium to apply to a call for tenders to be circulated by the Secretariat aimed at an age and growth study. The Group agreed that said consortia would be best served if headed by an individual having local knowledge of the fisheries and logistical procedures needed for project success.

The overall budget available for the billfishes Species Group and related decisions taken by the Group are summarized below:

Activity	***Amount (€)***	***Status/action***
Comprehensive study of strategic investments related to artisanal fisheries data collection in ICCAT fisheries of the Caribbean/Central American region	40,000	Contract awarded (Dr. Freddy Arocha) Work ongoing (interim report provided as SCRS/2018/012)
Genetics study for species and stock differentiation	5,000	More genetic kits to be purchased and distributed to national scientists Dr. John Hoolihan (USA) will lead this research activity
Age and growth study	10,000	Draft ToR to launch a Call for tenders
Sampling collection and shipping	10,000	Draft ToR for a Call for tenders aiming the collection of samples for age and growth of billfishes

6. Other matters

The Group discussed and draft the tentative agenda for the blue marlin stock assessment session to be held 18-22 June 2018. The agenda is contained in **Appendix 5** to this report.

7. Recommendations

7.1 To the Commission

Given the need for continued support of the collection of fishery data on billfish catches landed by artisanal fleets, as recognized in [Rec. 15-05], and the termination of the ERPB; recommend that the Commission and CPCs considers supporting the collection of fishery data on billfish when providing funds in support of the SCRS work.

It was recommended that the Commission develops a process which can support funding of research programs for longer than biannual budget limits, as most tuna and other ICCAT research programs require multiannual and multiregional initiatives. The ICCAT Strategic research plan recognizes that such longer term commitment is essential for improving scientific advice.

7.2 To CPCs with catches of billfish

The SCRS recommends that countries that are engaged in fishing on moored FADs should report on their Annual Reports the prevalence of such mode of fishing and whenever possible the evolution of such fishing practice, including the number of moored FADs been used, the gear used around them and the species caught in them.

The ICCAT Secretariat has again started to receive reports of billfish unclassified catches from some CPCs. The Group reminds the CPCs that they should report these catches by species to facilitate the assessments and compliance on billfish recommendations on catch limits [Rec. 15-05]. The Group noted that reports of Task I billfish catches in the Mediterranean and from many sport fishing fleets are not being provided on a regular basis.

Some scientists were partially effective in participating and engaging in the blue marlin data preparatory meeting through remote communication. It is, however, essential that CPCs that have significant catches of billfish send scientists to attend the billfish data preparatory and assessment meetings.

7.3 To the SCRS

The SCRS should investigate billfish catches reported to FAO by non-member countries in ICCAT and not included in ICCAT statistics with a view of improving the ICCAT Task I and Task II databases.

Recommend that the Sub-Committee on Statistics, considers:

a) adding a moored FAD fishing mode to the ICCAT codes;
b) requesting that countries fishing on moored FADs report catch and effort of Task II by specifying a fishing mode: FAD or non-FAD.

Recommend that SCRS scientists engaged in standardization of CPUE of blue marlin consider using data on blue marlin habitat generated from Goodyear (2016) as a covariate in CPUE standardization. Such habitat data is available for 1950-2012 and it is best used in conjunction with data on depth of hooks.

Recommend CPC scientists provide information at the blue marlin stock assessment meeting on relevant management measures adopted in response to [Rec. 15-05].

Recommend support for a more comprehensive biological sampling from artisanal fisheries to facilitate the study of genetics and age and growth of billfish. Also recommend scientists from CPCs with industrial fisheries facilitate obtaining similar samples.

It was noted that some CPUE series that are critical to the stock assessment (e.g. Ghana gillnet, EU longline, Venezuela longline, Venezuela gillnet) were not updated. The Group reminds the SCRS that historical CPUE series used in billfish assessments have to be regularly updated by all relevant CPCs.

8. Adoption of the report and closure

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

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