REPORT OF THE 2017 ICCAT SHORTFIN MAKO DATA PREPARATORY MEETING

(Madrid, Spain 28-31 March 2017)

1. Opening, adoption of Agenda and meeting arrangements

The meeting was held at the ICCAT Secretariat in Madrid, 28-31 March 2017. Dr. Enric Cortes (USA), the Species Group ("the Group") rapporteur and meeting Chairman, opened the meeting and welcomed participants. Dr. Miguel Neves dos Santos (ICCAT Scientific Coordinator) adressed the Group on behalf of the ICCAT Executive Secretary, welcomed the participants and highlighted the importance of the meeting due to the Commissions increasing interest in by-catch issues, particularly those related to shark species. The Chairmen 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 abstarcts of all SCRS documents presented at the meeting are included in **Appendix 4**. The following served as rapporteurs:

Sections	*Rapporteur*
Items 1, 2, 12	P. de Bruyn, C. Palma
Item 3	A. Domingo, P. de Bruyn
Item 4	R. Coelho
Item 5	A. Domingo, D. Rosa
Item 6	Y. Semba, D. Courtney
Item 7, 9	E. Cortes
Item 8	D. Courtney
Item 10, 11	D. Die

2. Review of data held by the Secretariat

2.1 Task I and II catch data

The Task I nominal catch (T1NC) statistics of SMA by stock, flag and gear, are presented in **Table 1**. The Secretariat informed the Group that several updates were made to the historical catch series, namely for:

- EU-Spain LLHB (SCRS/2017/062)
- South Africa (SCRS document to be sent)
- Japan (2014, 2015)
- and some other minor corrections

For the rest of the flags, only the most recent years of official catches were added/updated and duly incorporated into T1NC. The most recent updates significantly increase the amount of information available for the species although there is a lack of official catch statistics prior to 1997 for some of the major CPCs for both shortfin mako stocks (North and South). **Table 2** and **Figures 1a and b** show the comparison between the previously available Task I information and the set revised using the most recent data obtained prior to the meeting. It was also highlighted that as substantial historical revisions have been made to the Task I data, the current Task I catches (new) were considered by the Group to be acceptable for use in the assessment models. As such, the extensive historical calculations (for multiple fleets) carried out for the 2012 assessment (Anon., 2013) based on ratios of shortfin mako to a variety of target species were not made for the current assessment. As a result, the historical catches to be used in the current assessment are lower than those documented in the Report of the 2012 Shortfin Mako Stock Assessment (Anon., 2013).

It was also noted that in the ICCAT databases (since 2015) and reporting forms (from 2018), the code MAK (*Isurus spp*) has been discontinued (everything for this code - ~2% - was reclassified/merged as SMA in the ICCAT DB in 2016).

2.2 Task II effort and size data

The shortfin mako shark datasets of Task II catch and effort (T2CE) and Task II size information (T2SZ) were presented to the Group for the Atlantic North, South and Mediterranean. The data catalogues for this information relative to submitted Task I data are presented in **Tables 3a and b**, respectively. The Group noted that many gaps exist in these datasets and this could be problematic for stock assessment purposes. The Group noted, however, that much observer data regarding size information exist and these data are being compiled by national scientists and are described in section 4 of this report. In addition, the Task II CE data are not often used in shark stock assessments as CPCs usually provide standardised CPUE indices using more comprehensive data than are available in the Task II dataset.

2.3 Tagging data

The shortfin mako shark conventional tagging data available in the ICCAT database are presented in **Table 4**. There is a total of 9,318 SMA individuals released between 1962 and 2015. The total number of individuals recovered is 1,258, which represents on average a recovery ratio of about 13.5%. The apparent movement (straight displacements between release and recovery positions) shown in **Figure 2** (complemented by the release and recovery density maps of **Figure 3**) indicates that the largest amount of the shortfin mako tagging took place in the Western North Atlantic. The Group acknowledged the important work (national scientists and the Secretariat) behind the ICCAT tagging database on sharks, in particular the data recovery process made during the most recent years, and recommended its continuity.

Some additional analysis of the tagging data was conducted by the Secretariat in cooperation with national scientists. The tagging recovery data was filtered to remove entries that did not include information on either the release or recovery positions. The distance between the release and the recovery positions was then calculated and tabulated against a) the length of the released individual (**Table 5**) and b) the days at liberty (**Table 6**) in order to investigate any potential trends in distances covered by size bin or by days at liberty. Although it was noted that most individuals of all sizes were recaptured within 400km of release, it was also noted that that the majority of recaptures occurred within a year of release. At this stage, no firm conclusions can be drawn from this work, but it was agreed that the increased use of tagging data is important and thus the continuation of this work was encouraged. In addition it was noted that work regarding the analysis of the size information (size at release and size at recapture) was also being conducted. This work aims to provide complimentary information to existing growth curves.

3. Alternative catch estimation methodologies

In 2016 the Group noted that a comprehensive estimation of historic catches for blue shark was made in 2015 for stock assessment purposes (Anon., 2016). This data was estimated to provide historic levels of catches for time periods for which official data were not available for fleets which are believed to have significant catches during that time. Initially it was proposed that a similar exercise would be conducted for shortfin mako; however the Group noted that the same methodology may not be appropriate for this species. It was noted that unlike the blue shark, shortfin mako has always had commercial value and thus discards have been less. As such reported catch is likely to be more realistic than that for the blue shark. In addition, there is likely to be better observer data for this species that can be used to make these historical estimations. As such the Group recommended that the Secretariat coordinate with CPC scientists to develop historical estimations of catch using this observer data as well as other potential techniques to provide these estimations for review by the Group during the 2017 Data Preparatory meeting (this meeting). It was further recommended that for those series where no additional information is available, catch ratios will be used to make these estimations as was done for the blue shark in 2015. The following CPCs and time periods were identified as being of highest priority for this exercise:

North Atlantic

- Morocco (before 2011)
- EU-Spain (before 1997)
- Canada (before 1995)

South Atlantic

- EU-Spain (before 1997)
- Namibia (before 2002)
- South Africa (before 2002)
- Chinese Taipei (before 1994)
- Brazil (before 1998)
- China P.R. (before 2000)

As noted in section 2, official historical revisions were received for EU-Spain (North and South) and South Africa. Chinese Taipei (North and South Atlantic Ocean) provided historical estimates (1981-2014) in an SCRS document (SCRS/2017/071) and the Group agreed to use these estimates in the assessment models. These data are not yet considered official and thus will not at this stage be used to update the Task I dataset. Canada and Namibia stated their intention to provide data prior to the assessment. This will need to be done before the deadline determined by the Group for inclusion in the assessment models. As such, catches were calculated for Morocco (North), Brazil and for 3 years of China P.R. (South).

North Atlantic

Morocco - An approach using ratios was considered based on Task I swordfish catches, as shortfin mako shark has traditionally been a by-catch of the swordfish pelagic longline fishery. Shortfin mako shark catches were estimated for the period 1961-2010, based on the ratio of 0.66 SMA to 1 SWO. This figure corresponds to the mean ratio (SMA:SWO) calculated on the basis of the reported shortfin mako shark and swordfish catches for the period 2011-2014 (Task I data). The ratio was calculated for each year and then the un-weighted mean ratio across all years was calculated.

The final catches to be made available for the assessment are provided in **Table 7** for the North Atlantic.

South Atlantic

Brazil - The same approach was used for Brazil as for Morocco. A ratio of 0.06 SMA to 1 SWO was used to calculate catches for the period 1971-1998. The ratio was based on the mean ratio (SMA:SWO) of the reported Task I catch for the period 1999-2015.

China PR - In the case of China PR, there are official data submissions from 1993-2015, but missing years in 2004-2006. The Group was not convinced that the ratio of SMA:SWO was appropriate in this instance, while the ratio of SMA:TUN (main tuna species) was very high in the available data. As such an estimation was made for 2004-2006 using the Task II CE data as well as the Effdis dataset maintained by the Secretariat. Task II CE for 2007-2015 was used to calculate an average CPUE for this time period (by dividing the total reported SMA catches by the total reported hooks for the entire period). This CPUE was then multiplied by the Effdis estimated for the years 2004-2006 to obtain annual catches for these years.

The final catches to be made available for the assessment are provided in **Table 8** for the South Atlantic.

The Group specified that any additional catch data or revisions to the data provided in **Tables 7 and 8** that CPCs may wish to see incorporated in the assessment, must be submitted by the end of April 2017, or it will not be included in the assessment input files.

Other estimations

Document SCRS/2017/062 presented estimations of landings of shortfin mako by the Spanish surface longline fleet targeting swordfish in Atlantic for the period 1950-2015 combining different sources of information. The Group welcomed the substantial additional information provided by this study and thanked the authors for this work. The Group agreed to officially adopt the estimations provided in the document and include them in the official Task I database.

During the 2013 Intersessional Meeting of the Sharks Species Group meeting (Anon., 2014), the EU presented the outputs of a research project which estimated shark catches in the Atlantic for the period 2000-2010 (Murua *et al*., 2013). These potential shark catches by major fleets and countries were estimated based on the ratio of shark catch/by-catch over target species catch estimated through observers, literature, or personal communications. A detailed explanation of the method is available in section 5 of the Report of the 2014 Intersessional Meeting of the Shark Species Group (Anon., 2015). At the 2014 meeting, the sharks Working Group requested EU scientists to try to improve the methodology, namely by applying this method to each year in order to have the time series of the catch.

A new EU project (EASME/EMFF/2016/008 - SC01) has recently started and one of the tasks is in part to address this issue. The method is still being refined, but a preliminary shortfin mako time series for the ICCAT area (all Atlantic) was presented. The authors are now trying to split the whole Atlantic Ocean into the North and South Atlantic stock areas. The series is particularly different in the first years, and that will have an influence in the model assumptions about catch for the years before the model starting year. The Group agreed that this series could be useful as a sensitivity run in the 2017 Shortfin mako Stock Assessment.

4. Analysis of length composition data by sex and region to aid in the definition of fleets and specification of selectivities

SCRS/2017/048 revised size data distributions and trends for shortfin mako in the Atlantic using observer data. This work was done as part of an ongoing cooperative program for fisheries and biological data collection for sharks, and currently includes information from Brazil, EU-Portugal, Japan, Uruguay, USA, Venezuela and Chinese Taipei. Currently, a total of 36,903 shortfin mako records collected between 1992 and 2015 were compiled, with the sizes ranging from 30 to 366 cm FL (fork length). Considerable variability was observed in the size distribution by region and season, with larger sizes tending to occur in equatorial and tropical regions and smaller sizes in higher latitudes. Most fleets showed unimodal distributions, but in some cases there were possible bimodal patterns that may need to be addressed for stock assessment. The distributional patterns presented in this study provide a better understanding of different aspects of the shortfin mako distribution in the Atlantic, and can be considered for use in the stock assessment (**Figure 4**).

The examination of the currently available shortfin mako length data by fleet revealed some bimodal patterns for some cases, but not the same strong bimodal distributions for some fleets that were apparent for North Atlantic blue shark. Consequently, the need to split data into sub-fleets based on this data might not be needed for this species. Still, this is an issue that needs to be further explored as the SS model is prepared, and also as more data from the other main fleets becomes available. In general, if needed, splitting the data into sub-regions/fleets to have relatively more unimodal size distributions is possible, but other needed inputs as the associated catch data from those sub-regions/fleets could be problematic. In the future, national scientists from each CPC may need to revise the catch data in order to calculate the respective catch in each of those sub-regions/fleets.

Specifically for the US data, a slight bimodal length distribution is observed in the North Atlantic, likely due to more inshore vs offshore fishing locations. It was discussed if this data could be disaggregated into those sub-regions so that the data becomes more unimodal shaped. It was noted that although the length frequencies could be stratified/disaggregated in this way, it would not be possible to obtain the corresponding catches specific to those locations. It was also noted that the observed bimodality might not be as problematic as for blue shark where there was a strong bimodality in the length frequency data.

For the Japanese fleet the question of whether there was a latitudinal difference in the length frequency was raised, likely due to the different fleets targeting bluefin tuna in northern latitudes and the fleet targeting tropical tunas in tropical and equatorial waters. However, this difference was not observed clearly for the aggregate years. Thus, it was decided to treat the Japanese data as one fleet.

It was also noted that the information presented is important and can contribute to the ICCAT statistical areas revisions that are currently being carried out by the SCRS species groups. Those areas will probably move from statistical areas that are defined for major groups to a species by species approach with statistical areas having more biological meaning. However, a general approach for identifying statistical areas by species for sharks, e.g, based on geographic areas with similar size composition data, has not been identified.

Finally, it was noted that size composition data from some of the main fleets are still missing and should be included. The priority fleets to contribute with size composition data are:

- *North Atlantic*

  - EU-Spain: Main fleet landing shortfin mako in the North Atlantic. National scientists are checking if size composition data are available; some data may be available from the ICCAT database directly (2013-2015).
  - Morocco: Recent shortfin mako landings from Morocco have been increasing, so it would be important to have the size composition data.
  - Canada: Submits detailed size composition data to ICCAT so it might be possible to use the ICCAT database directly.
  - USA: In addition to the available observer data, submits weight composition data (headed and gutted port sample weight) to ICCAT so it might be possible to use the ICCAT database directly.

- *South Atlantic*

  - South Africa: National scientists were contacted during the meeting and should be able to provide size composition data.
  - Namibia: National scientists were contacted during the meeting. The Group is awaiting confirmation of data available.

The available length frequencies are provided in **Figure 5**.

In terms of deadlines for the continuation of this work the following was agreed:

- To be included in the final analysis (as with the catch data) the remaining size data should be sent by the end of April.

5. Review of life history information

SCRS/2017/058 presented information on male size-at-maturity and a length-HG (eviscerated weight) relationship for both sexes combined. Male size-at-maturity based on maturity ogives and clasper-fork length relationships yielded consistent results, with a median size at maturity (LMat50%) of 166 cm FL and a full size at maturity (LMat100%) of 180 cm FL. Median size at maturity estimates were smaller than those reported for the North Atlantic, as has also been reported to be the case for females.

The method of fitting a segmented linear regression to the CLI-FL relationship does not provide an *L*50% estimate but rather identifies different maturity transition points between maturity stages (Segura *et al.* 2013). Assuming a three-stage maturity form (i.e. two transition points) this method can identify the size range at the onset of maturity (after the first transition point) and the average size at which all individuals in the population are mature (after the second transition point).

It was noted that the presented eviscerated weight (HG) to fork length relationship is of great use, as this relationship was not available for the southeast Atlantic and it had been recommended in the 2016 Intersessional Meeting of the Sharks Species Group as mentioned in Anon. (in press) for countries to provide these relationships.

Document SCRS/2017/051 presented an update on the SRDCP study on age and growth of shortfin mako in the Atlantic. Preliminary growth models were presented for the North Atlantic. It was suggested that fitting a model to the 3 readers band pair count jointly, could be an alternative to fitting to an agreed age (when at least 2 out of the 3 readers agreed) which represented only 73% of the sample (the remaining sample was discarded). This method would allow the introduction of process error into the growth model.

Additionally, an integrated growth analysis using both tag-recapture data and age readings was discussed. For this analysis the ICCAT conventional tag data would be used. This data, which is derived from several sources, is being investigated to determine the observed growth from direct observations. It was agreed that the full dataset should be used, as even very high growth rates could be real, as observed in other species, and the negative growth will introduce observation error, avoiding bias in the estimations.

An updated table was presented to the Group containing life history parameters for shortfin mako (SMA) in the Atlantic Ocean. The Group discussed and agreed on the parameters to be used for the next assessment. Note that the *a* and *b* parameters of the recommended female maturity ogive for females in the North Atlantic were not reported in the original paper (Mollet *et al.* 2000) and so the authors will be contacted for elucidation (**Table 9**).

6. Review of indices of abundance, including identification of conflicting time series for potential grouping

SCRS/2017/049 provided standardized CPUEs for the shortfin mako shark in the North Atlantic (>5˚ N) captured by the Portuguese pelagic longline fishery during the years 1995-2015. The analysis was based on data collected from fishery observers, port sampling and skippers logbooks (self sampling). CPUEs were modeled with Tweedie and Delta GLM approaches for the CPUE standardization procedure. In general, there was a large variability in the nominal CPUE trends for the North Atlantic with the standardized series flatter than the nominal. For the size distribution there were no major trends in the time series, but the sizes tended to be larger in the South Atlantic and showed larger variability. The data presented in this working document can be considered for use in the upcoming 2017 shortfin mako stock assessment in the Atlantic Ocean, specifically the standardized CPUE for the North Atlantic and the size distribution for both hemispheres.

Diagnostic plots for Tweedie and Delta models were discussed and the rationale for using these distributions was explained citing the high ratio of zero catch in the logbook data.

The spike in 2007 from the nominal CPUE was noted and it was suggested that this spike was only apparent for shortfin mako and not other species. It was questioned whether this spike was recorded for a specific vessel or several vessels and it was noted that this data was recoded for a specific area.

SCRS/2017/054 revised previous estimates of standardized CPUE for shortfin mako caught by the Japanese tuna longline fishery in the Atlantic Ocean (Semba and Yokawa 2016) with consideration for the temporal changes in the operational pattern for the Japanese fleet in the North Atlantic between 1994 and 2015. Investigation of the spatiotemporal distribution of fishing effort suggested that displacement of fishing effort for Atlantic bluefin tuna (*Thunnus thynnus*), especially in the area north of 20˚ N, caused an unrealistic decline in CPUE for the North Atlantic shortfin mako in the past five years in the previous analysis.

Based on the investigation of numbers of sets and nominal CPUE of shortfin mako, the area stratification was revised and explanatory variables included in the GLM analysis were modified. Following the data filtering described in Semba *et al.* (2012), CPUE of North Atlantic shortfin mako was standardized using a zero inflated negative binomial model. The revised abundance index showed a declining trend in the earliest few years and stable trend around 0.1 (fish/1000 hooks) between 1995 and 2005, followed by high fluctuations between 2005 and 2013. Although uncertainty remains in the estimates for several years, the current analysis has reduced the uncertainty apparent since the late 2000s in the past analysis and suggests that the annual trend of the abundance index does not show a continuous increasing/decreasing trend between 1994 and 2015.

The ratio of 0 catch was questioned, which was 46% in logbook data before filtering. The method of estimating fleet-specific catch was discussed and one possible approach was the application of effort data in 5 by 5 grid which is available from the ICCAT database. Based on a discussion of the spatial pattern of operation and nominal CPUE of shortfin mako, the definition of fleets was discussed.

It was noted that based on a discussion of observed differences (SCRS/2017/054, Appendix 1, lower left panel) in the number of sets by gear type within area, that it may be important to treat the Japanese CPUE in the North Atlantic as two separate fleets: one fleet in area-1, and a second fleet in area-2 and area-3 combined.

Although the operation pattern is likely to differ depending on areas in Japanese fisheries, a spatial investigation of size frequency does not support differentiation into several fleets, as discussed in section 4, where it was reiterated that the Japanese fleet be treated as one fleet in the Stock Synthesis analysis. The size frequency is identified in the the working document Appendix 2.

It was noted that the filtering method was designed to reduce over and under estimation from the CPUE standardization, and that the filtering method is described in detail in previous SCRS documents cited in the report.

SCRS/2017/056 revised two stock status indicators for mako sharks (*Isurus* spp.) encountered by the US pelagic longline fleet. First, standardized indices of relative abundance were developed from data in the US pelagic longline logbook program (1986-2015) and the US pelagic longline observer program (1992-2015). Indices were calculated using a two-step delta-lognormal approach that treats the proportion of positive sets and the CPUE of positive catches separately. Observations that were affected by fishing regulations (time-area closures or bait restrictions) were subsequently excluded in a restricted analysis. The logbook time series showed a concave shape from the beginning of the series in the mid-1980s to 2009-2010, followed by a downward trend thereafter. The observer time series also showed a concave shape from the beginning of the series in the early 1990s to 2011, followed by a declining trend thereafter. Overall, the logbook index did not show a substantial change in relative abundance since the late 1990s and the observer index showed a generally increasing tendency since the mid-1990s. The lack of strong trends in all series suggests that the status of the stock is stable, yet the declining trend since 2009-2011 should continue to be closely monitored. No discernible trends in size were detected, suggesting that no specific segment of the population is being disproportionately affected.

A question was raised about the distribution of pregnant females and it was indicated that there is little information on this even from the analysis based on size data from the main CPCs. The question was raised about the very small sample size in the logbook data in 1986. It was suggested that the reason was uncertain but it may partly result from this year being the first year for the data collection scheme for logbook data of US longline fishery. An additional question was raised about the decline indicated in 1986 in the restricted analysis, which was not observed in the full analysis. Time area closures were not the cause because they were implemented later in the time series. The trend after 1986 was quite similar among estimates and thus the effect of that year was suggested to be small; nevertheless the standardized CPUE for the full analysis was recommended for use in the assessment.

SCRS/2017/057 provided preliminary results from an analysis of environmental conditions on CPUE of shortfin mako from the US pelagic longline observer program (1992-2016). CPUE was calculated using a generalized linear mixed model (GLMM) with a delta-lognormal approach. The GLMM analysis included consideration of the following environmental variables as predictor variables: sea surface height, sea surface temperature, and bathymetry. The addition of environmental predictor variables resulted in an index that spans 2003-2012. The final index was used to predict average CPUE based on environmental conditions. The two portions of the delta-lognormal approach retained different suites of variables with sea surface temperature and bathymetry retained to predict proportion of positive sets while bathymetry was retained to predict the CPUE of positive catches. Quantile regression was also performed to evaluate whether environmental variables can predict spatial areas with high CPUE. As with the delta approach, environmental data were used to predict conditions that favor high CPUE. Maps generated from both the approaches will later be used for determining mako shark habitat for a spatial management strategy evaluation.

The Group discussed the detail of environmental data and its resolution. It was clarified that the data were downloaded from satellite databases and the resolution for SST and SSH was weekly and daily, respectively. The degree which the model explained the data was questioned. It was noted that GLMM suggested that environmental variables explained < 3 % deviance and that for gear effect explained a bit more. It was noted that diagnostic methods for the quantile regression as well as final model selection methods were still under development and that there was an increasing residual pattern of the GLMM relative to the predicted values

It was also noted that gear was selected for inclusion in the GLMM but not in the quantile regression, and that this is consistent with the idea that gear type would be relatively more important in lower CPUE areas. The mechanism in which SSH affects the distribution was suggested to be related to the front.

SCRS/2017/058 summarized preliminary results of a Uruguayan analysis comparing shortfin mako CPUE and mean shortfin mako size between longline fishing vessels with different gear configurations, namely: deep vs. shallow sets, and fishing sets using reinforced stainless steel branch lines vs. simple monofilament branch lines.

All data analyzed was gathered by the Uruguayan National Observer Program and onboard the R/V Aldebarán form DINARA. Comparisons of CPUE and mean fork length between deep and shallow fishing sets was assessed by analyzing Japanese and Uruguayan longline fishing vessels operating within the Uruguayan Exclusive Economic Zone. Within the Uruguayan longline fleet, the use of reinforced branch lines in some vessels and the use of simple nylon monofilament branch lines in others also allowed the comparison of both CPUE and mean fork length of captures between these different configurations of shallow longline fishing sets.

Results suggests that shortfin mako CPUE is considerably lower in deep fishing sets compared to shallow fishing sets, whereas both types of shallow fishing sets render similar CPUE values. Mean fork length of sharks caught was higher in shallow fishing sets using reinforced branch lines, but was not significantly different between shallow simple branch line sets and deep sets. Although these results should be considered preliminary and further analysis are needed, this document highlights the potential effects of deep vs. shallow longline sets, as well as different branch line configurations, over the catchability and selectivity of the shortfin mako. It is suggested that these aspects should be taken into consideration when standardizing CPUE time series and in the assessment models as they could potentially bias the results if not considered.

Based on catch data from the Uruguayan longline fleet using reinforced branch lines, smaller size classes of the shortfin mako seem to occur at intermediate latitudes

The Group noted that selecting datasets where there is overlap for a particular factor is effective because more information is available than when using the whole data set. The Working Group noted that the shallow and deep sets should be treated as different fleets because the catchability is different.

SCRS/2017/059 provided standardized CPUEs for the shortfin mako shark in the Southwestern Atlantic caught by the Uruguayan longline fleet using information from national onboard observed program between 2001 and 2012. Because of the large proportion of zeros catches (23%) the CPUE (catch per unit of effort in nunmbers of individuals) was standardized by Generalized Linear Mixed Models (GLMMs) using a Delta Lognormal approach. The independent variables included in the models as main factors and first-order interactions in some cases were: Year, Quarter, Area, Sea Surface Temperature and Gear. A total of 1,706 sets were analyzed. Standardized CPUE showed an apparent increasing trend during the last six years of the study period.

The Group discussed that observer coverage in the Uruguayan fleet is 52-60% and much higher compared to other countries. It was also noted that the trend of the standardized CPUE was quite similar to that of the Brazilian CPUE. Regarding the difference between observer and logbook data, the difference in Uruguay is much smaller than that in USA where observer coverage is lower. The reason for criteria of cutting data with SST <15°C was questioned and it was noted that it is based on swordfish operation strategy rather than biological reasons.

SCRS/2017/061 provided a summary of shark catches from two Mauritanian long line vessels fished during 2016 (latitude ~19-20, mean 500 m depth). Results were presented in number by species. 99% of catches consisted of sharks. Mean length of shortfin mako was 2 m (compliments other data sets).

It was discussed that the species identification was at the group level for some species (e.g., thresher) and this was identified as an area of concern for prohibited species. It was noted that sharks were landed head off, which could also make it hard to identify to species as well as convert to original length.

SCRS/2017/071 provided estimates of standardized CPUE for shortfin mako based on catch and effort data from observers' records of Taiwanese large longline fishing vessels operating in the Atlantic Ocean from 2007-2015. Based on the shark by-catch rate, four areas, namely, I (north of 20ºN), II (5ºN-20ºN), III (5ºN-15ºS), and IV (south of 15ºS), were categorized. To cope with the large percentage of zero shark catch, the catch per unit effort (CPUE) of shortfin mako shark, as the number of fish caught per 1,000 hooks, was standardized using a two-step delta-lognormal approach that treats the proportion of positive sets and the CPUE of positive catches separately. Standardized indices with 95% bootstrapping confidence intervals were reported separately for the North and South Atlantic (separated at 5ºN). The standardized CPUE of shortfin mako sharks in the South Atlantic was relatively stable from 2007-2013 but peaked in 2014 and decreased in 2015. The standardized CPUE in the North Atlantic peaked in 2009, decreased in 2010 and fluctuated thereafter. The shortfin mako shark by-catch in weight of the Chinese Taipei large-scale longline fishery, updated as described in this document, ranged from 2 tons (1989) to 89 tons (2009) in the North Atlantic Ocean and ranged from 29 tons (1989) to 280 tons (2011) in the South Atlantic Ocean.

The definition of North Atlantic was questioned and the Group accepted that Area I and Area II in the present study were regarded as North Atlantic. It was noted that the ratio of zero catch in this data was very high compared to other fleets. The method of estimation for catch for the period between 2007 and 2015 and before 2007 (no observer data was available) was checked and the Working Group agreed that their method for estimation was sound.

The CPUE indices available for use are shown in **Figure 6** and **Table 10** (North Atlantic) and **Table 11** (South Atlantic). For the North Atlantic, the Group recommended using the US (logbook), EU-Portugal, Japan, and Chinese Taipei CPUE indices. The EU-Spain CPUE index was requested and it is hoped it will be made available by the data deadline to be included in the assessment; the US observer index was recommended for a sensitivity analysis if appropriate. For the South Atlantic, the Group recommended using the Brazil, Japan, Chinese Taipei and both Uruguayan indices (logbook and observer). In the case of Uruguay, the observer series covers an additional two years (2011 and 2012) not covered by the logbook series. An index from Spain for the South Atlantic is also expected to be made available in time for inclusion in the assessment.

Hierarchical cluster analysis and cross-correlation of selected CPUE indices

A hierarchical cluster analysis and cross-correlation of selected CPUE indices for shortfin mako in the North and South Atlantic was conducted by the ICCAT Secretariat during the Shortfin Mako Data Preparatory meeting.

It is not uncommon for CPUE indices to contain conflicting information. However, when CPUE indices are conflicting, including them in a single assessment (either explicitly or after combining them into a single index) tends to result in parameter estimates intermediate to what would be obtained from the data sets individually. Schnute and Hilborn (1993) showed the most likely parameter values are usually not intermediate but occur at one of the apparent extremes. Including conflicting indices in a stock assessment scenario may also result in residuals not being identically and independently distributed (IID) and so procedures such as the bootstrap cannot be used to estimate parameter uncertainty. Consequently, when CPUEs with conflicting information are identified, an alternative is to assume that indices reflect hypotheses about states of nature and to run scenarios for single or sets of indices that represent a common hypothesis.

CPUE indices were evaluated for conflicting information separately for the North and South Atlantic. The agreed CPUE indices in the North and South Atlantic were evaluated for consistency with the average trend by area from a lowess smoother (fitted to year for each area with series as a factor-separately for North and South Atlantic). Time series of residuals from the lowess fit to agreed indices were evaluated separately for the North and South Atlantic. Pairwise scatter plots for agreed indices were evaluated separately the North and South Atlantic to identify correlations and high leverage points among indices. A hierarchical cluster analysis (Murtagh and Legendre, 2014) was used to group the agreed indices based on their correlations separately for the North and South Atlantic. Cross-correlations between agreed indices were evaluated to identify lagged correlations (e.g., due to year-class effects).

Results are provided in **Appendix 5**. There was generally strong agreement among selected indices in both the North and South Atlantic.

7. Other data relevant for stock assessment and remaining issues in preparation for the June stock assessment meeting

Two background documents (Vaudo *et al.* 2016 and Vaudo *et al.* 2017) were briefly presented. Vaudo *et al.* (2016) presents information on the vertical distribution of shortfin makos obtained by tagging eight individuals with pop-up satellite archival tags off the northeastern United States and the Yucatan Peninsula, Mexico. Depth and temperature records across 587 days showed vertical movements strongly associated with ocean temperature. The sharks showed diel diving behavior, with deeper dives occurring primarily during the daytime (maximum depth: 866 m). Overall, sharks experienced temperatures between 5.2 and 31.1°C. When the opportunity was available, sharks spent considerable time in waters ranging from 22 to 27°C, indicating underestimation of the previously reported upper limit of the mako sharks' preferred temperature.

Vaudo *et al.* (2017) was a study on long-term satellite tracking that revealed region-specific movements of shortfin mako in the western North Atlantic Ocean. Among other results, the study found that sharks moved across the jurisdictional management boundaries of 17 nations and the proportion of tracked sharks harvested (22%) was twice that obtained from previous fisheries-dependent, conventional tagging studies.

It was subsequently brought to the attention of the Group that a study that had just been submitted for publication that augmented the sample size from Vaudo *et al.* (2017) had found that the proportion of harvested sharks was *ca*. 30%. In discussions about this new paper (Byrne *et al.* in review), it was asked whether the sharks harvested by fishermen had been caught near the tagging locations and shortly after being tagged. After asking clarification from the senior author, it was clarified that the 12 animals caught by fishers had been at liberty an average of *ca.* 5 months and only 4 of the 12 animals had been fished in areas near the original tagging locations (three off the Yucatan Peninsula in Mexico and one off Cape Hatteras in the USA). The significance of this paper is that the fishing mortality rate found is almost an order of magnitude larger than found in the 2012 Shortfin Mako Stock Assessment (Anon., 2013). The limitations of the study, e.g. that it was not designed to estimate mortality, covered only an area in the western North Atlantic and may not be representative of the whole stock, were noted, but nevertheless the study was considered interesting enough for the Group to discuss that it could be worthwhile to investigate through modeling the implications on stock status of considering such large fishing mortality rate once the paper is published.

8. Discussion on models to be used during the assessment and their assumptions

8.1 Production models

Document SCRS/2017/055 presented results on the application of the Bayesian Surplus Production (BSP) software, which uses the Sampling-Importance-Resampling (SIR) method to integrate posterior distributions, to the shortfin mako data used in the 2012 assessment. The paper noted that the 2014 blue shark assessment (Anon., 2015) used both the BSP software and the Markov Chain Monte Carlo (MCMC) algorithm, implemented in the JAGS software, and found that the JAGS and BSP model results were not always consistent. In this document, both the BSP1 software (without process error) and the BSP2 software (with process error), and two independent MCMC software packages, JAGS and Stan, were applied to the data from the 2012 mako shark assessment (Anon., 2013) to determine whether the same problem existed. Although all modeling packages gave similar results for other species, they are not consistent for mako sharks. This may be because there is a long period of catches with no CPUE data, or because the catch and CPUE data are not consistent with each other.

It was noted that the issue will be further addressed intersessionally with the data derived at this meeting that extend to 2015.

Bayesian production models specify priors, among other things, for r_{max}, the intrinsic or maximum rate of population increase, which will be computed based on the life history parameters derived at this meeting, and further require a single catch series and indices of relative abundance, which will derived at this meeting. For the North Atlantic, production models using the SIR algorithm with and without process error and MCMC algorithms incorporating process error will be used. For the South Atlantic, it is envisaged that production models incorporating process error will be used.

Vectors of natural mortality, M, and estimates of productivity and steepness will be developed intersessionally, presented in a document, and made available to the stock assessment analysts for inclusion in the models. It was discussed that M will be calculated based on a suite of life history invariant methods, and it was noted that r_{max} is obtained by definition after the stock has been fully exploited and exploitation has ceased and the stock is at low population levels growing under ideal conditions.

8.2 Stock Synthesis

Stock Synthesis will be implemented for the North Atlantic stock (as a length-based age-structured statistical model; Methot and Wetzel 2013; Methot 2013). Stock Synthesis is an integrated modeling approach (Maunder and Punt, 2013) and was proposed to take advantage of the length composition data sources available for the North Atlantic stock. An advantage of the integrated modeling approach is that the development of statistical methods that combine several sources of information into a single analysis allows for consistency in assumptions and permits the uncertainty associated with multiple data sources to be propagated to final model outputs (Maunder and Punt, 2013). A disadvantage of the integrated modeling approach is the increased model complexity. Because of the model complexity, its application will be limited to the North Atlantic stock, and will follow closely upon that previously developed by the Group for blue sharks in the North Atlantic.

It was discussed that information needed for the model includes time series of catch, abundance, and length composition data starting in 1971 (based on available time series of reliable catch history), with separate sex (based on observed differences in growth among sexes). Catch in metric tons will be grouped into separate fleets with similar gear characteristics and size frequency. If a fishery is known to have occurred before 1971 and catch is available (Spain, Morocco) then the average catch during the period prior to 1971 will be input as the equilibrium catch prior to 1971 in Stock Synthesis. If a fishery is known to have occurred before 1971 and catch is not available (Japan) then the average catch during the first 10 years (1971-1980) will be input as the equilibrium catch prior to 1971 in Stock Synthesis, as done in the previous blue shark assessment.

The indices of abundance to be used in SS3 are detailed in Section 6. Catches and length compositions were assigned to fleets in the model based on similar observed size frequency.

It was discussed that, as done in the previous blue shark assessment, life history data will be utilized based on recommendations provided by the Group at the Data Preparatory meeting. A table of recommended life history values can be found in Section 5.

8.2.1 Sensitivity Analysis Proposals for SS3

Several sensitivity analyses were proposed during the course of the Data Preparatory meeting and are summarized here:

Catch

It was discussed that an alternative catch stream based on estimates developed under an EU project could be appropriate for a sensitivity analysis (see Section 3) to reflect a high catch scenario.

CPUE

It was noted that it might be appropriate to consider splitting CPUEs of some fleets based on gear characteristics. If this were done and if new CPUEs were produced by 30 April, then the CPUEs could be included as sensitivities.

Compositional data

Additional size composition data may be available from the ICCAT Task II sz database.

Growth and stock productivity

It was noted that alternative growth models from the SRDCP may be available before 30 April, which include the results of vertebral ageing and tagging data.

It was noted that these alternative growth models could be included as sensitivities, but that it would be important to insure the stock productivity and other associated derived parameters – e.g. natural mortality, are consistent with the alternative growth parameters.

Other sensitivity runs proposed include: weighting method for the CVs of CPUEs, weighting method for sample size of length compositions, and several combinations of parameters in the low fecundity stock recruitment function in SS3, and recruitment deviations. Sometime after 30 April, assessment analysts will plan to send the very preliminary SS model to the Group as soon as available so that the assessment model development work can be conducted collaboratively to develop a reasonable base model and a reasonable range of sensitivity analyses before presenting the model and sensitivity analyses to the Group at the June meeting.

The assessment sensitivity runs should try to incorporate a narrow range for parameter sensitivities developed collaboratively with the Group based on reasonable parameters from a scientific viewpoint and not grid all possible parameter values because this could lead to unreasonable parameter value combinations.

9. Shark Research and Data Collection Plan (SRDCP)

The ICCAT Shark Research and Data Collection Program (SRDCP) aims to develop and coordinate science and science-related activities needed to support provision of sound scientific advice for the conservation and management of pelagic sharks in the Atlantic. This Program was developed in 2013-2014 by the Sharks Species Group, and framed within the 2015-2020 SCRS Strategic Plan. Within this Program, specific studies have been developed for 1) age and growth, 2) satellite tagging for habitat use, 3) satellite tagging for post-release survival, 4) population genetics and 5) isotope analysis.

Updates on the execution state of those projects were discussed and presented in some preliminary SCRS documents. Plans for the future of SRDCP were also discussed.

Age and growth

Document SCRS/2017/051 presented an update on the SRDCP study on age and growth of shortfin mako in the Atlantic. There are currently 721 sampled sharks (384 males, 332 females, five specimens with undetermined sex) collected and processed from both the Northern (379 samples) and Southern (342 samples) hemispheres. The size range of the samples varies from 52-366 cm FL in the North and 81-330 cm FL in the South. A workshop was carried out at the Northeast Fisheries Science Center (Narragansett Laboratory, NOAA Fisheries, USA) on 2-3 June 2016 to prepare a reference set of vertebrae that is being used as a guideline for the age readings. Preliminary growth models for the North Atlantic were presented. This project is ongoing and final results for the North Atlantic will be submitted in the intersessional period before the stock assessment meeting, in order to contribute to the 2017 shortfin mako stock assessment.

The Group discussed issues related with age validation and band deposition periodicity. The method being used is following Natanson work on age validation with tetracycline and bomb-radiocarbon. The Group also discussed the possibility to have a growth model incorporating tag-recapture data, following recommendations from the Group. Several hypotheses on the filtering method for the tag-recapture data can be considered. More details on the discussion of the paper are presented in section 5 (life history) of this report.

Tagging studies

Document SCRS/2017/050 presented an update of the shortfin mako tagging projects within SRDCP for both habitat use and post-release mortality. Currently, all phase 1 (2015-2016) tags (23 tags: 9 miniPATs and 14 sPAT) have been deployed by observers on Portuguese, Uruguayan and US vessels in the temperate NE, temperate NW and SW Atlantic. A total of 668 tracking days have been recorded so far. In terms of post-release survivorship, data from 19 tags/specimens has been used. From those, six specimens died (31.6%) while the remaining 13 (68.4%) survived, at least the first 30 days after tagging. All planned project milestones and deliverables have been achieved and delivered in due time, including additional deliverables that were not originally planned. For the second phase of the project (2016-2017) 12 miniPATS were acquired and will be deployed during 2017 in various regions of the Atlantic, including temperate, tropical and equatorial waters.

The Group commented that the post-release mortality estimates are very useful, especially when considering possible mitigation measures. The post-release survival estimates will also be useful for future Ecological Risk Assessments. The Group also commented that the current evidence from tagging is consistent with other information from conventional tagging, genetics and life history.

The Group suggested that the tagging data can in the future be used for building habitat models, especially as more funds are made available to continue this work and more information is compiled. While this can be possible, it is also important to note that the funds that have been available for this work are very limited and as such the number of tags used is also limited. One important point to note is that the participants in the SRDCP have committed and are contributing with data from other projects and as such there is now also information from additional projects that can be used.

Genetics

Current results on the genetic study (Taguchi *et al.* in press) were introduced. Mitochondrial analyses indicated that the Atlantic shortfin mako was significantly differentiated at least among the northern, southwestern, and southcentral and southeastern areas, while the microsatellite analyses did not show any genetic structuring of the Atlantic shortfin mako. Ongoing project is under processing which aims to investigate the population structure in the North Atlantic in finer scale based on the specimens collected from waters off Florida, the Mediterranean, and tropical Atlantic Ocean.

The preliminary results seem to indicate that there may be 3 stocks of shortfin mako in the Atlantic (N, SW and SE). The stock boundary areas are still uncertain, but with the new samples from the Caribbean, Gulf of Mexico and Mediterranean this will be further refined.

The porbeagle genetics study was briefly discussed, preliminary results seem to indicate that the North Atlantic porbeagle is a separate stock, but for the South Oceans (Atlantic, Indian and Pacific) the separations are not clear.

Plan for the 2017 funds

For 2017 the SRDCP had its funds reduced. The revised table with the new funds allocated for 2017 is shown below:

Project	*Participating CPCs*	*Project leader*	*Initial Budget (€) 2017*	*New Proposal (€) 2017*
Shortfin Mako				
Stock boundaries (Genetics)	Japan, EU, Uruguay, US, etc.	Yokawa	15,000	15,000
Fatty acids/Isotopes (Trophic relations)	Uruguay, EU, Japan, US, etc.	Domingo	15,000	15,000
Movements, habitat use, and post-release mortallity (PSATs)	EU, Uruguay, US, etc.	Coelho	40,000	
Life history (Reproduction)	US, Uruguay, Japan, EU, etc.	Cortés	5,000	5,000
Porbeagle				
Life history (Reproduction)	US, Uruguay, Japan, EU, etc.	Cortés	15,000	5,000
Movements and habitat use (PSATs)	Uruguay, EU, US, etc.	Domingo	45,000	60,000
Total			**150,000**	**100,000**

Plan for the next funding cycle (2018-2019)

As agreed before in the 2016 Sharks Working Group meeting (Anon., in press) the priorities for the new funding should prioritize the following:

1. Porbeagle: The next species to be assessed will be porbeagle in 2019. ICCAT Recommendation 15-06 on porbeagle caught in association with ICCAT fisheries supports this in saying that: "Paragraph 4: *CPCs are encouraged to implement the research recommendations of the joint 2009 ICCAT-ICES inter-sessional meeting. In particular, CPCs are encouraged to implement research and monitoring projects at regional (stock) level, in the Convention area, in order to close gaps on key biological data for porbeagle and identify areas of high abundance of important life-history stages (e.g. mating, pupping and nursery grounds). SCRS should continue joint work with ICES Working Group on Elasmobranch Fishes*". The Group therefore agreed that part of the next funds should be allocated to POR with high priority.

2. Shortfin mako: The two phases of the SRDCP were devoted to shortfin mako shark, as the species to be assessed in 2017. While considerable work has been produced, there are still uncertainties on some important biological parameters and it is important to continue the work that has been started on this species. Additionally, ICCAT Recommendation 14-06 on shortfin mako caught in association with ICCAT fisheries supports this in saying that: "Paragraph 3: *CPCs are encouraged to undertake research that would provide information on key biological/ecological parameters, life-history and behavioural traits, as well as on the identification of potential mating, pupping and nursery grounds of shortfin mako sharks. Such information shall be made available to the SCRS*". As such, the Group recommends that it is important to continue the shortfin mako shark work and allocate part of the new funds for this species to continue this work.

3. Other shark species: Even though the main ICCAT shark species are blue shark, shortfin mako and porbeagle, the Sharks Working Group is also responsible for providing scientific advice on other pelagic, oceanic and highly migratory shark species that are caught in association with ICCAT fisheries. Most of those other species are data-limited species, and as such it is a priority to start biological projects and data collection on those species, in order to provide better advice in the future. Several ICCAT Recommendations also support and ask

that research should be implemented on those other shark species, specifically in the cases of the Recommendations for hammerheads and threshers: ICCAT Recommendation 10-08 on hammerhead sharks caught in association with ICCAT fisheries: Para 5: "*CPCs shall, where possible, implement research on hammerhead sharks in the Convention area in order to identify potential nursery areas. Based on this research, CPCs shall consider time and area closures and other measures, as appropriate*"; ICCAT Recommendation 09-07 on thresher sharks: Para 5: "*CPCs shall, where possible, implement research on thresher sharks of the species Alopias spp in the Convention area in order to identify potential nursery areas. Based on this research, CPCs shall consider time and area closures and other measures, as appropriate*". Other species under ICCAT management such as blue, silky and oceanic whitetip sharks should also be addressed. As such, the Group recommends allocating part of the future funds for research to those species.

In terms of priority areas for projects, those should focus on biological parameters (age and growth, reproduction), tagging and population genetics. The Group agreed to work inter-seasonally on the plan for the next 2-year funding cycle and present at the Species Groups meetings (September) a finalized plan for the consideration of the SCRS.

10. Other Matters

Collaboration between CITES and tuna RFMOs

During COP17 CITES urged member countries that are also members of fishery RFMOs to help CITES in their efforts to conserve shark and ray resources.

CITES Decision 17.214 Sharks and rays (Elasmobranchii spp.).

Decision directed to: Parties
Parties that are also members of regional fisheries management organizations or bodies (rfmos/rfbs) are urged to:

a) Work through the respective mechanisms of these RFMOs/RFBs to develop and improve methods to avoid by-catch of sharks and rays, where retention, landing, and sale of these species is prohibited under RFMO requirements, and reduce their mortality, including by exploring gear selectivity and improved techniques for live release;
b) Encourage the RFMOs/RFBs to consider making CITES-listed species a priority for data collection, data collation and stock assessments among non-target species, and provide these data to their members; and
c) Cooperate regionally on research, stock assessments, data sharing and analysis to help Parties making legal acquisition findings and ndfs for shared stocks, and on training initiatives for CITES authorities, fisheries staff and customs officers, in cooperation with the cites and FAO Secretariats.

In March 2017 CITES organized a workshop to improve collaborations between CITES, FAO and RFMOs in matters related to sustainable use of ocean resources, particularly sharks. This activity was a continuation of the collaborative work conducted in 2016 between these organizations, which included the CITES/ICCAT West Africa shark capacity building workshop that was held in Madrid in September 2016. The March meeting, held at CITES HQ in Geneva, was attended by scientists from FAO, CITES, WECAFC and SEAFDEC and national scientists involved in ICCAT[*], IOTC and IATTC. The meeting gave RFMOs the opportunity to provide feedback on the successes and challenges faced during the prior collaborative project as well as input into the possible new project. Continuation of the project depends on funding provided by the EU and is likely to focus on activities on a selected group of countries as opposed to regional initiatives as was done during 2016. ICCAT representatives provided input to FAO and CITES on the relative scientific capacity of ICCAT CPCs in relation to sharks as indicated by their participation on the work of the ICCAT Working Group on sharks.

The March meeting also provided the opportunity to exchange information about the scientific process which supports the objectives of CITES and RFMOs. This exchange highlighted the benefits of this collaboration, especially regarding the indicators of sustainable use which are derived by both types of organizations. It was pointed out that tuna RFMOs have, for many species of oceanic sharks, the best information on the levels of harvest that may be sustainable for each stock. Such information is very useful to countries in need of providing "Non Detriment Finding" (NDF) determinations for trade transactions related to CITES-listed species. Additionally, CITES has expertise on trade statistics, traceability and trade regulations that is relevant to RFMOs. Understanding trade can help RFMOs to better interpret the trade statistics sometimes used in the assessment process. Fin-trade

[*] Enric Cortés (ICCAT Shark Working Group Rapporteur), Rui Coelho (ICCAT Atlantic Swordfish Rapporteur) and David Die (SCRS Chair).

statistics, for example, have been used in the assessment process for blue sharks, and could be used in the future for other sharks. As of now, however, the CITES database holds very limited data on shark trades, partially because CITES has only listed shark species in the recent years.

During the meeting it was also noted that CITES procedures under "Introduction From The Sea" (IFTS) have recently disrupted scientific work conducted by tuna RFMO scientists. It is presently unclear whether biological samples of tissues of CITES-listed species require NDFs under IFTS procedures. As a result, European scientists that were conducting biological collections of CITES-listed shark tissues in the high seas of the Atlantic and Indian Oceans, or in the EEZs of coastal countries, stopped these collections. This situation hampers the ability of RFMO scientists to conduct their research. During the meeting it was requested that CITES and RFMOs examine their regulations with the view of not hampering the process of scientific research.

The Group supported the continued collaboration between ICCAT and CITES and pointed out the need of continuing this collaboration given the need to:

- evaluate the effectiveness of ICCAT regulations to mitigate impacts of ICCAT fisheries on CITES-listed shark species
- provide clarity on the IFTS process in regards to scientific sampling of CITES-listed species
- improve the input of ICCAT science into the CITES processes of consideration of species listing/de-listing proposals and NDFs

Commission recommendations from 2016 Annual meeting

In 2016 ICCAT passed two new Recommendations on sharks: *Recommendation by ICCAT on management measures for the conservation of Atlantic blue shark caught in association with ICCAT fisheries* [Rec. 16-12] and *Recommendation by ICCAT on improvement of compliance review of conservation and management measures regarding sharks caught in association with ICCAT fisheries* [Rec. 16-13]. The Group noted that [Rec. 16-12] requests that during the next assessment of blue sharks (planned for 2021):

"…shall provide, if possible, options of HCR with the associated limit, target and threshold reference points for the management of this species in the ICCAT Convention area."

The Group therefore agreed of the need to plan to adjust future shark work plans and research proposed for the shark research plan to support the estimation of such reference points and development of blue shark HCR options prior to 2021.

In [Rec. 16-13] regarding submission of data by CPCs on the implementation of shark conservation measures, the Commission requests that:

"CPCs may be exempt from the submission of the check sheet when vessels flying their flag are not likely to catch any sharks species covered by the abovementioned Recommendations in paragraph 1, on the condition that the concerned CPCs obtained a confirmation by the Shark Species Group through necessary data submitted by CPCs for this purpose."

The Group agreed that it would be best to provide guidance to CPCs on the kind of information they should provide so that the Group can confirm the exemption request. A draft describing such information was developed and is included as a recommendation in section 11 of this report.

11. Recommendations

- The ICCAT Shark Research Program has had great success in advancing the knowledge on blue shark, shortfin mako and porbeagle biology and life history, and has significantly contributed to the information available to the assessment of these species completed or to be completed in 2015, 2017 and 2019, respectively. The Group recommends the continuation of this program into 2018 and requests the Commission continued support of these activities. Considering [Rec. 16-13], future research should expand from the current focus on these three species to species of sharks for which ICCAT has already implemented by-catch conservation measures: silky, oceanic whitetip, hammerheads and thresher sharks.

The Group will provide a budget for 2018-2019 activities of the Shark Research and Data Collection Program prior to the 2017 Meeting of the Standing Committee on Research and Statistics (SCRS) annual meeting.

- Since the addition of some shark species to the CITES Appendix 2 list, ICCAT researchers have faced difficulties in conducting their ocean-wide research on those sharks, which requires the shipment of biological samples collected in the high seas or in foreign country EEZs to the laboratories that are processing the samples. These difficulties have, for example, led to scientists being forced to stop the collection of porbeagle samples from both the Indian and Atlantic Ocean. This issue was raised by tuna RFMO scientists at the March 2017 meeting between CITES and RFMOs that was held at the CITES headquarters. The Group recommends that the ICCAT Secretariat make an official request to CITES to facilitate the sampling of CITES listed species for the purposes of scientific research conducted under the auspices of ICCAT research programs. Ideally, the ICCAT Secretariat would make this request in collaboration with the IOTC Secretariat to both strengthen the request and to facilitate the collection of samples from both Oceans. Furthermore, the Group recommends that CITES and ICCAT continue their collaboration with the view of strengthening the knowledge about the status of shark populations and the effectiveness of fishery management measures in the conservation of these resources.

- The Group recommends that the SCRS ad-hoc Working Group on tagging considers:

    - Doing an ICCAT-wide review of experiences regarding the effectiveness of different designs of conventional tags with the purpose of making recommendations on the preferred design to be used in future ICCAT tagging efforts.

    - Collaborating with IOTC scientists to conduct a review of information on movements of ICCAT and IOTC species around the southern boundary of the Indian and Atlantic Oceans with the view to inform both Commissions on stock structure and movement of fish across such boundary.

- The Group recommends that CPCs requesting an exception of the requirement to submit information to the Commission regarding the implementation of shark conservation measures (pursuing Rec. 16-13), should submit the following information to the Group so that it can make a determination that the exception is justified:

    - List of species of sharks recorded to be present in the area of tuna fishing activities of the CPC;
    - Evidence (scientific surveys, scientific observer data, landing surveys) that clearly indicate the lack of interactions between CPCs tuna fleets and shark species considered by ICCAT conservation measures;
    - Information on the spatial extent of fishing effort by CPC tuna fleets;
    - A plan for periodic review of the scientific information that justifies the exemption request.

  This information has to be provided to the ICCAT Secretariat at least two weeks prior to the meeting of the Group in September. The Group will then make a recommendation on whether the request for exemption is justified and will transmit this recommendation to the plenary of the SCRS for review.

- The Group recommends identifying regional fishery bodies that can be candidates for collaboration on research on shark species of common interest.

- The Group recommends the 2019 assessment of the northern stock of porbeagle should be conducted in collaboration with ICES.

- The Group recommends starting a collaboration with CCSBT, in order to support the stock assessment of the southern stock(s) of porbeagle.

- The Group recommends that CPCs continue the recovery of Task II CE and SZ data.

- The Group recommends that CPCs continue to revise their historical shark catches with the aim of classifying “unclassified” catch reports into the appropriate species.

12. 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 shortfin mako (*Isurus oxyrinchus*) by area, gear and flag.

			1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	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
TOTAL			753	1293	2042	1575	2182	4346	4057	3448	3794	3543	3440	3095	4084	5748	5896	8407	7808	5799	5680	4345	5151	4739	5375	7704	6263	6611	6326	6935	5447	6179	6675	7031	7385	5646	6177	5913
	ATN		525	1065	1261	1170	1502	3686	3581	3173	2868	2098	2323	2193	3103	4158	3758	5347	5346	3580	3879	2791	2592	2682	3416	3923	3864	3479	3378	4083	3566	4116	4188	3771	4478	3646	2906	3227
	ATS		228	227	781	405	680	661	476	263	926	1446	1116	902	981	1590	2138	3060	2461	2213	1793	1549	2555	2050	1957	3779	2398	3115	2938	2850	1881	2063	2486	3258	2905	2001	3271	2686
	MED		0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	6	8	5	4	7	2	2	2	17	10	2	1	1	2	2	2	0	0	0
Landings	ATN	Longline	525	680	648	802	573	737	2284	2702	2068	1407	2035	1965	2806	3464	3401	3868	5092	3397	3703	2695	2272	2452	3145	3906	3439	3172	3105	3901	3387	3919	4007	3549	4191	3362	2629	2875
	ATN	Other surf.	0	385	613	368	929	2949	1297	462	795	681	278	217	258	671	335	1450	253	182	176	94	320	230	270	17	425	307	272	176	169	177	178	213	268	278	265	341
	ATS	Longline	228	227	781	405	680	661	476	262	926	1446	1116	847	966	1579	2117	3044	2445	2189	1781	1539	2532	2033	1942	3748	2323	3101	2895	2809	1799	2057	2485	3196	2842	1953	3238	2669
	ATS	Other surf.	0	0	0	0	0	0	0	1	0	0	0	55	15	11	21	15	16	25	12	10	22	18	15	31	76	14	43	30	82	7	1	62	55	47	31	15
	MED	Longline	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	6	8	5	4	7	2	2	2	17	10	2	1	1	2	2	2	0	0	0
	MED	Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Discards	ATN	Longline	0	0	0	0	0	0	0	9	5	9	10	11	38	24	21	29	1	0	0	0	0	0	0	0	0	0	0	7	9	20	2	9	19	5	12	10
	ATN	Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	ATS	Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	8	0	2	2
	ATS	Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MED	Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Landings	ATN	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	28	69	114	99	1	1
	ATN	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ATN	Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	111	67	110	69	70	78	69	78	73	80	91	71	72	43	53	41	37	29	35	55	85
	ATN	China PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	81	16	19	29	18	24	11	5	2
	ATN	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61	21	16	25	31	48	21	7	0	84	57	19	30	25	23	11	14	13	14	8	5	10
	ATN	EU.España	279	293	333	600	389	543	2097	2405	1851	1079	1537	1390	2145	1964	2164	2209	3294	2416	2223	2051	1561	1684	2047	2068	2088	1751	1918	1816	1895	2216	2091	1667	2308	1509	1481	1362
	ATN	EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	2	0	0	0	1	1
	ATN	EU.Portugal	0	0	0	0	0	0	0	0	0	0	193	314	220	796	649	657	691	354	307	327	318	378	415	1249	473	1109	951	1540	1033	1169	1432	1045	1023	820	219	222
	ATN	EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	2	1	1	1	0	0	0	1	15	0	0	0	0	0	
	ATN	FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	4	0	0	4	0	
	ATN	Japan	246	387	273	159	141	142	120	218	113	207	221	157	318	425	214	592	790	258	892	120	138	105	438	267	572	0	0	82	131	98	116	53	56	33	69	47
	ATN	Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	27	15	8	2
	ATN	Maroc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	420	406	667	624	947
	ATN	Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	10	16	0	10	6	9	5	8	6	7	8	8	8	4	4	4
	ATN	Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	49	33	39	0	0	0	19	7	
	ATN	Philippines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
	ATN	Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	17	21	0	0	2	0	2	2
	ATN	St. Vincent and Grenadines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	ATN	Sta. Lucia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	
	ATN	Trinidad and Tobago	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	3	1	2	1	1	1	1	1	0	2	1	1	1
	ATN	U.S.A.	0	385	655	410	971	3001	1361	540	896	795	360	315	376	948	642	1710	469	407	347	159	454	395	415	142	521	469	386	375	344	365	392	383	412	406	398	524
	ATN	UK.Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ATN	Venezuela	0	0	0	0	0	0	3	2	3	8	1	6	5	1	7	7	17	9	8	6	9	24	21	28	64	27	14	19	8	41	27	20	33	9	13	7
	ATS	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	0	17	2	0	32	59	78	88	1	15
	ATS	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	83	190	0	27	219	409	226	283	238	426	210	145	203	99	128	192	196	93	268	124
	ATS	China PR	0	0	0	0	0	0	0	0	0	0	0	0	0	34	45	23	27	19	74	126	305	22	208	260	0	0	0	77	6	24	32	29	8	9	9	5
	ATS	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	116	166	183	163	146	141	127	63	0	626	121	128	138	211	124	117	144	203	150	157	157	112
	ATS	Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	9	13	10	20	13	15	23	10	10	9	15	15	30	15	14	16	25	0	5	7	0	20	34	19	11
	ATS	EU.España	0	0	0	0	0	0	6	0	378	809	552	327	421	772	552	1084	1482	1356	984	861	1090	1235	811	1158	703	584	664	654	628	922	1192	1535	1207	1083	1077	862
	ATS	EU.Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	92	94	165	116	119	388	140	56	625	13	242	493	375	321	502	336	409	176	132	127	158
	ATS	EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	11	0	0	0	0	0	
	ATS	Japan	228	206	703	252	462	540	428	234	525	618	538	506	460	701	1369	1617	514	244	267	151	264	56	133	118	398	0	0	72	115	108	103	132	291	114	181	110
	ATS	Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	13	7	7	4	4
	ATS	Namibia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	459	375	509	1415	1243	1002	295	23	307	377	586	9	950	661
	ATS	Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	1	0	0	0	0	0	0	0	10	0	0	0	0	0	0	
	ATS	Philippines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
	ATS	Russian Federation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ATS	Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	34	23	0	11
	ATS	South Africa	0	0	0	0	0	0	0	1	0	0	0	46	66	45	24	49	37	31	171	67	116	70	12	116	101	111	86	224	137	146	152	218	108	250	476	613
	ATS	U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ATS	UK.Sta Helena	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ATS	Uruguay	0	21	78	153	218	121	43	28	23	19	26	13	20	28	12	17	26	20	23	21	35	40	38	188	249	146	68	36	41	106	23	76	36	1	0	
	ATS	Vanuatu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	12	13	1	0	0	0	0	0	0	0	
	MED	EU.Cyprus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	
	MED	EU.España	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	6	7	5	3	2	2	2	2	2	4	1	0	0	1	2	2	0	0	0
	MED	EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	MED	EU.Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	5	0	0	0	15	5	0	0	0	0	0	0	0	0	
	MED	Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	MED	Maroc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ATN	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
	ATN	Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	ATN	Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ATN	U.S.A.	0	0	0	0	0	0	0	9	5	9	10	11	38	24	21	28	1	0	0	0	0	0	0	0	0	0	0	7	10	20	2	9	18	5	11	8
	ATN	UK.Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ATS	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	
	ATS	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	2	2
	ATS	EU.France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MED	EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2. Comparison of Task I data for SMA prior to the data preparatory meeting in 2017 (old) and including the official revisions during the meeting (new).

	SMA-N		SMA-S		MED	
	new	old	new	old	new	old
1950	106		0		0	
1951	71		0		0	
1952	71		0		0	
1953	88		0		0	
1954	22		0		0	
1955	45		0		0	
1956	27		0		0	
1957	73		0		0	
1958	61		0		0	
1959	80		0		0	
1960	53		0		0	
1961	124		0		0	
1962	168		0		0	
1963	73		0		0	
1964	132		0		0	
1965	105		0		0	
1966	219		0		0	
1967	197		0		0	
1968	260		0		0	
1969	256		0		0	
1970	231	0	0	0	0	0
1971	359	112	88	88	0	0
1972	350	115	53	53	0	0
1973	341	61	202	202	0	0
1974	518	307	39	39	0	0
1975	618	344	45	45	0	0
1976	290	84	8	8	0	0
1977	478	236	229	229	0	0
1978	417	153	146	146	0	0
1979	234	45	268	268	0	0
1980	525	246	228	228	0	0
1981	1065	772	227	227	0	0
1982	1261	928	781	781	0	0
1983	1170	569	405	405	0	0
1984	1502	1112	680	680	0	0
1985	3686	3143	661	661	0	0
1986	3581	1483	476	471	0	0
1987	3173	768	263	263	12	12
1988	2868	1017	926	548	0	0
1989	2098	1019	1446	637	0	0
1990	2323	786	1116	564	0	0
1991	2193	803	902	575	0	0
1992	3103	957	981	495	0	0

1993	4158	2194	1590	774	0	0
1994	3758	1594	2138	1563	0	0
1995	5347	3138	3060	1930	0	0
1996	5346	2053	2461	944	0	0
1997	3580	3580	2213	2184	6	6
1998	3879	3855	1793	1794	8	8
1999	2791	2791	1549	1490	5	5
2000	2592	2597	2555	2593	4	4
2001	2682	2682	2050	2011	7	7
2002	3416	3416	1957	1963	2	2
2003	3923	3923	3779	3687	2	2
2004	3864	5180	2398	2324	2	2
2005	3479	3479	3115	3021	17	17
2006	3378	3378	2938	2862	10	10
2007	4083	4083	2850	2647	2	2
2008	3566	3566	1881	1754	1	1
2009	4116	4116	2063	1957	1	1
2010	4188	4188	2486	2362	2	2
2011	3771	3771	3258	3213	2	2
2012	4478	4478	2905	2889	2	2
2013	3646	3646	2001	1983	0	0
2014	2906	2975	3271	3039	0	0
2015	3227	3274	2686	2670	0	0

Table 3. SMA 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 2015 (2016 is provisional). a) is for the North Atlantic and b) is for the South Atlantic.

a)

a)				T1 Total		5347	5346	3580	3879	2791	2592	2682	3416	3923	3864	3479	3378	4083	3566	4116	4188	3771	4478	3646	2906	3227			
Species	**Stock**	**Status**	**FlagName**	**GearGrp**	**DSet**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	Rank	%	%cum
SMA	ATN	CP	EU.España	LL	t1	2209	3294	2416	2223	2051	1561	1684	2047	2068	2088	1751	1918	1816	1895	2216	2091	1667	2308	1509	1481	1362	1	53.2%	53%
SMA	ATN	CP	EU.España	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	b	b	b	1		
SMA	ATN	CP	EU.Portugal	LL	t1	657	691	354	307	327	318	378	415	1249	399	1109	951	1540	1033	1169	1432	1045	1023	817	209	213	2	20.0%	73%
SMA	ATN	CP	EU.Portugal	LL	t2	a	a	a	a	a	a	a	a	a	a	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	2		
SMA	ATN	CP	Japan	LL	t1	592	790	258	892	120	138	105	438	267	572			82	131	98	116	53	56	33	69	47	3	6.2%	79%
SMA	ATN	CP	Japan	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1			-1	-1	ab	ab	ab	a	a	a	a	3		
SMA	ATN	CP	U.S.A.	LL	t1	310	234	242	195	89	164	181	167	141	188	187	129	222	197	221	226	213	198	190	207	341	4	5.4%	85%
SMA	ATN	CP	U.S.A.	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	b	b	b	b	b	b	ab	ab	ab	ab	ab	ab	ab	4		
SMA	ATN	CP	U.S.A.	SP	t1	1422	232	164	148	69	290	214	248														5	3.6%	88%
SMA	ATN	CP	U.S.A.	SP	t2	-1	-1	-1	-1	-1	-1	-1	-1														5		
SMA	ATN	CP	Maroc	LL	t1																	390	380	616	580	807	6	3.5%	92%
SMA	ATN	CP	Maroc	LL	t2																	-1	a	a	-1	a	6		
SMA	ATN	CP	U.S.A.	RR	t1		0	0	0	0	1	0	0	0	333	282	257	158	156	163	168	178	229	219	201	190	7	3.2%	95%
SMA	ATN	CP	U.S.A.	RR	t2		-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	7		
SMA	ATN	CP	Canada	LL	t1	93	56	99	55	54	59	60	61	63	69	74	64	64	39	50	39	37	28	35	53	84	8	1.6%	97%
SMA	ATN	CP	Canada	LL	t2	-1	a	a	a	a	a	a	-1	a	a	a	-1	-1	-1	a	abc	ab	ab	ab	ab	ab	8		
SMA	ATN	NCC	Chinese Taipei	LL	t1	21	16	25	31	48	21	7		84	57	19	30	25	23	11	14	13	15	8	6	11	9	0.6%	97%
SMA	ATN	NCC	Chinese Taipei	LL	t2	-1	-1	-1	-1	-1	-1	-1		ab	ab	ab	ab	ab	ab	a	ab	ab	ab	ab	ab	ab	9		
SMA	ATN	CP	Belize	LL	t1															23	28	69	114	99	1	1	10	0.4%	98%
SMA	ATN	CP	Belize	LL	t2															ab	ab	ab	ab	-1	-1	-1	10		
SMA	ATN	CP	Venezuela	LL	t1	4	12	3	1	2	2	20	16	22	58	20	6	11	2	35	22	18	24	6	7	7	11	0.4%	98%
SMA	ATN	CP	Venezuela	LL	t2	b	b	b	b	b	b	b	b	b	ab	a	ab	ab	ab	ab	ab	a	ab	a	a	a	11		
SMA	ATN	CP	Maroc	PS	t1																	30	26	51	44	140	12	0.4%	99%
SMA	ATN	CP	Maroc	PS	t2																	-1	-1	-1	-1	-1	12		
SMA	ATN	CP	China PR	LL	t1						0							81	16	19	29	18	24	11	5	2	13	0.3%	99%
SMA	ATN	CP	China PR	LL	t2						-1							a	a	a	a	a	a	a	a	a	13		
SMA	ATN	CP	Canada	GN	t1	17	10	9	12	14	17	8	14	8	9	15	6	7	2	3	2	0	1	0	1	0	14	0.2%	99%
SMA	ATN	CP	Canada	GN	t2	a	a	a	a	a	a	a	-1	a	a	a	-1	-1	-1	a	ac	a	ab	a	a	a	14		
SMA	ATN	CP	Panama	LL	t1					1	0						0	49	33	39				19	7		15	0.2%	99%
SMA	ATN	CP	Panama	LL	t2					-1	-1						-1	a	a	a				a	a		15		
SMA	ATN	CP	Mexico	LL	t1	10					10	16		10	6	9	5	8	6	7	8	8	8	4	4	4	16	0.2%	99%
SMA	ATN	CP	Mexico	LL	t2	-1					-1	b		a	a	a	a	ab	a	a	a	a	a	a	a	a	16		
SMA	ATN	CP	Venezuela	GN	t1	3	6	6	8	4	7	4	5	6	6	7	8	8	6	6	5	2	9	3	6		17	0.1%	100%
SMA	ATN	CP	Venezuela	GN	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	a	a	a	a		17		

b)

Species	Stock	Status	FlagName	GearGrp	DSet	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Rank	%	%cum
				T1 Total		3060	2461	2213	1793	1549	2555	2050	1957	3779	2398	3115	2938	2850	1881	2063	2486	3258	2905	2001	3271	2686			
SMA	ATS	CP	EU.España	LL	t1	1084	1482	1356	984	861	1090	1235	811	1158	703	584	664	654	628	922	1192	1535	1207	1083	1077	862	1	39.7%	40%
SMA	ATS	CP	EU.España	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	b	b	b	b	b	1		
SMA	ATS	CP	Namibia	LL	t1					1			459	375	509	1415	1243	1002	295	23	306	328	554	9	950	661	2	15.3%	55%
SMA	ATS	CP	Namibia	LL	t2					-1			a	-1	ab	ab	ab	ab	ab	ab	ab	ab	a	ab	a	a	2		
SMA	ATS	CP	EU.Portugal	LL	t1	92	94	165	116	119	388	140	56	625	13	242	493	375	321	502	336	409	176	132	127	158	3	9.5%	65%
SMA	ATS	CP	EU.Portugal	LL	t2	-1	-1	a	a	a	a	a	a	a	a	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	3		
SMA	ATS	CP	Japan	LL	t1	1617	514	244	267	151	264	56	133	118	398			72	115	108	103	132	291	114	181	110	4	9.4%	74%
SMA	ATS	CP	Japan	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1			-1	-1	ab	ab	ab	a	a	a	a	4		
SMA	ATS	CP	Brazil	LL	t1		83	190		27	219	409	226	283	177	426	183	152	121	92	128	179	193	80	256	120	5	6.7%	81%
SMA	ATS	CP	Brazil	LL	t2		-1	-1		-1	ab	a	a	a	a	ab	a	-1	a	a	a	-1	a	-1	-1	a	5		
SMA	ATS	NCC	Chinese Taipei	LL	t1	166	183	163	146	141	127	63		626	121	128	138	211	124	117	144	204	158	157	159	114	6	6.4%	87%
SMA	ATS	NCC	Chinese Taipei	LL	t2	-1	-1	-1	-1	-1	-1	-1		ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	6		
SMA	ATS	CP	South Africa	LL	t1	46	36	29	168	66	103	68	12	115	101	111	86	224	137	146	152	218	108	250	476	613	7	6.1%	93%
SMA	ATS	CP	South Africa	LL	t2	-1	-1	-1	-1	-1	ab	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	ab	ab	ab	ab	7		
SMA	ATS	CP	China PR	LL	t1	23	27	19	74	126	305	22	208	260				77	6	24	32	29	8	9	9	5	8	2.4%	95%
SMA	ATS	CP	China PR	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1				a	a	a	a	a	a	a	a	a	8		
SMA	ATS	CP	Uruguay	LL	t1	17	26	20	23	21	35	40	38	188	249	146	68	36	41	106	23	76	36	1			9	2.2%	98%
SMA	ATS	CP	Uruguay	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	ab	ab	ab	a	-1	ab	ab	ab			9		
SMA	ATS	CP	Belize	LL	t1											38		17	2		32	59	78	88	1	15	10	0.6%	98%
SMA	ATS	CP	Belize	LL	t2											-1		a	a		ab	ab	ab	-1	-1	a	10		
SMA	ATS	CP	Côte d'Ivoire	GN	t1	13	15	23	10	10	9	15	15	30	15	14	16	25					19	33	19	11	11	0.5%	99%
SMA	ATS	CP	Côte d'Ivoire	GN	t2	-1	-1	-1	-1	-1	-1	-1	b	b	-1	-1	-1	a					a	a	ab	a	11		
SMA	ATS	CP	Brazil	UN	t1										61	0	27	5	78	7		7	2			3	12	0.4%	99%
SMA	ATS	CP	Brazil	UN	t2										-1	-1	-1	-1	-1	-1		-1	-1			-1	12		
SMA	ATS	CP	Senegal	LL	t1																	13	34	23		11	13	0.2%	99%
SMA	ATS	CP	Senegal	LL	t2														a		a	a	a	a		-1	13		
SMA	ATS	CP	Namibia	BB	t1																0	48	31				14	0.2%	99%
SMA	ATS	CP	Namibia	BB	t2																-1	-1	-1				14		
SMA	ATS	CP	Vanuatu	LL	t1										52	12	13	1	0								15	0.1%	100%
SMA	ATS	CP	Vanuatu	LL	t2										-1	a	a	-1	-1								15		
SMA	ATS	CP	Korea Rep.	LL	t1																29	13	7	7	4	4	16	0.1%	100%
SMA	ATS	CP	Korea Rep.	LL	t2																-1	b	a	abc	a	a	16		

Table 4. Tagging summary - Shortfin Mako (SMA, *Isurus oxyrinchus*).

			Years at liberty								
Year	*Releases*	*Recaptures*	*< 1*	*1 - 2*	*2 - 3*	*3 - 4*	*4 - 5*	*5 - 10*	*10+*	*Unk*	*% recapt*
1962	5	0									
1963	8	0									
1964	5	1	1								20.0%
1965	11	2	2								18.2%
1966	20	2	2								10.0%
1967	12	1			1						8.3%
1968	59	1	1								1.7%
1969	29	2	1			1					6.9%
1970	11	1	1								9.1%
1971	18	4	3			1					22.2%
1972	15	1					1				6.7%
1973	16	0									
1974	15	0									
1975	13	1		1							7.7%
1976	18	5	3	1	1						27.8%
1977	111	17	7	5	1	2	1	1			15.3%
1978	118	12	5	5			2				10.2%
1979	157	13	6	6		1					8.3%
1980	171	11	4	3	2	2					6.4%
1981	185	13	7	1	3		2				7.0%
1982	241	21	14	3		2	2				8.7%
1983	228	25	15	4	2	1	1	2			11.0%
1984	196	31	16	10	1	1	1	1	1		15.8%
1985	249	24	15	4		3	1	1			9.6%
1986	176	13	6	3	4						7.4%
1987	264	25	14	6	1	1	1			2	9.5%
1988	119	17	6	6	1	1	2		1		14.3%
1989	145	19	10	6	3						13.1%
1990	172	22	13	7	2						12.8%
1991	296	35	18	10	4	1	1			1	11.8%
1992	537	53	28	15	2	3	2	2	1		9.9%
1993	505	65	32	22	3	4	1	1		2	12.9%
1994	425	74	42	19	2	3		2		6	17.4%
1995	295	47	29	8	5	2				3	15.9%
1996	143	20	13	5	1			1			14.0%
1997	233	36	20	10	4	1	1				15.5%
1998	267	36	22	9	3	2					13.5%
1999	298	48	22	19	2		1	2		2	16.1%
2000	375	49	29	8	3			4		5	13.1%
2001	375	64	38	13	5	1	3	2	1	1	17.1%
2002	360	44	28	10	1	1	1	1		2	12.2%
2003	257	41	19	7	10	3				2	16.0%
2004	389	65	42	18	1			1		3	16.7%
2005	244	36	22	7	2	1	1	1		2	14.8%
2006	255	42	26	13	1			1		1	16.5%
2007	368	83	53	19	5		4			2	22.6%
2008	279	52	23	21	3	2	1			2	18.6%
2009	237	39	24	8	4	3					16.5%
2010	182	21	13	8							11.5%
2011	161	9	8	1							5.6%
2012	25	10	7	2	1						40.0%
2013	20	5	5								25.0%
2014	5	0									
Grand Total	**9318**	**1258**	**715**	**323**	**84**	**43**	**30**	**23**	**4**	**36**	**13.5%**

Table 5. Distance (km) of recapture from release by size bin (cm).

Count of F	Distance (Kms)																																												
Length (cr	0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100	3200	3300	3400	3500	3600	3700	3900	4300	4400	4500	4800	5300	5600	Grand Tot
0	1	9	10	10	4	5		6	4	2	2	5	4		1	2	2	2	1		1		1	1	1		1		2	1			1														79
30					1																																									1
40				1		1																																							2
45		2	1	3						1	1											1	1																							10
50		1	2		2	1	1																																							7
55				1				1		1																							1	1															5
60	1	2	2	1	1	3	3	1				1					1							1			1	1						1						1								21
65		1				1				1	1	2									1											1																	8
70	1	1	1	2	2	3	2	1		3	1		1	1		1						1	1	2		1								1												26
75	4	7	4	5	2	2	4	4	2	3	1	3	4	1	1			1	1		3		2			2	1	2	1																			60
80	2	3	4	4	1	3	1	2	3	2	2		1				1		1	1						1				1																33
85		2		2	2	2	1		3		3	2	2			1	1			2			1			1		3	1	1																30
90	16	19	14	20	9	8	7	4	4	3	4	3	1	3	2	2	1		1	2		4	3	2		1		2	1	2																138
95		2	1	1	5	4	3	2		3	2	4	1			1		1		1										1																32
100		3	8	3	1	3	3	2	2	1	2			2								1		1	1	1					3																37
105	9	20	9	7	7	4	4	2	3		1	2	2	5			1	3	1		1	1	1	1	3		1	1	1	1	1	1													1			94
110	1	3	2	3	1	2	2	1	1			2										1					1				1																21
115	1	3	1	3	2	1	1	1		1	1						1		1			1							1																	1	20
120	9	28	27	19	13	4	8	9	4	3	1	3	3	2	2	4	2	2	2	4	3	4	1	3	6	3	1	2		3		2	1		3	1	3				1			1		187
125		1	2	1	2	1	1	1					1	1	1	1			1					1		1																			16
130		2	2	2	2	2		2							1		1						1			1			1					1														18
135	1	10	14	9	14	6	3	1	2				1		1	1		1	2	1	1		1	1	2	3	2	1	3	1															1				83
140	1	2	2			1	2	2		1						1			1			1			1							1														16
145		2	3	1		1							1																				1														9
150	9	18	12	14	11	6	4	7	4	2	5			2		1		3		2	2	4	3	4	1			1	3		3								1	1						123
155		1	1	1		1	1	1																						1															7
160		2	1	1		2	4	1	1					1																												1				14
165		1	1	1	1	1							1			1	2											1	2		1														13
170	1	5	3	2	3	2	3	1	1		1	1			1				1			2	1	1		1	1																			31
175			1	1									1								1									1																5
180		1		2	3	1			1											2				1			1																				12
185	1	2	2	5	2	4		1	1	1						1	1					1		2			1					1						1										27
190						2	1	1			1			1											1									1													8
195			1	1											1																																3
200	2	1	3		2	1	1		1														1		1								1															14
210									1		1																																				2
215								1												1			1																									3
220										1																																				1
225			1																																												1
230		1		1	1																1							1																				5
240				1																																											1
250		1																																														1
275													1																				1														2
280																							1																								1
290						1																																									1
300						1																																									1
320	1																																														1
Grand Tot	61	156	135	128	94	80	60	55	38	29	30	28	24	20	10	17	15	15	11	17	17	19	19	22	17	16	11	15	13	19	7	5	8	2	3	1	4	1	1	1	1	2	1	1	1	1230

Table 6. Distance (km) of recapture from release by time at liberty (days).

Count of F	Distance km																																													
Days liber	0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100	3200	3300	3400	3500	3600	3700	3900	4300	4400	4500	4800	5300	5600	Grand Tot
0	19	23	16	11	11	2	1	1		2	1	2		1			1			1				1		2			1	1							1									98
50	10	36	23	27	10	4	6	2	4	3	1	2	1			1				1			1	1	1				1		1						1									137
100	2	8	10	7	2	10	5	5	3	2	2	2	3	2					1		1	1	1				2		3	1	1		1				1		1							77
150		1	4	4	4	2	5	3	3	3	2	5	1	2	1	1	1	1					1	2	1	2		1	2	2			2													56
200			2	4	1	6	7	7	5	2	5	6	3	2	1	3	3	4	2	3	2	1		3			1	2	3	1					2											81
250		2	1	5	5	8	6	5	7	1	4	3	3	2	3	3		3	1	3	2	3	5	2	5	1	2	2	2	2																91
300	4	7	8	13	11	7	5	6	1	3	2		1	3			1	1	2		3	2	1	2	1		1	2			1	3										1	1			93
350	10	24	19	8	12	7	6	4	3	2	4			1		1		1			1	5	1			4		1		3					1			1								119
400	1	22	14	11	13	3	4	3	2	1	2		1				2	1		1								1				1	1													84
450	2	6	6	2	4	9	2	5		2		1	2	1	1		1	1						1				1		3			1	1						1						53
500					2	2	1			2	2		1			2	2			1					2	1																		1		19
550		1	2	2	2		2	2			1	2	1	1		1					1			1	1	2	1	1		1												1				26
600			2		2	2	2	2	2	2	1		1					2					1		1		1	1		1						1	1									25
650	1	2	2	4	3	2	2	1	1		1	1	1	1	1				1	1			1	1	1	1				1	1															31
700	5	9	10	9	2			1	1			1				1			1	1		2	3			1	1																			48
750	4	9	4	1	1	4																	1	1																					1	26
800		2	2	1				1			1		1												1							1														10
850					1		1															1		2																						5
900				1		1		2															1					1																		6
950					2		1	1	2	1		1	2	1	1					1	1	1												1							1					17
1000			1	1		2	2		2						1										1																					10
1050	1		1	1	1		1					1							1							1																				8
1100		3	1	3				2	1	1			1				1		1		2		1	2																						19
1150				1		1																2			1		1						1													7
1200						2	1				1																																			4
1250			1																											1																2
1300				1																	1			1	1																					4
1350										1														1		1																				3
1400				1	2							1	1		1					1											1															8
1450				2	1											1																	1													5
1500	1			2																	1			1						1																6
1550		1			1	3										1																														6
1600			1					1																																						2
1650																1																														1
1700																	1										1		1																	3
1750				2						1						1	1														1															6
1800																	1			1											1															3
1850	1			1																																										2
1900				1																								1																		2
2000									1												1																									2
2050																				1	1									1																3
2100																							1																							1
2200			1																	1																										2
2300					1																																									1
2350			1			1																																								2
2550								1																																						1
2650																						1																								1
2850														1																																1
3000			1			1																																								2
3050																												1																		1
3450														1																																1
3600																			1																											1
3850																																	1													1
4550				1																																										1
4650						1																																								1
4950														1																																1
34850			1																																											1
36300				1																																										1
39350			1																																											1
40350																		1																												1
Grand Tota	61	156	135	128	94	80	60	55	38	29	30	28	24	20	10	17	15	15	11	17	17	19	19	22	17	16	11	15	13	19	7	5	8	2	3	1	4	1	1	1	1	2	1	1	1	1230

Table 7. Final catches for use in the assessment models for the North Atlantic shortfin mako stock (yellow is non-official data but represents the SCRS best estimates).

					Ratio estimate		SCRS/2017/071							
Flag	EU.España	EU.Portug	Japan	U.S.A.	Maroc	Canada	Chinese T	Venezuela	U.S.A.	U.S.A.	Belize	Maroc	China PR	Rest
Gear	LL	LL	LL	LL	LL	LL	LL	LL	SP	RR	LL	PS	LL	All
1950	105.63													
1951	70.615													
1952	70.615													
1953	87.94													
1954	22.296													
1955	45.249													
1956	27.34													
1957	73.101													
1958	60.82													
1959	80.411													
1960	52.779													
1961	124.271				3.9657									
1962	168.132				7.9314									
1963	73.101				3.9657									
1964	131.581				11.8971									
1965	104.753				9.2533									
1966	219.229				7.9314									
1967	196.641				7.27045									
1968	259.58				8.59235									
1969	255.998				10.5752									
1970	230.998				9.2533									
1971	247.373		112		13.87995									
1972	234.653		115		9.91425									
1973	280.195		61		6.6095									
1974	211.48		307		7.9314									
1975	273.908		344		9.91425									
1976	205.851		84		7.9314									
1977	241.89		236		3.9657									
1978	263.966		153		7.27045									
1979	188.746		45		137.4776									
1980	278.513		246		89.8892									
1981	293.353		387		81.9578		32		384.96					
1982	332.9		273	42.08	60.14645		52		613.06					0.04
1983	600.486		159	42.19	82.61875		59		368.1					
1984	389.167		141	42.46	52.21505		70		929.03					
1985	543.211		142	51.9	90.55015		71		2947.47					1.34
1986	2097.43		120	63.97	117.6491		78	2.7806	1295.94					0.79
1987	2404.529		218	86.103	126.9024		22	1.7422	461.72					0.46
1988	1851.314		113	105.905	128.8853		4	2.5706	794.61					0.54
1989	1078.543		207	122.84	144.7481		2	8.1191	670.35					10.73
1990	1537.211	193	221	92.997	15.8628		9	1.4618	268.43					9.08
1991	1390.079	314	157	112.703	60.8074		39	2.1246	209.98					6.7825
1992	2145.437	220	318	160.8	27.09895		16	0.6655	250.31					7.605
1993	1964.07	796	425	301.88	17.84565		9	0.5819	666.74					4.0564
1994	2163.559	649	214	331.82	4.62665		29	3.4869	316.96	0.82				17.3493
1995	2209.481	657	592	309.73	18.5066	93.391	32	4.2242	1421.5					38.9207
1996	3293.768	691	790	234.1	23.13325	56.074	45	11.7085	231.89	0.22				21.1289
1997	2415.551	354	258	242.08	157.9671	99.01	42	3.3823	163.62	0.31				18.5674
1998	2223.05	307	892	194.98		54.63	47	0.7586	148.19	0.24				27.5222
1999	2050.882	327.389	120	89.47	23.13325	53.834	75	1.9567	69.03	0.19				30.6295
2000	1560.654	317.5	138	163.8	25.1161	58.678	56	2.1912	289.89	0.58			0.2	40.2645
2001	1684.47	377.626	105	180.5	174.4908	59.638	47	20.3403	214.17	0.33				32.7188
2002	2046.583	414.7	438	166.776	101.7863	61.123	53	16.0433	247.87	0.137				24.3136
2003	2067.596	1248.63	267	141.43	147.3919	63.362	37	21.9359		0.18				29.0009
2004	2087.648	398.684	572	187.784	168.5423	69.393	70	57.95		332.564				100.1417
2005	1751.301	1109.323	0	186.904	214.8088	73.861	68	19.626		282.115				36.6064
2006	1918.017	950.556	0	129.287	220.0964	64.453	40	6.29		256.662				22.3372
2007	1815.556	1539.669	82.415	222.435	151.3576	63.688	6	11.103		158.299			80.5	84.5259
2008	1895.257	1033.063	130.861	196.539	282.8866	38.937	27	1.802		156.036			15.5	74.1082
2009	2216.171	1169.311	98.389	220.994	475.884	50.342	89	35.1		162.728	23.078		19	109.233
2010	2090.744	1431.934	116.293	225.682	636.4949	38.635	14	21.871		167.778	28.094		28.602	23.68237
2011	1667.129	1044.634	53.266	212.865	390	37.177	54	17.965		178.1828	69.176	30	17.676	40.0095
2012	2307.992	1022.551	56.051	198.449	380	27.607	35	24.268		229.4714	113.772	26	24.02	52.70829
2013	1508.829	817.433	32.662	190.036	616	34.654	13	5.825632		219.387	98.527	50.7	11.461	52.34125
2014	1480.932	208.6014	69.231	206.878	580	53.1159	16	7.476		201.4369	1.246	44	4.997	42.31324
2015	1361.72	213.254	47.12	341.087	807	84.19217	11.368	7.454433		190.0192	0.613	140	1.52	21.61344
Grand Tot	65332.28	17805.86	9656.288	5799.454	6981.93	1235.795	1369.368	322.8053	12963.82	2537.686	334.506	290.7	203.476	981.4602

Table 8. Final catches for use in the assessment models for the South Atlantic shortfin mako stock (yellow is non-official data but represents the SCRS best estimates. Namibia is in red as neither estimations nor updates have been made for this fleet yet).

					Ratio estimate	SCRS/2017/071			Ratio estimate					
Flag	EU.España	Japan	Namibia	EU.Portuga	Brazil	Chinese Ta	South Africa	Uruguay	China PR	Côte d'Ivoir	Belize	Brazil	Senegal	Rest
Gear	LL	LL	LL	LL	LL	LL	LL	LL	LL	GN	LL	UN	LL	All
1971		88			9.326622684									0
1972		53			7.32806068									0
1973		202			9.750560079									0
1974		39			28.16155551									0
1975		45			31.12911727									0
1976		8			22.10530701									0
1977		229			23.25599422									0
1978		146			22.22643198									0
1979		268			31.49249218									0
1980		228			95.62816375									0
1981		206			39.60786516	108		21.484						0
1982		703			61.65260969	131		77.965						0
1983		252			47.29930075	59		153.336						0
1984		462			28.28268048	36		218.497						0
1985		540			34.03611655	91		120.513						0
1986	5.563	428			45.54298869	87		42.679						0
1987	0	234			57.35267326	66		28.206						0.555
1988	378.147	525			70.37360752	35		22.697						0.447
1989	808.882	618			70.73698243	29		18.948						0.057
1990	552.125	538			102.7139745	36		26.19						0.076
1991	327.408	506			79.45798027	80		13.485		9.3				46.032
1992	421.251	460			158.0075233	44	64.344	20.303		13.1				1.968
1993	772.223	701			121.9122822	31	43.388	28.028	34.438	9.52				1.459
1994	552.147	1369			95.14366387	65	22.959	11.917	45.331	19.57				1.351
1995	1084.035	1617		92	119.3080954	87	46.062	16.786	22.625	12.51				2.656
1996	1481.659	514		94	114.5842215	117	36.01	26.282	27	14.9				1.374
1997	1356.001	244		165	248.3061883	139	29.205	20.282	19.2	22.6				3.781
1998	984.153	267		116	232.8021922	130	168.417	23.257	74.4	10.2				3.168
1999	861.303	151	1.228	118.5	26.776	198	66.107	21.006	126	9.8				26.872
2000	1089.67	264		387.7	218.5	162	102.536	34.542	305.399	9				16.356
2001	1234.616	56		140.1	409.4	120	67.8063	39.983	22	15.23				2.422
2002	810.512	133	458.85	56	225.6	146	11.64	38.301	208	15.06				0.364
2003	1158.228	118	374.71	624.61	282.505	83	115.4441	187.76	260	30.26				1.142
2004	702.702	398	509.023	12.781	177.4837	180	101.268	248.601	68.142572	15		60.544		52.164
2005	583.604	0	1415.252	241.788	425.839	226	110.545	145.729	45.182235	14	38.405	0.015		12.55
2006	664.367	0	1243.498	493.325	183.225	166	86.152	68.051	69.66616	16.09		26.938		18.376
2007	653.869	72.29	1001.812	374.735	152.239859	147	223.931	35.631	76.8	25.07	17.44	4.601812		0.589
2008	627.998	115.157	294.55	321.022	120.680663	172	136.582	41.024	5.5		1.6	78.167917		14.792
2009	921.981	108.276	23.318	502.262	91.785	141	146.157	105.668	24			6.751		15.709
2010	1192.159	103.242	306.438	336.2883	127.7012318	221	151.629	22.611	32.494		31.768			37.673
2011	1535.429	132.302	328.465	409.158	178.6102371	280	217.866	76.007	29.206		59.022	6.562836	13.421	68.307
2012	1207.143	290.96	554.342	175.93	192.85318	218	107.572	36.123	8.071	19.2238	77.885	2.166	34.275	40.88634
2013	1082.638	114.027	8.5	132.185	80.1626	129	249.96	1.4784	8.736	33.335	88.245		23.075	20.8642
2014	1076.899	180.853	949.8	126.598	256.0528	202	476.211		9.421	18.86142	1.455			15.929
2015	861.575	109.847	660.9	157.565	120.05	113.939	613.051		4.585	11.02802	15.214	2.95	10.6375	4.826
Grand Tota	24988.287	13836.954	8130.686	5077.5473	5276.989522	4275.939	3394.8424	1993.3704	1526.197	343.65824	331.034	188.696565	81.4085	412.74554

Table 9. Life history parameters for shortfin mako (North and South) stocks.

	NA	SA	References
Reproduction			
L_{mat} (♂)		180	Mas et al. (2017) [SCRS]
L_{50} (♂)	180-185 FL	166	Natanson et al. (2006) Maia et al. (2006) Mas et al. (2017) [SCRS]
T_{mat} (♂)	8		Campana et al. (2005)
T_{50} (♂)	8		Natanson et al. (2006)
L_{mat} (♀)			
L_{50} (♀)	275-298 FL		Mollet et al. (2000), Natanson et al. (2006)
T_{mat} (♀)	18		Campana et al. (2005)
T_{50} (♀)	18		Natanson et al. (2006)
Sex ratio	1:1		Mollet et al. (2000)
Cycle	3		Mollet et al. (2000)
GP (months)	16.5 (15-18)		Mollet et al. (2000)
L_0	70 FL-63 FL	81M-88F (FL)*	Natanson et al. (2006) Mollet et al. (2000) Doño et al. (2015)
Mean litter size (LS)	12.5		Mollet et al. 2000 (n=24)
Min LS	2		Mollet et al. 2000 (n=24)
Max LS	30		Mollet et al. 2000 (n=24)
LS vs MS relation	LS=0.81*TL^2.346		Mollet et al. 2000 (n=24)
Maturity ogive (♀)	Mat=1/(1+exp-(a+b*MS))	Use fit to clasper index (♂)	Mollet et al. 2000 (n=24); SCRS/2017/058
Age & Growth			
L_{inf} (♀)	366 (393) **	244*-408	Natanson et al. (2006) Doño et al. (2015) Barreto et al. (2016)
k (♀)	0.087 (0.054) **	0.04	Natanson et al. (2006) Barreto et al. (2016)
T_o / L_o (♀)	88.4 (70 fixed) **	-7.08	Natanson et al. (2006) Barreto et al. (2016)
T_{max} (♀)	32	23-28*	Natanson et al. (2006) Barreto et al. (2016) Doño et al. (2015)
L_{inf} (♂)	253 ***	261*; 329	Natanson et al. (2006) Doño et al. (2015) Barreto et al. (2016)
k (♂)	0.125	0.08	Natanson et al. (2006) Barreto et al. (2016)
T_o / L_o (♂)	71.6	-4.47	Natanson et al. (2006) Barreto et al. (2016)
T_{max} (♂)	29	11*-18	Natanson et al. (2006) Doño et al. (2015) Barreto et al. (2016)
Conversion Factors			
Length-length [cm]	FL=0.9286TL-1.7101	TL=1.127FL+0.358	Megalofonou et al. (2005) Kohler (1995)
Length-weight (b) [cm,kg]	W=5.2432E-06FL^3.1407	W=3.1142E-05FL^2.7243	Kohler (1995) García-Cortes & Mejuto (2002)
		$HG=7.5443x10^{-6}x (FL^{2,9568})$****	Mas et al. (2017) [SCRS]

* Derived with the Schnute model; ** Gompertz (VBGF in parentheses); *** VBGF with Lo; **** HG is eviscerated weight

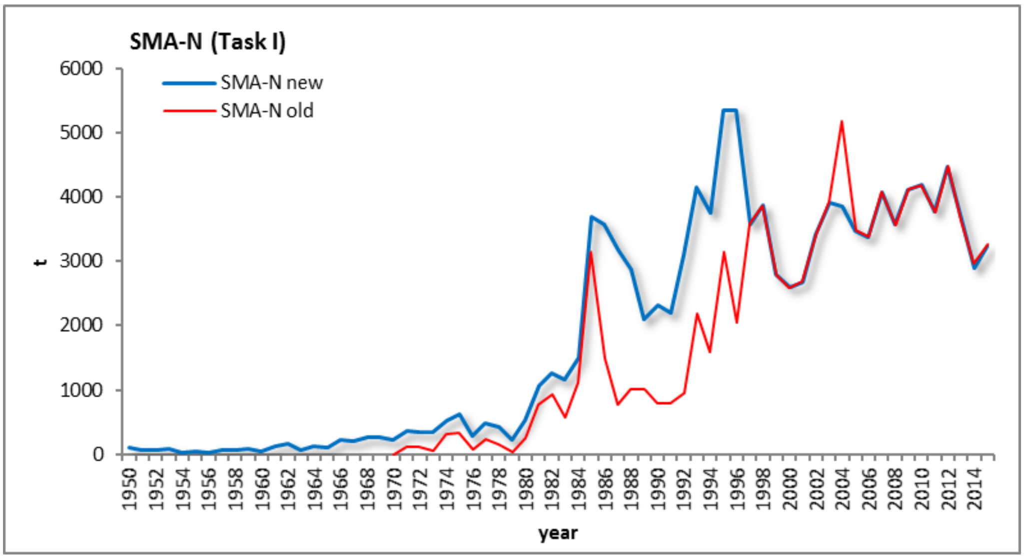
Table 10. Indices of relative abundance for the North Atlantic shortfin mako stock available for use in the stock assessment.

Year	US logbook (numbers)	US observer (numbers)	Japan LL N (numbers)	Portugal LL N (biomass)	Chinese Taipei LL N (numbers)
1978					
1979					
1980					
1981					
1982					
1983					
1984					
1985					
1986	1.157				
1987	1.163				
1988	0.917				
1989	1.063				
1990	0.833				
1991	0.740				
1992	0.876	1.121			
1993	0.767	0.857			
1994	0.721	0.576	0.179		
1995	0.694	0.890	0.108		
1996	0.618	0.511	0.112		
1997	0.569	0.668	0.113		
1998	0.538	0.493	0.092		
1999	0.526	0.531	0.079	18.263	
2000	0.557	0.807	0.081	22.394	
2001	0.507	0.674	0.116	26.385	
2002	0.532	0.815	0.118	30.805	
2003	0.573	0.678	0.106	35.330	
2004	0.676	0.996	0.099	28.353	
2005	0.680	0.711	0.096	31.037	
2006	0.529	0.770	0.133	54.240	
2007	0.803	0.870	0.136	47.896	0.014
2008	0.675	0.638	0.210	28.184	0.056
2009	0.862	1.350	0.201	45.236	0.200
2010	0.754	0.883	0.217	36.996	0.028
2011	0.704	1.261	0.141	23.998	0.103
2012	0.513	1.105	0.114	28.914	0.088
2013	0.543	0.777	0.084	28.422	0.033
2014	0.489	0.811	0.167	28.181	0.093
2015	0.484	0.630	0.091	10.675	0.0279

Table 11. Indices of relative abundance for the South Atlantic shortfin mako stock available for use in the stock assessment.

Japan LL S (numbers)	Brasil LL (numbers)	Chinese Taipei LL S (numbers)	URU logbook (biomass)	URU observer (number)
	0.013			
	0.007			
	0.033			
	0.01			
	0.01		76.7435	
	0.006		29.7195	
	0.04		14.1074	
	0.058		10.8288	
	0.044		12.2419	
	0.021		22.9678	
	0.075		16.5596	
	0.059		25.3889	
	0.131		31.0258	
	0.043		30.2003	
	0.052		31.8473	
	0.015		38.4034	
0.092	0.077		78.2997	
0.059	0.138		68.3719	
0.067	0.147		33.2201	
0.081	0.078		47.0128	
0.067	0.16		33.6447	
0.099	0.081		46.8908	
0.077	0.052		71.3699	
0.065	0.179		73.8665	0.89
0.053	0.21		54.9208	1.38
0.075	0.246		60.8198	1.68
0.077	0.271		55.1507	1.57
0.069	0.163		47.0225	0.82
0.150	0.158		48.5133	1.18
0.094	0.200	0.052	32.9740	0.75
0.117	0.227	0.067	32.3168	1.32
0.148	0.191	0.051	50.4609	1.16
0.147	0.194	0.066	74.1968	2.61
0.315	0.394	0.072		1.19
0.238	0.223	0.068		1.73
0.123		0.056		
0.274		0.080		
		0.038		

a)



b)

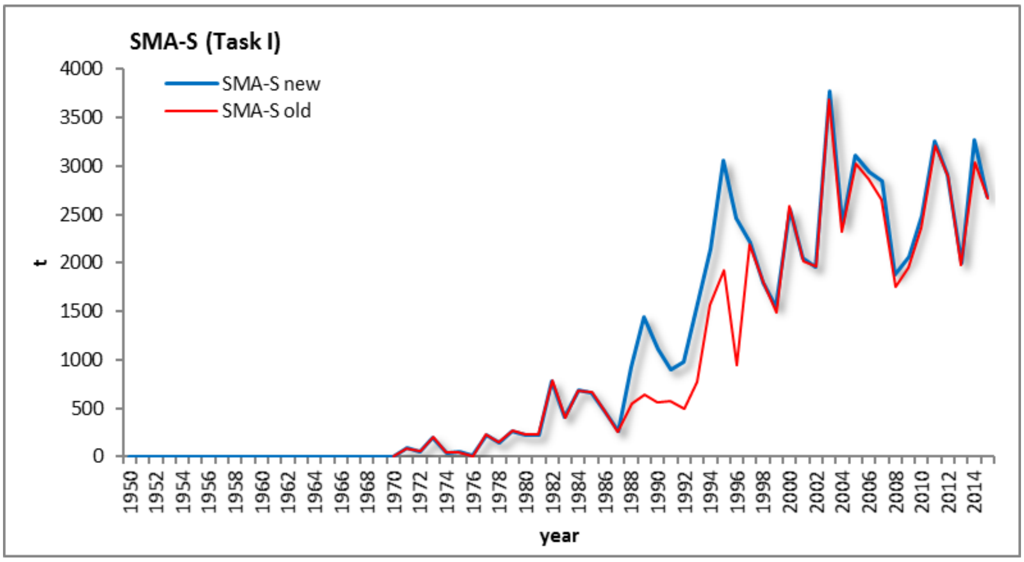


Figure 1. Comparisons of Task I available prior to the 2017 SMA data preparatory meeting (old) and Task I updated during the meeting (new) for the a) North and b) South Atlantic.

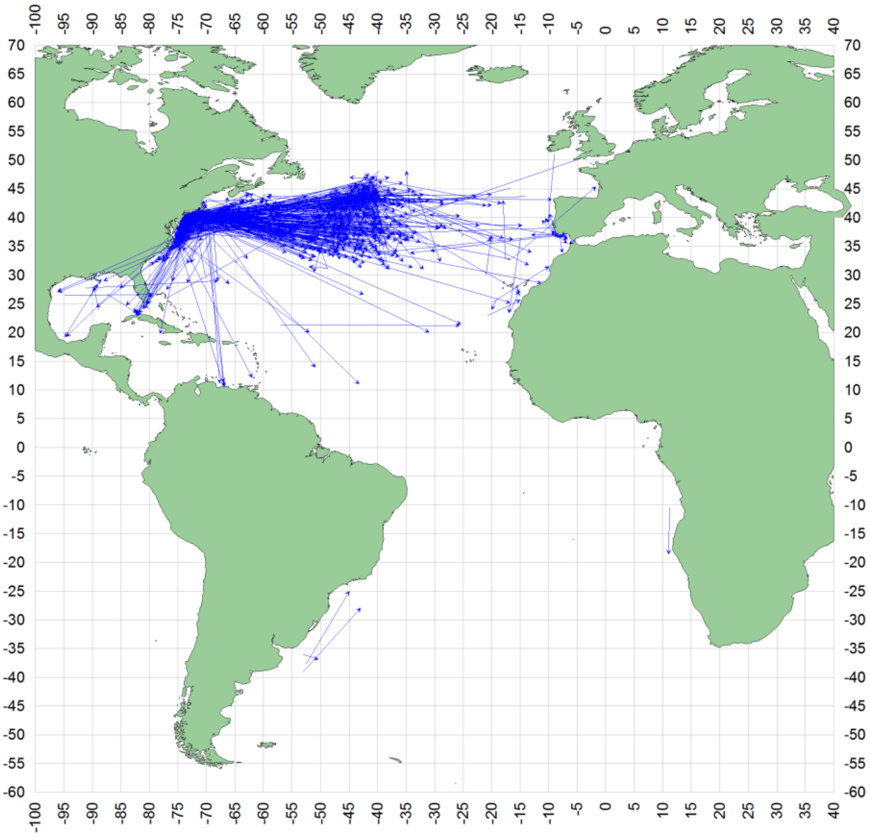


Figure 2. Straight displacements between release and recovery positions (apparent movement), from conventional tagging of shortfin mako sharks.

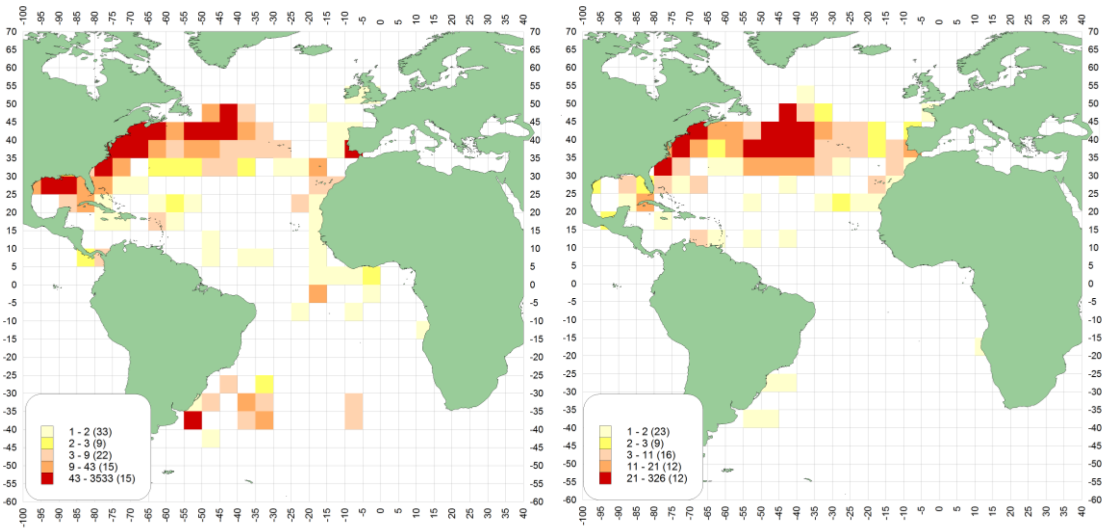


Figure 3. Density (5 x 5 degrees squares) of shortfin mako shark releases (left) and recoveries (right).

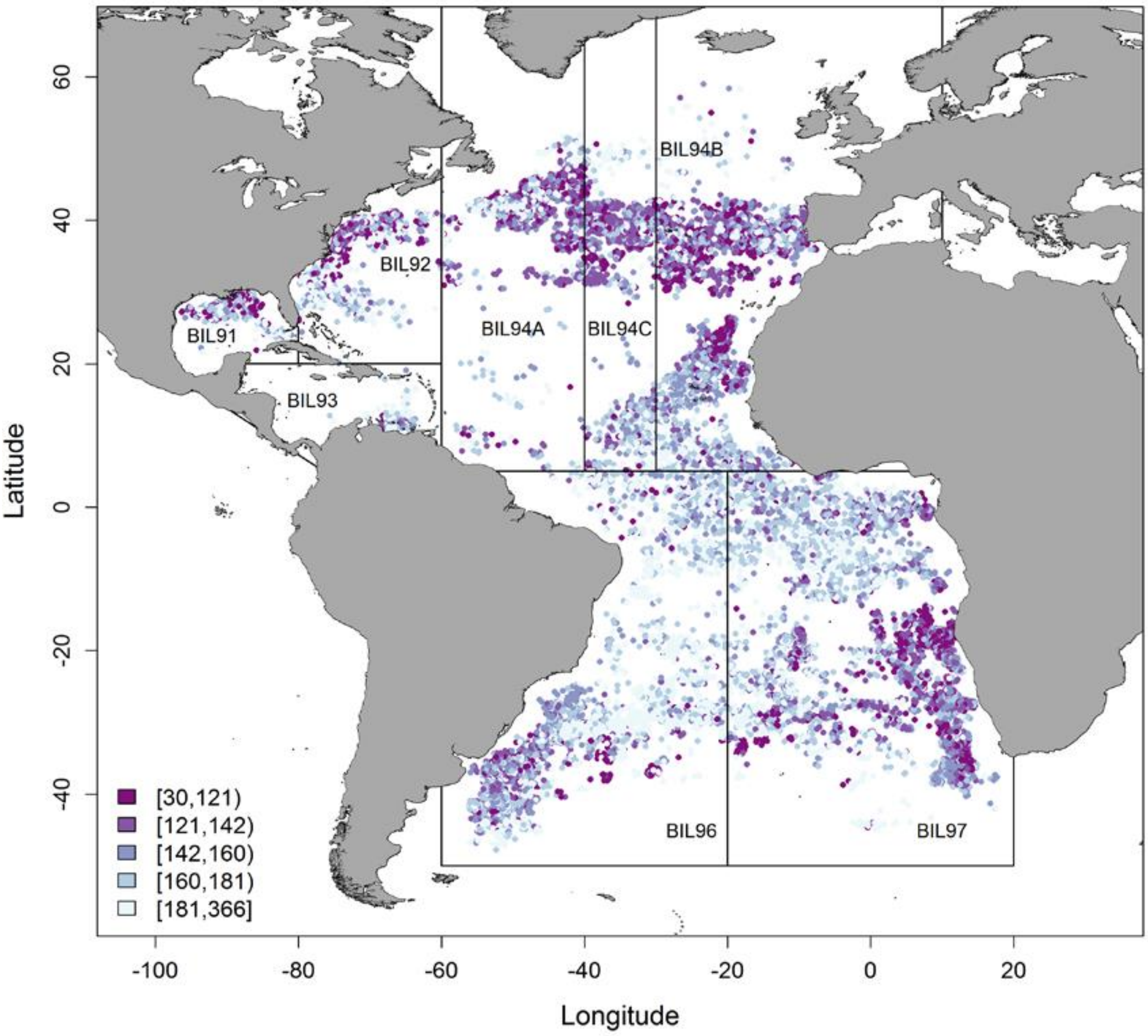


Figure 4. Location and catch-at-size (FL, cm) of the shortfin mako (*Isurus oxyrinchus*) in the Atlantic Ocean based on observer data provided by Portugal, Uruguay, Chinese Taipei, USA, Japan, Brazil and Venezuela. The color scale of the dots represents specimen sizes, with darker colors representing smaller specimens and lighter colors larger specimens. The categorization of size classes for the map was carried out using the 0.2 quantiles of the data. The ICCAT sampling areas for sharks are identified (black lines). The values in parentheses in the legend represent the lower and upper limit of each 0.2 quantile.

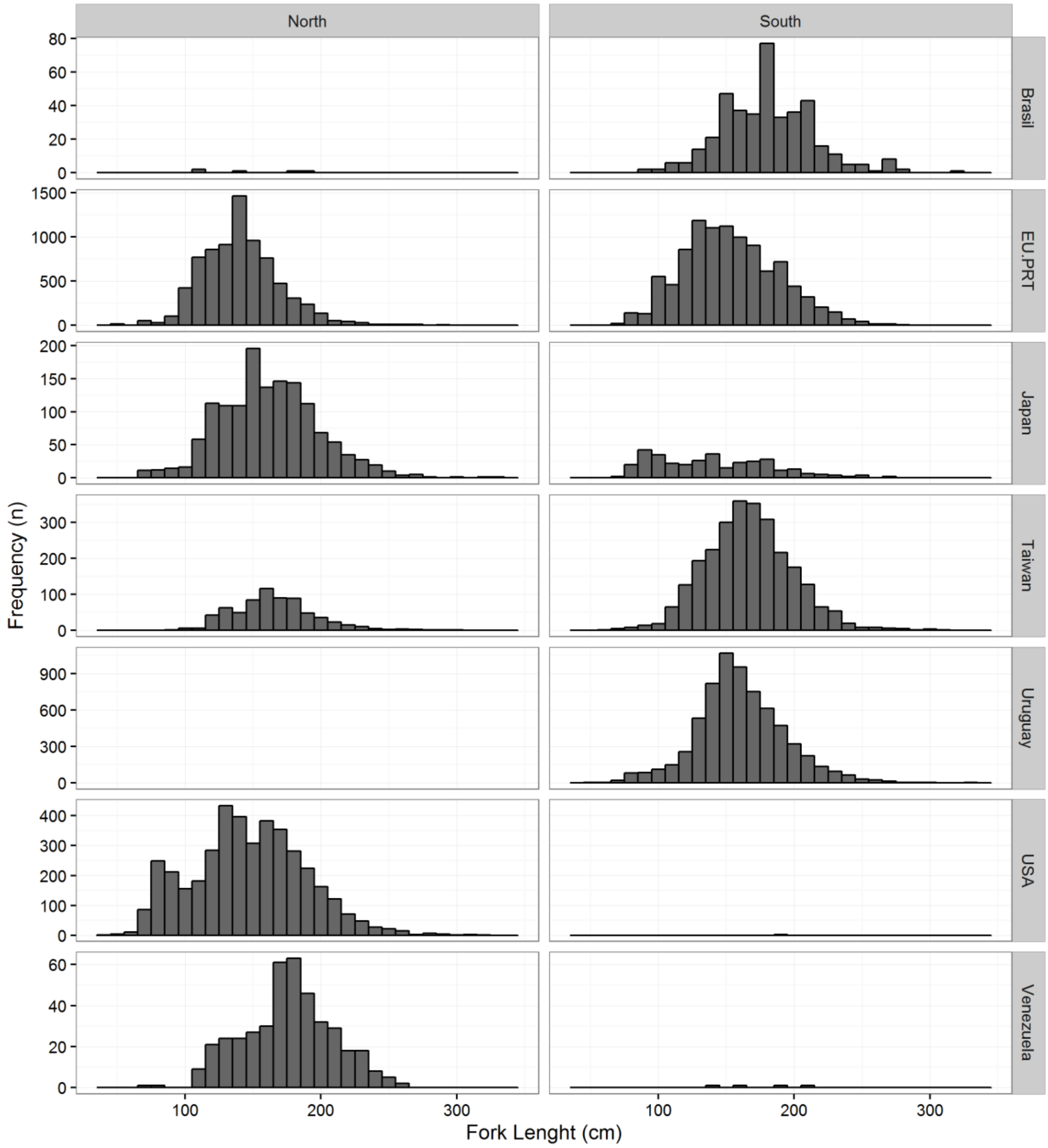
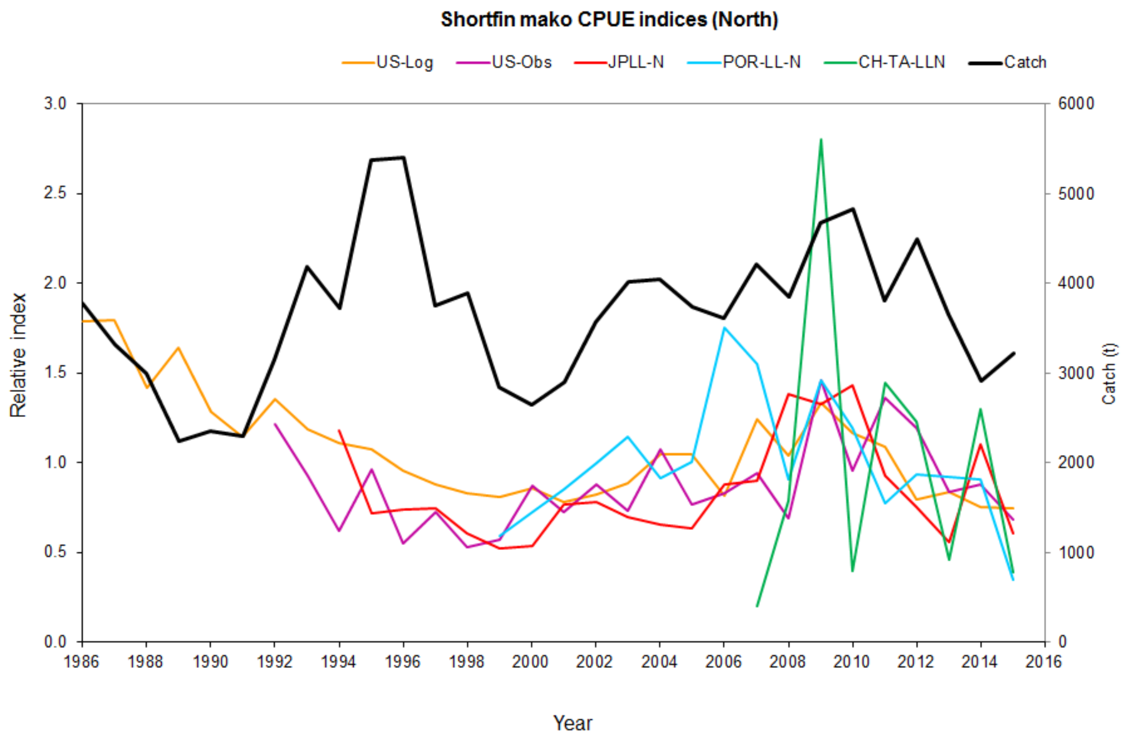


Figure 5. Available length frequencies for shortfin mako by fleet and area.



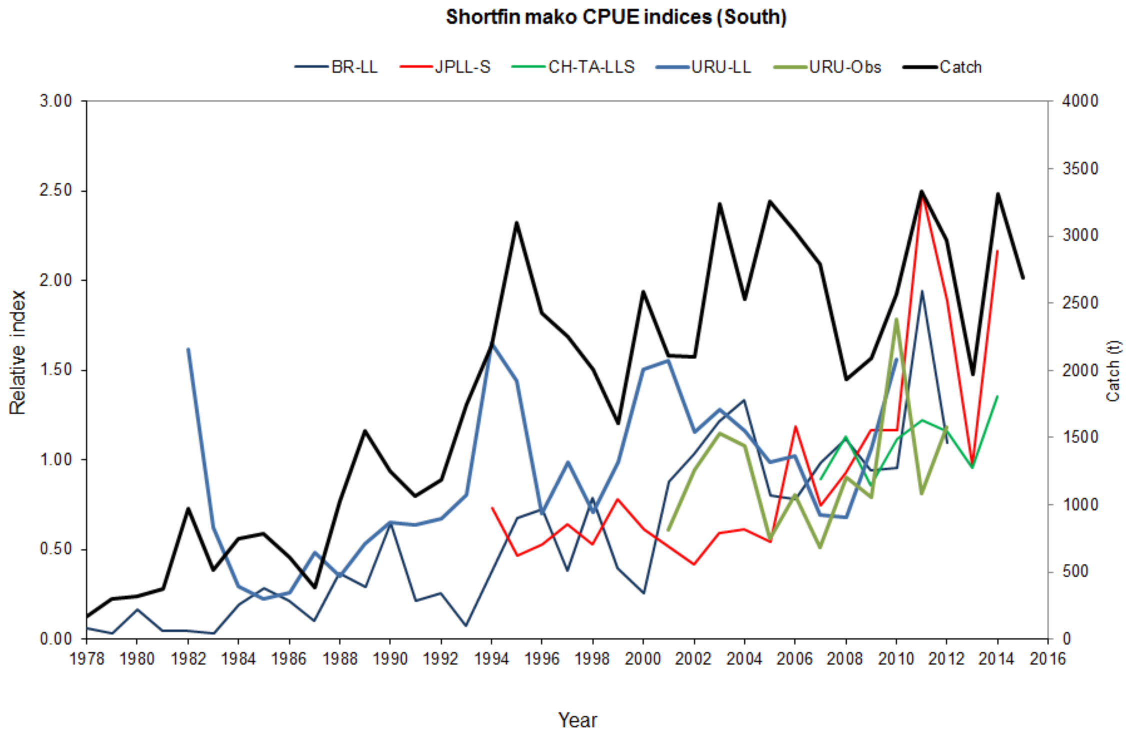


Figure 6. Selected indices of abundance and total catches for the North Atlantic and South Atlantic shortfin mako. All indices are scaled by the mean of the overlapping years between indices.

Appendix 1

Agenda

1. Opening, adoption of Agenda and meeting arrangements
2. Review of data held by the Secretariat
   - 2.1 Task I and II catch data
   - 2.2 Task II effort and size data
   - 2.3 Tagging data
3. Alternative catch estimation methodologies
4. Analysis of length composition data by sex and region to aid in the definition of fleets and specification of selectivities
5. Review of life history information
6. Review of indices of abundance, including identification of conflicting time series for potential grouping
7. Other data relevant for stock assessment and remaining issues in preparation for the June stock assessment meeting
8. Discussion on models to be used during the assessment and their assumptions
9. Shark Research and Data Collection Plan (SRDCP)
10. Other Matters
11. Recommendations
12. Adoption of the report and closure

Appendix 2

List of Participants

CONTRACTING PARTIES

BRAZIL
Hazin, Fabio H. V.
Universidade Federal Rural de Pernambuco - UFRPE / Departamento de Pesca e Aqüicultura - DEPAq, Rua Dois Irmãos, 447, Apto. 603-B, Apipucos, Recife, Pernambuco
Tel: +55 81 999 726 348, Fax: +55 81 3320 6512, E-Mail: fabio.hazin@depaq.ufrpe.br;fhvhazin@terra.com.br

CÔTE D'IVOIRE
Konan, Kouadio Justin
Chercheur Hidrobiologiste, Centre de Recherches Océanologiques (CRO), 29 Rue des Pêcheurs, BP V 18, Abidjan 01
Tel: +225 07 625 271, Fax: +225 21 351155, E-Mail: konankouadjustin@yahoo.fr

EUROPEAN UNION
Biton Porsmoguer, Sebastián
Biological Oceanographer - Fisheries Scientist, Mediterranean Institute of Oceanography (MIO), Aix-Marseille University Campus de Luminy, 13286 Marseille, France
Tel: +33 6 19 95 26 19, E-Mail: Sebastien.BITON@univ-amu.fr

Coelho, Rui
Portuguese Institute for the Ocean and Atmosphere, I.P. (IPMA), Avenida 5 de Outubro, s/n, 8700-305 Olhão, Portugal
Tel: +351 289 700 504, Fax: +351 289 700 535, E-Mail: rpcoelho@ipma.pt

Fernández Costa, Jose Ramón
Ministerio de Economía y Competitividad, Instituto Español de Oceanografía - C. Costero de A Coruña, Paseo Marítimo Alcalde Francisco Vázquez, 10 - P.O. Box 130, 15001 A Coruña, Spain
Tel: +34 981 218 151, Fax: +34 981 229 077, E-Mail: jose.costa@co.ieo.es

Macías López, Ángel David
Ministerio de Economía y Competitividad, Instituto Español de Oceanografía, C.O. de Málaga, Puerto pesquero s/n, 29640 Fuengirola Málaga, Spain
Tel: +34 952 197 124, Fax: +34 952 463 808, E-Mail: david.macias@ma.ieo.es

Rosa, Daniela
IPMA - Portuguese Institute for the Ocean and Atmosphere, Av. 5 de Outubro s/n, 8700-305 Olhão, Portugal
Tel: +351 289 700 500, E-Mail: daniela.rosa@ipma.pt

JAPAN
Semba-Murakami, Yasuko
Researcher, Tuna Fisheries Resources Group, Tuna and Skipjack Resources Division, National Research Institute of Far Seas Fisheries, 5-7-1 Orido, Shimizu-ku, Shizuoka-City, Shizuoka 424-8633
Tel: +81 5 4336 6045, Fax: +81 5 4335 9642, E-Mail: senbamak@fra.affrc.gjo.jp

MAURITANIA
Braham, Cheikh Baye
Halieute, Géo-Statisticien, modélisateur; Chef du Service Statistique, Institut Mauritanien de Recherches Océanographiques et des Pêches (IMROP), BP 22 Nouadhibou
Tel: +222 2242 1038, E-Mail: baye_braham@yahoo.fr; baye.braham@gmail.com

NORWAY
Albert, Ole Thomas
Head of Research Group for Deep Sea Species and Elasmobranchs, Institute of Marine Research, P.O. Box 6404, 9294 Tromso
Tel: +47 99626002, E-Mail: ole.thomas.albert@imr.no; oleta@imr.no

UNITED STATES
Cortés, Enric
Research Fishery Biologist, NOAA/NMFS/SEFSC Panama City Laboratory, 3500 Delwood Beach Road, Panama City Florida
Tel: +1 850 234 6541, Fax: +1 850 235 3559, E-Mail: enric.cortes@noaa.gov

Courtney, Dean
Research Fishery Biologist, NOAA/NMFS/SEFSC Panama City Laboratory, 3500 Delwood Beach Road, Panama City Beach Florida 32408
Tel: +1 850 234 6541, E-Mail: dean.courtney@noaa.gov

O'Farrell, Halie
4600 Rickenbacker Causeway, Miami, FL 33149
Tel: +1 305 421 4316, E-Mail: hofarrell@rsmas.miami.edu

URUGUAY

Domingo, Andrés
Dirección Nacional de Recursos Acuáticos - DINARA, Laboratorio de Recursos Pelágicos, Constituyente 1497, 11200 Montevideo
Tel: +5982 400 46 89, Fax: +5982 401 32 16, E-Mail: adomingo@dinara.gub.uy;dimanchester@gmail.com

SCRS CHAIRMAN

Die, David
SCRS Chairman, Cooperative Institute of Marine and Atmospheric Studies, University of Miami, 4600 Rickenbacker Causeway, Miami Florida 33149, United States
Tel: +1 673 985 817, Fax: +1 305 421 4221, E-Mail: ddie@rsmas.miami.edu

******

ICCAT Secretariat
C/ Corazón de María 8 – 6th floor, 28002 Madrid – Spain
Tel: +34 91 416 56 00; Fax: +34 91 415 26 12; E-mail: info@iccat.int

Neves dos Santos, Miguel
De Bruyn, Paul
Palma, Carlos

Appendix 3

List of Papers

Number	*Title*	*Authors*
SCRS/2017/048	A revision of the shortfin mako shark size distribution in the Atlantic using observer data from the main pelagic longline fleets	Coelho R., Domingo A., Courtney D., Cortés E., Arocha F., Liu K-M., Yokawa K., Yasuko S., Hazin F., Rosa D., and Lino P.G.
SCRS/2017/049	Standardized CPUE and size distribution of shortfin mako shark in the Portuguese pelagic longline fishery in the Atlantic	Coelho R., Rosa D., and Lino P.G.
SCRS/2017/050	Satellite tagging of shortfin mako for habitat use and post-release survival: progress report for SRDCP	Coelho R., Domingo A., Carlson J., Natanson L., Cortés E., and Miller P.
SCRS/2017/051	Progress on the Atlantic-wide study on the age and growth of shortfin mako shark: progress report for SRDCP	Rosa D., Mas F., Mathers A., Natanson L., Domingo A., Carlson J., and Coelho R.
SCRS/2017/054	Revised standardized CPUE of shortfin mako (*Isurus oxyrinchus*) caught by the Japanese tuna longline fishery in the North Atlantic Ocean between 1994 and 2015	Semba Y., Kai M., and Yokawa K.
SCRS/2017/055	Bayesian surplus production models for shortfin mako sharks: are the results consistent when using different software packages?	Babcock E., and Cortes E.
SCRS/2017/056	Stock status indicators of mako sharks in the western North Atlantic Ocean based on the US pelagic longline logbook and observer programs	Cortes E.
SCRS/2017/057	Evaluation of environmental conditions as predictors for mako shark CPUE using generalized linear mixed modeling and quantile regression	Ofarrell H., and Babcock E.
SCRS/2017/058	CPUE, size and maturity of shortfin mako, *Isurus oxyrinchus*, caught by longliners in the Southwestern Atlantic Ocean	Mas F., Forselledo R., and Domingo A.
SCRS/2017/059	Standardized CPUE of shortfin mako, *Isurus oxyrinchus*, based on data gathered by the National Observer Program on board the Uruguayan longline flee (2001-2012)	Mas F., Forselledo R., Pons, M. and Domingo A.
SCRS/2017/061	Description of a fishing of two Mauritanian longline vessels generating excessive catches of sharks	Braham C.B.
SCRS/2017/062	Updated and retrospective estimates of shortfin mako (*Isurus oxyrinchus*) landings by the Spanish surface longline fishery targeting swordfish in areas of the Atlantic Ocean during the 1950-2015 period	González-González I., Fernández-Costa J., Ramos-Cartelle A., and Mejuto J.
SCRS/2017/069	Observed live releases and dead discards of shortfin mako shark (*Isurus oxyrinchus*) from Canadian fisheries	Bowlby H., Joyce W., and Fowler M.
SCRS/2017/071	Standardized catch rates of the shortfin mako (*Isurus oxyrinchus*) caught by the Chinese Taipei longline fishery in the Atlantic Ocean	Tsai W.-P., and Liu K.-M.

Appendix 4

SCRS Document Abstracts

SCRS/2017/048 - The shortfin mako is an important shark species captured in pelagic longline fisheries targeting tunas and swordfish. As part of an ongoing cooperative program for fisheries and biological data collection, information collected by fishery observers and scientific projects from several fishing nations in the Atlantic (EU-Portugal, Uruguay, Chinese Taipei, USA, Japan, Brazil and Venezuela) were analyzed. Datasets included information on geographic location, size and sex. A total of 36,903 shortfin mako records collected between 1992 and 2015 were compiled, with the sizes ranging from 30 to 366 cm FL (fork length). Considerable variability was observed in the size distribution by region and season, with larger sizes tending to occur in equatorial and tropical regions and smaller sizes in higher latitudes. Most fleets showed unimodal distributions, but in some cases there were bimodal patterns that can complicate the stock assessment models. The distributional patterns presented in this study provide a better understanding of different aspects of the shortfin mako distribution in the Atlantic, and can be used in the 2017 ICCAT SMA stock assessment.

SCRS/2017/049 - This working document provides fishery indicators for the shortfin mako shark captured by the Portuguese pelagic longline fishery in the Atlantic, in terms of standardized CPUEs and size distribution. The analysis was based on data collected from fishery observers, port sampling and skippers logbooks (self sampling), collected between 1995 and 2015. The mean sizes were compared between years, seasons (quarters), stocks (north and south) and sampling areas. The CPUEs were analyzed for the North Atlantic and compared between years, and were modelled with tweedie and Delta GLM approaches for the CPUE standardization procedure. In general, there was a large variability in the nominal CPUE trends for the North Atlantic with the standardized series flatter than the nominal. For the size distribution there were no major trends in the time series, but the sizes tended to be larger in the South Atlantic and showed larger variability. The data presented in this working document can be considered for use in the upcoming 2017 shortfin mako stock assessment in the Atlantic Ocean, specifically the standardized CPUE for the North Atlantic and the size distribution for both hemispheres.

SCRS/2017/050 - This paper provides an update of two projects developed within the ICCAT Shark Research and Data Collection Program (SRDCP) using satellite telemetry, specifically a study on habitat use and another on post-release survival. Currently, all phase 1 (2015-2016) tags (23 tags: 9 miniPATs and 14 sPAT) have been deployed by observers on Portuguese, Uruguayan and US vessels in the temperate NE, temperate NW and SW Atlantic. A total of 668 tracking days have been recorded so far. The preliminary movement analysis shows that specimens tagged in the temperate NE moved to southern areas, while specimens tagged in the tropical NE region close to the Cabo Verde Archipelago moved easterly to the African continent shelf. One specimen was tagged in equatorial waters and moved south to Namibia. The specimens tagged in the SW Atlantic off Uruguay stayed in the same general area, and the specimens tagged in the temperate northwest Atlantic showed some general southward movements. In terms of post-release survivorship, data from 19 tags/specimens has been used. From those, 6 specimens died (31.6%) while the remaining 13 (68.4%) survived, at least the first 30 days after tagging. All planned project milestones and deliverables have been achieved and delivered in due time, including additional deliverables that were not originally planned. For the 2nd phase of the project (2016-2017) 12 miniPATS were acquired and will be deployed during 2017 in various regions of the Atlantic, including temperate, tropical and equatorial waters.

SCRS/2017/051 - The ICCAT Shark Research and Data Collection Program (SRDCP) aims to develop and coordinate science and science-related activities needed to support provision of sound scientific advice for the conservation and management of pelagic sharks in the Atlantic. This Program was developed in 2013-2014 by the Sharks Species Group, and framed within the 2015-2020 SCRS Strategic Plan. Within this Program, a specific study on the age and growth of shortfin mako in the Atlantic was developed, with the purpose of contributing to the 2017 ICCAT shortfin mako stock assessment. In the paper, we provide an update of the project, including preliminary growth models for the North Atlantic Ocean.

SCRS/2017/054 - Previous estimates of standardized CPUE for shortfin mako (*Isurus oxyrinchus*) caught by Japanese tuna longline fishery in the Atlantic Ocean was revised with consideration for the temporal changes in the operational pattern for Japanese fleet in the North Atlantic between 1994 and 2015. Investigation of spatiotemporal distribution of fishing effort suggested that displacement of fishing effort for Atlantic bluefin tuna (*Thunnus thynnus*) especially in the area north of 20˚ N caused unrealistic decline of CPUE for the North Atlantic shortfin mako in the past five years in the previous analysis. Based on the investigation of number of set and nominal CPUE of shortfin mako, area stratification was revised and explanatory variables included in GLM analysis was modified. Following the data filtering described in Semba *et al.* (2012), CPUE of North Atlantic shortfin mako was standardized using zero inflated negative binomial model. The revised abundance index showed a declining trend in the earliest few years and stable trend around 0.1 (fish/1000 hooks) between 1995 and 2005, followed by continuous increasing and declining trend between 2005 and 2013. Although uncertainty has been left in the estimates of several years, the current analysis improved the uncertainty indicated since late 2000s in the past analysis and suggested that annual trend of the abundance index would not show continuous increasing/decreasing trend between 1994 and 2015.

SCRS/2017/055 - The Bayesian Surplus Production (BSP) software, which uses the Sampling-Importance-Resampling (SIR) method to integrate posterior distributions, was used for the ICCAT mako assessments through 2012. The 2014 assessment of blue shark used both the BSP software and the Markov Chain Monte Carlo (MCMC) algorithm, implemented in the JAGS software, and found that the JAGS and BSP model results were not always consistent. We applied both the BSP1 software (without process error) and the BSP2 software (with process error), and two independent MCMC software packages, JAGS and Stan, to the data from the 2012 mako shark assessment to determine whether the same problem exists. Although all modeling packages give similar results for other species, they are not consistent for mako sharks. This may be because there is a long period of catches with no CPUE data, or because the catch and CPUE data are not consistent with each other.

SCRS/2017/056 - Two stock status indicators were examined for mako sharks (*Isurus* spp.) encountered by the US pelagic longline fleet. First, standardized indices of relative abundance were developed from data in the US pelagic longline logbook program (1986-2015) and the US pelagic longline observer program (1992-2015). Indices were calculated using a two-step delta-lognormal approach that treats the proportion of positive sets and the CPUE of positive catches separately. Observations that were affected by fishing regulations (time-area closures or bait restrictions) were subsequently excluded in a restricted analysis. The logbook time series showed a concave shape from the beginning of the series in the mid-1980s to 2009-2010, followed by a downward trend thereafter. The observer time series also showed a concave shape from the beginning of the series in the early 1990s to 2011, followed by a declining trend thereafter. Overall, the logbook index did not show a substantial change in relative abundance since the late 1990s and the observer index showed a generally increasing tendency since the mid-1990s. The lack of strong trends in all series suggests that the status of the stock is stable, yet the declining trend since 2009-2011 should continue to be closely monitored. No discernible trends in size were detected, suggesting that no specific segment of the population is being disproportionately affected.

SCRS/2017/057 - Environmental conditions were evaluated for their influence on catch per unit effort (CPUE) of shortfin mako (*Isurus oxyrinchus*). Catch rates of shortfin mako were calculated from the US pelagic longline observer program (1992-2016) using a generalized linear mixed model (GLMM) with a delta-lognormal approach. The GLMM analysis included consideration of the following environmental variables as predictor variables: sea surface height, sea surface temperature, and bathymetry. The addition of environmental predictor variables resulted in an index that spans 2003-2012. The final index was used to predict average catch per unit effort (CPUE) based on environmental conditions. The two portions of the delta-lognormal approach retained different suites of variables with sea surface temperature and bathymetry retained to predict proportion of positive sets while bathymetry was retained to predict the CPUE of positive catches. Quantile regression was also performed to evaluate whether environmental variables can predict spatial areas with high CPUE. As with the delta approach, environmental data were used to predict conditions that favour high CPUE. Maps generated from both the approaches will later be used for determining mako shark habitat for a spatial management strategy evaluation.

SCRS/2017/058 - This documents presents preliminary results comparing shortfin mako CPUE and mean shark size between longline fishing vessels with different gear configurations, namely: deep vs. shallow sets, and fishing sets using reinforced stainless steel branch lines vs. simple monofilament branch lines. Male size at maturity and length-HG relationship for both sexes combined are also presented. All data analyzed was gathered by the Uruguayan National Observer Program and on board the R/V Aldebarán form DINARA. Comparisons of CPUE and mean fork length between deep and shallow fishing sets was assessed by analyzing Japanese and Uruguayan longline fishing vessels operating within the Uruguayan Exclusive Economic Zone. Within the Uruguayan longline fleet, the use of reinforced branch lines in some vessels and the use of simple nylon monofilament branch lines in others also allowed the comparison of both CPUE and mean fork length of captures between these different configurations of shallow longline fishing sets. Results suggests that shortfin mako CPUE is considerably lower in deep fishing sets compared to shallow fishing sets, whereas both types of shallow fishing sets render similar CPUE values. Mean fork length of sharks caught was higher in shallow fishing sets using reinforced branch lines, but was not significantly different between shallow simple branch line sets and deep sets. Although these results should be considered preliminary and further analysis are needed, this document highlights the potential effects of deep vs. shallow longline sets, as well as different branch line configurations, over the catchability and selectivity of the shortfin mako. It is suggested that these aspects should be taken into consideration when standardizing

CPUE time series and in the assessment models as they could potentially bias the results if not considered. Based on catch data from the Uruguayan longline fleet using reinforced branch lines, smaller size classes of the shortfin mako seem to occur at intermediate latitudes. Male size at maturity based on maturity ogives and clasper-fork length relationships rendered consistent results with a median size at maturity (LMat50%) of 166 cm FL and a full size at maturity (LMat100%) of 180 cm FL. Median size at maturity estimates were smaller than those reported for the North Atlantic, as it has also been reported to be the case in females.

SCRS/2017/059 - This study presents the standardized catch rate of shortfin mako shark, *Isurus oxyrinchus*, caught by the Uruguayan longline fleet in the Southwestern Atlantic using information from national on board observed program between 2001 and 2012. Because of the large proportion of zeros catches (23%) the CPUE (catch per unit of effort in n° of individuals) was standardized by Generalized Linear Mixed Models (GLMMs) using a Delta Lognormal approach. The independent variables included in the models as main factors and first-order interactions in some cases were: Year, Quarter, Area, Sea Surface Temperature and Gear. A total of 1,706 sets were analyzed. Standardized CPUE showed an apparent increasing trend during the last six years of the study period.

SCRS/2017/061 - Ce travail décrit la marée de deux palangriers Mauritaniens travaillant en 2016 et ciblant les espèces de thons. Les captures réalisées pendant cette marrée sont constitués de 99% des requins y compris le requin taupe-bleu. En absence des observations scientifiques à bord pendant cette marée, nous avons trouvé une difficulté pour identifier les espèces débarquées. Les captures importantes des requins réalisées nous interpellent sur les prises importantes de 62 thoniers travaillant dans la zone Mauritanienne dans le cadre des accords de pêche dont le débarquement est effectué en dehors de la Mauritanie. Un suivi rapproché de l’activité des palangriers et d’autres flottilles thonières devraient être renforcé et assurée pour mieux décrire et comprendre la dynamique de cette pêcherie.

SCRS/2017/062 - Landings of shortfin mako (*Isurus oxyrinchus*) by the Spanish surface longline fleet targeting swordfish in Atlantic areas were estimated for the period 1950-2015 combining different sources of information. Landings from the period 1950-1982 were obtained by the retrospective application of the ratio between shortfin mako and the target species (swordfish) landings observed at the beginning of the 1980s in this fishery. Landings for the period after 1982 were estimated either by reports available in literature for some of the years or by means of trip reports for the periods in which data were not previously available. A new data set was generated for the nine-year period 1988-1996 applying a data mining approach to trips during that period. Additionally, a revision of the Task I data available in the ICCAT data base 1997-2015 was carried out. Information from all these sources was combined to revise the data available and propose a new set of figures for landings by stock for the period 1950-2015.

SCRS/2017/069 - As requested by the ICCAT shark species group, this paper provides Shortfin Mako shark (*Isurus oxyrinchus*) discards (alive and dead) from Canadian fisheries in the Northwest Atlantic Ocean. Official data on discards from Canada has not traditionally been available for this species, even though an observer program has been in place since the late 1980s. Here we have included records from all fisheries within the Canadian EEZ (both national and ICCAT managed) that capture Shortfin Mako, with the expectation that this may be more informative for population assessment relative to reporting discards from ICCAT-managed fisheries only. The available data is partitioned into live releases and dead discards for use in assessment, as in Task 1 catch data submissions to ICCAT. Only at-vessel mortality was considered when partitioning totals, post-release mortality estimates were not used to adjust for probable mortality of sharks released alive. We recognize that this is an interim document in that further work may be done to scale up observed discard values to fishery-level totals. However, further analyses and the regional data to support them were not available in time for the 2017 data inputs meeting for Shortfin Mako shark.

SCRS/2017/071 - In this document, the shortfin mako shark catch and effort data from observers’ records of Chinese Taipei large longline fishing vessels operating in the Atlantic Ocean from 2007-2015 were analyzed. Based on the shark by-catch rate, four areas, namely, I (north of 20ºN), II (5ºN-20ºN), III (5ºN-15ºS), and IV (south of 15ºS), were categorized. To cope with the large percentage of zero shark catch, the catch per unit effort (CPUE) of shortfin mako shark, as the number of fish caught per 1,000 hooks, was standardized using a two-step delta-lognormal approach that treats the proportion of positive sets and the CPUE of positive catches separately. Standardized indices with 95% bootstrapping confidence intervals are reported. The standardized CPUE of shortfin mako sharks in the South Atlantic was relatively stable from 2007-2013 but peaked in 2014 and decreased in 2015. The standardized CPUE peaked in 2009, decreased in 2010 and fluctuated thereafter in the North Atlantic. The shortfin mako shark by-catch in weight of the Chinese Taipei large-scale longline fishery ranged from 2 tons (1989) to 89 tons (2009) in the North Atlantic Ocean and ranged from 29 tons (1989) to 280 tons (2011) in the South Atlantic Ocean.

Appendix 5

CPUE Analysis

The CPUE time series are plotted in **Appendix 5-Figure 1** along with a lowess smoother fitted to CPUE each year using a general additive model (GAM) to compare trends by stock (North Atlantic and South Atlantic). The overall trend for the Northern indices is an initial decrease followed by an increase from 2000 and a decline in the recent years. While for the South a continuous increase in abundance is seen, which may be difficult to explain as an increase catches has also been seen over the time series.

Residuals from the lowess fits to CPUE are compared in **Appendix 5-Figure 2** to look at deviations from the overall trends. This allows conflicts between indices (e.g. highlighted by patterns in the residuals) and autocorrelation within indices (which may be due to year-class effects or the importance of factors not included in the standardization of the CPUE) to be identified. For example, in the Japanese longline series in the South, there is a series of negative residuals in the mid period (e.g., evidence for a less marked increase), and some evidence of autocorrelation and higher variability in the more recent years.

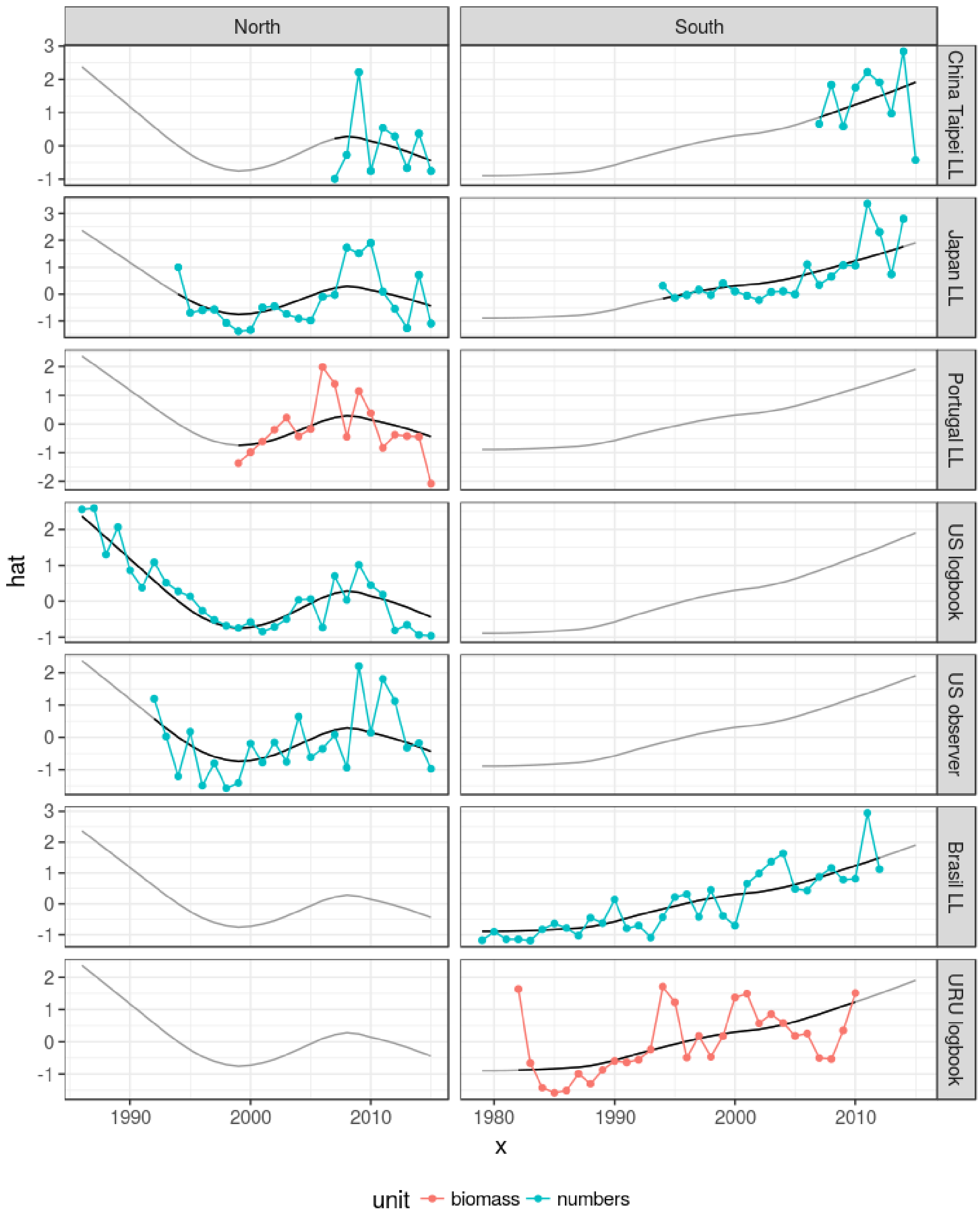
Correlations between indices were evaluated for the North Atlantic in **Appendix 5-Figure 3**. The lower triangle shows the pairwise scatter plots between indices with a regression line, the upper triangle provides the correlation coefficients, and the diagonal provides the range of observations. A single influential point may cause a strong spurious correlation, so it is important to look at the plots as well as the correlation coefficients. For example, the correlation between US observer and Chinese Taipei is high at 0.78; however, this is likely to be due to a single point (i.e. 2009). Also, a strong correlation could be found by chance if two series only overlap for a few years.

If indices represent the same stock components, then it is reasonable to expect them to be correlated. If indices are not correlated or are negatively correlated, i.e. they show conflicting trends, then this may result in poor fits to the data and bias in the parameter estimates obtained within a stock assessment model. Therefore, the correlations can be used to select groups of indices that represent a common hypothesis about the evolution of the stock (ICCAT 2016, 2017). **Appendix 5-Figure 4** shows the results from a hierarchical cluster analysis evaluated for the North Atlantic using a set of dissimilarities. All series appear to be similar, with the US observer and Chinese Taipei having the greatest similarity, but, as mentioned above, this could be due to one influential point.

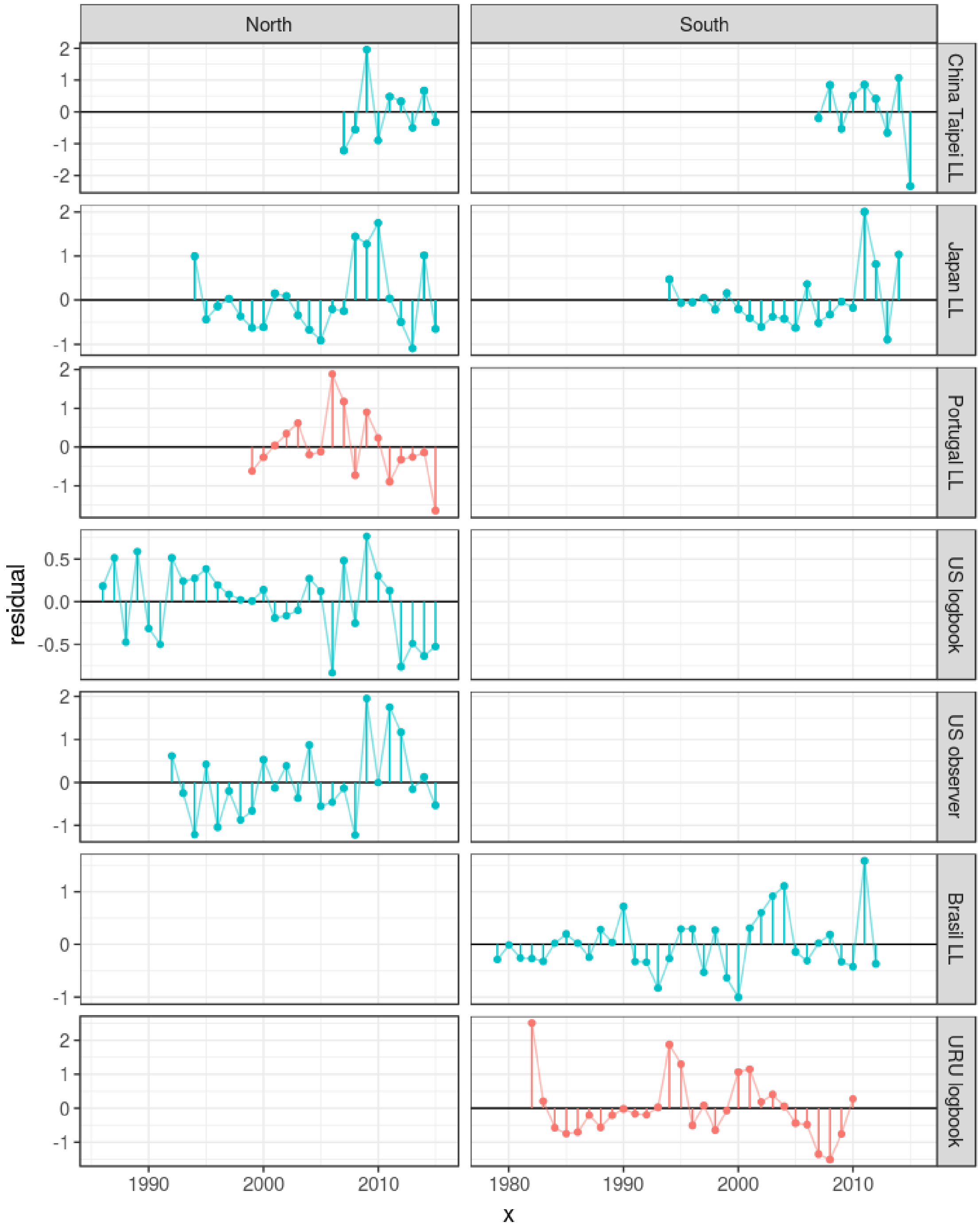
Cross-correlations for the North Atlantic are plotted in **Appendix 5-Figure 5** (i.e., the correlations between series when they are lagged by -10 to 10 years). The diagonals show the autocorrelations of an index lagged against itself. For example, the US logbook (3rd diagonal element) shows strong autocorrelation over 3 years, this could be due to year-class effects. This could also be a reason for strong cross-correlations between series. A strong negative or positive cross-correlation could be due to series being dominated by different age-classes, e.g. Portuguese longline and US observer has a negative lag of 2-3 that could be due to the US series catching younger individuals.

The corresponding plots for the South Atlantic are shown in **Appendix 5-Figures 6, 7 and 8**.

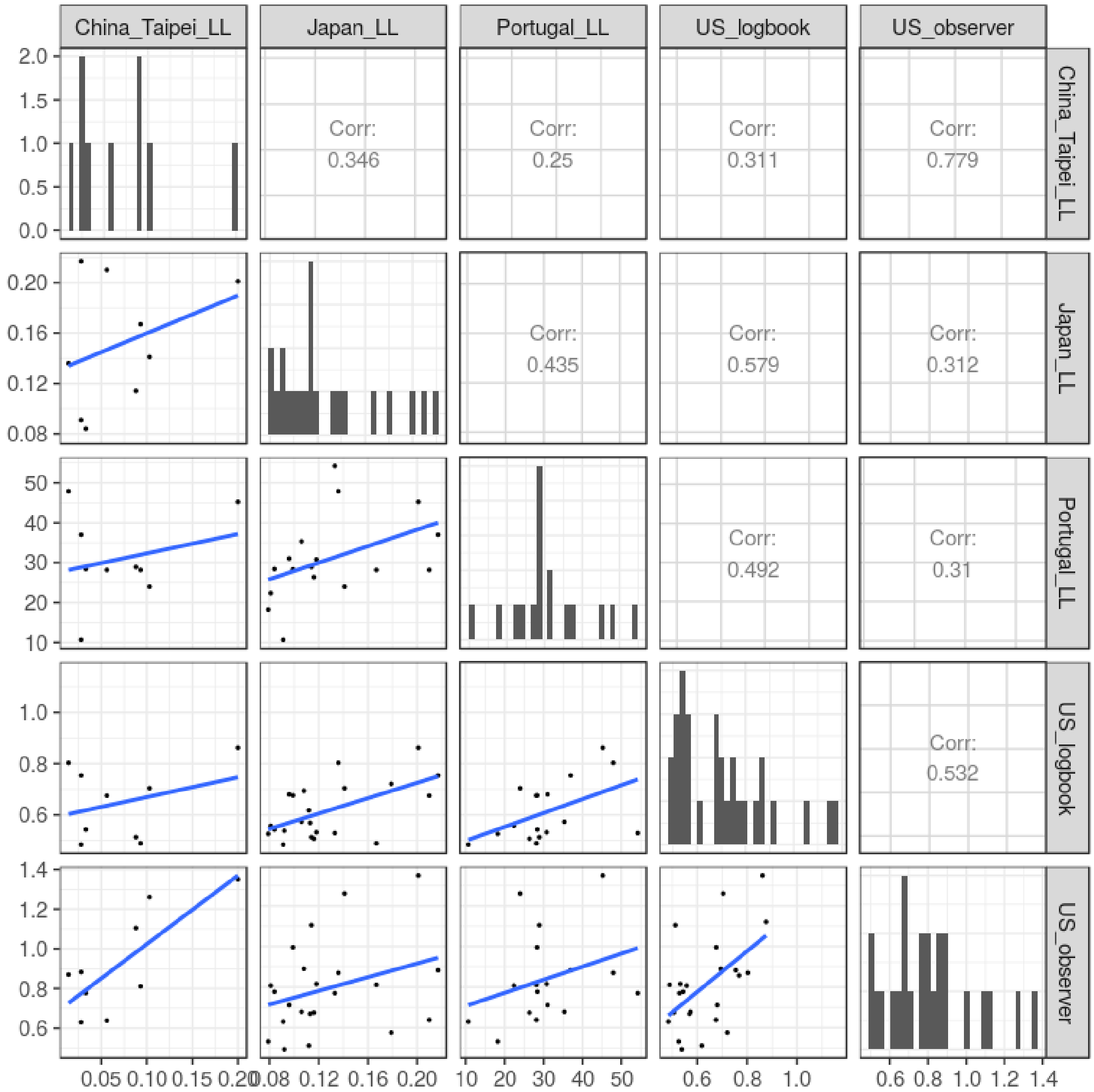
All analyses was conducted using R and FLR and the diags package which provides a set of common methods for reading these data into R, plotting and summarizing them (e.g., see: http://www.flr-project.org/).



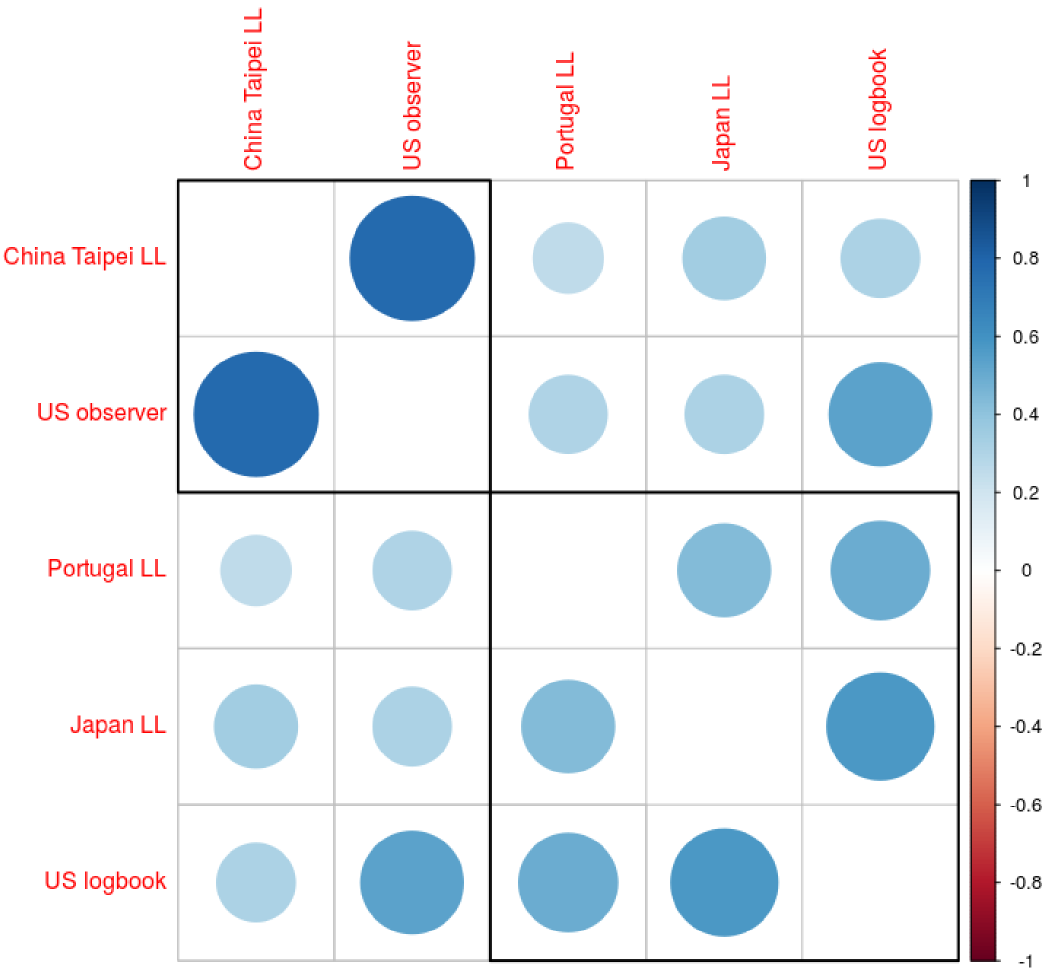
Appendix 5-Figure 1. North and South Atlantic time series of agreed CPUE indices, points are the standardised values, continuous black lines are a loess smoother showing the average trend by area (i.e. fitted to year for each area with series as a factor). X-axis is time, Y-axis are the scaled indices.



Appendix 5-Figure 2. North and South Atlantic time series of residuals from the loess fit to agreed indices. X-axis is time, Y-axis are the scaled indices.



Appendix 5-Figure 3. North Atlantic pairwise scatter plots for agreed indices. X- and Y-axis are scaled indices.



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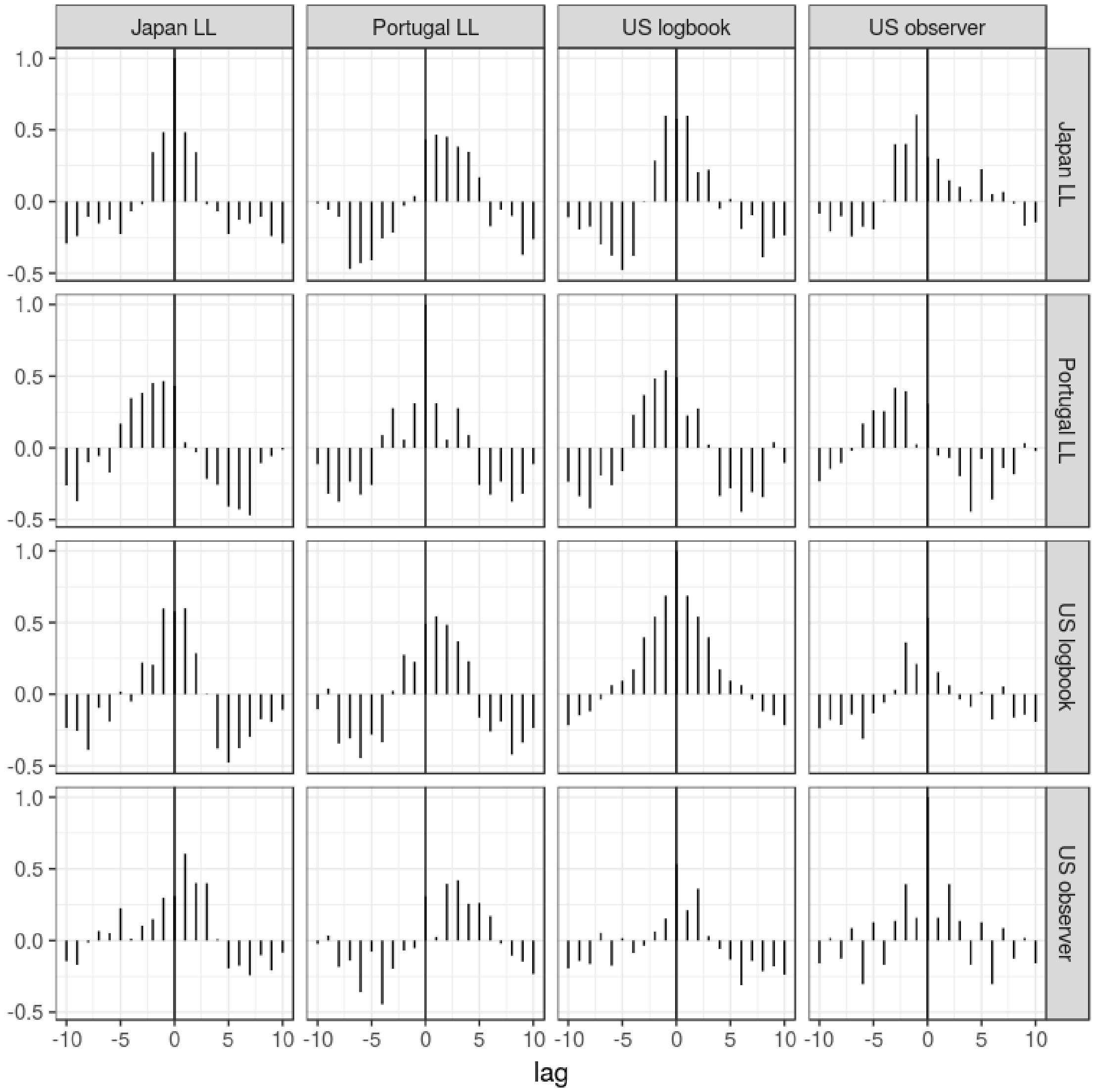
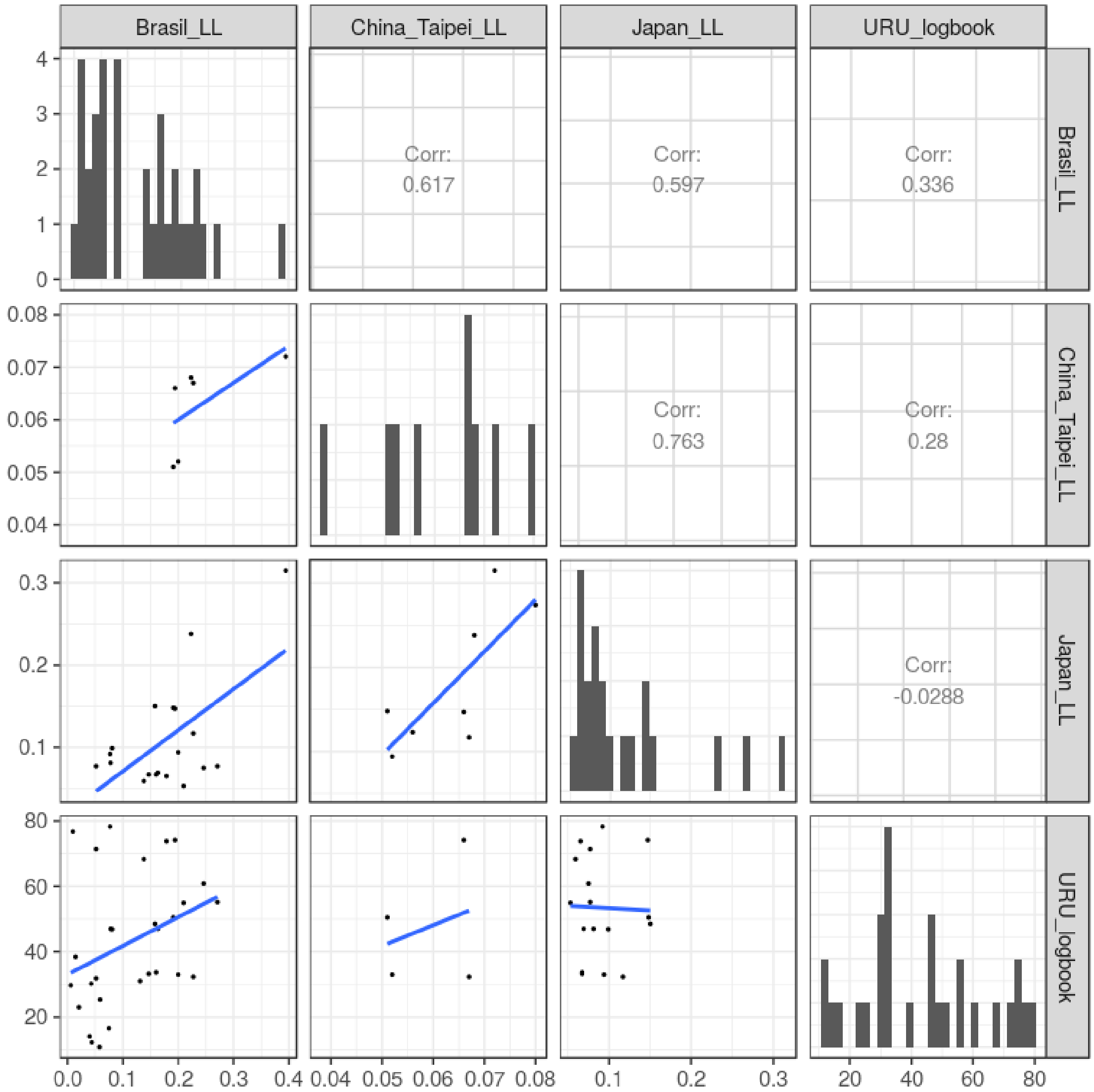
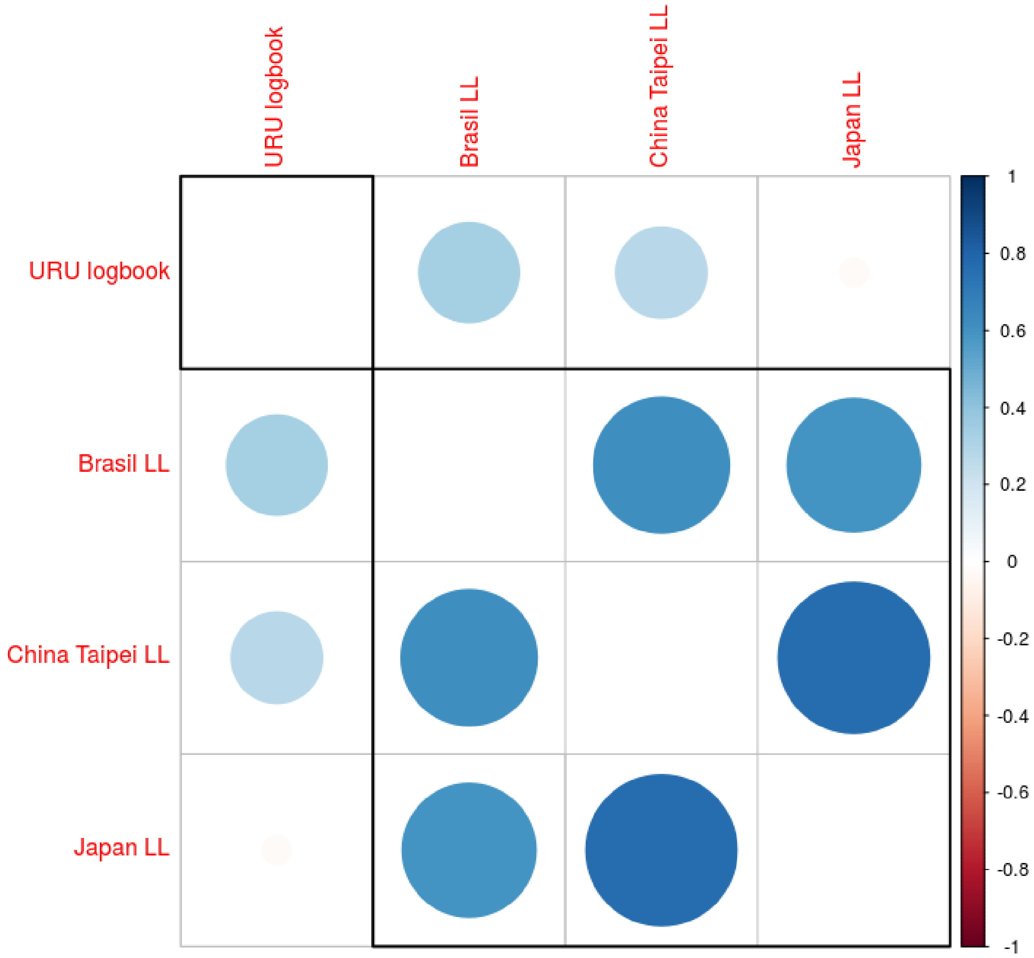
Appendix 5-Figure 4. North Atlantic correlation matrix for the agreed indices; blue indicates positive and red negative correlations, the order of the indices and the rectangular boxes are chosen based on a hierarchical cluster analysis using a set of dissimilarities.



Appendix 5-Figure 5. North Atlantic cross-correlations between agreed indices to identify lagged correlations (e.g., due to year-class effects). X-axis is lag number, and y-axis is cross-correlation.



Appendix 5-Figure 6. South Atlantic pairwise scatter plots for agreed indices. X- and y-axis are scaled indices.



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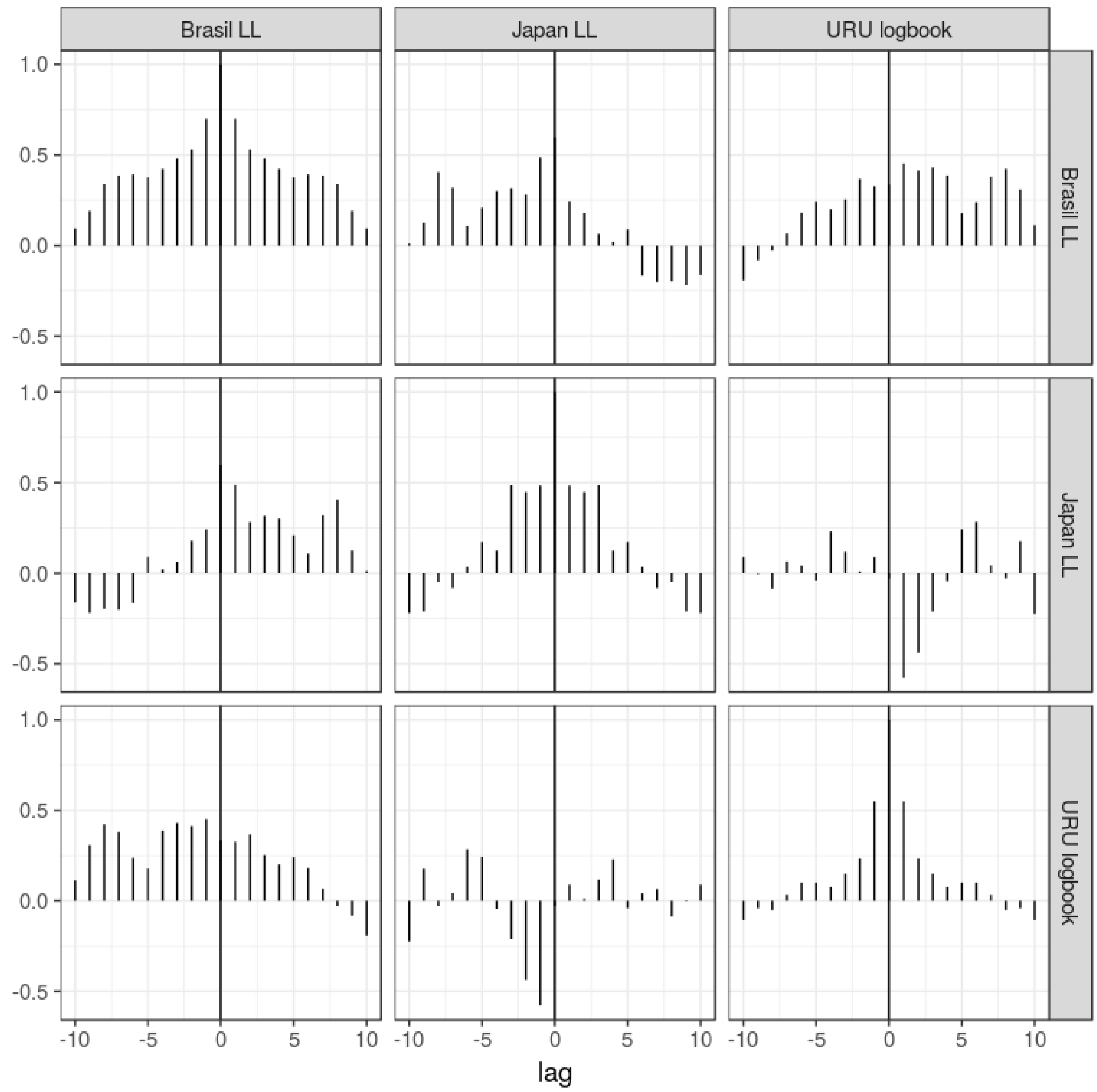
Appendix 5-Figure 7. South Atlantic correlation matrix for the agreed indices; blue indicates positive and red negative correlations, the order of the indices and the rectangular boxes are chosen based on a hierarchical cluster analysis using a set of dissimilarities.



Appendix 5-Figure 8. South Atlantic cross-correlations between agreed indices to identify lagged correlations (e.g., due to year-class effects). X-axis is lag number and y-axis is correlation.