2012 SHORTFIN MAKO STOCK ASSESSMENT AND ECOLOGICAL RISK ASSESSMENT MEETING

(Olhão, Portugal - June 11 to 18, 2012)

1. Opening, adoption of Agenda and meeting arrangements

Dr. Paul de Bruyn, on behalf of the ICCAT Executive Secretary, opened the meeting and welcomed participants. The meeting was chaired by Dr. Andrés Domingo, the Shark Species Group Rapporteur. Dr. Domingo welcomed Working Group participants and addressed the terms of reference for the meeting.

After opening the meeting, the Agenda was reviewed and adopted without changes (**Appendix 1**). The List of Participants is included as **Appendix 2**. The List of Documents presented at the meeting is attached as **Appendix 3**.

The following participants served as Rapporteurs for various sections of the report:

Section	*Rapporteurs*
1	P. de Bruyn
2	F. Lucena, Y. Semba-Murakami, K. Yokawa
3	E. Cortés, Y. Semba-Murakami, K. Yokawa
4	R. Coelho, M. Neves dos Santos, C. Palma, E. Cortés, P. de Bruyn
5	E. Babcock, E. Cortés
6	E. Babcock, E. Cortés
7	E. Babcock, E. Cortés
8	J. Santiago, A. Domingo
9	A. Domingo

2. Review of the information for the Ecological Risk Assessment (ERA)

The following documents were presented in this section: SCRS/2012/040, SCRS/2012/071 and SCRS/2012/079.

SCRS/2012/040 addresses sampling of Venezuelan artisanal off-shore longline fleets targeting tuna and tuna-like species (e.g., billfish and sharks). This is an enhanced species-specific monitoring program for vessels <15m that summarizes at-sea sampling protocols and associated activities to estimate total catches of tuna and tuna-like species, particularly shark species. It illustrates and provides a successful approach for at-sea sampling of artisanal fishing vessels targeting tuna-like species (sharks and billfish). The Group suggested that this approach be considered as a successful reference for monitoring many of the ICCAT Atlantic artisanal fleets that target tuna-like species.

Document SCRS/2012/079 presented a level-2 semi-quantitative Productivity Susceptibility Analysis (PSA) applied to 29 elasmobranchs of northern European shelf seas based on four mixed fisheries in both the demersal (otter trawl and set net) and pelagic (longline and trawl) environments. In the demersal ecosystem, spurdog were found to be the most vulnerable species in both bottom trawl and set net fisheries. A further six elasmobranchs (tope, blonde, thornback, sandy, shagreen, and undulate ray) and two teleosts (Norway redfish and cod – as the main target teleost) comprised the 10 most vulnerable species in demersal fisheries. In the pelagic ecosystem, porbeagle were identified as the most vulnerable followed by three further commercially-important bycatch sharks (shortfin mako, thresher and blue shark), and then swordfish, a target teleost. Within the discussion, information on how the relative risk rankings included in the model were accounted was requested.

Comment was made on the choice of the appropriate population parameters when several estimates are available. Regarding the scoring for the biological traits, it was clarified that the level of confidence was based on expert judgment and discussion among the personnel involved in the research. The difference with the results of ERA conducted previously in ICCAT was also discussed and it was noted that the difference may be explained by the quantitative approach adopted by ICCAT. A question regarding whether this approach could be extended across all fisheries operating in an area, in one ERA was asked, and although not done in this study, relative weightings can be given to each fishery examined in the ERA. Comments regarding the future application of the ERA included parameter 'aggregating nature' for other species assessments such as pelagic teleosts were made. The outliers seen with respect to the ground-truthing exercise were commented upon, and it was re-iterated that an ERA can only give risk ratings in relation to the other species included, and is to identify research priorities – it is not intended to be conducted in the place of a quantitative stock assessment

Document SCRS/2012/071 presented preliminary information on the biology and movements of the porbeagle from electronic tagging studies (14 sharks and 2062 days of data) conducted around the British Isles. The furthest confirmed distance recorded by a porbeagle shark from the British Isles, was from a shark which moved to the west central Atlantic after being tagged in north-west Ireland during the summer. Overall, sharks showed short, frequent shallow diving behavior in shelf seas (<150m), and long, deeper diving over the continental slope (>200m), that appear to correspond to the day/night cycle. Information from discard observer programme were also presented as well biological information was provided for length-weight conversion factors, data on liver, gonads and fin weights, as proportions of total weight, were also summarized.

3. Ecological Risk Assessment (ERA): Productivity and Susceptibility

Ecological Risk Assessment (ERA), also known as productivity and susceptibility analysis (PSA) has become a common tool to provide information for data-limited shark populations. The SCRS was a pioneer in applying ERA analysis for 11 pelagic shark and 1 ray species in 2008; the Shark Detailed Report of 2008 (Anon., 2008) gives detailed information on the analysis. This was later peer reviewed and published in Cortés et al. (2010).This approach is not a substitute for stock assessment, but can be used to help determine appropriate management action and research recommendations. This type of analysis typically assesses the risk based on two factors: biological productivity and susceptibility to a particular type of fishery. Although the analysis can be undertaken at different levels (from purely qualitative to semi-quantitative to quantitative), we conducted a level-3 quantitative ERA. We were able to complete the productivity analysis portion of the ERA for 16 species (*Prionace glauca, Isurus oxyrinchus, Isurus paucus, Lamna nasus, Sphyrna zygaena, Sphyrna lewini, Alopias vulpinus, Alopias superciliosus, Carcharhinus longimanus, Carcharhinus falciformis, Carcharhinus signatus, Carcharhinus obscurus, Carcharhinus plumbeus, Galeocerdo cuvier, Pteroplatytrygon violacea, Sphyrna mokarran*) of pelagic elasmobranchs taken in Atlantic pelagic longline fisheries. Five of these species (*C. signatus, C. obscurus, C. plumbeus, G. cuvier,* and *S. mokarran*) had not been assessed in 2008. The susceptibility component will be completed after the meeting because not all data were made available in time for analysis. In addition to Brazil, Namibia, Portugal, Uruguay, USA, and Venezuela, which also provided information for the 2008 assessment, five new countries provided data for the current ERA (Canada, Japan, Mexico, South Africa, and Chinese Taipei).

The biological information used to conduct the productivity analysis is listed in **Table 1**. The analysis incorporated uncertainty in the knowledge of the biological parameters through Monte Carlo simulation of life tables and Leslie matrices. Briefly, uncertainty was incorporated by randomly drawing values from probability density functions (pdfs) of age at maturity, longevity, age-specific natural mortality and age-specific fecundity. Results of the productivity analysis are listed in **Table 2**. The most productive species was the blue shark, and the least, the bigeye thresher shark. These results will be combined with those of the susceptibility analysis to provide an overall vulnerability ranking for the species/stocks included. The susceptibility factor is calculated as the product of four conditional probabilities: availability of the stock to the fishery (i.e., the horizontal overlap between the stock and fleet distributions), encounterability of the stock by the fishing gear (i.e., the vertical overlap between animal distribution and depth at which the gear fishes), selectivity (i.e., the probability of the animal getting caught if it encounters the gear), and post-capture mortality (i.e., the probability that the animal will die once it has been caught). Data for the susceptibility factor have already been assembled for the availability and post-capture mortality components for the fleets of CPCs that provided observer information (Brazil, Canada, Japan, Mexico, Namibia, Portugal, South Africa, Uruguay, USA and Venezuela). During the meeting information from Chinese Taipei was received, and it will be incorporated into the analysis. Data for the encounterability component will be assembled based on qualitative or quantitative descriptions of the depth at which gear fishes for each fleet and data on the vertical habitat use of pelagic sharks obtained through archival tags presented in published papers or made available to the shark Working Group, specifically for use in the analysis. Data for the selectivity component will be assembled based on already available lengths of animals recorded in observer programs, which will then be compared to predicted lengths obtained from stable age distributions from the demographic analyses to calculate an overlap between the two.

Maps of species distribution (**Figures 1 to 17**) and of effort for 1995-2009 by individual fleets (**Figures 18 to 28**) are presented. Participants agreed that as for productivity and susceptibility, information and comments are expected within two weeks after the end of the meeting for those maps. The ERA analysis will be completed and presented as an SCRS document at the September species group meeting.

4. Review of the data for the Shortfin mako assessment

4.1 Biological data, including tagging data

SCRS/2012/033 addressed shortfin mako shark length composition, spatial and temporal sex ratio from the Venezuelan Pelagic Longline fishery, and reported by trained observers for the period 1994-2011 in the Caribbean Sea and adjacent Atlantic. Shortfin mako were caught in 3% (n=161) of the observed pelagic longline sets and most of the shortfin mako sharks were caught in the Caribbean Sea (79%). Pooled seasonal size information indicated that mean size for males ranged from 158.5 to 187.5 cm FL and for females ranged from 163.9 to 189.5 cm FL. The overall sex ratio was dominated by females (56%) in the Caribbean Sea, and seasonal sexual segregation in the Caribbean Sea resulted in an increasing gradient from Oct-Dec through to July-September where the proportion of females increased progressively from a low of 0.30 to 0.70.

SCRS/2012/073 reported an overview of the catch-at-size and sex-ratios of shortfin mako captured by the Portuguese pelagic longline fishery in the Atlantic Ocean. The analysis presented was based on data collected from fishery observers onboard commercial vessels, and from skippers logbooks (self sampling program). The data series included catch-at-size information between the years of 1997 to 2011, and was analyzed in terms of trends between years, seasons and regions. The sex-ratios proportions were compared between region and seasons. In general, a tendency for decreasing captured sizes for the more recent years was noted, particularly for the South Atlantic. In terms of regional analysis, there were significant differences in the mean catch-at-size between regions, with a tendency for smaller sized specimens in the northern areas and larger specimens in the tropical and southern regions. In terms of seasonal variations, the size distribution along the year (analysed by month) were relatively similar for the North Atlantic, while in the South Atlantic there were more noticeable differences, with smaller sized specimens captured during the months of May and June. In terms of sex-ratios, significant differences were found between major fishing regions, with higher proportions of males found in the NE and SW Atlantic regions, while higher proportions of females were found in the eastern tropical and southeast Atlantic. Seasonal differences in the sex-ratios were found for the south, but not in the north Atlantic.

The Secretariat presented a summary of the current conventional tagging information available in the ICCAT database. This update already contains the integration of about 130,000 new tagging events reported by the United States (APEX tagging program) during the year. For shortfin mako (**Table 3** and **Figure 29**) there are now over 9200 releases and 1200 recaptures, with around 60% within 2 years at large. Almost all releases and recaptures were concentrated in the northeast coast of the United States. For porbeagle, there are 1960 tag releases and 340 recaptures (**Table 4** and **Figure 30**). The blue shark (BSH) total number of releases is about 136 thousand releases (with 8750 recaptures). **Table 5** presents a summary table of releases and recaptures and **Figure 31** a density plot in 5x5 degree squares.

4.2 Catch estimates

The Secretariat presented to the Working Group the most recent TaskI nominal catch statistics available for shortfin mako (SMA, *Isurus oxyrinchus*) and the other shark species included in the Ecological Risk Analyses (ERA). **Table 6** presents the standard SMA executive summary table with total landings and discards by stock, flag and major gears. The total Task I catches of the 18 sharks used in ERA by year are presented in **Table 7**. Despite some important Task I catch series recovered (EU-España: 1997-2010; EU-Portugal: 1990-2010; Uruguay: 1981-2010; South Africa: 1998-2010) in recent years, the Working Group considers that the SMA overall catch reported as Task I continues to be underestimated, in particular before 2000 (incomplete series can be seen in **Table 6)**. The aggregated catches, shown in **Figure 32** (cumulative SMA Task I catch by stock) and **Figures 33** and **34** (respectively, Northern and Southern stocks cumulative SMA Task I catches by major gear), clearly differentiate these two periods: historical period (1990s and before) where the reported Task I is incomplete, and, recent period (end of the 1990s onwards) where a larger number of Task I catch series were reported. The Working Group restated the need to recover the missing (incomplete in some cases) SMA catch series of the historical period where some important longline fleets (Belize, China PR, Chinese Taipei, Korea, Panama, Philippines, Mexico, Vanuatu, etc.) were identified as having the potential to catch pelagic sharks.

During the 2011 Shark Data Preparatory Meeting (Anon, 2012), the Working Group recognized that, historically, sharks were reported in aggregated form (no species breakdown) by a considerable number of the above mentioned fleets. Those sharks “unclassified” catch series (CVX: Carcharhiniformes; CXX: Coastal Sharks nei; DGX: Squalidae; PXX: Pelagic Sharks nei; SHX: Squaliformes; SKH: Selachimorpha; SYX: Scyliorhinidae), which represents about 20% on average (ranging from 11% to 32% between 1994 and 2002) of the total shark catches, were kept in the Task I database. An explicit recommendation was therefore made to split these catches by shark species. Since then, no improvements have been made.

During the meeting, a new SMA catch series was presented by Japan (SCRS/2012/075). It reported the estimates of the number and weight of shortfin mako caught by Japanese tuna longline vessels in the Atlantic using logbook data and standardized CPUE from 1994 to 2010. Live release and dead discard was estimated based on the information on the life status which was collected during the observer program. Catch numbers were estimated to be 1,916-4,395 for the North (from the equator to the south of 50 degrees north) and 665-6,720 for the South, and catch weights were estimated to be 72-227 tonnes for the North and 32-308 tonnes for the South. For the North Atlantic, catch number and weight gradually declined from 1995 to 1999 and then gradually increased after that. For the South Atlantic, catch number/weight decreased from 1994 to1996 and was stable until 2000. After 2000, the catch number/weight showed fluctuations between 2000 and 2006. After 2006, the estimated catch gradually increased in number, but was relatively stable in terms of weight. No continuous decreasing trend was indicated for either region in the present analysis. The Working Group observed the large differences available between these estimations and the current Task I Japanese official catch series, and reiterated the importance of having the SCRS best scientific estimates in Task I.

Some minor corrections were also reported by Namibia but not included in Task I. They should be properly sent to the ICCAT secretariat. No changes were made to the report of SMA dead discards in the Task 1 data.

On the follow up of a Working Group request to compare ICCAT Task I data with EUROSTAT yearly statistics, the Secretariat prepared a consolidated dataset containing three data sources: (a) ICCAT Task I; (b) EUROSTAT statistics; (c) FAO statistics. This work is presented in document SCRS/2012/078. The Working Group recognized the importance of having all this information harmonized in a unique database, and considered that considerable data mining work is needed to explore and interpret the differences among datasets (SMA and nearly 90 other shark species). This should be a long-term task and count with the participation of the ICCAT CPC scientists.

The Task I catch data are known to be incomplete for shortfin mako sharks before 1996, when the Commission requested that data on sharks be submitted. Therefore, the Shark Working Group in 2008 estimated catches for each fleet for years with no data. For the purposes of the assessment model, the catches were estimated by calculating the ratio of shortfin mako catches to the total catch of tuna plus swordfish from each fleet in recent years, and multiplying this ratio times the tuna plus swordfish catch in each historical year. In the current assessment, the Working group used the 2008 Working Group’s estimates of catches by fleet and year through 1996, and the Task 1 estimates of catch by fleet from 1997 through 2010, with the following exceptions. For Japan, the numbers presented in SCRS/2012/075 were used for 1994 through 2010. For Chinese Taipei, the 2008 Working Group’s estimates were used through 2002. The 2008 estimates were also used to fill in zeros for Brazil in 1998 and South Africa in 2000 (**Table 8, Figure 35**). **Table 9** provides information on the Task I fleet characteristics with the current distributions of the number of longline vessels reported by CPCs, as an indicator of LL fishing power in the Atlantic. No update was made to the longline effort distribution by flag, month and 5x5 degree squares (EffDIS, 1950 to 2009). The overall estimations of the number of hooks by flag and year, associated with the SMA Northern and Southern stock, are presented respectively in **Tables 10** and **11.**

4.3 Task II data (catch-effort and size samples)

The Secretariat presented in **Table 12** the SMA standard catalog, which compares Task I against the existence of Task II (both catch and effort and size frequencies) per fleet, gear and year. The poor Task II coverage, of both catch and effort data and size frequencies, is still an important drawback in SMA and the majority of shark species. The Working Group considers that efforts should continue aiming to recover Task II information on sharks. The corresponding most up to date datasets of Task II size frequencies were also made available to the assessment.

4.4 Estimates of relative abundance indices

SCRS/2012/046 provided information on the standardized catches per unit of effort (in number and weight) obtained for the Atlantic shortfin mako (*Isurus oxyrinchus*) using General Linear Modeling (GLM) procedures based on trip data from the Spanish surface longline fleet targeting swordfish in the North and South Atlantic Ocean over the period 1990-2010. In all cases area was considered to be the most relevant factor in explaining CPUE variability. Area, area* quarter and ratio were the most important factors in the North Atlantic, and area, year and quarter or area* quarter in the South Atlantic. Other factors were also identified as significant but with a minor effect on CPUE variability. Part of the CPUE variability was explained by the targeting criteria or ratio between the two most prevalent species in the catches (swordfish to blue shark), especially in the North Atlantic case. The significant models explained between 35% and 44% of CPUE variability. The mean variability of the predicted standardized CPUE between pairs of consecutive years was between 14% and 16% or between +2% and +4% when their absolute increments or both positive and negative increments were considered, respectively.

Updated indices of abundance were developed for mako sharks (*Isurus spp*.) from two commercial sources, the U.S. pelagic longline logbook program (1986-2010) and the U.S. pelagic longline observer program (1992-2010) in document SCRS/2012/070. Indices were calculated 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% confidence intervals are reported. The logbook and observer time series showed a concave shape, marked by an initial decline until the late 1990s, followed by an upward trend to 2010.

Document SCRS/2012/072 provided information on Portuguese longliners targeting swordfish and operating in the Atlantic Ocean. This fleet regularly captures elasmobranch fishes as bycatch. Of those, the blue shark (*Prionace glauca*) and the shortfin mako (*Isurus oxyrinchus*) constitute the two main shark species captured. This paper reports the CPUE trends and standardization of the shortfin mako captured by this fleet. The data was collected by fishery observers and compiled from self reporting skippers' logbooks. The CPUEs (kg/1000hooks) were standardized with Generalized Linear Models (GLMs) using the delta method and tweedie models. The factors year, quarter, location and vessel were used as explanatory variables, and model validation was carried out with residual analysis. The results presented are part of an ongoing study, and provide the first preliminary standardized trends of the shortfin mako catch rates from the Portuguese longline fishery operating in the Atlantic Ocean.

In document SCRS/2012/074, standardized CPUE for shortfin mako (*Isurus oxyrinchus*) caught by the Japanese tuna longline fishery in the Atlantic Ocean was estimated using the logbook data from 1994 and 2010. It revised the method to extract accurate records of the shortfin mako catch from logbook data, based on the information on data collected during the observer program. For the North Atlantic, the standardized CPUE ranged from 0.07 to 0.1 between 1994 and 2005, and thereafter showed a continuous increasing trend. For the South Atlantic, the standardized CPUE was stable around 0.06 from 1994 to 2006, and then displayed a continuous increasing trend as observed in the North Atlantic. The data for cruises assumed to be unreliable due to species misidentification were removed based on the new filtering method, which applied the scoring of logbook data based on the frequency pattern of reporting rate of shortfin mako in each cruise. The sensitivity analysis showed that the trends of standardized CPUE were generally similar among several datasets for different thresholds of filtered data.

SCRS/2012/076 presented an update of the standardized catch rate of the shortfin mako shark, *Isurus oxyrinchus*, caught by the Uruguayan tuna longline fleet based on information from logbooks between 1982 and 2010. We analyzed a total of 19,272 sets. Of these, 11,395 (59%) records had reported catches of shortfin mako. The CPUE was standardized by Generalized Linear Models (GLMs) using a Delta Lognormal approach. A not clear trend was observed along the study period for the standard shortfin mako CPUE. Between 2001 and 2008 a decrease was observed; however, there was an increase in the last two years (2009-2010).

The standardized index of abundance for shortfin mako sharks from the National Marine Fisheries Service Marine Recreational Fishery Statistics Survey (MRFSS) was updated in document SCRS/2012/077 with data from 1981 through 2010. The catch per unit effort (CPUE) data were standardized using a general linear mixed model (GLMM) with year, season, fishing mode (private versus charter boat) and region included as explanatory variables. Because of the large number of zero observations, the CPUE was standardized using a delta-lognormal approach. Both the fraction of trips with a positive observation, and the delta-lognormal abundance index were highly variable, and showed a high in the mid-1990s, followed by a decline, then a stable trend over the last 10 years.

In document SCRS/2012/080, catch and effort data from 88423 sets made by the Brazilian tuna longline fleet (national and chartered), in the equatorial and southwestern Atlantic Ocean, from 1978 to 2011 (34 years), were analyzed. The CPUE of mako was standardized by a GLM, assuming a Zero Inflated Negative Binomial (ZINB) distribution. The factors used in the model were: quarter, year, area, and strategy. The standardized CPUE series obtained for mako sharks by the zero inflated negative binomial was not much different from the one done in 2008. Abundance indices showed a moderate inter-annual oscillation, with a gradual increase in values of CPUE until 2003, with a decreasing trend from that year forward.

The individual CPUE series are presented in **Table 13**. The Secretariat was then asked to apply the CPUE scoring methodology developed during the 2012 Working Group on Stock Assessment Methods meeting (see Table 2) to the CPUE series presented at this meeting. The Methods Working Group have proposed the method and have requested feedback and continued support from the working groups trialing the method (the By-catch Coordinator was tasked with providing the feedback on this trial to the methods Working Group). The exercise was intended to demonstrate to the Group how the method worked rather than to use it to select CPUEs for the shark stock assessment. It was explained that the exercise should also be conducted by a panel of experts, not by an individual, and the Group agreed this would be useful for future meetings. The Group also agreed that this evaluation should take place at a data preparatory meeting, or by identified experts prior to the stock assessment meeting, as it is a potentially time consuming exercise that delays the assessment process during dedicated assessment meetings. **Table 14** shows an example of scoring scale for CPUE from 1 (worst) to 5 (best).

The CPUE indices are plotted in **Figures 35** and **36** as scatter plots, i.e., they are plotted against each other and by year; the blue lines are linear regressions with 95% confidence intervals. Comparison to the Y=0 line allows significant and non-significant correlations to be identified. A fundamental assumption of many assessment methods is that indices are proxies for abundance trends. Non-significant and negative correlation between indices will cause problems in fitting since there will be conflicting signals. Inspection of the Hessian will be a useful diagnostic. Suitability and consistencies of the CPUE series are further addressed under the stock assessment section. It can be clearly seen that for several fleets non-significant and negative correlations exist in both the northern and southern regions.

5. Methods and other pertinent data for stock assessment

Document SCRS/2012/063 presented an elasticity analysis for shortfin mako shark. When providing scientific advice it is important to include a statement about the robustness of that advice to uncertainty. Often the biological processes are assumed to be known without error and that they do not vary over time. The impact of the biological assumptions can be evaluated by conducting sensitivity analyses or Management Strategy Evaluation. However both procedures can be complex to apply and require considerable computing time. Therefore we use a simpler technique, elasticity analysis that is widely used in economics and conservation management although to date has not been much used in fisheries management.

SCRS/2012/064 presented a generic population simulator based on life history theory. The adoption of the Precautionary Approach requires a formal consideration of uncertainty, for example in the quality of the available data and knowledge of the stocks and fisheries. An important principle is that the level of precaution should increase with uncertainty about stock status, so that the level of risk is approximately constant across stocks. Therefore often stocks are classified as data rich or poor implying uncertainty is greater when fishery data are lacking. However, even when data are limited, empirical studies of teleosts have shown that there is significant correlation between the life history parameters such as age at first reproduction, natural mortality, and growth rate. This may mean that from something that is easily observable like the maximum size it is possible to infer other life history parameters, such as natural mortality. In this study we show how to simulate stock dynamics based on life history theory for use in cases where data and knowledge are limited.

The Group agreed that this method was potentially very useful and should be continued in order to support the assessment techniques, to enhance the biological information which complements the fisheries data and to improve the management advice by facilitating the development of scenario testing.

The assessment conducted in 2012 included the North and South Atlantic, but did not cover the Mediterranean.

5.1 Bayesian Surplus Production Model (BSP) methods

The Bayesian Surplus Production Model (BSP) software that was used in the 2008 assessment of blue and mako sharks was used again for the current assessment. This is the same software as the BSP model in the ICCAT catalog, except that it was modified in 2008 to allow catches to be estimated from effort for part of the history of the fishery (Babcock and Cortes. 2009).

For the North Atlantic the CPUE indices in the base case were the U.S. longline logbook series, Japanese longline, Portuguese longline and Spanish longline (**Table 13, Figure 37**). The CPUE data points were either weighted equally, or weighted by the catch of the corresponding fleets, or weighted by the spatial area covered by the corresponding fleets measured from the number of 5x5° squares covered by each fleet in each year (**Table 15**). The starting year in the base case was 1971 and CPUE and catch data were available through 2010. To calculate the biomass and fishing mortality rate in the current year (2011), the catch in 2011 was assumed to be equal to the catch in 2010. The prior for r was lognormal, with mean of 0.058 and log standard deviation of 0.12. The prior for K was uniform on log(K) and the prior for the starting biomass ratio (Bo/K) was uniform between 0.2 and 1.1.

A number of sensitivity analyses and scenarios (**Table 16**) were conducted to evaluate the impact of the input data and model assumptions on model results. ICCAT made its first recommendation to collect data on sharks in 1995 [Res. 95-02], and most major fisheries were reporting shark catches by 1997. Because the Working Group considered that catches were not well estimated before 1997, a number of alternative catch scenarios were considered. In run 3, the model was started in 1997, and allowed to estimate the starting biomass ratio in 1997 with an uninformative prior. In runs 13 and 14, the fishery was assumed to start in 1971, but catches before 1997 were estimated, either from effort (run 13) or as a free constant (run 14). Other sensitivity analyses included varying the prior for r or the starting biomass ratio, starting the fishery in 1956, and adding and subtracting CPUE indices (**Table 16**). The continuity run, corresponding to the base case in the 2008 assessment, used area weighting, the CPUE indices from the US, Japan and Spain, a uniform prior for the starting biomass ratio, and a slightly more pessimistic prior for r (lognormal with mean 0.014 and log-sd 0.28).

The same priors and model assumptions were used for the South Atlantic stock of shortfin mako shark (**Table 17**). The base case CPUE indices came from the longline fisheries of Uruguay, Japan, Brazil, Portugal and Spain. The continuity case included all these series except Portugal because it was not available in the last assessment.

The Sampling Importance Resampling (SIR) algorithm was used to calculate the posterior distributions, using either the priors or a multivariate t distribution as an importance function.

5.2 Catch-Free Age-Structured Production Model (CFASPM) methods

As in the 2008 assessment, the catch-free model (fully described in Porch *et al*. 2006 was applied to North and South Atlantic stocks of the shortfin mako. In general, the catch-free model is an age-structured production model that derives all the fishery information from CPUEs rather than a combination of catches and CPUEs. The model outputs management benchmarks, but cannot estimate catch scenarios or yield estimates. A brief description of the main features of the method was presented at the meeting.

5.3 Length-based methods

Simple length-based methods are valuable for checking assumptions about selectivity made in more complex assessment models and for choosing starting values or for fixing values. This method is described in detail in Kell and Kell (2012). **Figure 38** shows the length-frequency data for the main fleets used in the catch free assessment and the Powell-Wetherall plots are shown in **Figure 39**. There appears to be an inflection point at a length of about 150cm (fork length). **Figure 40** presents unstandardised time series of mean size by area and fleet. These data could be used as input to a stock assessment based on the Beverton and Holt equation (Inoue et al 2012). There appeared to be a slight decreasing trend in mean size in the South Atlantic for the Portuguese and Namibian fleets in the recent period.

6. Results of the stock status

6.1 .BSP Results

North Atlantic

For the North Atlantic shortfin mako shark stock, all of the 16 BSP model runs were able to converge on a posterior distribution with good diagnostics of convergence, although several of the models that used an uninformative prior for the starting biomass ratio estimated a mode value of starting biomass ratio at the upper boundary of 1.1 (**Table 18**). The CPUE indices were fairly consistent in showing a decline during the 1990s followed by an increase after 2000. This trend was not consistent with the catches, which were decreasing in the 1990s and stable after 2000 (**Figure 37**). Because of this inconsistency between the catch and CPUE data the production model was not able to fit the trend in the CPUE data very well (**Figure 41**). When catches were estimated from effort (**Figure 42**) the model estimated a fairly flat trend in catches up until 1996, and the trend in abundance was declining (**Figure 41.d**). Because of the poor fit between the CPUE indices and the biomass trend, the estimated trends in biomass relative to B_{MSY} and fishing mortality rate relative to F_{MSY} were very uncertain, with very broad 80% credibility intervals (**Figure 43**). The posterior distributions of r were very similar to the prior, and the posterior of K was very poorly estimated, indicating that the data were not informative (**Figure 44**).

There was a discussion about why the model was unable to fit the U-shaped trend in the abundance indices, with increases after 2000. To verify that the poor fit was indeed caused by the discrepancy between the CPUE indices and the catch data, we fit another model in which catches were assumed to be much higher in the 1970s and 1980s than the values used in the base case (**Figure 45**). These catches were not estimated from data; they were merely intended to test whether the model would be able to fit an increasing trend in the CPUE indices given a catch series that was consistent with the CPUE data. As expected, the model was able to fit the U-shaped CPUE trend with these catch data. It is possible that biomass has not increased since 2000, and the increase in the CPUE series was caused by an increase in catchability, targeting or even reporting of shortfin mako sharks. However, it is also possible that biomass has indeed been increasing since 2000. If there were large unreported catches before 1990, then it is possible that mako sharks were depleted in the past and have been recovering since 2000.

The production model results are dependent on catch data and the catches are very poorly estimated before 1997. The Group discussed whether any additional data exist on catches in the early years of the fishery, perhaps from sport fishing records or old scientific studies. Shortfin mako sharks are known to have been fished in the North Atlantic in the 1960s and 1970s, so large catches in the early years are possible.

The 16 models gave very consistent results (**Table 18, Figure 46**). All found that the median of the current stock abundance was above B_{MSY}. All found the median F was less than F_{MSY}, except for the run that used estimated catches from effort before 1997. **Figure 46** also indicated the 80% credibility intervals. The continuity run was also more pessimistic than most of the runs, presumably because of the lower mean in the prior for r.

South Atlantic

For the South Atlantic, the catches and most of the CPUE indices increased between the 1970s and the present (**Figure 47**). As in the North Atlantic, the catches and the CPUE data are not consistent with each other. All 13 runs had good diagnostics of convergence, although several of the runs estimated the starting biomass ratio close to the lower boundary of 0.2 (**Table 19**). The models generally estimated either a flat or an increasing trend at the mode of the posterior distribution (**Figure 48**). The credibility intervals of the B/B_{MSY} trend were relatively narrow, but F/F_{MSY} was poorly estimated (**Figure 49**). The posterior distributions for r were very similar to the prior, but K had a very flat posterior, with a non-zero probability of values as high as the upper bound of K (**Figure 50**).

For the South Atlantic stock, both the CPUE indices and the catches appear to be increasing from the 1970s to the present. Several of the model runs fit this trend by assuming that the population had been severely depleted in 1971 and increased throughout the time series. However, there is no evidence of large fisheries in the South Atlantic before the 1970s. The trend could be partly explained by better reporting of shark catches over time. Increases in catchability may also be a factor.

All the model runs estimated a median biomass above B_{MSY} and a median fishing mortality rate below F_{MSY} (**Figure 51, Table 19**). The continuity run estimated a lower biomass than the current model runs, presumably because of the lower mean value for the prior for r.

For both the North and South Atlantic stocks, because of the uncertainty in catch data, the Group mentioned using alternative methods to estimate population status, such as size-based methods, tagging data and life history data. For example, life history data has been used to estimate r, and F_{MSY} can be calculated from r. Fishing mortality rates can be estimated using length data and then used to compute current fishing mortality relative to F_{MSY}. Tagging and recapture data can also be used to estimate fishing mortality rates. Such methods require fewer assumptions about historical catches. Simulation testing could be used to evaluate any proposed method. In addition, it was suggested that a hierarchical modeling exercise be conducted to evaluate the CPUE indices for all species and all fleets together, to determine whether any of the trends in the CPUE indices can be explained by changes in regulations or changes in fishing methodology. For example, in the Uruguayan longline fishery, there appears to be a correlation between shortfin mako shark and swordfish catches (**Figure 52**), which may indicate that increased swordfish targeting increases mako catches.

6.2 CFASPM Results

North Atlantic

A number of scenarios and sensitivities were explored (**Table 20**). Input biological parameters, both those that were fixed (not estimated) and those that were estimated (given a prior) are listed in **Table 21**. Selectivities are estimated externally to the model and imputed as fixed parameters. The procedure for deriving selectivities is described in **Appendix 4**. Age frequencies were obtained from length frequencies by back-transforming raw length data into ages through the von Bertalanffy equation and then fitting a logistic equation as explained in **Appendix 1**. Median selectivity of approximately 150 cm FL (see section 5.3) corresponds to a 4-5 year old shark, which matches reasonably well the age frequency distribution obtained by directly back transforming lengths into ages through the VBGF. Selectivity parameters estimated for the different fleets in the North and South Atlantic are listed in **Table 22** and depicted in **Figure 53**. The selectivity for Spain and for a combined fleet to use in the assessment was computed as the mean of the selectivities of Japan, Portugal, Uruguay, and Brazil. Management benchmarks and the main estimated parameters are listed in **Table 23**.

Run 1 for the North Atlantic assumed virgin conditions in 1956 (as the 2008 assessment) and the modern period started in 1971; thus the historic period spanned 1956-1970 and the modern period, 1971-2010. No depletion was assumed to occur between 1956 and 1971. This run incorporated the USA, Japan, Spain, and Portugal longline indices, used equal weighting. Catchabilities for the indices were estimated and selectivities for the indices were imputed (see **Table 22**). A single fleet was considered and assigned the same selectivity for both the historic and modern periods. All model runs estimated a constant F for the historic period and an average F with annual lognormal deviations was estimated for the modern period. The base run estimated a relative depletion of 71% of virgin conditions (**Figure 54**). There was little information in the data to estimate M and alpha (maximum lifetime reproductive rate) values different from the means of the specified priors. The current fishing mortality was estimated as 41% of what would be required to drive the stock to MSY (F/F_{MSY}=0.41) and current SSB was estimated at 2.04 times that producing MSY (SSB/SSB_{MSY}=2.04). Other runs explored included inverse CV weighting of the indices (run 2), assuming a depletion of 20% from 1956 to 1971 (run 3), assuming the same 20% depletion and inverse CV weighting of the indices (run 4), removal of the US-LL index (run 5), removal of the Japan-LL index (run 6), using the US-LL series only (run 7), using the Japan-LL series only (run 8), using a hierarchical index (run 9; Conn 2010), and assuming virgin conditions in 1971, the beginning of the modern period in 1986, and a gradual depletion of 20% from 1971 to 1986 (run 10). The two scenarios that include inverse CV weighting (runs 2 and 4) were the least optimistic, but still estimated that the stock was not overfished and overfishing was not occurring. The intent of run 9 (hierarchical index) was to use a single index of relative abundance that accounted for process error (the degree to which an index measures artifacts above and beyond true relative abundance). A selectivity curve for this index was computed as the age-specific selectivities for USA, Japan, Spain, and Portugal weighted by the inverse variance weights calculated when fitting the hierarchical index. A functional form was then approximated to that curve for input into CFASPM (**Figure 53**). However, this run had little effect on results. **Figure 55** shows the fit and relative SSB depletion for run 4, which was the least optimistic of those explored and the only one in which the estimate of historic F was precisely estimated (**Table 23**). Estimates of SSB/SSB_{MSY} across all scenarios explored ranged from 1.63 to 2.04 and estimates of F/F_{MSY} ranged from 0.16 to 0.62 (**Table 23**; **Figure 56**). Biomass depletion with respect to virgin conditions ranged from 0.55 (run 4) to 0.71 (runs 1 and 8). In all runs the estimated relative biomass fit the CPUE series poorly, suggesting that improvement of both our knowledge of biological parameters and the factors affecting CPUE series are needed.

South Atlantic

All inputs for the South Atlantic stock were the same as for the North Atlantic, except for the indices, which included Uruguay, Japan, Brazil, Spain, and Portugal. Only two runs were explored: no weighting (run 11), and inverse CV weighting (run 12). Stock status estimates were very similar to those for the North Atlantic, with an estimated relative depletion of 72% of virgin conditions (**Figure 57**). In this case there was somewhat more information in the data as the estimates of M and alpha differed more from the means of the specified priors than in all cases for the North Atlantic. However, F for the historic and modern periods had to be fixed for the model to fit the indices. The current fishing mortality was estimated as 38-40% of what would be required to drive the stock to MSY (F/F_{MSY}=0.38-0.40) and current SSB was estimated at a little over 2 times that producing MSY (SSB/SSB_{MSY}=2.00-2.16) (**Figure 58**). As in the North Atlantic, stock status was not overfished and overfishing not occurring although again, the fit of the estimated relative biomass to the CPUE series was poor.

6.3 General conclusions

Assessment of the status of North and South Atlantic stocks of shortfin mako shark was conducted with updated time series of relative abundance indices and annual catches. Coverage of Task I and number of CPUE series have increased since the last stock assessment in 2008, with Task I data being available for most major longline fleets. The available CPUE series showed increasing or flat trends for the finals years of each series (since the last stock assessment) for both North and South stocks, hence the indications of potential overfishing shown in the previous stock assessment have diminished and the current level of catches may be considered sustainable.

The results indicated in general that the status of the North and South Atlantic stocks is healthy and the probability of overfishing is low; however, they also show apparent inconsistencies between estimated biomass trajectories and input CPUE trends, producing wide confidence intervals in estimated trajectories and other parameters. In the south Atlantic particularly, the increasing trend in the abundance indices since the 1970s is not consistent with the increasing catches. Taking into consideration results from the modeling approaches used in the assessment, the associated uncertainty, and the relatively low productivity of shortfin mako sharks, the Working Group recommends, as a precautionary approach, that the fishing mortality of shortfin mako sharks should not be increased until more reliable stock assessment results are available for both the northern and southern stocks. The high uncertainty in past catch estimates and deficiency of some important biological parameters, particularly for the southern stock, are still obstacles for obtaining reliable estimates of current status of the stocks.

7. Projections for different management scenarios including those specified in ICCAT Rec. 10-06

No projections were conducted due to the high uncertainty of the current stock status.

8. Recommendations

8.1 Research recommendations

The Working Group recommends the development of a Special Research Program on Sharks focused on the reduction of the main sources of uncertainty in the formulation of scientific advice. The program will be defined during 2013 and framed within the SCRS Science Strategic Plan foreseen for the period 2014-2020. The Group considers this a priority as this research program could resolve many of the issues/problems experienced by the Group during the assessment session. This program would largely address many of the following recommendations.

Due to the past reporting problems of shark species, especially prior to 1997, the Working Group had difficulties in obtaining reliable estimates of total catches by species. The Working Group, acknowledging coverage of Task 1 and the number of CPUE series have increased since the last stock assessment in 2008, considers proper reporting of species-specific Task I data critical as well as conducting analyses aimed at obtaining reliable estimates of shark catches by species for the entire time series.

The Working Group analyzed new alternative series of catches, including those provided by EUROSTAT and FAO, and found important unexplained discrepancies. The Working Group recommends investigation into the reasons for these discrepancies through the coordinated work of database experts from each organization (ICCAT/EuroStats/Fao). This coordinated effort should analyze the structure, data collection and data QC in each institution and defining the limitations, coverage, and completeness of the respective data. The result of this analysis should be reported to the Working Group.

There is a need for CPCs to determine whether their Task 1 shark catches include or not dead discards. Therefore, the Working Group recommends that the CPCs conduct a crosscheck analysis with their observer data to verify this information.

The Working Group recommends conducting data mining to recover historical data together with the exploration of comparative analysis of CPUE of SMA with CPUE of other target and non-target species, within a modeling framework, as a potential method of estimating historical catches of SMA.

Due to the uncertainty in the estimates of the absolute level of historic catches, the Working Group recommends the development and evaluation of alternative methods for providing management advice that are less dependent on absolute catch data, e.g. catch-free methods, those based on trends, those that make use of length-based or tagging information, and hierarchical models that can make use of information from multiple stocks or fleets.

The Working Group encourages the continuation of elasticity analysis in order to evaluate the relative importance of assumptions made in the assessment and management of shark species and in the establishment of an objective basis for defining research priorities on biological aspects and in the recovery of fishery statistics. The Working Group also recommends the integration of methods such as the elasticity analysis with the ERA application.

The Working Group recommends that a proposal for biological sampling priorities be defined during the Sharks Working Group meeting in September 2012 based on the ERA (and potentially elasticity) outcomes. Moreover, the coordination of the ongoing and future sampling activities conducted by the different CPCs should be encouraged. The Working Group emphasized again the critical necessity that observers be allowed to collect biological samples from those species whose retention is prohibited by current regulations.

The Working Group acknowledges the importance of ICCAT Recommendation [Rec. 10-10] and considers that the information provided by sound scientific observer programs and/or its alternative scientific monitoring approach are critical for filling the gaps in knowledge on the fishing activities impacting sharks populations and specifically paragraph 2a, i.e., species composition of the catches, Task I, Task II. Therefore, the Working Group encourages CPCs to make available the information obtained by these programs as soon as possible.

Considering the need to improve stock assessments of pelagic shark species impacted by ICCAT fisheries, the Working Group recommends that the CPCs provide the corresponding statistics of all ICCAT and non-ICCAT fisheries capturing these species, including recreational and artisanal fisheries. The Working Group considers that a basic premise for correctly evaluating the status of any stock is to have a solid basis to estimate total removals.

In the future, relevant RFMOs should be identified with which collaboration can be carried out regarding research on shark species of common interest.

The Working Group recommends that one of the main priorities for the By-catch Coordinator be the collation of the observer data collected by the different CPCs to make it available to the different SCRS Working Groups, especially to the Sharks Working Group and the Sub-Committee on Ecosystems. The Working Group encourages a closer collaboration with the SCECO in relation to the optimization of the observer programs in general.

8.2 Management recommendations

The Working Group recommends, as a precautionary approach, that the fishing mortality of shortfin mako sharks should not be increased until more reliable stock assessment results are available for both the north and south stocks.

9. Other matters

The Working Group discussed the issue of pelagic shark catches by artisanal and recreational fisheries in the area of the convention. It was noted by some CPCs that pelagic sharks are caught by artisanal fisheries with drift-gillnets in areas where the shelf is narrow. It was also noted that CPCs with artisanal drift-gill net that catch an important volume of billfishes, may also catch an unknown volume of shark species. The Working Group considered that it was important to take into account all levels of species-specific pelagic shark catches and effort in the assessments, including those from fisheries not regularly reported to ICCAT, like artisanal and recreational fisheries.

The Working Group addressed the need for improved data and biological information required to produce better assessments for the different shark species that are of concern to ICCAT. During the discussion it was noted that a research program would be required to enhance the collection of data and biological information, which would include biological samples, and most likely tagging. The Working Group agreed that a Shark Research Program sponsored by ICCAT would be the most appropriate way to achieve the enhanced data collection on sharks. It was noted that the goals and objectives of the suggested Shark Research Plan be defined and detailed during the upcoming SCRS Species Group meetings.

10. Adoption of the report and closure

The Working Group expressed their appreciation for all the arrangements and facilities provided by IPIMAR and their scientists for the more than satisfactory development of the meeting. The hospitality provided was extraordinary and the Working Group deeply acknowledges the unbelievable attention given to the participants by the Portuguese scientists.

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Table 1. Biological inputs into the ERA analysis.

Species/Stock	*Mean litter size*	*Reproductive Periodicity (yr)*	*Female K (yr^{-1})*	*L_∞ (cm FL)*	*t_0*	*Median age at maturity (yr)*	*Female longevity (yr)*	*S_0 (yr^{-1})*	*S_{1+} (yr^{-1})*
Alopias superciliosus (BTH) N	2	1	0.06	293	102*	12	22	0.88	0.83-0.92
Alopias vulpinus (ALV) N	4	1	0.11	483	121*	6	24	0.82	0.76-0.93
Carcharhinus falciformis (FAL) N	11	2	0.09	314.9	-3.18	9.5	22	0.81	0.77-0.91
Carcharhinus falciformis (FAL) S	9.6	2	0.09	303	-4.71	12.5	20	0.86	0.80-0.91
Carcharhinus longimanus (OCS) S	5.4	1	0.10	285	-3.39	6	17	0.82	0.78-0.90
Carcharhinus obscurus (DUS) N	7	3	0.04	421	-7.04	20	40	0.90	0.80-0.98
Carcharhinus plumbeus (CCP) N	8.4	2.5	0.12	181.15	-2.33	15.5	24	0.82	0.71-0.94
Carcharhinus signatus (CCS) S	11	2	0.114	265.4	-2.69	10	17	0.80	0.73-0.89
Galeocerdo cuvier (GAC) N	55	2	0.124	347	62*	10	29	0.80	0.78-0.93
Isurus oxyrinchus (SMA) N	12.5	3	0.054	432	70*	18	32	0.87	0.78-0.97
Isurus paucus (LMA) N**	4	2	0.054	432	70*	18	32	0.87	0.78-097
Lamna nasus (POR) N	4	1	0.061	289	-5.9	14	25	0.88	0.81-0.93
Prionace glauca (BSH) N	37	1	0.15	375	-0.87	6	16	0.71	0.72-091
Prionace glauca (BSH) S	30	1	0.16	352.1	-1.01	5	12	0.72	0.72-0.91
Pteroplatytrigon violacea (PST) N	6	0.5	0.2	116	17*	3	12	0.64	0.58-0.88
Pteroplatytrigon violacea (PST) S	4	1	0.2	116	17*	3	12	0.64	0.58-0.88
Sphyrna lewini (SPL) N	24	2	0.09	303	-2.22	15	31	0.84	0.76-0.94
Sphyrna lewini (SPL) S	18.5	1	0.05	300	51*	15	32	0.83	0.72-0.94
Sphyrna mokarran (SPM) N	15	2	0.13	286.7	-2.51	20	42	0.89	0.81-0.98
Sphyrna zygaena (SPZ) N	33.5	1	0.07	285	-7.3	9	18	0.85	0.85-0.90

N denotes that biological inputs were available for the North Atlantic Ocean, and S, for the South Atlantic
*L_0 (cm FL)
** All parameters, except for litter size and reproductive frequency, as for shortfin mako

Table 2. Productivity values for stocks of species in the ERA listed from highest to lowest.

Species	*Area*	*Productivity (r)*	*LCL*	*UCL*	*Generation time*
BSH	North	0.314	0.279	0.345	8.2
BSH	South	0.299	0.264	0.327	9.8
PST	North	0.230	0.181	0.279	6.2
SPZ	North	0.225	0.213	0.237	13.4
TIG	North	0.190	0.180	0.200	15.6
OCS	South	0.121	0.104	0.137	10.4
SPL	South	0.121	0.110	0.132	21.6
ALV	North	0.121	0.099	0.143	11.0
SPL	North	0.096	0.093	0.107	21.6
FAL	North	0.078	0.065	0.090	14.4
SPK	North	0.070	0.069	0.071	27.1
SMA	North	0.058	0.049	0.068	25.0
POR	North	0.052	0.044	0.059	20.3
PST	South	0.051	0.004	0.096	6.6
DUS	North	0.043	0.035	0.050	29.6
FAL	South	0.042	0.029	0.054	16.5
CCS	South	0.041	0.028	0.053	14.9
LMA	North	0.029	0.020	0.038	25.2
CCP	North	0.010	-0.005	0.024	21.8
BTH	North	0.009	-0.001	0.018	17.8

Values are medians.
LCL and UCL are the lower and upper 80% percentiles.
Generation time is the time required for the population to increase by R_0 (the net reproductive rate).

Table 3. Tagging summary - Shortfin Mako (SMA, *Isurus oxyrinchus*).

			Years at liberty								
Year	*Releases*	*Recaptures*	*< 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	63	38	13	5	1	3	2		1	16.8%
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	254	41	26	13	1					1	16.1%
2007	365	79	53	19	5					2	21.6%
2008	276	47	21	21	3					2	17.0%
2009	230	31	23	8							13.5%
2010	153	9	8	1							5.9%
2011	143	0									
2012	11	0									
TOTAL	9218	1203	687	313	79	38	25	22	3	36	13.1%

Table 4. Tagging summary - Porbeagle (POR, *Lamna nasus*).

Tagging summary -													
			Years at liberty										
Year	*Releases*	*Recaptures*	*< 1*	*1- 2*	*2-3*	*3-4*	*4-5*	*5 - 10*	*10+*	*15+*	*Unk*	*ERROR*	*% recaptures*
1961	1	1			1								100.0%
1962	13	12	5	5	2							1	92.3%
1963	2	2	2										100.0%
1965	1	0											
1967	2	0											
1968	1	0											
1978	1	0											
1979	1	0											
1980	4	0											
1981	18	0											
1982	9	2			2								22.2%
1983	31	8	2		2		2	2					25.8%
1984	21	6			2			4					28.6%
1985	20	4				2	2						20.0%
1986	38	6	2		2			2					15.8%
1987	99	30	2	4	6		2	15			1		30.3%
1988	69	22	2	2	2	2	4	10					31.9%
1989	7	2				1					1		28.6%
1990	1	0											
1991	47	7	3	2		1		1					14.9%
1992	41	7		2	3			2					17.1%
1993	134	34	6	4	4	10	3	5		1	1		25.4%
1994	173	72	14	19	18	9	4	7			1		41.6%
1995	155	44	10	12	5	12	3		1		1	1	28.4%
1996	70	16	5	4	4	1		2					22.9%
1997	147	22	8	6	2	3	1				2		15.0%
1998	94	9	6	2		1							9.6%
1999	180	20	6	3	4			4	1		2		11.1%
2000	89	4	1			1		1	1				4.5%
2001	8	0											

2002	43	3			3								7.0%
2003	44	3	1		2								6.8%
2004	30	1			1								3.3%
2005	26	1						1					3.8%
2006	72	1			1								1.4%
2007	32	0											
2008	22	1		1									4.5%
2009	77	0										1	
2010	83	0											
2011	49	0											
TOTAL	1955	340	75	66	66	43	21	56	3	1	9		17.4%

Table 5. Tagging summary - Blue shark (BSH, *Prionace glauca*).

			Years at liberty										
Year	*Releases*	*Recaptures*	*< 1*	*1-2*	*2-3*	*3-4*	*4-5*	*5-10*	*10+*	*15+*	*Unk*	*ERROR*	*% recapture*
1962	43	0											
1963	134	2	2										1.5%
1964	134	3	2		1								2.2%
1965	255	9	5	4									3.5%
1966	407	6	4		1		1						1.5%
1967	836	17	15		2								2.0%
1968	794	11	7	2	1			1					1.4%
1969	1468	53	46	6	1								3.6%
1970	505	15	7	4	2		1	1					3.0%
1971	546	16	11	5									2.9%
1972	923	25	18	5	1	1							2.7%
1973	361	12	8	3	1								3.3%
1974	630	16	13	2	1								2.5%
1975	809	40	30	5	2	1	1				1		4.9%
1976	1113	56	47	4	2		2				1		5.0%
1977	2843	111	92	12	4	2		1					3.9%
1978	3212	164	153	5	3	2					1		5.1%
1979	3807	137	107	20	7			1			2	1	3.6%
1980	3328	88	70	13	2	2	1						2.6%
1981	3121	109	87	9	8	1	2	2					3.5%
1982	2695	69	41	16	9	1				1	1		2.6%
1983	4274	117	59	32	14	5	1	3		1	2		2.7%
1984	2405	57	31	17	5	3					1		2.4%
1985	4471	167	128	20	12	3	2	2					3.7%
1986	2976	106	72	11	9	4	5	3			2		3.6%
1987	2780	81	48	22	8			3					2.9%
1988	3256	140	99	19	8	2	5	1			6		4.3%
1989	2779	143	98	16	11	9	1	4			4		5.1%
1990	3404	170	116	29	9	7		5			4		5.0%
1991	4661	230	162	39	11	2	5	5			6		4.9%
1992	6164	384	249	67	30	9	11	9			9	1	6.2%
1993	5494	373	249	65	19	15	6	7			12	1	6.8%
1994	5572	438	290	50	37	17	3	9	2		30		7.9%
1995	6940	566	249	137	89	33	12	12	2	1	31	1	8.2%
1996	7620	753	386	193	83	36	13	13			29		9.9%
1997	7290	713	383	159	91	34	11	5			30		9.8%
1998	4352	417	218	110	33	20	11	6			19	2	9.6%

1999	3762	343	196	87	23	17	3	8		9		9.1%
2000	3055	313	192	71	26	8	4	4		8	1	10.2%
2001	2635	282	151	60	33	14	2	3		19	1	10.7%
2002	2391	237	140	48	24	8	7	3		7	1	9.9%
2003	2670	242	121	66	26	12		2		15		9.1%
2004	2388	220	119	60	16	10	3	4		8		9.2%
2005	2198	214	116	48	18	13	5	4		10		9.7%
2006	1597	171	93	46	13	9		1		9	1	10.7%
2007	3043	281	148	70	38	13	1			11	1	9.2%
2008	3069	205	105	64	27	3				6		6.7%
2009	3134	159	109	44	5					1		5.1%
2010	2500	85	76	6						3		3.4%
2011	1407	9	9									0.6%
2012	4	0										
TOTAL	136255	8575	5177	1771	766	316	119	122	4	297	11	6.3%

Table 6. Estimated catches (t) of Shortfin mako (SMA, *Isurus oxyrinchus*) by area, gear and flag.

			1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	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
TOTAL			0	200	168	263	346	389	92	465	299	313	474	999	1709	975	1793	3803	1951	1028	1562	1648	1349	1326	1446	2966	2972	4870	2778	5570	5477	4097	4994	4654	5361	7324	7487	6336	6073	6753	5284	5981	6490
ATN			0	112	115	61	307	344	84	236	153	45	246	772	928	569	1112	3143	1481	766	1014	1011	785	797	953	2193	1526	3109	2019	3545	3816	2738	2568	2651	3395	3895	5063	3190	3113	3917	3403	3947	4014
ATS			0	88	53	202	39	45	8	229	146	268	228	227	781	405	680	661	471	262	548	637	564	529	493	773	1446	1761	759	2019	1652	1355	2422	1996	1964	3426	2423	3130	2951	2834	1880	2034	2474
MED			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	6	8	5	4	7	2	2	2	17	10	2	1	1	2
Landings	ATN	Longline	0	112	115	61	307	344	84	236	153	45	246	387	315	201	183	194	184	295	214	321	497	573	660	1499	1173	1633	1770	3369	3648	2645	2254	2424	3129	3792	4755	3172	3105	3901	3367	3551	3546
		Other surf.	0	0	0	0	0	0	0	0	0	0	0	385	613	368	929	2949	1297	462	795	681	278	213	254	670	331	1447	248	177	168	91	313	227	266	104	308	18	8	10	27	375	459
	ATS	Longline	0	88	53	202	39	45	8	229	146	268	228	227	781	405	680	661	471	262	548	637	564	519	480	763	1426	1748	744	1997	1642	1345	2413	1979	1949	3395	2347	3116	2907	2792	1798	2027	2473
		Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	13	10	20	13	15	23	10	10	9	18	15	31	76	14	43	30	82	7	1
	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	6	8	5	4	7	2	2	2	17	10	2	1	1	2
		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	0	0	0	0	0
Discards	ATN	Longline	0	0	0	0	0	0	0	0	0	0	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	9
		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	2	0	0	0	0	0	0	0	0	1	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	0	0	0	0	0	0	0	0	0	0	12	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	0	0	0	0	0	0	0	0	0	0	23	28
		Brasil	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	0	0	0	0	0
		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	111	67	110	69	70	78	69	78	73	80	91	71	72	43	53	41
		China P.R.	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	0	81	16	19	29
		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	0	84	57	19	30	25	23	11	13
		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	2416	2199	2051	1566	1684	2047	2068	3404	1751	1918	1816	1895	2216	2091
		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	0	0	0	15	2
		EU.Portugal	0	0	0	0	0	0	0	0	0	0	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
		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	0	0	0	2	3	2	1	1	1	0	0	0	1	15	0
		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	0	0	0	0	0	0	0	0	0	0	1	2	0	4
		Japan	0	112	115	61	307	344	84	236	153	45	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	117

	Mexico	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	10	0	0	0	0	10	16	0	10	6	9	5	8	6	7	8
	Panama	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	0	0	0	0	0	49	33	39	0
	Philippines	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	0	0	0	0	0	0	1	0	0
	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	0	0	0	0	0	0	8	17	21	0
	St. Vincent and Grenadines	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	3	0	0	0	0	0	0	0	0	0	0	0
	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	0	0	0	0	0	0	0	0	0	0
	Trinidad and Tobago	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	2	3	1	2	1	1	1	1	1
	U.S.A.	0	0	0	0	0	0	0	0	0	0	0	385	655	410	971	3001	1361	540	896	795	360	315	376	948	642	1710	469	407	347	159	454	395	415	142	411	187	130	216	188	202	217
	UK.Bermuda	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	0	0	0	0	0	0	0	0	0	0	0
	Venezuela	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	58	20	6	11	2	35	22
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	0	0	0	0	0	0	0	0	0	0	38	0	17	2	0	32
	Brasil	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	83	190	0	27	219	409	226	283	238	426	210	145	203	99	128
	China P.R.	0	0	0	0	0	0	0	0	0	0	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
	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	0	626	121	128	138	211	124	117	137
	Côte D'Ivoire	0	0	0	0	0	0	0	0	0	0	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
	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	1356	1141	861	1200	1235	811	1158	703	584	664	654	628	939	1192
	EU.Portugal	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	92	94	165	116	119	388	140	56	625	13	242	493	375	321	502	336
	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	0	0	0	0	0	0	0	0	0	0	5	0	0	11	0
	Japan	0	88	53	202	39	45	8	229	146	268	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	107
	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	0	0	0	0	0	29
	Namibia	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	459	0	509	1415	1243	1002	295	23	307
	Panama	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	24	1	0	0	0	0	0	0	0	10	0	0
	Philippines	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	2	0	0	0	0	0	0	0	0	1	0	0
	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	0	0	0	0	0	0
	South Africa	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	19	13	0	79	19	138	126	125	99	208	136	100	144
	U.S.A.	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	2	1	0	2	0	0	0	0	0	0	0	0	0	0
	Uruguay	0	0	0	0	0	0	0	0	0	0	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

		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	0	0	0	0	0	0	0	0	0	0	52	12	13	1	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	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
		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	6	7	5	3	2	2	2	2	2	4	1	0	0	1
		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	0	0	0	0	0
		EU.Portugal	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	5	0	0	0	15	5	0	0	0	0
		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	0	0	0	0	0	0
Discards	ATN	Mexico	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	0	0	0	0	0	0	0	0	0	0	0	0	0
		U.S.A.	0	0	0	0	0	0	0	0	0	0	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	9
		UK.Bermuda	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	2	0	0	0	0	0	0	0	0	0	0	0
	ATS	Brasil	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	0	12	0	0	0

Table 7. Total catch (Task I, t) of 15 of the 18 shark species used in the ERA models, between 1970 and 2010. Currently, no Task I data exists for pelagic stingray (PLS), crocodile shark (PSK) and giant manta (RMB).

	ALV	**BSH**	**BTH**	**CCP**	**CCS**	**DUS**	**FAL**	**LMA**	**OCS**	**POR**	**SMA**	**SPL**	**SPZ**	**TIG**	**WSH**
Year	*Alopias vulpinus*	*Prionace glauca*	*Alopias superciliosus*	*Carcharhinus plumbeus*	*Carcharhinus signatus*	*Carcharhinus obscurus*	*Carcharhinus falciformis*	*Isurus paucus*	*Carcharhinus longimanus*	*Lamna nasus*	*Isurus oxyrinchus*	*Sphyrna lewini*	*Sphyrna zygaena*	*Galeocerdo cuvier*	*Carcharodon carcharias*
1970										215					
1971										788	200				
1972										1272	168				
1973										1234	263				
1974										735	346				
1975										1196	389				
1976										1492	92				
1977										1128	465				
1978		4								1155	299				
1979		12								1580	313				

1980										1606	474				
1981		204								1382	999				
1982		9		0		0	0	0		598	1709			0	
1983		613		0				0	1	1169	975			1	
1984		121						0		726	1793			0	
1985		380		0				1	0	687	3803			0	
1986		1482		0				0	0	732	1951			0	
1987		1614		0		0	0	1		844	1028			6	1
1988		1835		0		0		3		1025	1562			2	2
1989		1810		0		1		2	1	1013	1648			2	2
1990		3028		0		2		1	0	1309	1349			4	2
1991		4307		1		1	13	1	0	1990	1326			7	3
1992		3643		111		64	341	29	8	2603	1446	363	4	13	
1993	2	9577	20	61	0	36	139	8	11	1910	2966	14		11	
1994	7	9562	18	146	3	270	92	18	10	2729	2972	33	3	10	
1995	9	9634	39	327	1	80	127	17	14	2140	4870	93	1	20	
1996		9560	14	468	0	52	531	3	8	1560	2778	50	42	5	
1997	30	37610	185	343	21	48	343	29	12	1859	5570	185	83	5	
1998	45	33809	114	154	23	54	33	10	15	1469	5477	16	48	9	
1999	1	35093		149	27	38	140	2	2	1403	4097	23	38	1	
2000	14	39101	43	174	91	48	118	20	642	1469	4994	272	40	13	
2001	25	34447	108	181	30	1	42	51	543	999	4654	319	38	10	
2002	136	32735	114	121	1466	2	358	67	205	848	5361	16	1472	4	
2003	30	35572	133	120	24	0	476	63	179	648	7324	22	58	4	
2004	65	36304	121	49	0	0	316	52	189	745	7487	20	40	22	
2005	104	43071	74	60	5247		74	0	82	571	6336	0	56	1	8
2006	109	40351	83	40	1035		7	1	78	507	6073		360	8	
2007	158	47044	131	12	1356	19	232	65	36	515	6753	0	61	65	177
2008	70	53900	108	2	42	2	31	15	246	600	5284	56	109	65	
2009	148	58840	135	22	35	15	70	109	54	475	5981	63	17	69	
2010	51	65195	50	5	46	21	23	77	124	134	6490	50	9	23	18

Table 8. Catch time series used for BSP model runs for North and South Atlantic shortfin mako sharks.

Year	*Catch North*	*Catch South*	*Year*	*Catch North*	*Catch South*
1971	3717	496	1991	4114	2197
1972	3014	583	1992	3871	1928
1973	3322	1180	1993	5364	2290
1974	3345	503	1994	4448	2111
1975	4280	487	1995	5840	2700
1976	3038	629	1996	4030	2375
1977	3642	624	1997	3532	2253
1978	3241	655	1998	3238	1962
1979	2402	630	1999	2838	1609
1980	3253	1082	2000	2666	2632
1981	3079	1011	2001	2812	2282
1982	3614	2006	2002	3250	2168
1983	4209	885	2003	3738	3382
1984	4480	1156	2004	4648	2094
1985	6900	1967	2005	3345	3162
1986	6589	1121	2006	3266	3060
1987	6336	940	2007	3960	2854
1988	5985	1675	2008	3507	1887
1989	4098	2296	2009	4013	2040
1990	3852	2056	2010	4066	2496

Table 9. Distribution of total longline vessels in GRT categories by year (source: Task I fleet characteristics).

	GRT categories (hp)													
Year	*<50*	*[50,100[*	*[100,150[*	*[150,200[*	*[200,300[*	*[300,400[*	*[400,500[*	*[500,600[*	*[600,700[*	*[700,800[*	*[800,900[*	*[900,1000[*	*1000>=*	*Total*
1970	100	113			252			38						503
1971	100	30			360			36						526
1972	100	30			416			56						602
1973	108	44			454			42						648
1974	106	44			549			32						731
1975	100	32			495			33						660
1976	175	55			462			28						720
1977	120	54			532			25						731
1978	0	72			512			24						608
1979	14	194			496			26						730
1980	19	191			527			28						765
1981	19	198			556			22						795
1982	130	224			539			27						920
1983	58	202			364			20						644
1984	61	204			421			26						712
1985	269	165			444			26						904
1986	379	210			407			18						1014
1987	32	487			315			17						851
1988	250	188			318			20						776
1989	335	263			371			32						1001
1990	408	187			350			63						1008
1991	556	188			417			24						1185
1992	311	192			393			25						921
1993	688	173			431			64						1356
1994	541	253			366			68						1228
1995	816	188			377			78						1459
1996	630	197			423			87						1337
1997	736	230			402			87						1455
1998	482	193			276			9						960
1999	838	149			373			99						1459

2000	617	186			448			53						1304
2001	1131	239			446			142						1958
2002	600	206	1		61	222	49	19		48	2			1208
2003	331	85	69	25	42	259	47	5	2	47	10			922
2004	682	97	38	30	42	273	62	12	9	46	2			1293
2005	1948	155	84	35	25	253	46	10	4	46	3			2609
2006	1324	152	32	38	41	229	33	23	22	27		21		1942
2007	885	199	73	40	23	100	114	17	9	38		1		1499
2008	1038	220	35	27	16	117	145	25	21	35		1		1680
2009	813	232	56	32	20	101	122	29	17	41			6	1469
2010	1017	338	88	47	16	87	120	37	15	41	1		1	1808

Table 10. Overall number of hooks of the longline fleet by major flag, between 1950 and 2009, associated to the SMA northern stock (source: LLEffDIS).

Year	Japan	Chinese Taipei	Korea Rep.	Brasil	Venezuela	U.S.A.	Panama	EU.España	Cuba	EU.Portugal	Mexico	China P.R.	St. Vincent	Philippines	Belize	Maroc	Trinidad and Tobago	U.S.S.R.	Vanuatu	AT_oth	TOTAL
1950								4705743													4705743
1951								3145847													3145847
1952						6679		3145847													3152526
1953						954		3917654													3918608
1954								993254													993254
1955						4771		2015817													2020588
1956	25585							1217957													1243542
1957	451598				872737	15267		3256570													4596172
1958	2683198				1331939	38167		2709466													6762770
1959	5907150				2257954	185109		3582227	219048											1432110	13583598
1960	7540030				2727304	954		2351243	219048											1470136	14308716
1961	5696454				2917581			5536169	219048							20818				1037068	15427138
1962	15897198	187492			4959888	103050		7490111	292064							41637				1041070	30012509

1963	23255759	293112			4262206	1103974		3256570	1533335							20818				5722317	39448091
1964	37774793	315211	44856		3049507	1314845		5861826	1022223							62455		39997		6671170	56156882
1965	37869635	168356	139618		2902359	977069		4666665	1384382							48576		370635		3926892	52454186
1966	21400132	1319360	1964880		3343802	546739		9766453	1798382							41637		581664		3614099	44377148
1967	9820714	4496608			3470653	343501		8760173	5658004							38167		1796798		4485204	38869823
1968	10633215	6994112			2907433	180338		11564080	4292606							45107		1737756		4362149	42716796
1969	11791534	10330684	72511		4003429	90646		11404508	2722764							55516		1629955		3372801	45474348
1970	14134196	17649600			3323506			10290761	4746035							48576		1271510		3983007	55447191
1971	36152898	13268707			4521428			11020233	3942860							72864		1671095		611726	71261811
1972	28952705	13368052	17364813		6273478		687121	10453589	4380956							52046		1169043		621888	83323691
1973	17725101	25087189	15880781		2880709	954	13948241	12482432	5938605							34697		1699283		266252	95944244
1974	23643614	20055234	16173099		2458301	954	5834893	9421257	5914290							41637		2298089		158967	86000334
1975	35842115	16196252	38498371		1514613		5159037	17145840	14315137							52046		2210477		356014	131289903
1976	22990332	43129638	27153972		1677288		11109215	14104204	15626844							41637		2557114		521640	138911885
1977	15150351	34474232	37232201		2604376		5083446	15484990	18142876							20818		2376558		517125	131086975
1978	17090446	22457510	29911980		3596219	2881590	6641077	11759474	11810032							38167		1043720		2708379	109938594
1979	18504548	13524528	20109286		6791408	3710191	1858040	8734120	36009620							721705		1003723		2800591	113767761
1980	33401732	12585828	15297378		5473993	4850528	6047305	12407531	24199523							471884		1119904		1584192	117439798
1981	44074180	12332817	17822500		8471784	3938819	2366694	13110950	16930904		39502					430247		750412		581624	120850433
1982	38500109	20253152	18696544		4643215	5187817	6188873	16015811	17427235		120388					315746		940580		517934	128807404
1983	19339656	26284463	10706549		984315	4840499	5432333	23782730	21247482							433717	167401	78820		1722661	115020627
1984	23661649	30877109	7798410		1218318	5661085	7964054	21060237	12303016	16850						274109	80212	907206		1167276	112989531
1985	28395548	36399918	10580421	262193	1534402	5726178	2821185	24417761	10858857	31594						475354	76557	663059		1133524	123376550
1986	23901523	53979223	7711911		3210687	10100089	3255778	31976260	7658908	943607						617613	29108	3104039		2463351	148952098
1987	23311904	24283743	1691735		2738829	10908367	5473998	25801059	7768912	2072565						666189	70881	5073290		2435724	112297196
1988	29053811	7556452	879086		2438047	17352634	3394951	37560701	3889814	1289035						676598	29829	4349686		3467806	111938450
1989	41981722	4760290	9367256		1616398	14254336	2636942	24131156	3492727	615030						759872	28561	2021657		5963533	111629477

1990	37956030	20552899	5617825		1167415	12007030	4388061	25710914	7522901	1023645						83274	93945	574449		7727644	124426030
1991	36977827	36987979	197396		1375955	10328296	4664676	29305148	265202	1998846						319216	184533			11849182	134454254
1992	46186833	25695039	1509656		1775890	15648844	5341054	30301948	265202	1167503						142259	169196			9302380	137505804
1993	27677734	23533014	377698		3949386	12038053		33506174		4138812	168692	292158				93683	4287			8035577	113815267
1994	35540735	31294809	275454		5218736	11761572		35569733		3332997	1087252	788413				24288	74851			11991650	136960488
1995	38447269	21566407	467097		3628439	13322138		37516360		4271928	1096657	909627				97153	63118			13958817	135345007
1996	51608124	27557065	1711224	212724	3043288	34684073		35896546		6835732	1286707	904447				121441	84012			19117488	183062871
1997	55423574	21044584	2655777	80019	4236192	11694036		38807784	53040	2820825	732991	669270				829266	96496			28732925	167876780
1998	62659044	24741143		40281	4570677	9062380		28967274	53040	1414506	742634	2899826		332818			87254			43055743	178626617
1999	51274433	38566659		1204234	1523307	8570073		27046917		3340358	1559091	11174535		558217		121441	81544			37585310	182606118
2000	48787828	33459169		1813712	2548010	15637061		17504171		3262200	1741285	1961936	70787159	264667		131850	35826			24144796	222079670
2001	47394796	34371120	921		2584380	12503075		15001866		2603297	1346105	10518055	89019060	89193		916010	50665			16031057	232429599
2002	37292366	31447355		918003	2236306	15670046		12683165	1088571	4617811	1568860	16133820	22778016	218207		534339	57723			4719887	151964475
2003	38309835	27088842		476850	2568807	20133169		13102225	2218474	3652898	1825816	17747759	8668227	238492		780690	65021			4157013	141034119
2004	48814663	34426963		773583	3334264	13710387		16048734	2785265	4137401	2093825	4991749	50002864	962660		1845899	73198		5141712	3522854	192666021
2005	50051331	17676657	2142764	614298	818401	9838424		15071665	2781560	5135069	2094210	19751164	11391458	885402		2321841	96076		5999094	4668140	151337555
2006	37196022	10725850	1350350	111550	1605739	7658141	1280400	17348134	3277965	4412613	2051923	10393785	17534680	526503		11837699	100969		3921721	3810800	135144844
2007	34316604	9573852	2554526	175494	3026449	12197465	13614539	15779318		3461564	1853577	11189009	6907500	271078	1836892	9942726	95261		2116147	3207510	132119513
2008	30146851	10676964	6482069	11609	1529894	9585957	17492093	12686103		2907226	1814003	8982007	28750000	667941	1364901	7339484	97359		2428860	4595805	147559127
2009	30070738	8019368	4222066	133577	3522946	12171614	9503163	15960081		3214785	1812853	5651524	24032642	337818	1553950	812890	118149		2145848	4386546	127670558

Table 11. Overall number of hooks of the longline fleet by major flag, between 1950 and 2009, associated to the SMA southern stock (source: LLEffDIS).

Year	Japan	Chinese Taipei	Korea Rep.	Brasil	Uruguay	Venezuela	U.S.A.	Panama	EU. España	South Africa	Cuba	EU. Portugal	China P.R.	Namibia	St. Vincent	Philippines	Belize	U.S.S.R.	Vanuatu	AT_oth	TOTAL
1950									30135												30135
1951									20145												20145
1952									20145												20145
1953									25088												25088
1954									6361												6361
1955									12909												12909
1956	77652								7800												85452
1957	2506573					10439			20855												2537867
1958	1917206			1409645		15931			17351												3360133
1959	5663532			4796034		27007			22940		177391									360653	11047556
1960	9350612			3807662		32621			15057		177391									472938	13856281
1961	16727512			4131718		34897			35453		177391									576470	21683441
1962	23543926	201820		1458254		59324			47965		236521									609794	26157605
1963	24994214	315513		2106366		50979			20855	311980	1241736									2802450	31844093
1964	32821372	339300	96509	1477697		36474			37538	323132	827824							74727		3496539	39531113
1965	47809559	181222	300391	725886		34714			29885	2574	1121110							692471		2775971	53673783
1966	31902777	1420188	4227496	537934		39994			62543	26308	1456379							1086746		2175273	42935638
1967	12355378	4840249	7041301	738848		41512			56099		4582007							3357028		2013453	35025875
1968	17374981	16299195	7522602	814192		34775			74054		3476270							3246716		3104125	51946910
1969	21353407	27544144	26866369	577630		47884			73032		2204969							3045309		2771022	84483767
1970	21411467	24406242	17027367	880623		39752			65900		3843469							2375611		2988933	73039365
1971	17402717	29910488	18988217	546845		309594			70572		3193036							3122171		406995	73950634
1972	22201393	50609961	32680801	414792				593493	66943		3547818							2184167		612982	112912350
1973	23560536	49413703	29887834	407501				12047640	79935	7435	4809244							3174836		252175	123640840

1974	8831832	38286947	30437980	962447		13120		5039825	60332		4789554							4293608		118437	92834083
1975	11531042	33395109	24670872	1031786		8084		4456061	109799		11287388							4129920		211955	90832015
1976	5179288	45467979	26919168	1848500		8952		8645448	90321		8454939							4777555		304161	101696313
1977	14102110	34935922	29092496	3573402		13900		3764953	99163		14554621							4440215		348855	104925638
1978	28934997	44733360	18992333	3338542		19194		3956001	75306		16007794							1950022		2296049	120303599
1979	34602073	48541278	13532454	2971119		2849542		935336	55932	32885	22608795							1875295		2684606	130689315
1980	38534718	43333205	12335813	2727731		2296780		4579005	79456	282731	22295657							2092360		1404655	129962110
1981	32593469	44554951	14736725	2559889	135968	3554595		2586839	83960	437100	8269013							1402023		472314	111386846
1982	41961716	55046257	18163724	4198009	747896	1948202		5177794	102562	119000	8088341							367565		493214	136414281
1983	22376618	27793165	20576515	4486789	3852738	678183		3858781	152300	731000	14427762							355134		1317994	100606978
1984	43764273	17104809	17447622	3928252	8110293	738342		3699689	134866	629500	11270923							687609		945671	108461850
1985	47687427	50777642	18221222	2717455	8821455	626262		2642806	156367	81735	20613544							502560		1198607	154047080
1986	30106714	65660280	11948864	4082272	2512059	967316		6999517	204770	296826	11840119									2239991	136858728
1987	27457601	80092202	12614230	4751242	1567428	363926		2509278	11120303	4302	13552453									4109563	158142528
1988	48421677	71235298	9915527	5345940	1088401	323960	19756	1556244	7642369	106255	15022731									5814987	166493144
1989	53756351	63533198	12590532	6359955	836379	214782	76125	1208773	13607583	287	8597520									10265532	171047015
1990	70530780	87458467	3073749	6996607	610151		66148	2011485	14310717		8976571									14152833	208187509
1991	61468468	80470565	5782012	8751556	458644		5597	2138285	13206398		316448									17603965	190201939
1992	58214783	75265159	1653774	16806555	782875		8335	2448336	13698619		316448									13754051	182948937
1993	59531867	92470879	1925769	22220136	342018			27285401	19189244				414661							15808672	239188647
1994	66885582	90595073	3561423	8711425	305253		36725	33573719	18292013				1118998	981368						19824386	243885965
1995	57438620	75045941	874566	9935603	483326		2001	24881651	21582283	479			1291038				26597			20874155	212436259
1996	53184612	86621575	3547840	7538581	803733		746802	16694859	20097272				1283686							25064439	215583399
1997	40610232	85726942	1874029	10674763	783661		528992	9159407	21138493		63290	4262899	949898	10231			27997			34714241	210525073
1998	36314413	80982233	994924	11485746	1148094		216157	4444757	18130506	168204	63290	2037904	4115735	7162		3114292				54888370	218111787
1999	34413135	100386231	1141619	14154571	976926		201107	1527412	17816559	289358		1262500	15860065	902383		5223433	181980			50028504	244365781
2000	34585184	113241152	5668257	18423817	1196096	11844	439206	456861	13978495	1133502		357933	21364109	1190778	3840699	2476582	105268			35008468	253478251

2001	27405695	103725276	13837	28728590	1184401	12013	496340		13563469	1723819		284132	15385406	4045980	4829907	834610				22449815	224683290
2002	26485443	102316600	261260	26132905	1919593		224472		11559425	1518172		477105	13277903	4292232	1235867	2041837				6192631	197935447
2003	46168773	130396110	912075	19353010	2771770		75469		11390288	889588			9028528	5803531		2231652				7302087	236322883
2004	33975727	85679631	2927783	14835221	2945980		71017		11031958	1119376		487040	15677291	5473030	318431	1605390			27301	4174322	180349499
2005	21083241	69599663	1718833	17091907	3174002	620			10105729	961484		614803	10495027	3278079	72544	1476550	33176		1850350	4708307	146264314
2006	29573685	48859987	2095173	13082204	1559990	1800		606400	9043272	875789		1641059	20456052	7397932	5770710	5052583	1410238		5150903	4925696	157503474
2007	43442364	61242504	3698861	9070658	877721	3600		612159	8613291	1687328		2526879	16022239	5356816	4928800	6905520	1862660		2779410	4907918	174538728
2008	38251250	47839039	4961649	6646400	800679	1374		7854047	7351214	918003		2098187	9338692	3124267	9660000	3471927	1149262		3190136	4957095	151613221
2009	31795035	59160855	5479571	6742525	2286523		1387	2473974	8877519	1177900		1263794	11394044	679993	8137825	3635458	1174390		2818419	5272944	152372156

Table 12. SMA catalog 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 2010 (2011 is provisional).

Status	Flag	GearGrp	Values	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	avg(90-10)
CP	Belize	LL	t1																38		17	2	23	60	28
			t2																-1		a	a	ab	ab	
	Brasil	BB	t1																0	0		4			1
			t2																a	a		a			
		HL	t1														0								0
			t2														-1							a	
		LL	t1							83	190		27	219	409	226	283	177	426	183	152	121	92	128	194
			t2							-1	-1		-1	ab	a	a	a	a	ab	a	-1	a	a	a	
		SU	t1															61	0						30
			t2															-1	-1						
		UN	t1																	27	5	78	7		29
			t2																	-1	-1	-1	-1		
	Canada	GN	t1						17	10	9	12	14	17	8	14	8	9	15	6	7	2	3	2	10

		t2					a	a	a	a	a	a	a	-1	a	a	a	-1	-1	-1	a	ab	
	HL	t1					0	0	0	0	0	0	1	0	0	0	1	0	0				0
		t2					a	a	a	a	a	a	a	-1	a	a	a	-1	-1				
	HP	t1								1	1	1		1	1	1	1	0	1	0			1
		t2								a	a	a		-1	a	a	a	-1	-1	-1			
	LL	t1					93	56	99	55	54	59	60	61	63	69	74	64	64	38	50	39	62
		t2					-1	a	a	a	a	a	a	-1	a	a	a	-1	-1	-1	a	ab	
	RR	t1										1	0	0				0	0	1		0	0
		t2										a	a	-1				-1	-1	-1		ab	
	TL	t1									0		0	0	0	0							0
		t2									a		a	-1	a	a							
	TP	t1					0							0									0
		t2					-1							-1									
	TW	t1					1	1	2	2	2	0	0	1	1	0	1	0	1	1	0	0	1
		t2					a	a	a	a	a	a	a	-1	a	a	a	-1	-1	-1	a	ab	
	UN	t1																		1			1
		t2																		-1			
China P.R.	LL	t1			34	45	23	27	19	74	126	306	22	208	260				157	21	43	61	95
		t2			-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1				a	a	a	a	
Côte D'Ivoire	GN	t1	9	13	10	20	13	15	23	10	10	9	15	15	30	15	14	16	25				15
		t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	b	b	-1	-1	b	a				
	LL	t1																			5	7	6
		t2																			-1	-1	
EU.España	LL	t1							3777	3347	2917	2769	2921	2859	3228	4108	2337	2586	2470	2523	3155	3284	3020
		t2							-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	
EU.France	GN	t1																			0	0	0
		t2																			-1	-1	

	LL	t1																				13		13
		t2																				-1		
	PS	t1																				0	0	0
		t2																				-1	-1	
	TN	t1																				0		0
		t2																				-1		
	TP	t1																				0		0
		t2																				-1		
	TW	t1																				1	2	1
		t2																				-1	-1	
EU.Portugal	LL	t1	193	314	220	796	649	749	785	519	424	446	706	523	471	1781	411	1366	1449	1914	1335	1304	1315	841
		t2	-1	-1	-1	-1	-1	a	a	a	a	a	a	a	a	a	a	a	ab	ab	ab	ab	ab	
	PS	t1														0	0	0				0	0	0
		t2														a	a	a				a	a	
	SU	t1														93	74			0	19	367	454	168
		t2														a	a	a	a	a	a	a	a	
	TP	t1									0								0	0				0
		t2									-1								-1	-1				
Japan	LL	t1	759	663	778	1126	1583	2209	1304	502	1159	271	402	161	571	385	970			155	246	207	224	720
		t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1			-1	-1	ab	ab	
Korea Rep.	LL	t1																					29	29
		t2																					-1	
Mexico	LL	t1						10					10	16		10	6	9	5	8	6	7	8	9
		t2						-1					a	ab	a	a	a	a	a	ab	a	a	a	
Philippines	LL	t1										3	0								1			2
		t2										-1	-1								-1			
South Africa	BB	t1												2									0	1

		t2												a								a	a	
	HL	t1																					0	0
		t2																				a	a	
	LL	t1									19	13		77	19	138	126	125	99	208	136	100	143	100
		t2									-1	-1	ab	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	
St. Vincent and Grenadines	UN	t1							0			3												1
		t2							-1			-1												
Trinidad and Tobago	LL	t1										1		1	2	3	1	2	1	1	1	1	1	1
		t2										-1		-1	a	a	a	a	a	a	a	a	a	
	RR	t1																		0				0
		t2																		a				
U.S.A.	GN	t1	9	3	3	3	12	7	3	0	3		0				0							4
		t2	-1	-1	-1	-1	-1	-1	-1	-1	-1		-1				b							
	HL	t1				0	1	0	1	1	0	0				0	1	0	0	0	1	1	1	0
		t2				-1	-1	-1	-1	-1	-1	-1				b	b	b	b	b	b	b	b	
	HP	t1					0			0				0										0
		t2					-1			-1				-1										
	LL	t1	93	113	161	302	332	310	234	244	196	90	166	181	167	142	188	187	129	222	197	221	225	195
		t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	b	b	b	b	b	b	ab	ab	
	RR	t1					1		0	0	0	0	1	0	0	0	222			0				20
		t2					-1		-1	-1	-1	-1	-1	-1	-1	-1	-1			-1				
	SP	t1	268	210	250	667	317	1422	232	164	148	69	290	214	248									346
		t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1									
	TR	t1	0																0					0
		t2	-1																-1					
	TW	t1		0	0	1	1	0												0				0
		t2		-1	-1	-1	-1	-1											b	b				

	UN	t1																	0	1	0	0	0
		t2																	-1	-1	-1	-1	
UK.Bermuda	LL	t1																	0	0		0	0
		t2																	-1	-1	a	a	
	RR	t1								1	2	2							0			0	0	1
		t2								-1	-1	-1							-1			-1	-1	
Uruguay	LL	t1	26	13	20	28	12	17	26	20	23	21	35	40	38	188	249	146	68	36	41	106	23	56
		t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	ab	ab	ab	a	-1	
Vanuatu	LL	t1															52	12	13	1	0			16
		t2															-1	a	a	-1	-1			
Venezuela	GN	t1																						
		t2																						
	LL	t1															58	20	6	11	2	35	22	22
		t2					b	b	b	b	b	b	b	b	b	b	ab	a	ab	ab	ab	a	a	
EU.Cyprus	LL	t1																	1	1	0	0	0	1
		t2																	a	a	a	-1	a	
EU.Malta	LL	t1																						
		t2										a												
EU.United Kingdom	GN	t1																0		0	1	2		1
		t2																a		a	-1	a		
	HL	t1																				0	0	0
		t2																a				a	a	
	LL	t1																0	5		0	24		7
		t2																a	a		-1	a		
	TN	t1																						
		t2																a						
	TP	t1																				0		0

			t2											a		
		TW	t1									0				0
			t2							a		a				
		UN	t1	2	3	2	1	1	1							2
			t2	-1	-1	-1	-1	-1	-1							
	FR.St Pierre et Miquelon	LL	t1									1	2		4	2
			t2									-1	-1		a	
	Namibia	BB	t1												0	0
			t2												-1	
		LL	t1	1			459		509	1415	1243	1002	295	23	306	584
			t2	-1			a		ab	ab	ab	ab	ab	ab	ab	
	Panama	LL	t1	25	1						0	49	43	39		26
			t2	-1	-1						-1	a	a	a		
	Russian Federation	LL	t1							0						0
			t2							-1						
	Senegal	LL	t1									8	17	21		15
			t2									-1	a	-1	a	
	UK.Sta Helena	RR	t1													
			t2								a	a	a	a	a	
NCC	Chinese Taipei	LL	t1					710	178	147	168	236	147	129	150	233
			t2					ab	ab	ab	ab	ab	ab	ab	ab	
NCO	Sta. Lucia	UN	t1										0		0	0
			t2										-1		-1	

Table 13. Summary table of the CPUE series presented during the 2012 Shortfin Mako Stock Assessment and Ecological Risk Assessment Meeting.

North												
Year	*US-MRFSS-N*	*CV*	*US-Log-N*	*CV*	*US-Obs-N*	*CV*	*JPLL-N*	*CV*	*POR-LL-N*	*CV*	*ESP-LL-N*	*CV*
1981	0.06	0.95										
1982	0.13	1.25										
1983	0.04	1.37										
1984	0.06	1.31										
1985	0.17	1.18										
1986	0.34	1.15	1.151	0.142								
1987	0.24	1.22	1.145	0.084								
1988	0.17	1.18	0.906	0.084								
1989	0.19	1.15	1.047	0.08								
1990	0.25	1.15	0.829	0.082							1.2	0.649
1991	0.16	1.16	0.741	0.085							1.15	0.886
1992	0.44	1.15	0.884	0.083	1.147	0.224					1.37	0.379
1993	0.55	1.15	0.772	0.083	0.867	0.19					1.25	0.528
1994	0.21	1.17	0.725	0.083	0.582	0.206	0.118	0.441			1.11	1.215
1995	0.4	1.15	0.672	0.082	0.911	0.194	0.074	0.882			1.33	0.406
1996	0.22	1.17	0.601	0.085	0.528	0.488	0.071	0.79			1.8	0.193
1997	0.2	1.18	0.549	0.087	0.657	0.249	0.113	0.394			1.1	1.281
1998	0.34	1.15	0.519	0.089	0.502	0.323	0.085	0.524			1.28	0.476
1999	0.18	1.18	0.509	0.092	0.547	0.266	0.073	0.692			1.2	0.664
2000	0.36	1.17	0.539	0.092	0.875	0.217	0.067	0.754	20.858	0.111	1.29	0.466
2001	0.19	1.16	0.494	0.094	0.739	0.257	0.091	0.453	28.152	0.115	1.26	0.512
2002	0.12	1.18	0.517	0.094	0.943	0.249	0.078	0.644	25.668	0.109	1.66	0.231
2003	0.07	1.21	0.56	0.096	0.748	0.232	0.099	0.441	37.265	0.105	2.03	0.168

2004	0.14	1.17	0.663	0.093	1.276	0.186	0.076	0.502	28.952	0.098	2.26	0.148
2005	0.13	1.18	0.667	0.094	0.854	0.209	0.078	0.467	23.656	0.101	2.1	0.163
2006	0.19	1.17	0.521	0.098	0.96	0.202	0.114	0.334	28.241	0.122	1.91	0.19
2007	0.2	1.18	0.785	0.091	1.081	0.187	0.123	0.432	20.868	0.116	2.51	0.137
2008	0.03	1.23	0.663	0.091	0.755	0.178	0.135	0.355	23.2	0.12	2.59	0.132
2009	0.14	1.19	0.838	0.091	1.594	0.165	0.17	0.377	20.255	0.111	2.4	0.141
2010	0.23	1.19	0.745	0.093	1.006	0.188	0.159	0.592	30.304	0.105	2.06	0.171
South												
Year	*UR-LL-S*	*CV*	*JPLL-S*	*CV*	*BR-LL-S*	*CV*	*POR-LL-S*	*CV*	*ESP-LL-S*	*CV*		
1978					0.031	0.209						
1979					0.014	0.302						
1980					0.064	0.182						
1981					0.02	0.266						
1982	76.744	0.165			0.024	0.171						
1983	29.719	0.432			0.015	0.251						
1984	14.107	0.482			0.126	0.139						
1985	10.829	0.456			0.151	0.181						
1986	12.242	0.321			0.166	0.138						
1987	22.968	0.478			0.082	0.184						
1988	16.56	0.392			0.16	0.146						
1989	25.389	0.388			0.13	0.147						
1990	31.026	0.287			0.174	0.415			1.126	0.971		
1991	30.2	0.268			0.108	0.125			0.876	0.767		
1992	31.847	0.27			0.074	0.165			1.091	1.214		
1993	38.403	0.681			0.1	0.62			1.118	0.874		
1994	78.3	0.252	0.074	1.808	0.123	0.127			1.145	0.727		
1995	68.372	0.35	0.055	2.459	0.238	0.115			1.311	0.328		

1996	33.22	0.53	0.05	2.718	0.271	0.155			1.298	0.288
1997	47.013	0.725	0.072	1.868	0.201	0.144			0.919	0.81
1998	33.645	0.425	0.052	2.69	0.288	0.073			0.712	0.217
1999	46.891	0.318	0.044	3.166	0.253	0.08			0.574	0.131
2000	71.37	0.212	0.055	2.466	0.088	0.072	48.022	0.238	0.951	1.393
2001	73.866	0.172	0.053	2.73	0.455	0.07	24.241	0.31	1.186	0.385
2002	54.921	0.234	0.054	2.648	0.424	0.062	42.88	0.192	1.119	0.623
2003	60.82	0.193	0.057	2.412	0.494	0.077			1.118	0.657
2004	55.151	0.176	0.061	2.294	0.413	0.059	150.415	0.189	1.004	58.746
2005	47.023	0.157	0.062	2.302	0.326	0.06	110.541	0.158	1.167	0.544
2006	48.513	0.279	0.062	2.243	0.376	0.094	81.219	0.199	0.967	1.982
2007	32.974	0.333	0.079	1.777	0.346	0.085	75.928	0.189	0.928	1.039
2008	32.317	0.44	0.091	1.474	0.248	0.503	71.639	0.115	0.868	0.526
2009	50.461	0.186	0.106	1.263	0.282	0.138	76.193	0.129	1.046	1.707
2010	74.197	0.198	0.133	1.002	0.318	0.11	52.502	0.157	1.177	0.471

Table 14. Example table to evaluate the sufficiency of CPUE series using the CPUE series presented during the 2012 Shortfin Mako Stock Assessment and Ecological Risk Assessment Meeting.

		1	2	3	4	5	6	7
	Document	SCRS/2012/072	SCRS-12-046	SCRS/2012/074	SCRS/2012/077	SCRS/2012/070	SCRS/2012/076	SCRS/2012/080
	Index	Portugal pelagic LL	Spanish SWO LL	Japanese LL	US recreational	US pelagic LL	Uruguay LL	Brazil LL
1	Diagnostics	4	4	1 (key diagnostics not included e.g., qqplots, boxplots or residuals). Information subsequently provided by authors.	4	4	4	4
2	Appropriateness of data exclusions and classifications (e.g. to identify targeted trips).	3 (Data exclusions are covered but No targeting proxy - vessel wouldn't cover changes in selectivity/catchability)	3 (GLM specifically includes a proxy targeting factor. Data exclusions not explicitly discussed)	4 (data exclusions are clearly identified and justified)	3/4 (data exclusions are presented and discussed, possible overly stringent criteria for excluding strata)	4(GLM specifically includes factors to address targeting. Exclusion of strata documented and justified)	3(GLM specifically includes factors to address gear changes, but not targeting. Exclusion of strata documented and justified)	4 (targeting is included in model, not sure if any data exclusions were carried out)

3	Geographical Coverage	2 (limited coverage of effort but it is explicitly presented. Although area maps are provided, distribution of effort is not, making spatial coverage difficult to identify)	2 (unknown effort coverage and acknowledged spatio-temporal limitations for early part of series. Exact spatial distribution of effort not presented)	3 (extensive coverage, but with admitted bias in effort distribution. Information clearly presented in maps)	2 (local recreational fishery, no maps of effort provided)	2 for observer (due to several areas being excluded) 3 for logbook (limited to western Atlantic, but difficult to tell from info in document. No maps on distribution of effort. Unknown effort coverage-after clarification by author, all reported)	2 (limited to south western Atlantic. Good distribution of effort maps provided)	2 (limited to south western Atlantic. Good distribution of effort maps provided)
4	Catch Fraction	?	?	?	1 (low catch)	?	?	?
5	Length of Time Series relative to the history of exploitation.	2 (series only runs from 2000)	3 (series runs from 1990)	3 (series runs from 1994)	5 (series from 1981)	4 (runs from 1986)	5 (series from 1982)	5 (series from 1978)
6	Are other indices available for the same time period?	1 (all others)	2 (Many)	2 (many)	4 (few)	3 (several)	4 (few)	5 (longest series)

7	Does the index standardization account for Known factors that influence catchability/selectivity ?	2 (standardised, but very few factors and no interactions)	4 (gear characteristics as well as fishing behaviour included. Interactions included)	3 (gear factor is included as is a selectivity proxy. Multiple interactions included)	3 (fishing mode is included as a factor, but uncertain if this will account for all possible changes although as this is a recreational fishery that may not be as important. Model does include multiple interaction terms)	4(analysis includes many factors that could affect fishing efficiency/selectivity . Multiple interactions included)	4(analysis includes many factors that could affect fishing efficiency/selectivity . Multiple interactions included)	4 (strategy is included as are interactions)
8	Are there conflicts between the catch history and the CPUE response?	5 (No conflict noted)	5 (No conflict noted)	5 (No conflict noted)	5 (No conflict noted)	5 (No conflict noted)	5 (No conflict noted)	5 (No conflict noted)
9	Is the interannual variability within plausible bounds (e.g. SCRS/2012/039)	5	5	4 (North fluctuations higher than for south)	5	2 for observer series. 5 for logbook series	4	5
10	Are biologically implausible interannual deviations severe? (e.g. SCRS/2012/039)	5	5	5	5	2 for observer series. 5 for logbook series	5	5

11	Assessment of data quality and adequacy of data for standardization purpose (e.g. sampling design, sample size, factors considered)	2 (assessment is carried out but authors concede work is preliminary, few factors available for standardisation and effort coverage is limited)	3 (data includes several factors including explicit targeting and gear/fishing behavior factors) This score would be higher if the proportion of the effort coverage was provided	4 (extensive self-analysis of data quality is included in the document including ranking of data quality)	2 (data quality is covered and limitations discussed. Authors acknowledge series should be treated with caution due to limitations)	3/4 (Analysis includes multiple factors and interactions. Not clear what proportion of effort was covered.)	4 (information includes length frequencies of catches in recent years. Multiple factors and interactions included. Sample design takes into account effort distribution although proportion of effort covered is not explicitly discussed)	3 (multiple factors were included, data quality explicitly explored in annex. Concern about design balance with regards to populating all strata with sufficient data, especially regarding fleet)
12	Is this CPUE time series continuous?	4 for north 3 for south	4	5	5	5	5	5

Table 15. Index weighting for BSP model runs in both the North and the South Atlantic.

(a) area weighting

	US-Log	*JPLL-N*	*POR-LL-N*	*ESP-LL-N*	*UR-LL*	*JPLL-S*	*BR-LL*	*POR-LL-S*	*ESP-LL-S*
1978							1.00		
1979							1.00		
1980							1.00		
1981							1.00		
1982					0.24		0.76		
1983					0.25		0.75		
1984					0.25		0.75		
1985					0.24		0.76		
1986	1.00				0.26		0.74		
1987	1.00				0.24		0.76		
1988	1.00				0.24		0.76		
1989	1.00				0.25		0.75		
1990	0.66			0.34	0.21		0.04		0.75
1991	0.62			0.38	0.14		0.40		0.46
1992	0.63			0.37	0.16		0.48		0.35
1993	0.63			0.37	0.24		0.02		0.75
1994	0.34	0.44		0.22	0.06	0.53	0.18		0.23
1995	0.32	0.47		0.21	0.07	0.48	0.22		0.23
1996	0.29	0.46		0.25	0.09	0.40	0.26		0.26
1997	0.30	0.44		0.26	0.08	0.38	0.23		0.32
1998	0.25	0.48		0.27	0.08	0.38	0.25		0.28
1999	0.24	0.48		0.28	0.09	0.35	0.27		0.30
2000	0.20	0.47	0.06	0.27	0.08	0.35	0.25	0.05	0.25
2001	0.22	0.47	0.07	0.24	0.08	0.34	0.25	0.06	0.27
2002	0.22	0.47	0.07	0.25	0.08	0.26	0.26	0.06	0.33
2003	0.20	0.46	0.08	0.26	0.11	0.42	0.01		0.46
2004	0.18	0.49	0.06	0.26	0.07	0.31	0.21	0.08	0.34
2005	0.19	0.51	0.06	0.24	0.10	0.25	0.30	0.06	0.28
2006	0.19	0.49	0.07	0.25	0.10	0.24	0.29	0.09	0.28
2007	0.17	0.42	0.10	0.31	0.01	0.22	0.25	0.11	0.42
2008	0.18	0.41	0.08	0.33	0.05	0.26	0.24	0.09	0.36
2009	0.16	0.39	0.10	0.34	0.02	0.27	0.25	0.08	0.37
2010	0.16	0.39	0.10	0.34	0.02	0.27	0.25	0.08	0.37

(b) catch weighting

	US-Log	*JPLL-N*	*POR-LL-N*	*ESP-LL-N*	*UR-LL*	*JPLL-S*	*BR-LL*	*POR-LL-S*	*ESP-LL-S*
1978							1.00		
1979							1.00		
1980							1.00		
1981							1.00		
1982					0.51		0.49		
1983					0.67		0.33		
1984					0.80		0.20		
1985					0.82		0.18		
1986	1.00				0.47		0.53		
1987	1.00				0.50		0.50		
1988	1.00				0.36		0.64		
1989	1.00				0.30		0.70		
1990	0.20			0.80	0.02		0.07		0.91
1991	0.16			0.84	0.01		0.08		0.91
1992	0.09			0.91	0.02		0.15		0.84
1993	0.26			0.74	0.01		0.14		0.85
1994	0.19	0.06		0.75	0.01	0.19	0.05		0.75
1995	0.35	0.05		0.60	0.02	0.09	0.06		0.83
1996	0.15	0.05		0.80	0.03	0.06	0.06		0.85
1997	0.14	0.04		0.82	0.01	0.06	0.11		0.82
1998	0.13	0.07		0.80	0.02	0.05	0.13		0.80
1999	0.07	0.03		0.90	0.02	0.08	0.03		0.87
2000	0.19	0.04	0.13	0.64	0.02	0.04	0.11	0.20	0.63
2001	0.15	0.05	0.15	0.65	0.02	0.02	0.22	0.08	0.66
2002	0.14	0.05	0.14	0.68	0.03	0.03	0.19	0.05	0.70
2003	0.04	0.03	0.35	0.58	0.11	0.04	0.17		0.68
2004	0.09	0.04	0.11	0.77	0.20	0.05	0.19	0.01	0.55
2005	0.06	0.05	0.35	0.55	0.10	0.02	0.30	0.17	0.41
2006	0.04	0.05	0.30	0.61	0.04	0.07	0.14	0.32	0.43
2007	0.06	0.03	0.42	0.49	0.03	0.07	0.11	0.29	0.50
2008	0.06	0.07	0.31	0.56	0.03	0.09	0.15	0.24	0.48
2009	0.06	0.05	0.31	0.59	0.06	0.07	0.06	0.29	0.53
2010	0.06	0.05	0.37	0.53	0.01	0.07	0.07	0.19	0.66

Table 16. BSP model runs for the North Atlantic. Base case indices were the USA (logbook), Japan, Portugal and Spain longline indices.

Run	*Indices*	*Weighting*	*Start year*	*Catch*	*Priors*	*Catch data start*	*Catch estimated*	*Name*
1	Base	equal	1971	Base	Base	1971	no	equal wt
2	Base	equal	1971	Base	Bo/K mean=1	1971	no	Bo/K=1
3	Base	equal	1997	Base	Base	1997	no	Bo in 1997
4	Base	catch	1971	Base	Base	1971	no	catch wt
5	Base	equal	1956	Base	Base	1971	no	Bo in 1956
6	Base	area	1971	Base	Base	1971	no	area wt
7	Base	area	1971	Base	*r* sd doubled	1971	no	*r* 2x sd
8	less US	equal	1971	Base	Base	1971	no	less US
9	less JLL	equal	1971	Base	Base	1971	no	less JLL
10	less Por	equal	1971	Base	Base	1971	no	less Por
11	less Esp	equal	1971	Base	Base	1971	no	less Esp
12	plus MRFSS	equal	1971	Base	Base	1971	no	plus MRFSS
13	Base	area	1971	Base	Bo/K mean=1	1997	effort	effort
14	Base	area	1971	Base	Bo/K mean=1	1997	constant	const C
15	Base	equal	1971	Big C	Bo/K mean=1	1971	no	Big C
16	less Por	area	1971	Base	from 2008	1971	no	Continuity

Table 17. BSP model runs for the South Atlantic. Base case indices were the Uruguay, Japan, Brazil, Portugal and Spain longline indices.

Run	Indices	Weighting	Start year	Catch	Priors	Catch data start	Catch estimated	name
1	Base	equal	1971	Base	Base	1971	no	equal wt
2	Base	equal	1971	Base	Bo/K mean=1	1971	no	B0/K=1
3	Base	catch	1971	Base	Base	1971	no	catch wt
4	Base	equal	1997	Base	Base	1997	no	Bo in 1997
5	Base	area	1971	Base	Bo/K mean=1	1971	no	area wt
6	Base	area	1971	Base	Bo/K mean=1	1997	effort	effort
7	Base	area	1971	Base	Bo/K mean=1	1997	const C	const C
8	less Por	area	1971	Base	From 2008	1971	no	Continuity
9	less Ur	equal	1971	Base	Base	1971	no	less Ur
10	less JLL	equal	1971	Base	Base	1971	no	less JLL
11	less Br	equal	1971	Base	Base	1971	no	less Br
12	less Por	equal	1971	Base	Base	1971	no	less Por
13	less Esp	equal	1971	Base	Base	1971	no	less Esp

Table 18. Means of the posterior distributions, with CV in parentheses, for BSP model results for North Atlantic shortfin mako sharks.

Run	*Description*	*K*	*r*	*MSY*	*Bcur*	*Binit*	*Bcur/Binit*
N1	equal wt	1401310(0.89)	0.058(0.12)	20278(0.91)	1230214(0.97)	960822(1.02)	1.292(0.38)
N2	Bo/K=1	1411984(0.9)	0.058(0.12)	20478(0.91)	1324038(0.95)	1270785(0.91)	0.972(0.19)
N3	Bo in 1997	1727088(0.76)	0.059(0.12)	25204(0.77)	1176821(0.85)	940140(0.92)	1.269(0.19)
N4	catch wt	1375473(0.91)	0.058(0.12)	19917(0.93)	1207153(0.99)	952087(1.03)	1.256(0.41)
N5	Bo in 1956	458516(1.2)	0.058(0.12)	6639(1.21)	350971(1.56)	320546(1.42)	1.067(0.43)
N6	area wt	1320490(0.95)	0.058(0.12)	19125(0.96)	1163589(1.03)	943009(1.06)	1.194(0.41)
N7	*r* 2x sd	1328402(0.94)	0.058(0.25)	19184(1)	1162019(1.03)	945537(1.05)	1.189(0.42)
N8	less US	1637308(0.78)	0.058(0.12)	23736(0.79)	1378877(0.85)	901886(0.96)	1.63(0.4)
N9	less JLL	1357219(0.92)	0.058(0.12)	19644(0.93)	1198825(1)	965417(1.03)	1.229(0.38)
N10	less Por	1400827(0.89)	0.058(0.12)	20257(0.91)	1227925(0.97)	956031(1.02)	1.3(0.38)
N11	less Esp	1255809(0.98)	0.058(0.12)	18184(1)	1113764(1.07)	937296(1.08)	1.129(0.39)
N12	plus MRFSS	1678172(0.77)	0.058(0.12)	24380(0.79)	1504646(0.83)	1159179(0.88)	1.338(0.33)
N13	effort	367224(1.32)	0.058(0.12)	5317(1.34)	272689(1.79)	326617(1.34)	0.656(0.43)
N14	const C	1339666(0.94)	0.058(0.12)	19426(0.96)	1253668(1)	1213559(0.96)	0.95(0.22)
N15	Big C	1437456(0.83)	0.058(0.12)	20838(0.84)	1265002(0.96)	1284987(0.85)	0.867(0.28)
N16	Continuity	1322431(0.94)	0.058(0.12)	19139(0.96)	1164598(1.03)	942094(1.05)	1.201(0.41)

Run	Ccur/MSY	Fcur/Fmsy	Bcur/Bmsy	Ccur/repy	Bmsy	repy	Note
N1	0.448(0.84)	0.37(1.23)	1.579(0.22)	0.806(0.5)	700655(0.89)	7562(0.88)	
N2	0.468(0.89)	0.335(1.24)	1.719(0.16)	1.056(0.31)	705992(0.9)	4339(0.44)	
N3	0.342(1.03)	0.31(1.29)	1.315(0.29)	0.609(51.53)	863544(0.76)	18593(0.9)	
N4	0.484(0.89)	0.452(1.63)	1.558(0.24)	0.857(0.55)	687736(0.91)	7371(0.92)	
N5	0.939(0.43)	0.922(0.72)	1.276(0.3)	1.177(0.24)	229258(1.2)	3722(0.37)	
N6	0.525(0.88)	0.518(1.68)	1.54(0.26)	0.912(0.55)	660245(0.95)	6799(0.92)	B0/K to 1.1
N7	0.534(0.9)	0.532(1.69)	1.534(0.26)	0.93(0.94)	664201(0.94)	6693(0.92)	B0/K to 1.1
N8	0.346(0.88)	0.271(1.25)	1.567(0.19)	0.608(0.64)	818654(0.78)	11392(0.86)	B0/K to 1.1
N9	0.48(0.85)	0.415(1.31)	1.572(0.23)	0.858(0.49)	678609(0.92)	6980(0.89)	
N10	0.445(0.84)	0.367(1.23)	1.578(0.22)	0.801(0.51)	700413(0.89)	7628(0.89)	
N11	0.555(0.85)	0.531(1.38)	1.535(0.26)	0.953(0.48)	627904(0.98)	6107(0.88)	B0/K to 1.1
N12	0.34(0.88)	0.247(1.25)	1.674(0.17)	0.729(0.52)	839086(0.77)	8218(0.81)	B0/K to 1.1
N13	1.237(0.44)	1.632(0.99)	1.154(0.42)	1.639(0.35)	183612(1.32)	2742(0.35)	
N14	0.594(1.09)	0.481(2)	1.696(0.19)	1.369(1.97)	669833(0.94)	3997(0.73)	
N15	0.353(0.66)	0.319(1.11)	1.527(0.26)	0.601(0.25)	718728(0.83)	7241(0.29)	
N16	0.518(0.88)	0.505(1.63)	1.543(0.26)	0.905(0.54)	661216(0.94)	6846(0.92)	B0/K to 1.1

Table 19. Means of the posterior distributions, with CV in parentheses, for BSP model results for South Atlantic shortfin mako sharks.

Run	*Description*	*K*	*r*	*MSY*	*Bcur*	*Binit*	*Bcur/Binit*
S1	equal wt	2321368(0.55)	0.062(0.11)	35698(0.56)	1791675(0.57)	570261(0.58)	3.137(0.12)
S2	B0/K=1	1119987(0.43)	0.059(0.12)	16380(0.44)	1024838(0.44)	731135(0.47)	1.427(0.16)
S3	catch wt	2025428(0.65)	0.06(0.12)	30421(0.66)	1594937(0.68)	585810(0.74)	2.772(0.19)
S4	Bo in 1997	1517990(0.86)	0.058(0.12)	22047(0.87)	1079256(0.94)	872656(1.01)	1.256(0.18)
S5	area wt	1894234(0.7)	0.058(0.12)	27558(0.72)	1802461(0.72)	1468718(0.73)	1.23(0.16)
S6	effort	956777(0.98)	0.059(0.12)	13978(0.99)	885085(1.03)	732358(1.01)	1.18(0.19)
S7	const C	1702977(0.78)	0.058(0.12)	24762(0.79)	1619836(0.79)	1317917(0.81)	1.228(0.16)
S8	Continuity	2068060(0.63)	0.061(0.12)	31110(0.64)	1619300(0.66)	578823(0.71)	2.836(0.18)
S9	less Ur	2238438(0.58)	0.061(0.11)	34189(0.59)	1731152(0.6)	565832(0.61)	3.063(0.13)
S10	less JLL	2304785(0.56)	0.062(0.11)	35329(0.56)	1778326(0.58)	569938(0.58)	3.118(0.12)
S11	less Br	1679761(0.78)	0.058(0.12)	24391(0.79)	1410130(0.82)	743997(0.98)	2.087(0.32)
S12	less Por	2303742(0.56)	0.062(0.11)	35389(0.56)	1777599(0.57)	567369(0.58)	3.133(0.12)
S13	less Esp	2337783(0.55)	0.062(0.11)	35940(0.55)	1800224(0.57)	568910(0.57)	3.159(0.11)

Run	*Ccur/MSY*	*Fcur/Fmsy*	*Bcur/Bmsy*	*Ccur/repy*	*Bmsy*	*repy*	*notes*
S1	0.107(0.79)	0.073(0.9)	1.522(0.08)	0.142(0.69)	1160684(0.55)	25033(0.53)	B0/K to 0.2
S2	0.197(0.62)	0.112(0.69)	1.81(0.05)	0.584(0.41)	559993(0.43)	5034(0.42)	
S3	0.147(0.93)	0.104(1.13)	1.537(0.11)	0.206(1.09)	1012714(0.65)	20044(0.65)	B0/K to 0.2
S4	0.284(1.1)	0.251(1.35)	1.362(0.28)	0.459(42.29)	758995(0.86)	15298(1.02)	
S5	0.182(1.03)	0.104(1.19)	1.862(0.05)	0.751(17.37)	947117(0.7)	5006(0.69)	
S6	0.36(0.76)	0.223(0.93)	1.755(0.09)	0.829(0.37)	478389(0.98)	3710(0.61)	
S7	0.238(1.17)	0.14(1.42)	1.85(0.06)	0.813(11.09)	851489(0.78)	4500(0.73)	
S8	0.14(0.91)	0.098(1.09)	1.532(0.1)	0.192(6.87)	1034030(0.63)	20849(0.62)	B0/K to 0.2
S9	0.115(0.82)	0.079(0.95)	1.522(0.09)	0.153(0.72)	1119219(0.58)	23813(0.55)	B0/K to 0.2
S10	0.108(0.8)	0.074(0.91)	1.522(0.08)	0.144(0.82)	1152392(0.56)	24791(0.53)	B0/K to 0.2
S11	0.222(0.99)	0.157(1.24)	1.609(0.14)	0.409(2.4)	839880(0.78)	12437(0.87)	B0/K to 0.2
S12	0.108(0.8)	0.074(0.91)	1.522(0.08)	0.144(0.98)	1151871(0.56)	24833(0.53)	B0/K to 0.2
S13	0.104(0.78)	0.071(0.88)	1.52(0.08)	0.138(0.76)	1168891(0.55)	25362(0.52)	B0/K to 0.2

Table 20. Scenarios explored with the CFASPM.

Model run	*Region*	*Historic period*	*Modern period*	*Depletion at t_{modern}*	*Indices used*	*Index weighting*
Run 1	North	1956-1970	1971-2010	0%	US, JP, ESP, POR	none
Run 2	North	1956-1970	1971-2010	0%	US, JP, ESP, POR	inverse CV
Run 3	North	1956-1970	1971-2010	20%	US, JP, ESP, POR	none
Run 4	North	1956-1970	1971-2010	20%	US, JP, ESP, POR	inverse CV
Run 5	North	1956-1970	1971-2010	0%	JP, ESP, POR	none
Run 6	North	1956-1970	1971-2010	0%	US, ESP, POR	none
Run 7	North	1956-1970	1971-2010	0%	US	none
Run 8	North	1956-1970	1971-2010	0%	JP	none
Run 9	North	1956-1970	1971-2010	0%	Hierarchical	inverse CV
Run 10	North	1971-1985	1986-2010	20%	US, JP, ESP, POR	none
Run 11	South	1956-1970	1971-2010	0%	UR, JP, BR, ESP, POR	none
Run 12	South	1956-1970	1971-2010	20%	UR, JP, BR, ESP, POR	inverse CV

Table 21. Biological inputs used for CFASPM for both North and South Atlantic shortfin mako sharks. All parameters were fixed (not estimated), except M and alpha, which were given a prior.

Linf (cm FL)	*K*	*t_0*	*W_a*	*W_b*	*Fecundity (pups/yr)*	*Median maturity*	*Maximum age*	*M (1-max)*	*alpha*
432	0.054	-3.71	5.24E-06	3.1407	2.5	18	32	LN (0.1, 0.2)	LN (4.88, 0.22)

Linf, K and t_0 are von Bertalanffy growth function parameters for females, W_a and W_b are parameters of the length-weight relationship, fecundity refers to female pups only, LN refers to a lognormal distribution with mean and CV.

Table 22. Selectivities for North and South Atlantic shortfin mako used in the CFASPM by fleet.

Functional form	*Fleet*
1 / (1 + Exp(-(age - 20.0) / (1.0)))	USA LL
1 / (1 + Exp(-(age - 7.23) / (22.09)))	Japan LL
1 / (1 + Exp(-(age - 7.27) / (19.96)))	Portugal LL NA
1 / (1 + Exp(-(age - 8.84) / (18.29)))	Portugal LL SA
1 / (1 + Exp(-(age - 6.93) / (17.72)))	Uruguay LL
1 / (1 + Exp(-(age - 6.52) / (14.07)))	Brasil LL
1 / (1 + Exp(-(age - 1.3) / (1.2)))	Hierarchical index
1 / (1 + Exp(-(age - 7.36) / (18.43)))	Combined fleet, Spain LL NA and SA

Table 23. CFASPM mean estimates for the shortfin mako in the North Atlantic. CVs are given in parentheses.

Model run	*Objective Function*	*SSBcur/SSB$_0$*	*SSBcur/SSBmsy*	*Fcur*	*Fcur/Fmsy*	*Fmodern*	*Fhistoric*	*Fmsy*	*SPRmsy*	*M*	*alpha*
Run 1	-43.1885	0.71 (0.27)	2.04 (0.87)	0.015 (0.86)	0.41 (0.29)	0.02 (0.70)	0.0024535 (23.6)	0.04 (0.10)	0.48	0.100 (0.20)	4.89 (0.18)
Run 2	-92.6243	0.58 (0.23)	1.67 (0.24)	0.023 (0.64)	0.60 (0.64)	0.03 (0.40)	0.000000029568 (>100)	0.038 (0.10)	0.48	0.101 (0.19)	4.95 (0.18)
Run 3	-43.1848	0.66 (0.28)	1.91 (0.30)	0.016 (0.85)	0.42 (0.85)	0.02 (0.68)	0.031407 (1.91)	0.038 (0.10)	0.48	0.100 (0.20)	4.88 (0.18)
Run 4	-86.8225	0.55 (0.23)	1.63 (0.26)	0.024 (0.63)	0.62 (0.63)	0.03 (0.20)	0.031568 (0.39)	0.038 (0.10)	0.48	0.101 (0.20)	4.94 (0.18)
Run 5	-44.0076	0.70 (0.27)	2.03 (0.29)	0.014 (0.92)	0.38 (0.92)	0.02 (0.76)	0.019031 (3.27)	0.038 (0.10)	0.48	0.101 (0.20)	4.89 (0.18)
Run 6	3.78419	0.69 (0.24)	1.94 (0.27)	0.017 (0.83)	0.16 (0.86)	0.02 (0.65)	0.00000011371 (>100)	0.104 (0.22)	0.49	0.100 (0.20)	4.88 (0.18)
Run 7	-45.4745	0.69 (0.25)	1.99 (0.27)	0.017 (0.83)	0.45 (0.83)	0.02 (0.65)	0.00000012317 (>100)	0.038 (0.10)	0.48	0.100 (0.20)	4.88 (0.18)
Run 8	-45.4459	0.71 (0.27)	2.04 (0.29)	0.015 (0.88)	0.41 (0.88)	0.02 (0.71)	0.003406 (18.77)	0.038 (0.10)	0.48	0.100 (0.20)	4.88 (0.18)
Run 9	-61.533	0.68 (0.25)	1.96 (0.27)	0.017 (0.82)	0.46 (0.82)	0.02 (0.64)	0.00000012027 (>100)	0.038 (0.10)	0.48	0.099 (0.20)	4.86 (0.18)
Run 10	-31.0612	0.66 (0.30)	1.90 (0.32)	0.016 (0.85)	0.41 (0.85)	0.02 (0.68)	0.039773 (1.27)	0.038 (0.10)	0.48	0.100 (0.20)	4.89 (0.18)
Run 11	-11.9462	0.72 (0.05)	2.09 (0.12)	0.016 (0.51)	0.40 (0.52)	0.002*	0.020*	0.039 (0.10)	0.48	0.104 (0.19)	4.99 (0.18)
Run 12	6.5506	0.73 (0.05)	2.16 (0.12)	0.015 (0.51)	0.38 (0.52)	0.002*	0.020*	0.041 (0.09)	0.47	0.109 (0.19)	5.13 (0.17)

Fmodern refers to fishing mortality during the modern period, Fhistoric to that in the historic period. * indicates parameters were fixed.

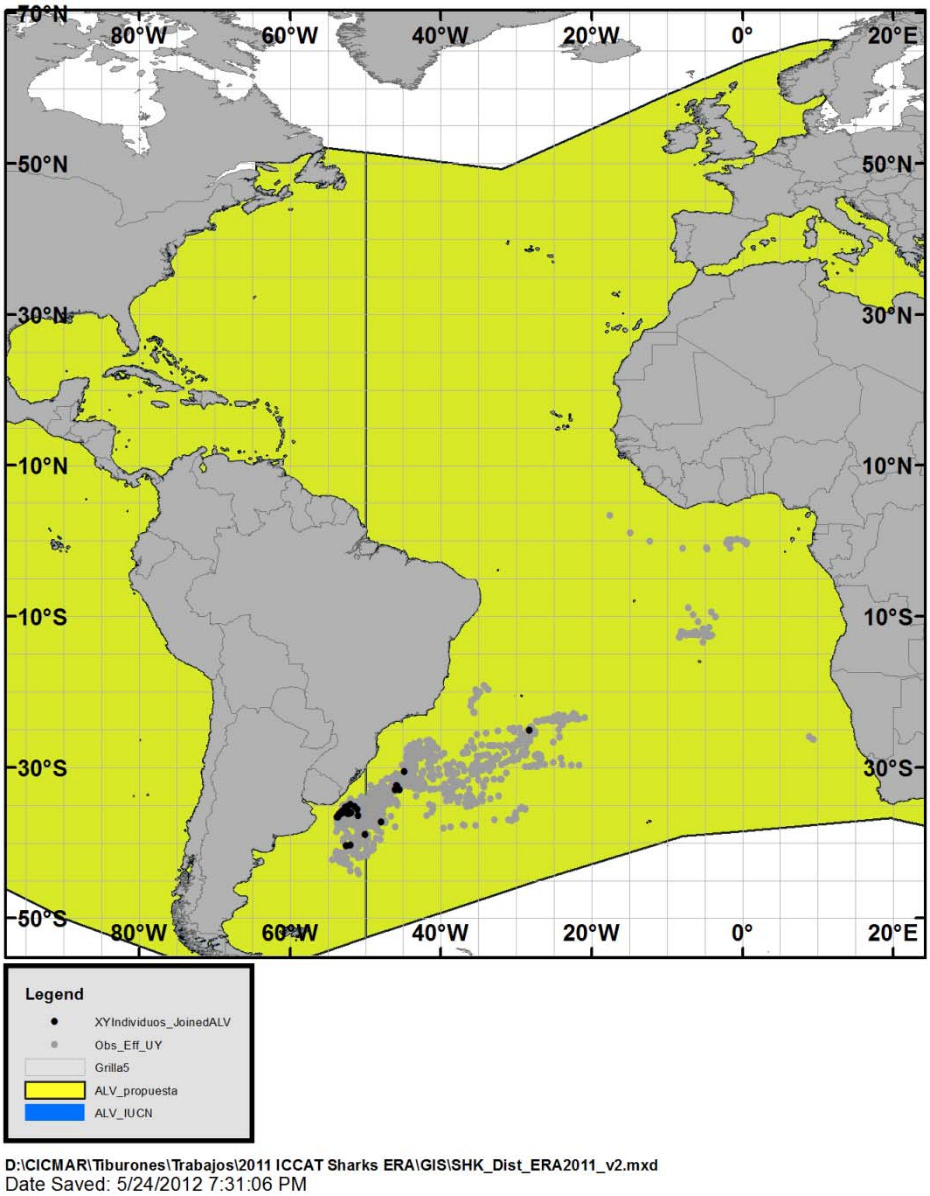

Figure 1. Species distribution for *Alopias vulpinus*.

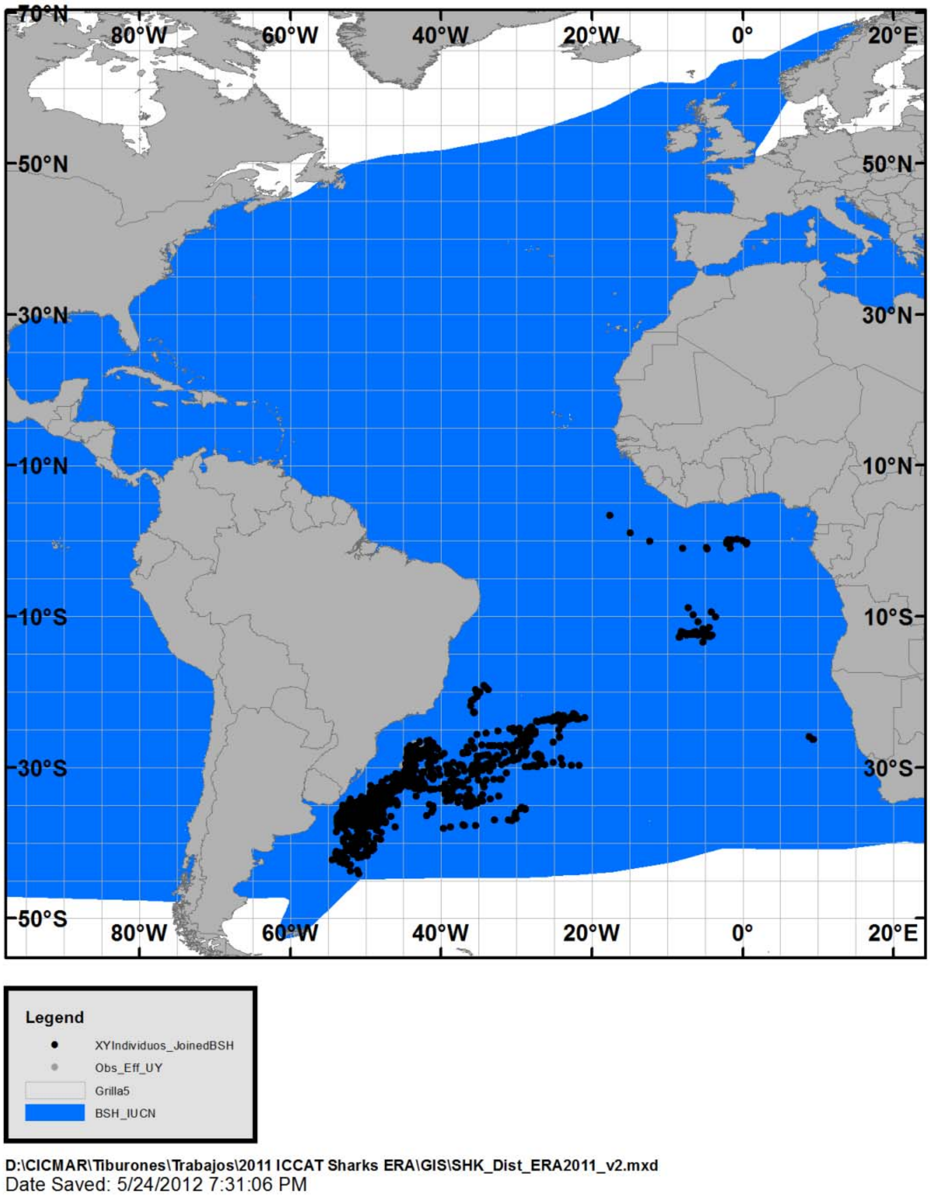

Figure 2. Species distribution for *Prionace glauca*.

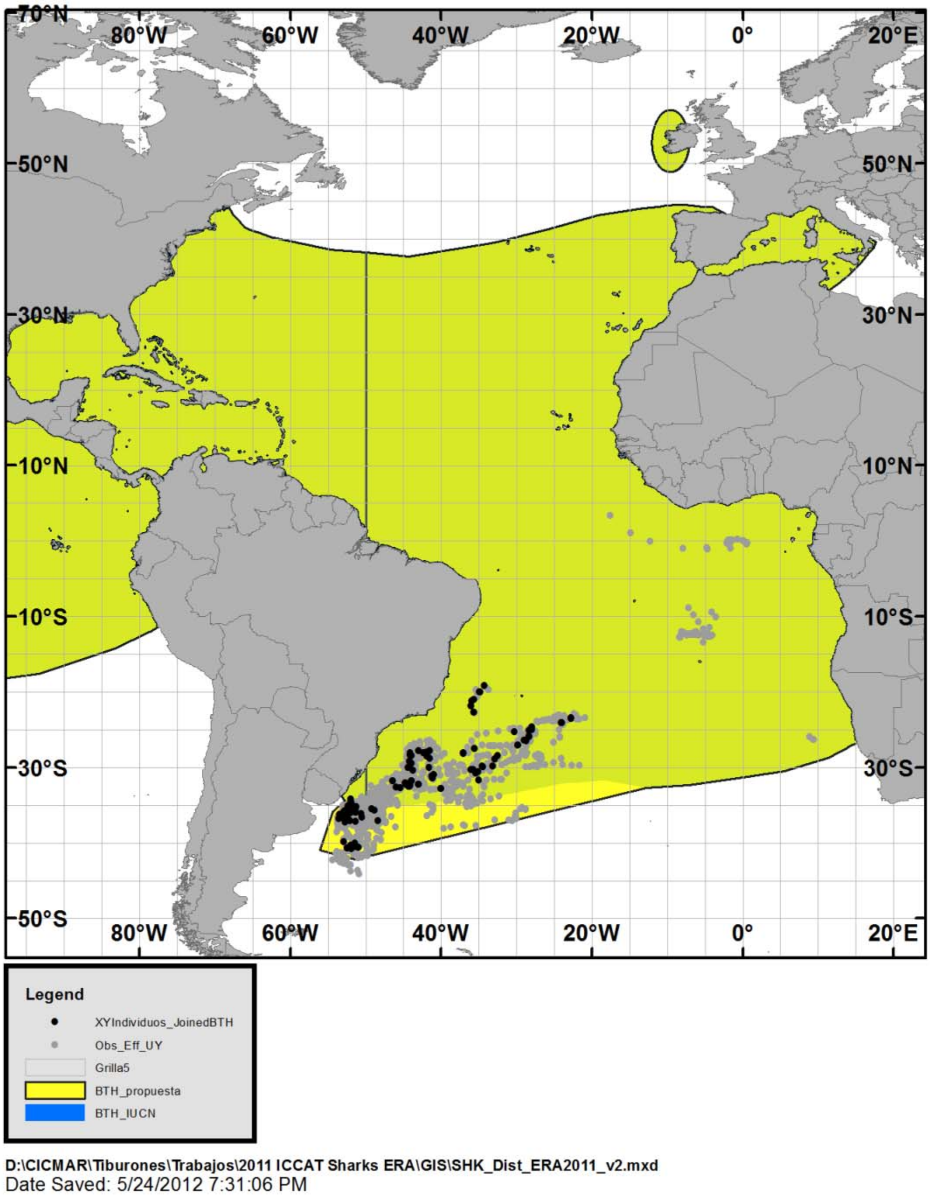

Figure 3. Species distribution for *Alopias superciliosus*.

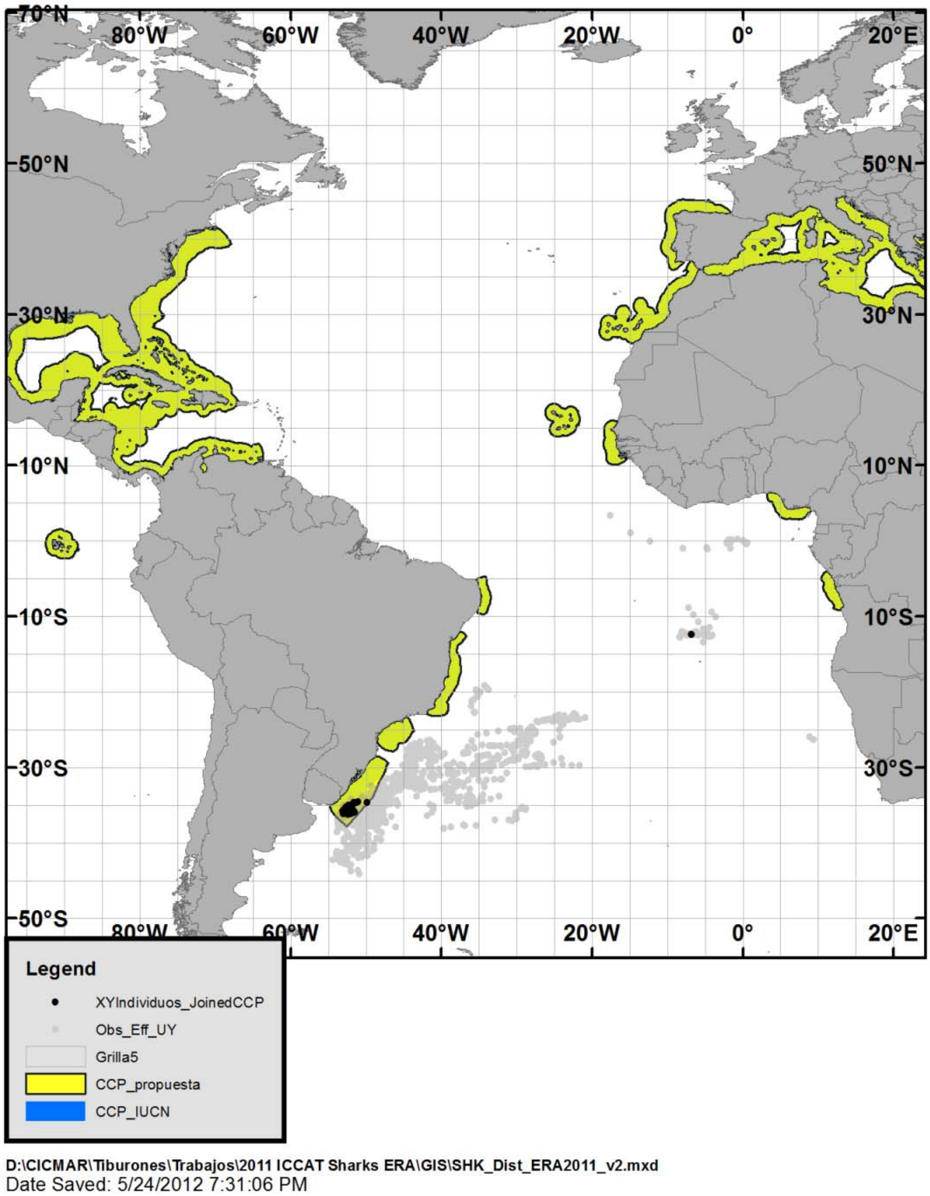

Figure 4. Species distribution for *Carcharhinus plumbeus*.

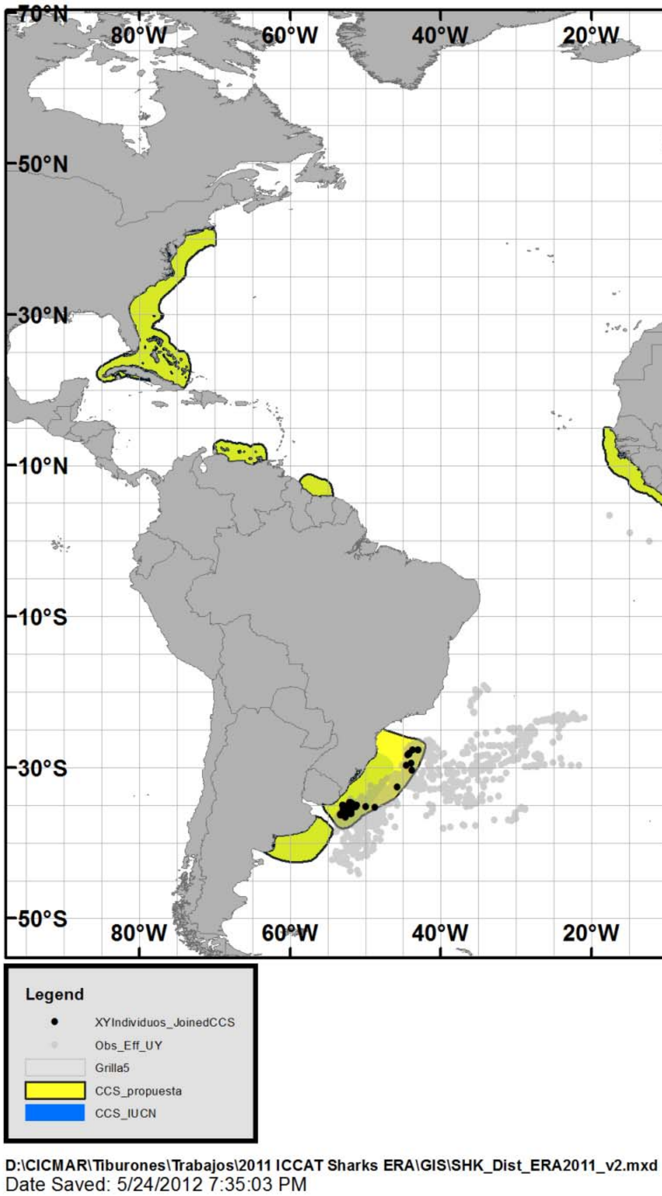

Figure 5. Species distribution for *Carcharhinus signatus*.

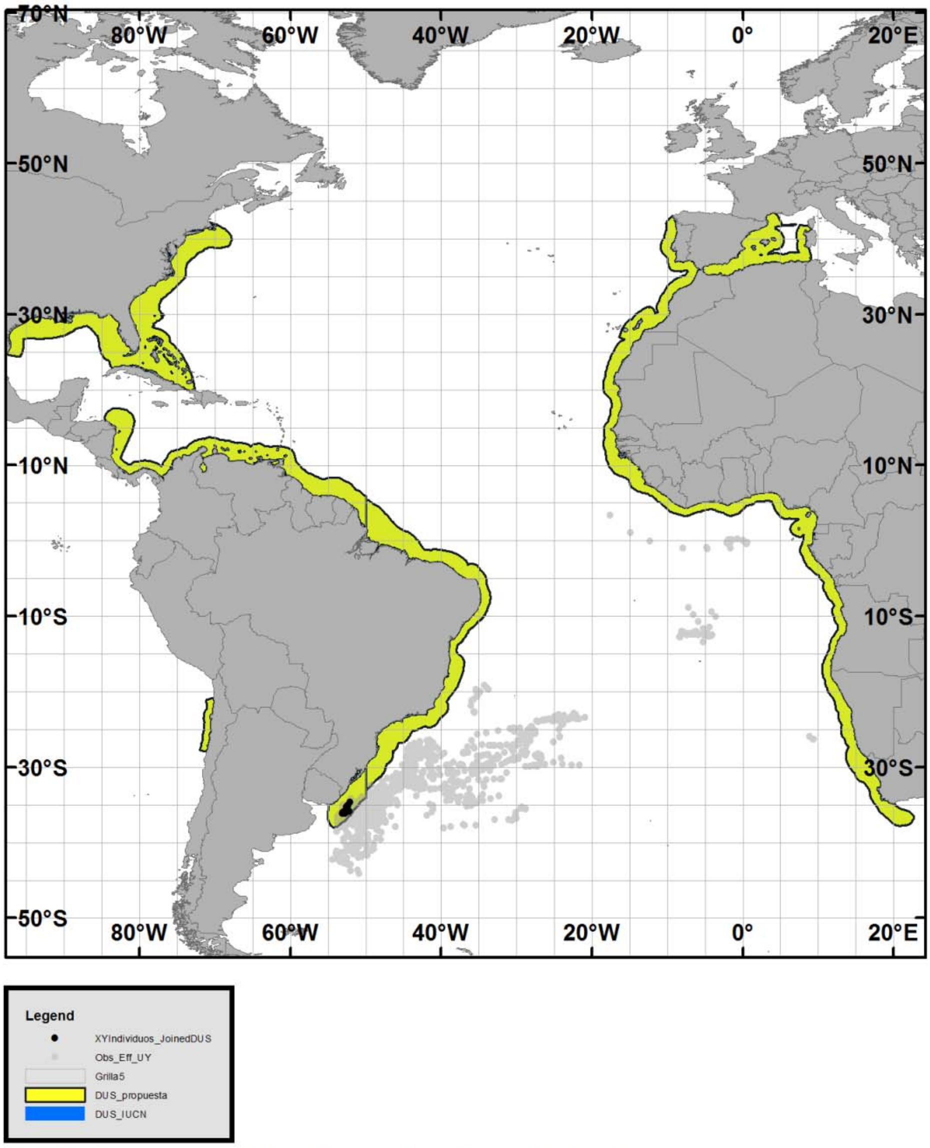

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Figure 6. Species distribution for *Carcharhinus obscures*.

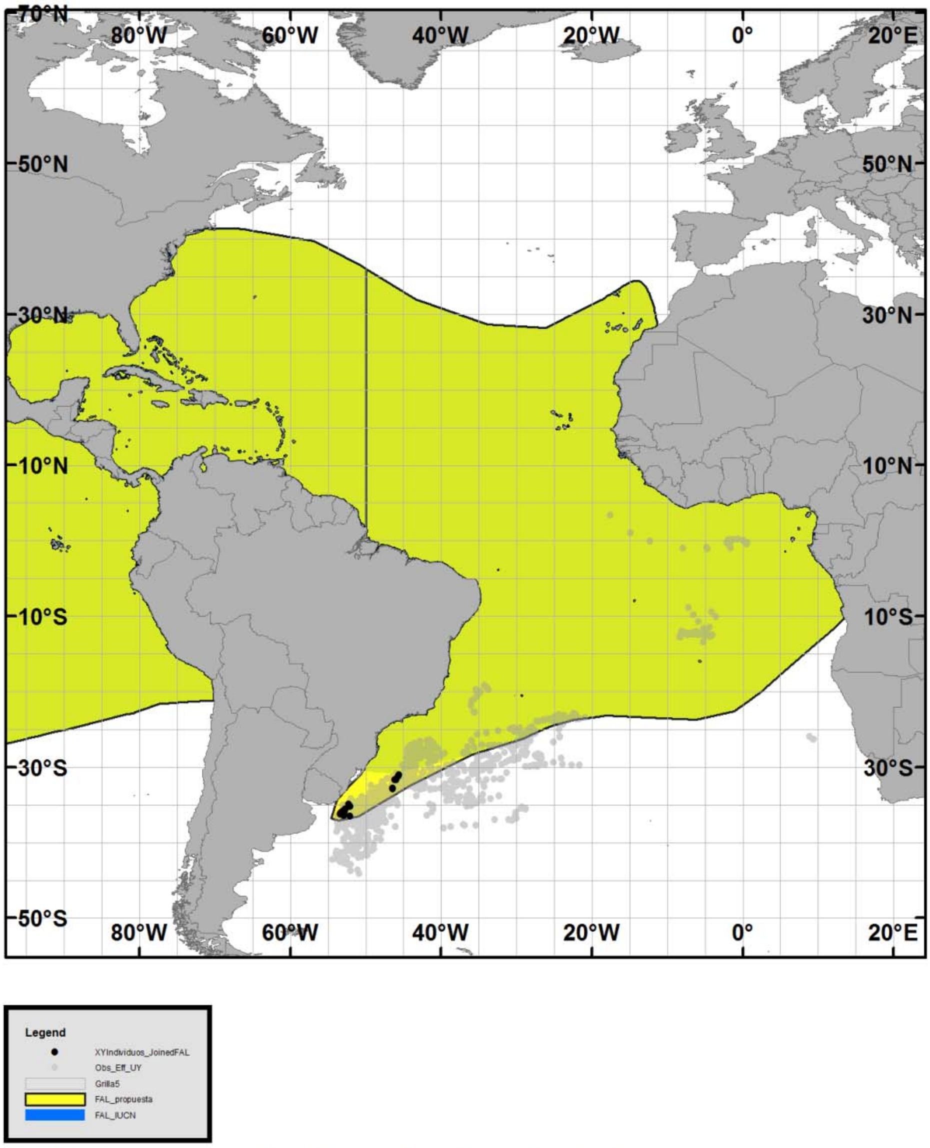

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Figure 7. Species distribution for *Carcharhinus falciformis*.

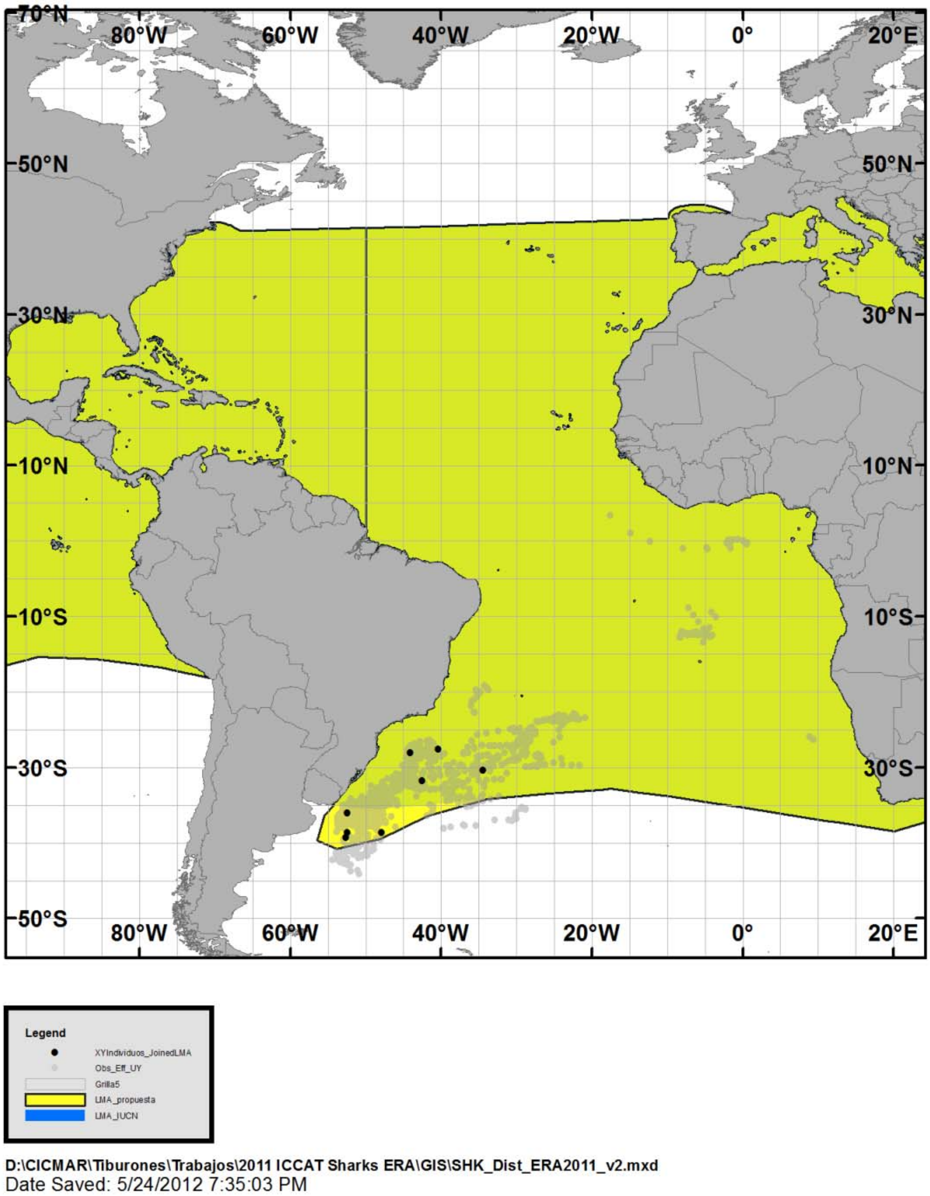

Figure 8. Species distribution for *Isurus paucus*.

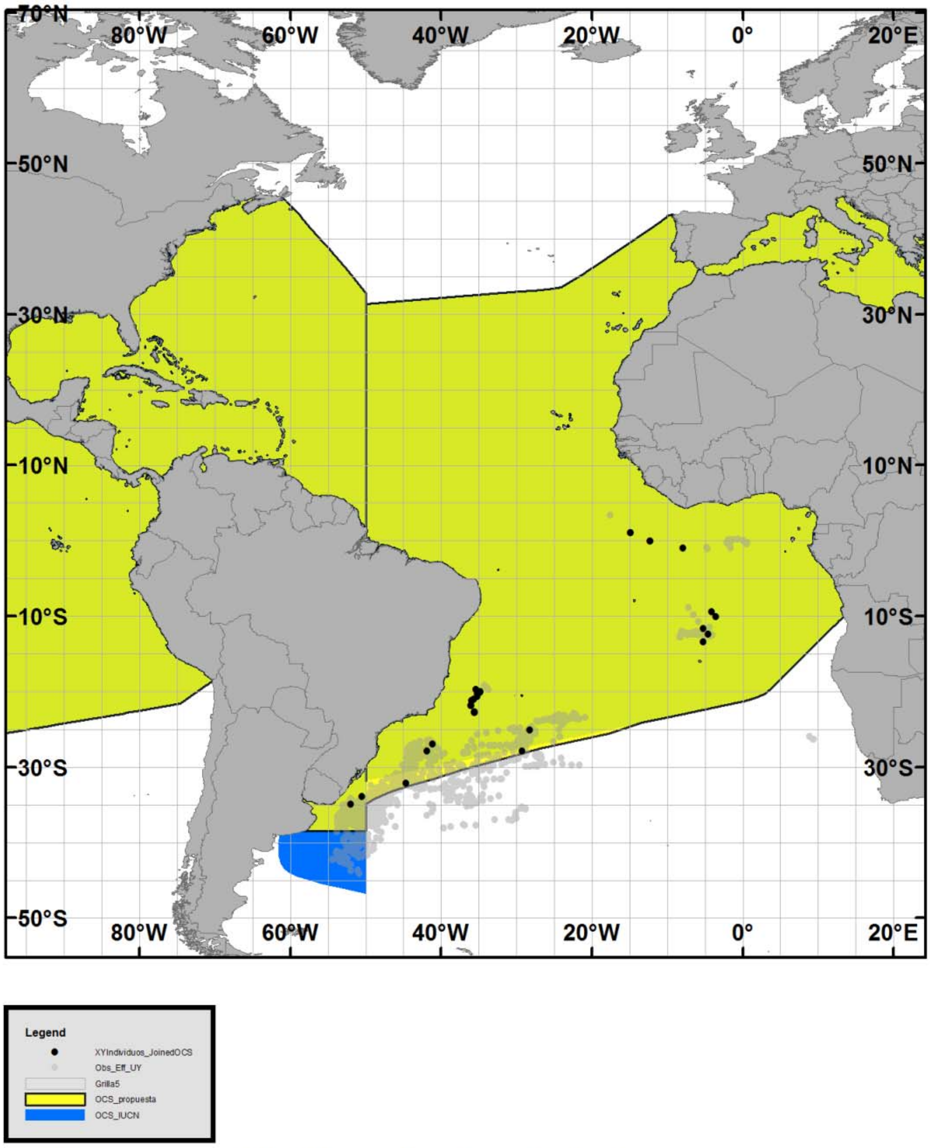

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Figure 9. Species distribution for *Carcharhinus longimanus*.

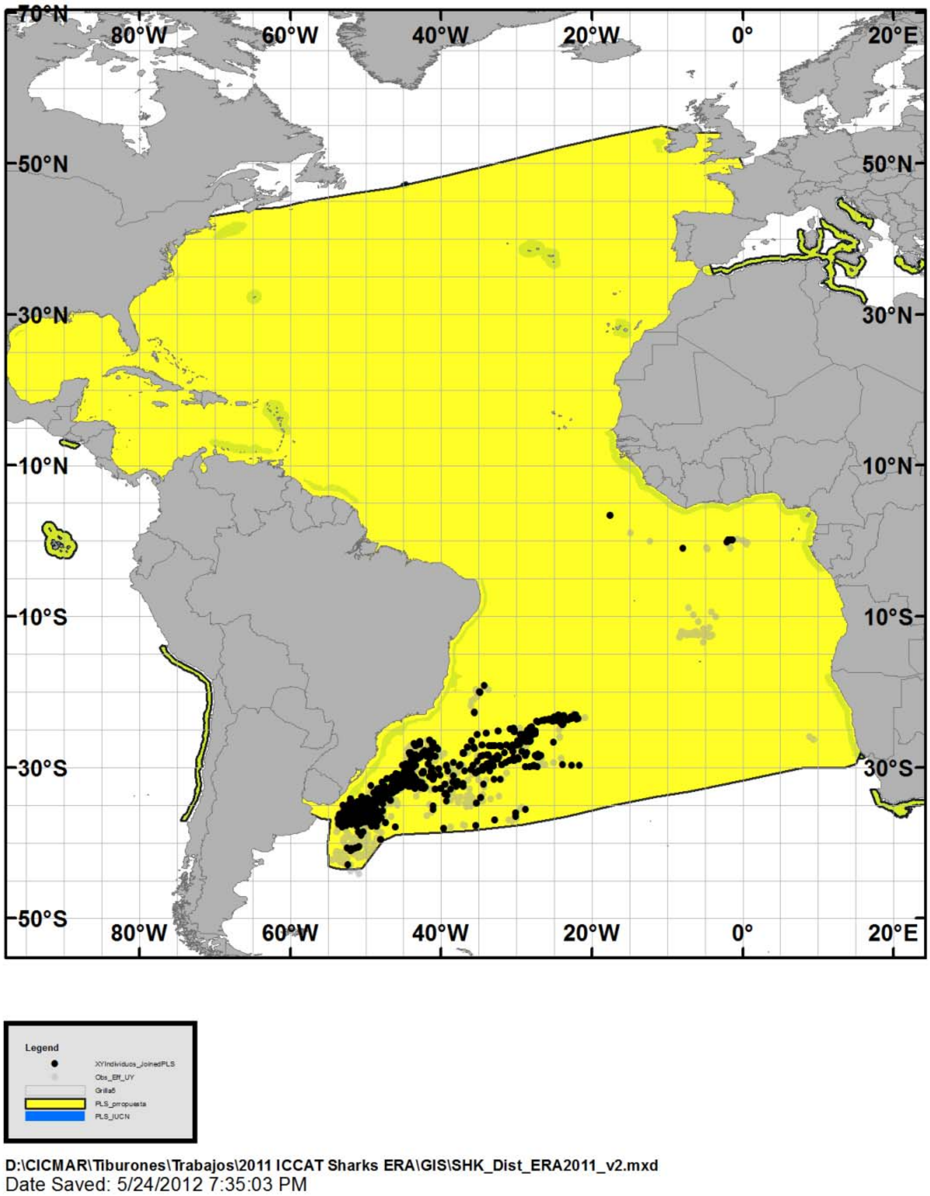

Figure 10. Species distribution for *Pteroplatytrygon violacea*.

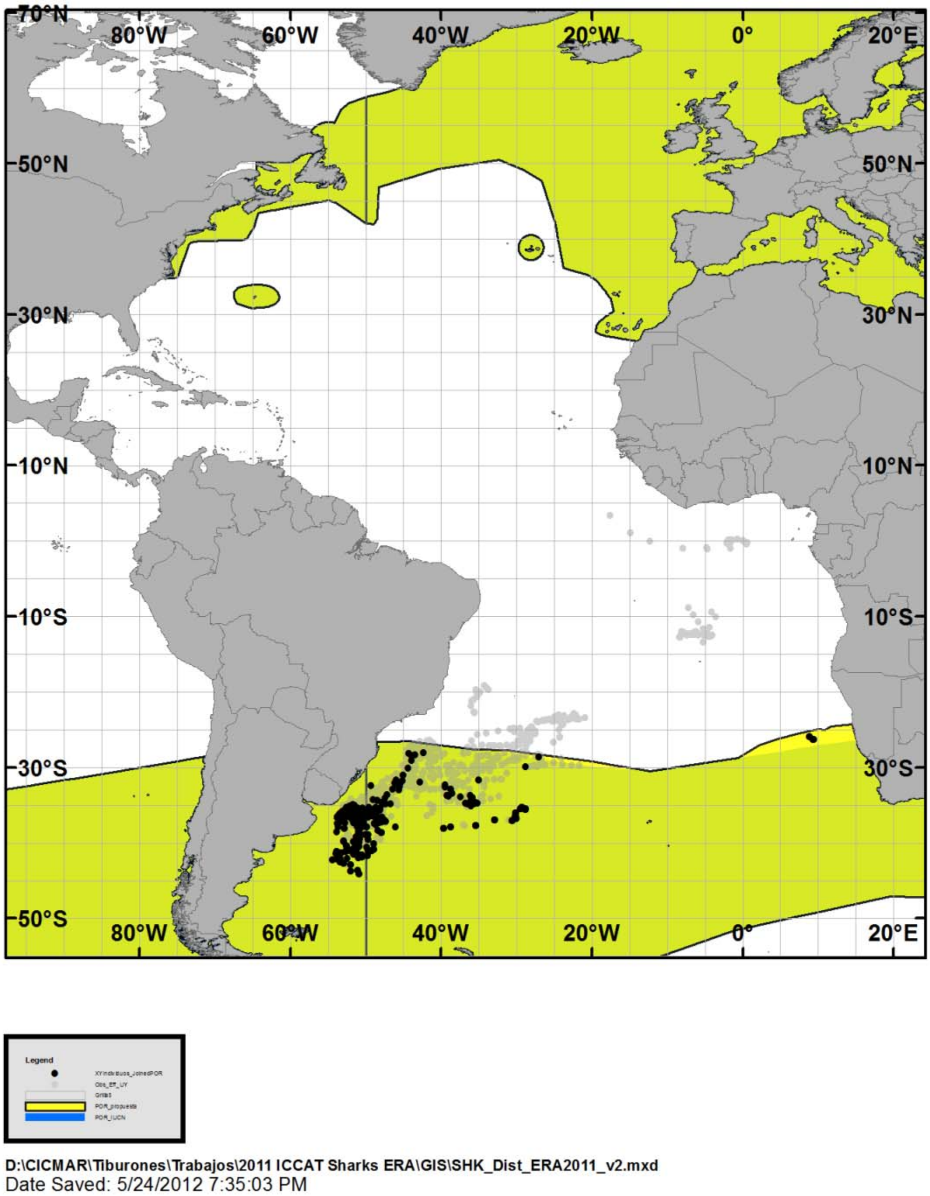

Figure 11. Species distribution for *Lamna nasus*.

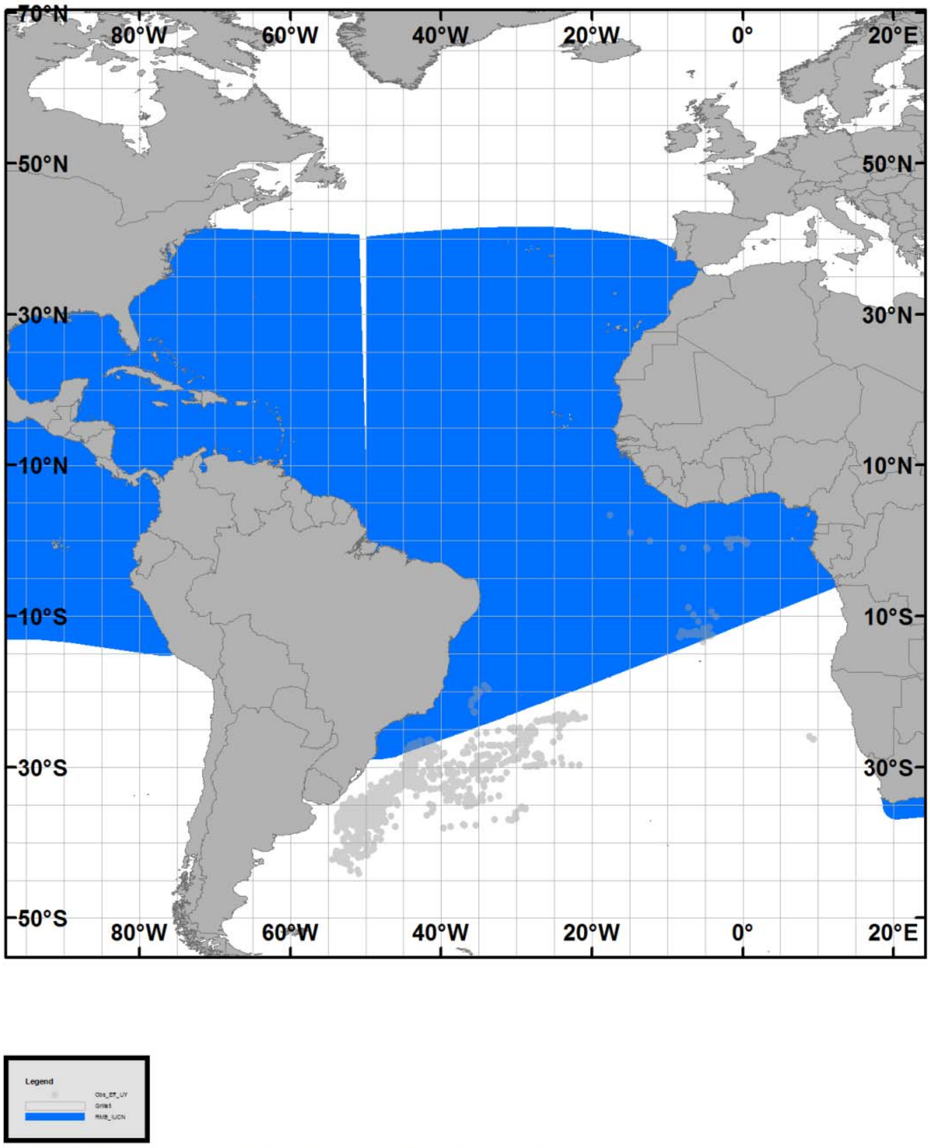

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Figure 12. Species distribution for *Manta birostris*.

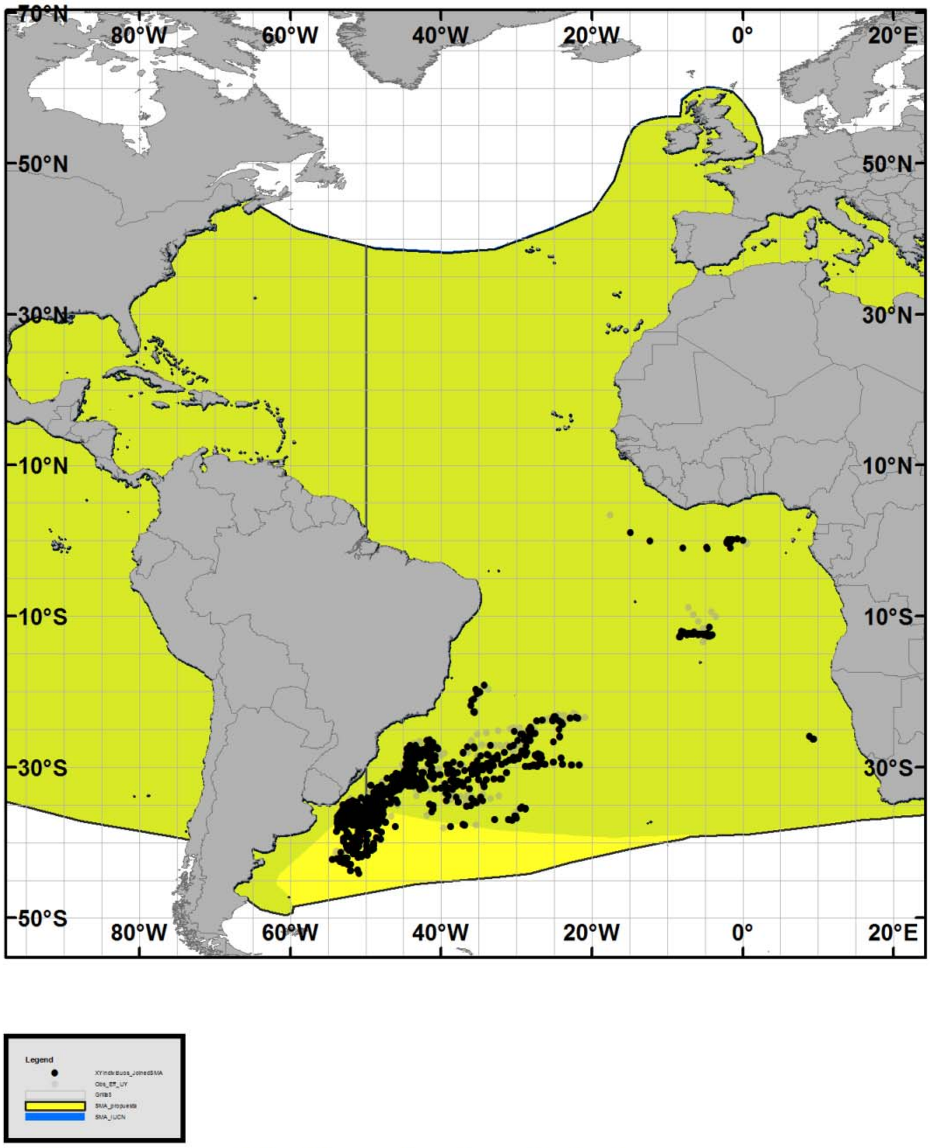

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Figure 13. Species distribution for *Isurus oxyrinchus*.

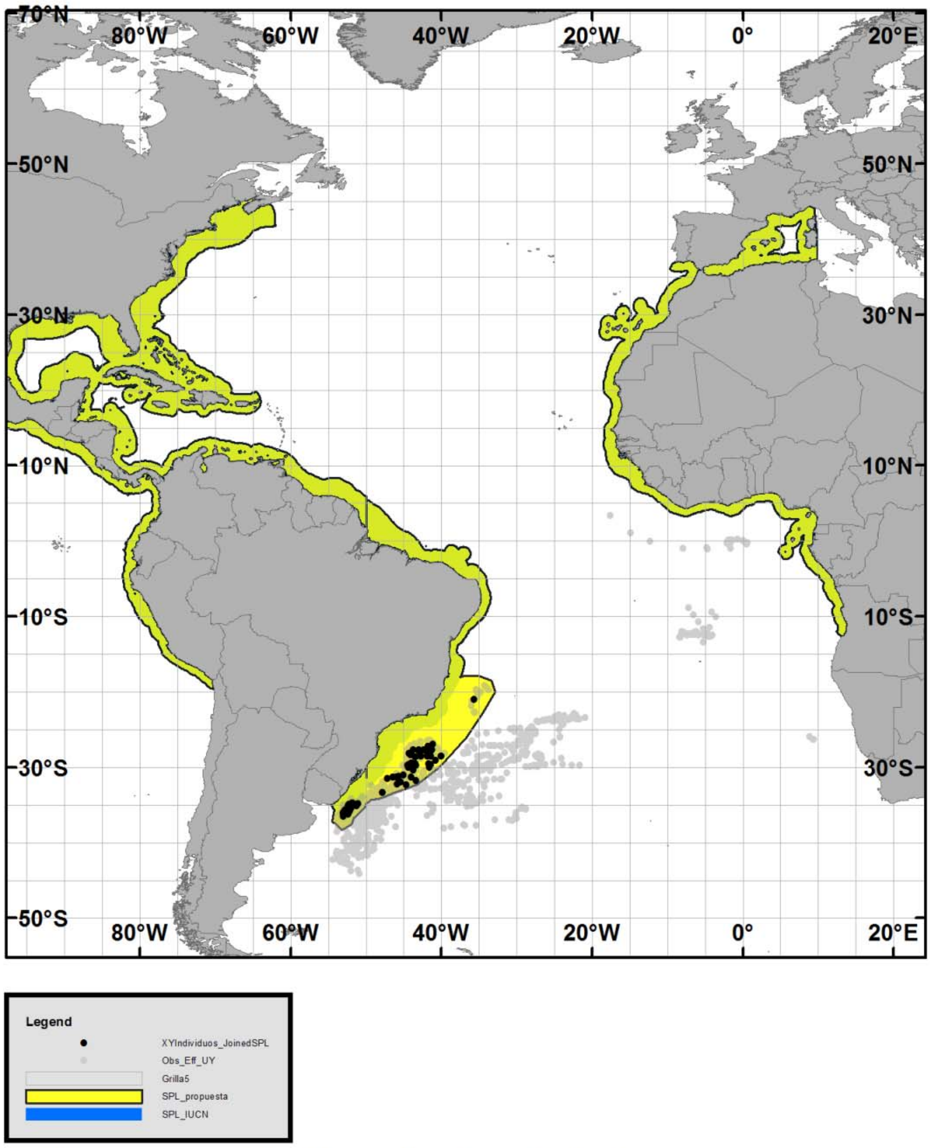

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Figure 14. Species distribution for *Sphyrna lewini*.

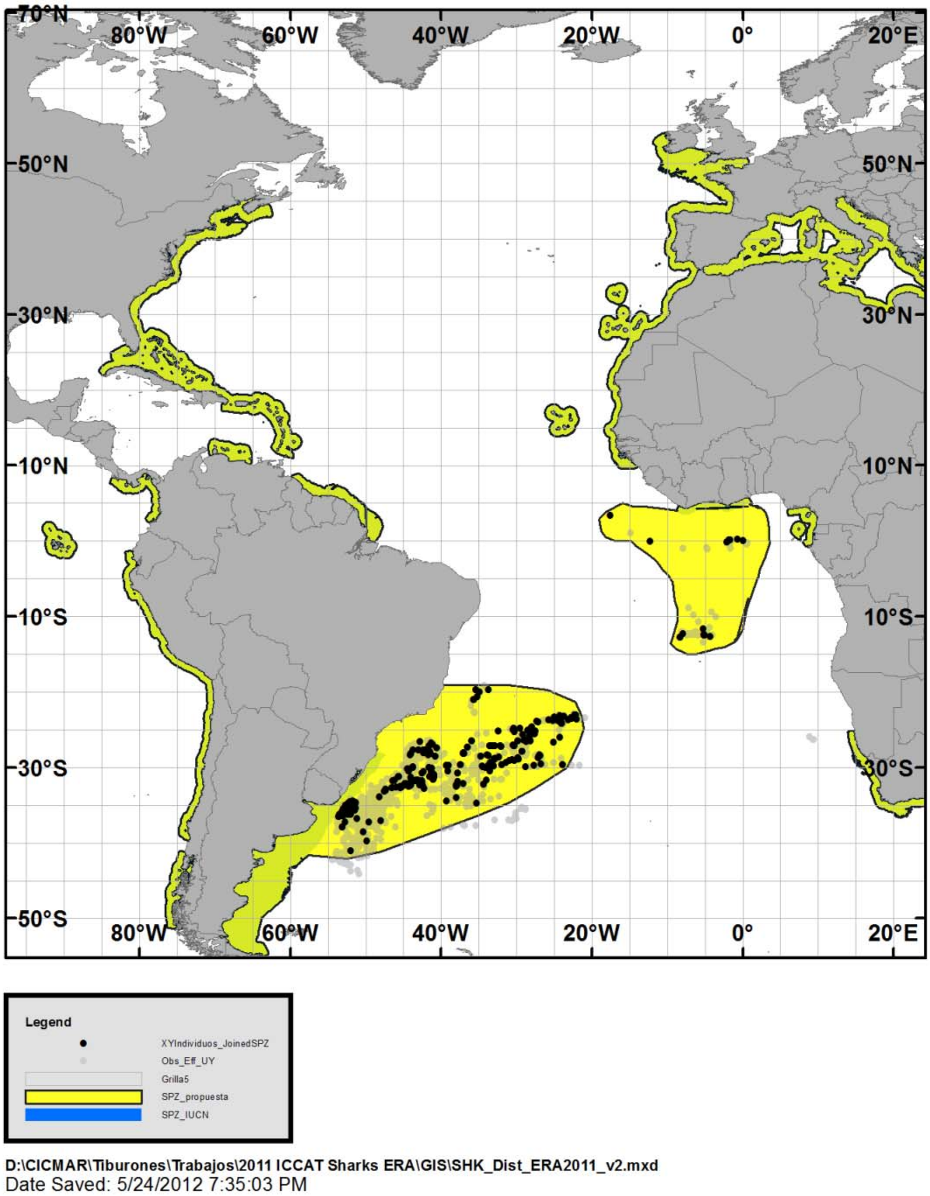

Figure 15. Species distribution for *Sphyrna zygaena*.

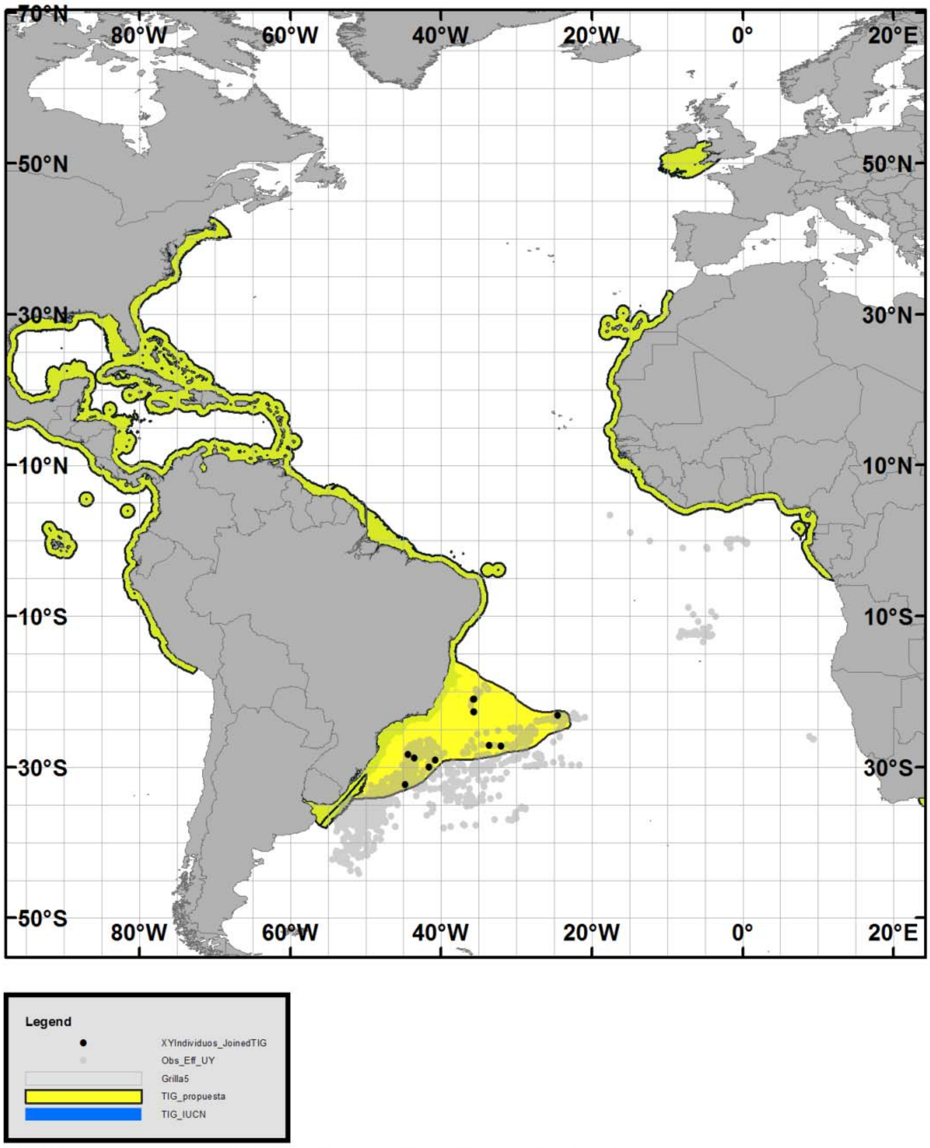

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Figure 16. Species distribution for *Galeocerdo cuvier*.

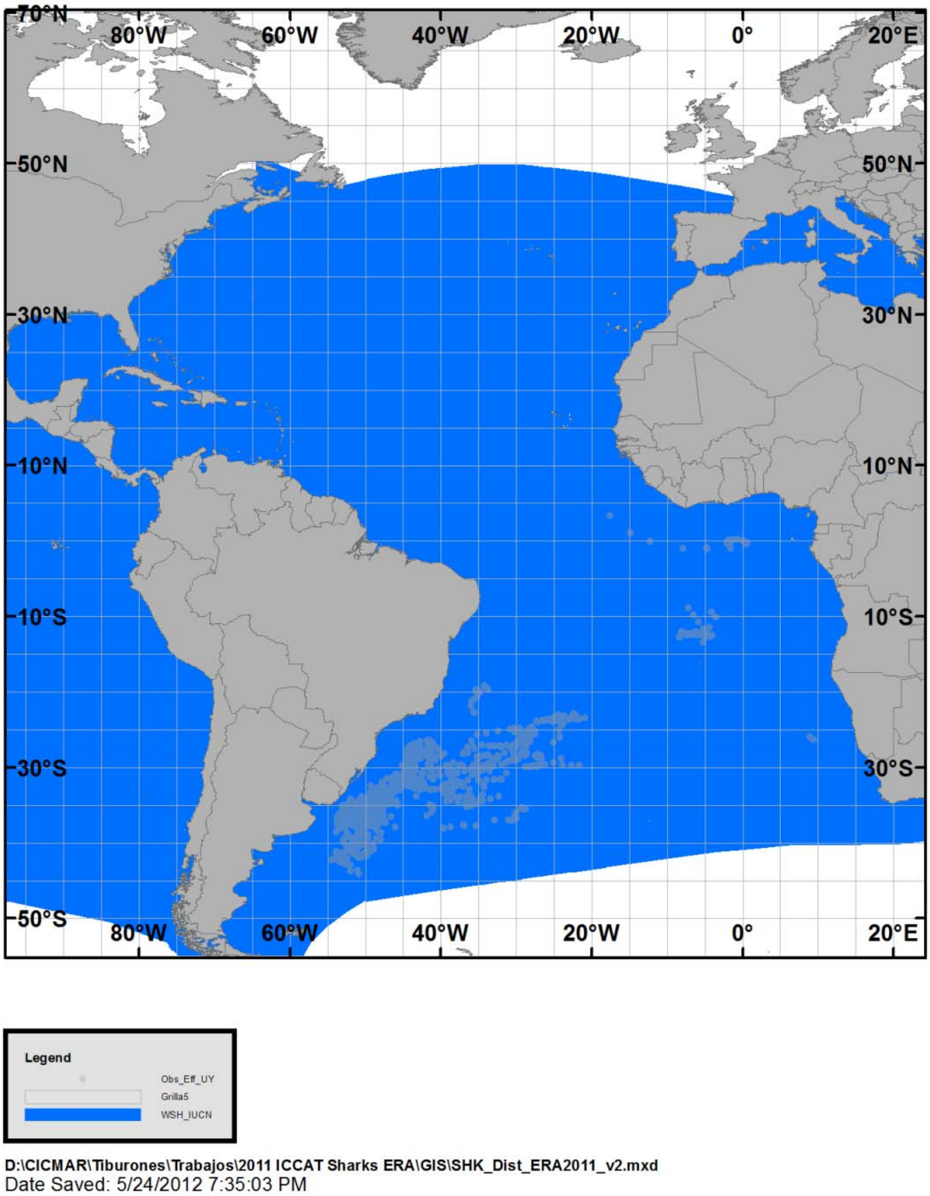


Figure 17. Species distribution for *Carcharodon carcharias*.

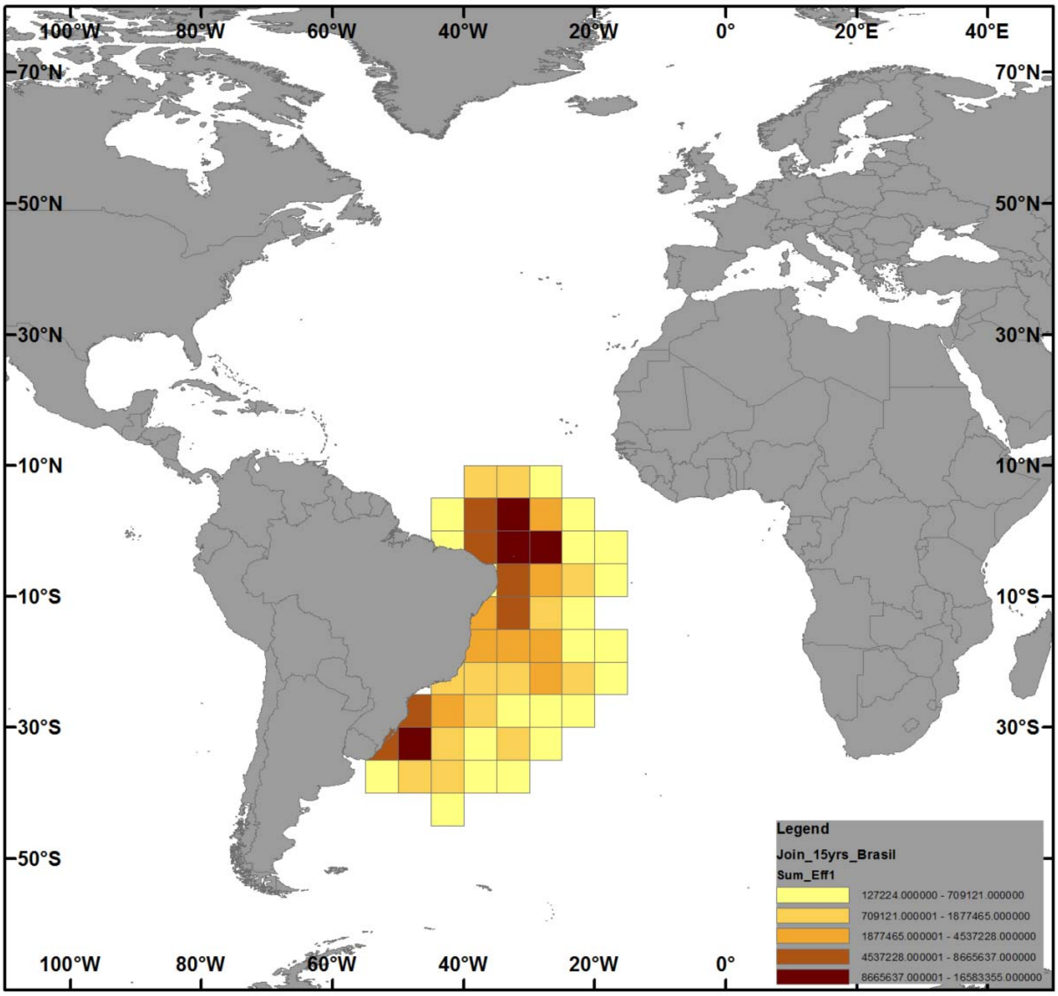


Figure 18. Effort distribution for Brazil (with observer coverage) for the ERA.

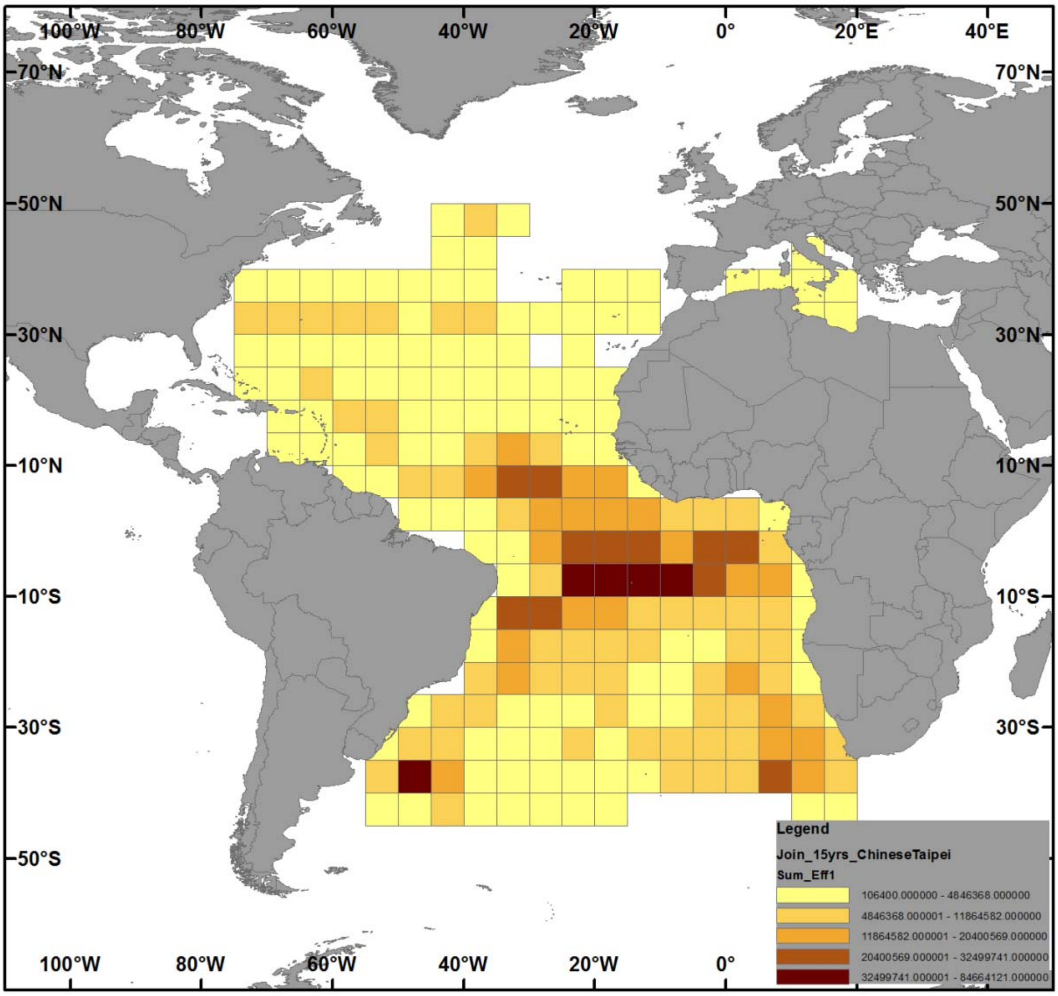


Figure 19. Effort distribution for Chinese Taipei (with observer coverage) for the ERA.

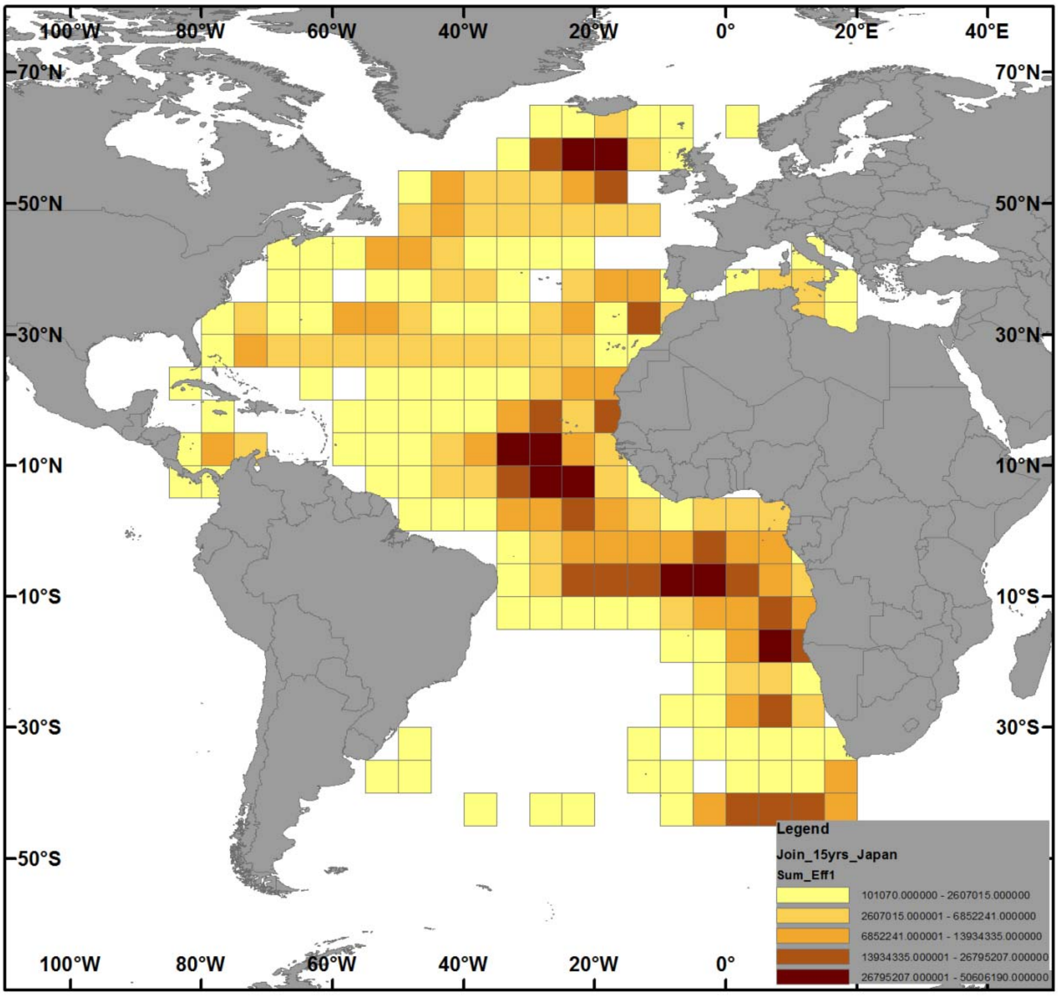


Figure 20. Effort distribution for Japan (with observer coverage) for the ERA.

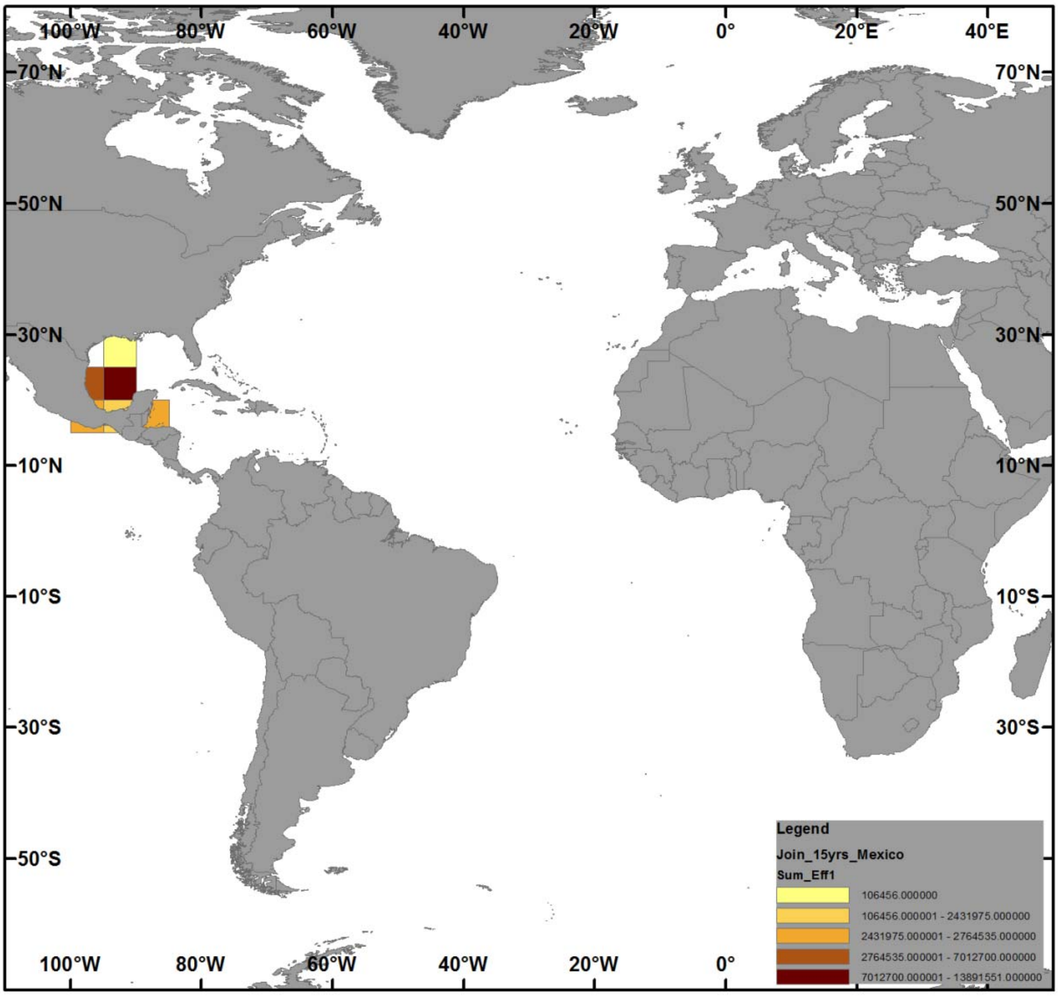


Figure 21. Effort distribution for Mexico (with observer coverage) for the ERA.

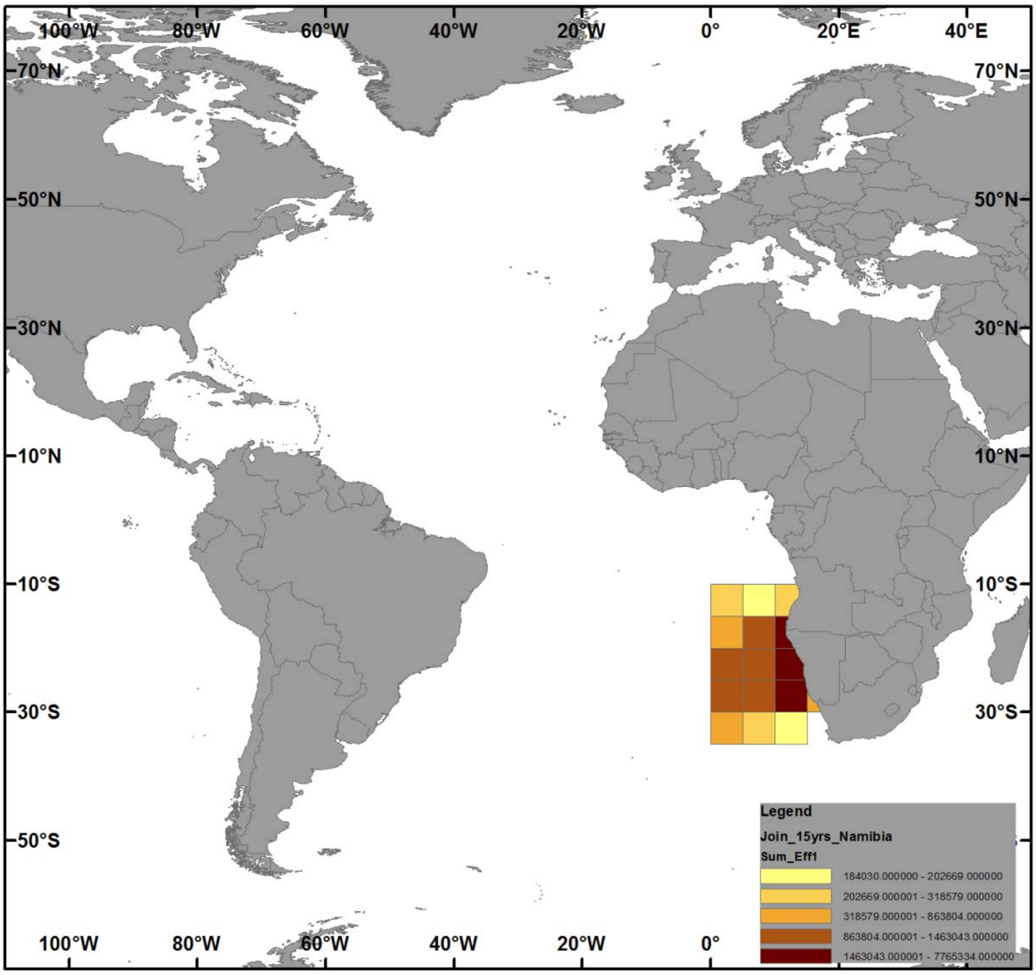


Figure 22. Effort distribution for Namibia (with observer coverage) for the ERA.

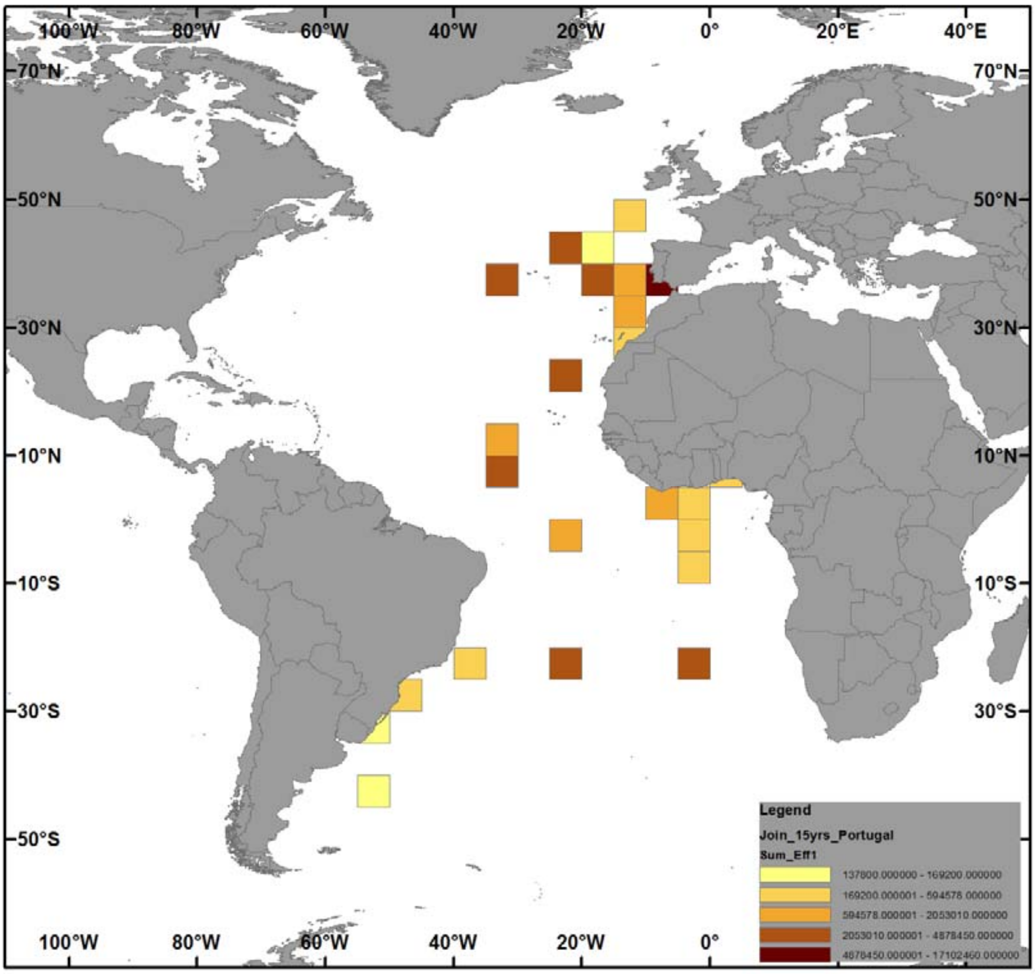


Figure 23. Effort distribution for Portugal (with observer coverage) for the ERA.

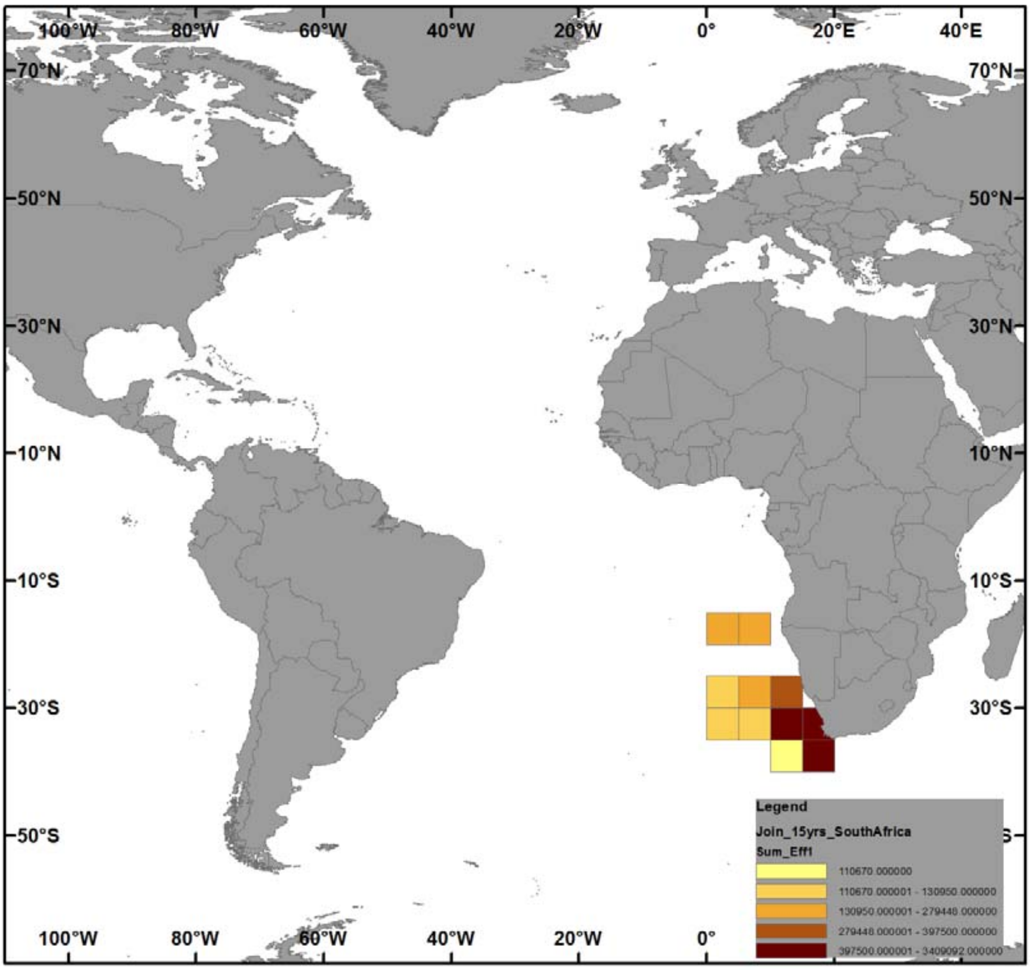


Figure 24. Effort distribution for South Africa (with observer coverage) for the ERA.

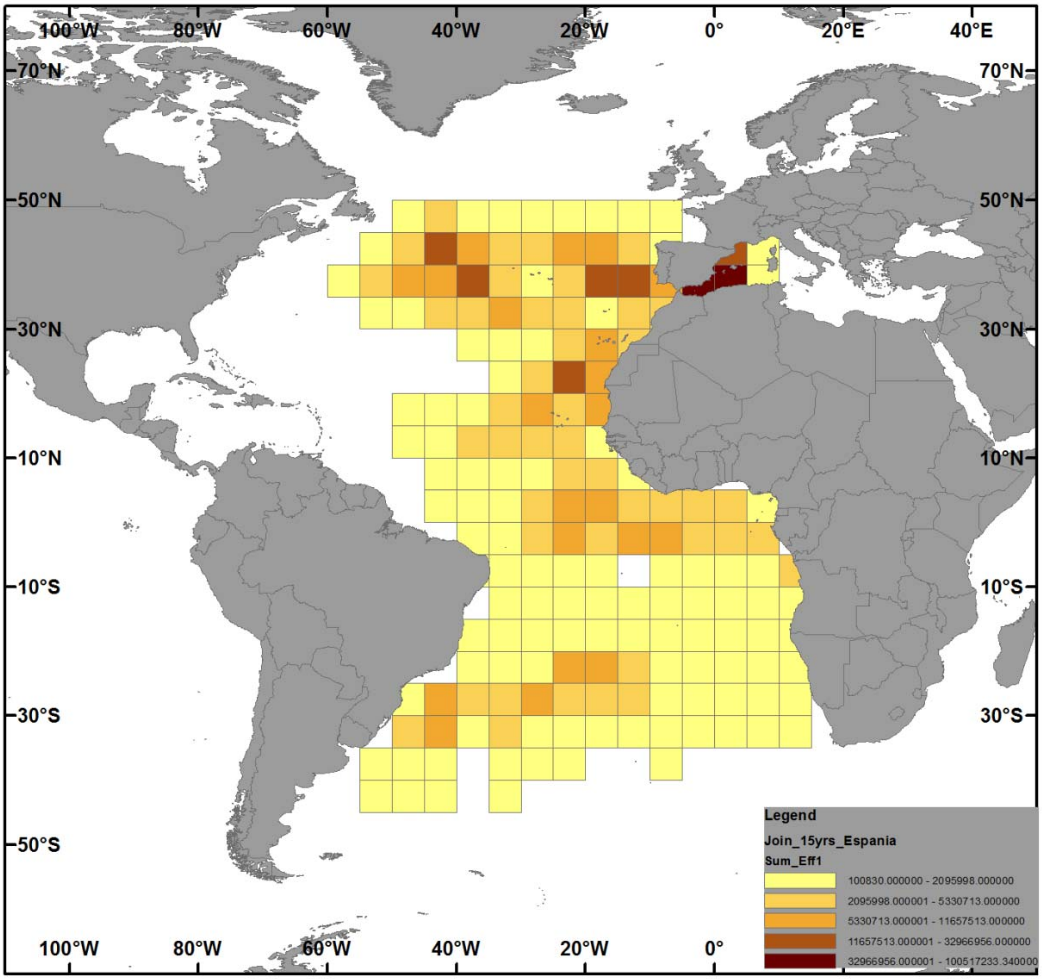


Figure 25. Effort distribution for Spain (with observer coverage) for the ERA.

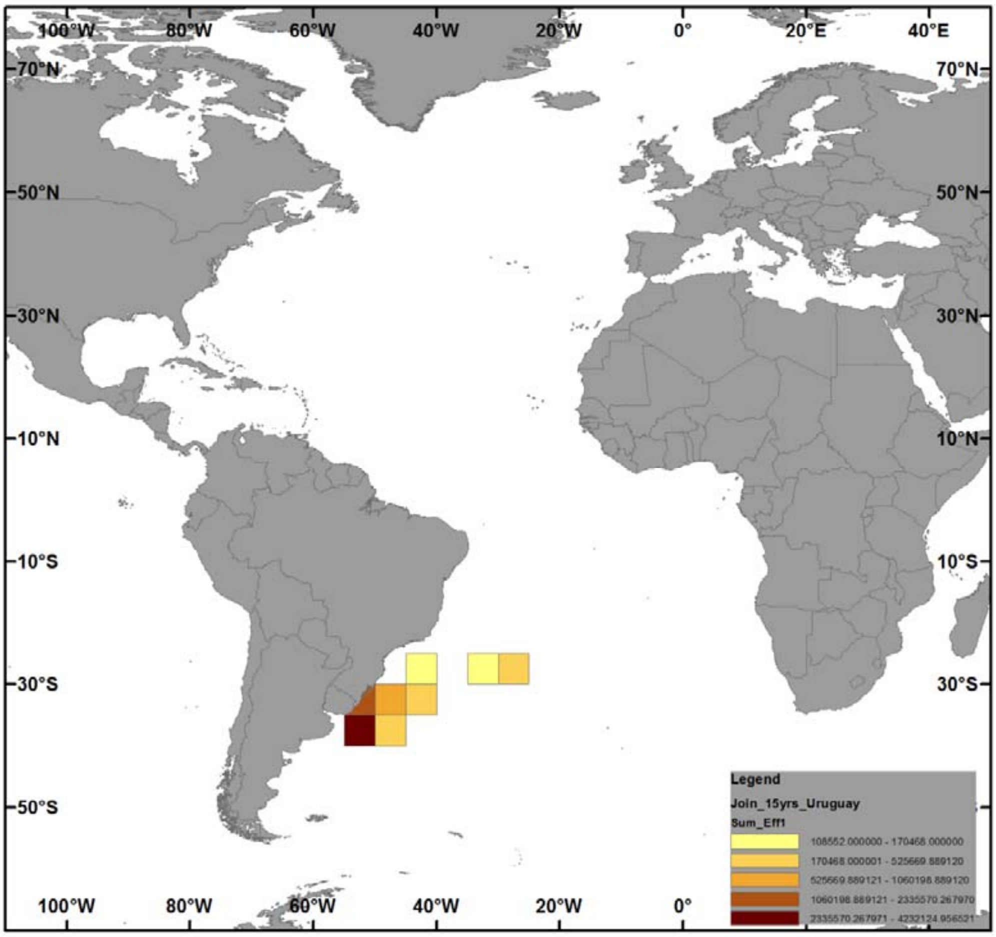


Figure 26. Effort distribution for Uruguay (with observer coverage) for the ERA.

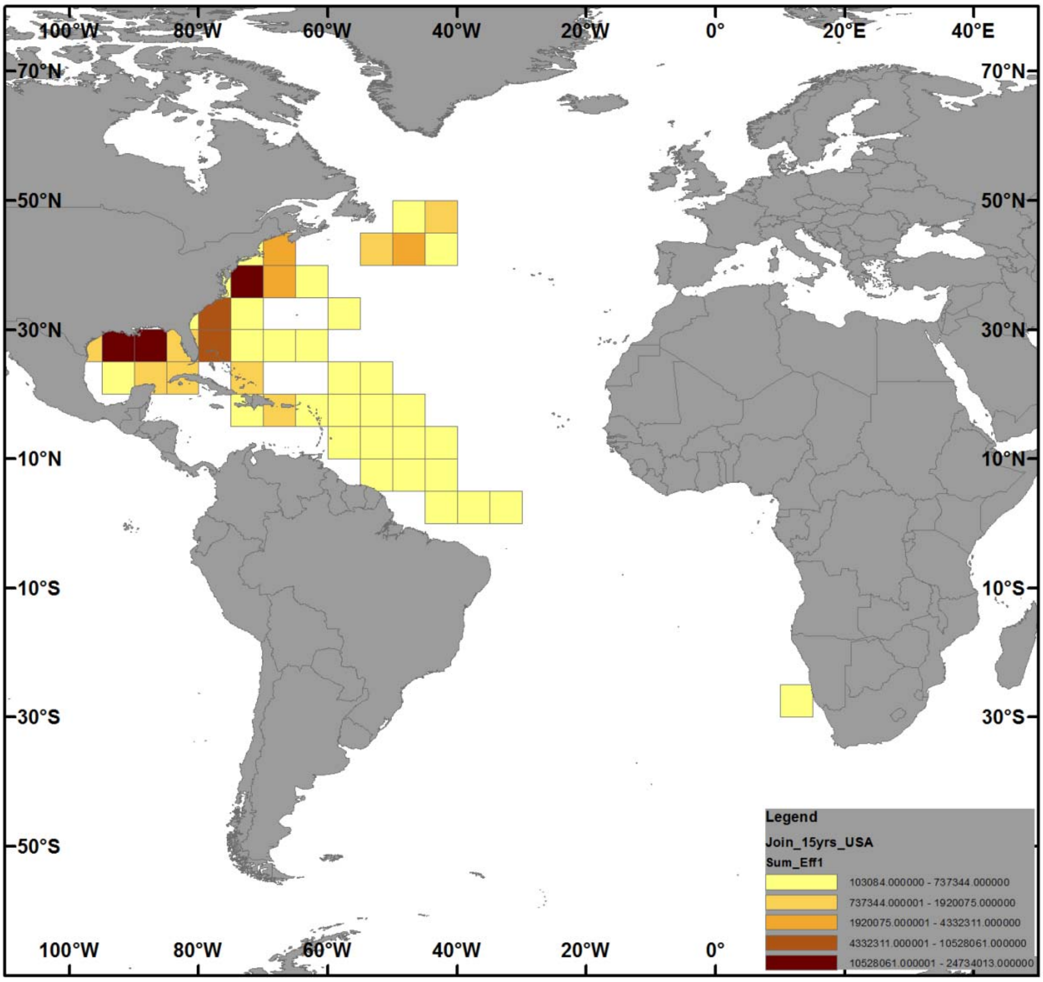


Figure 27. Effort distribution for USA (with observer coverage) for the ERA.

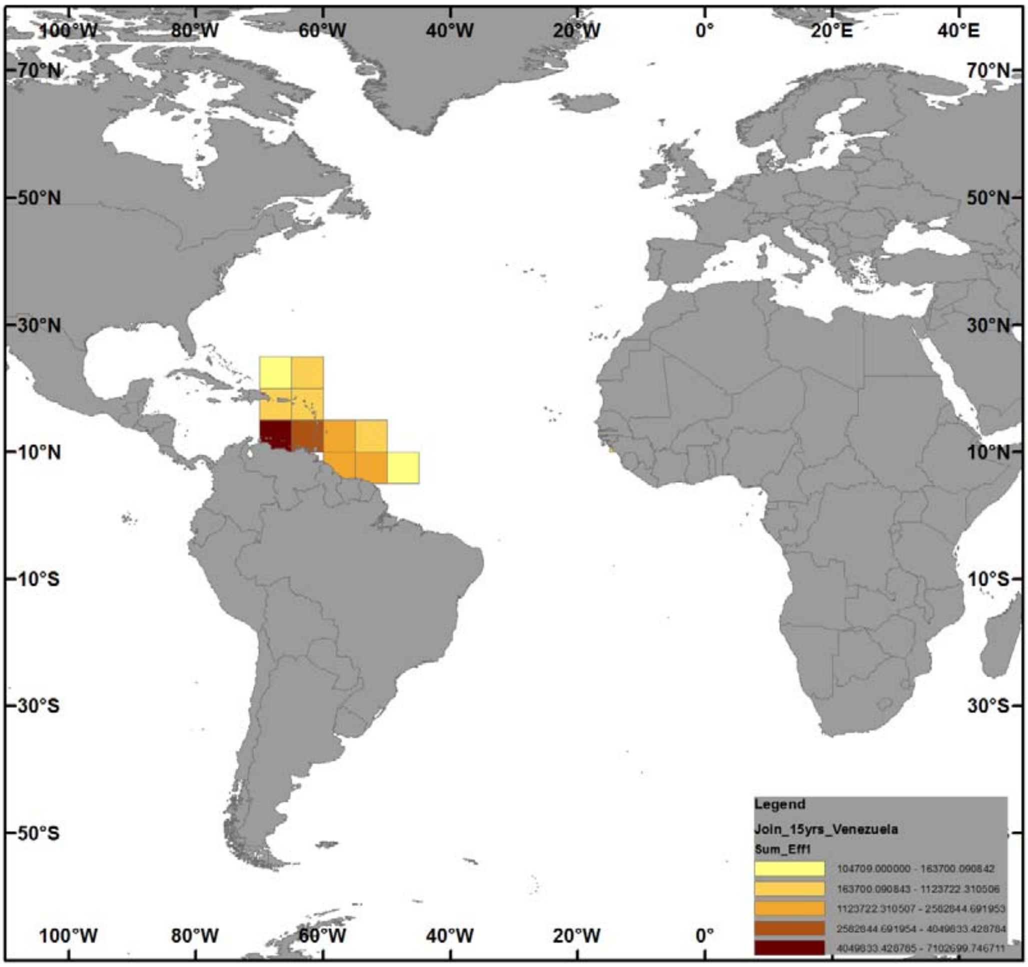


Figure 28. Effort distribution for Venezuela (with observer coverage) for the ERA.

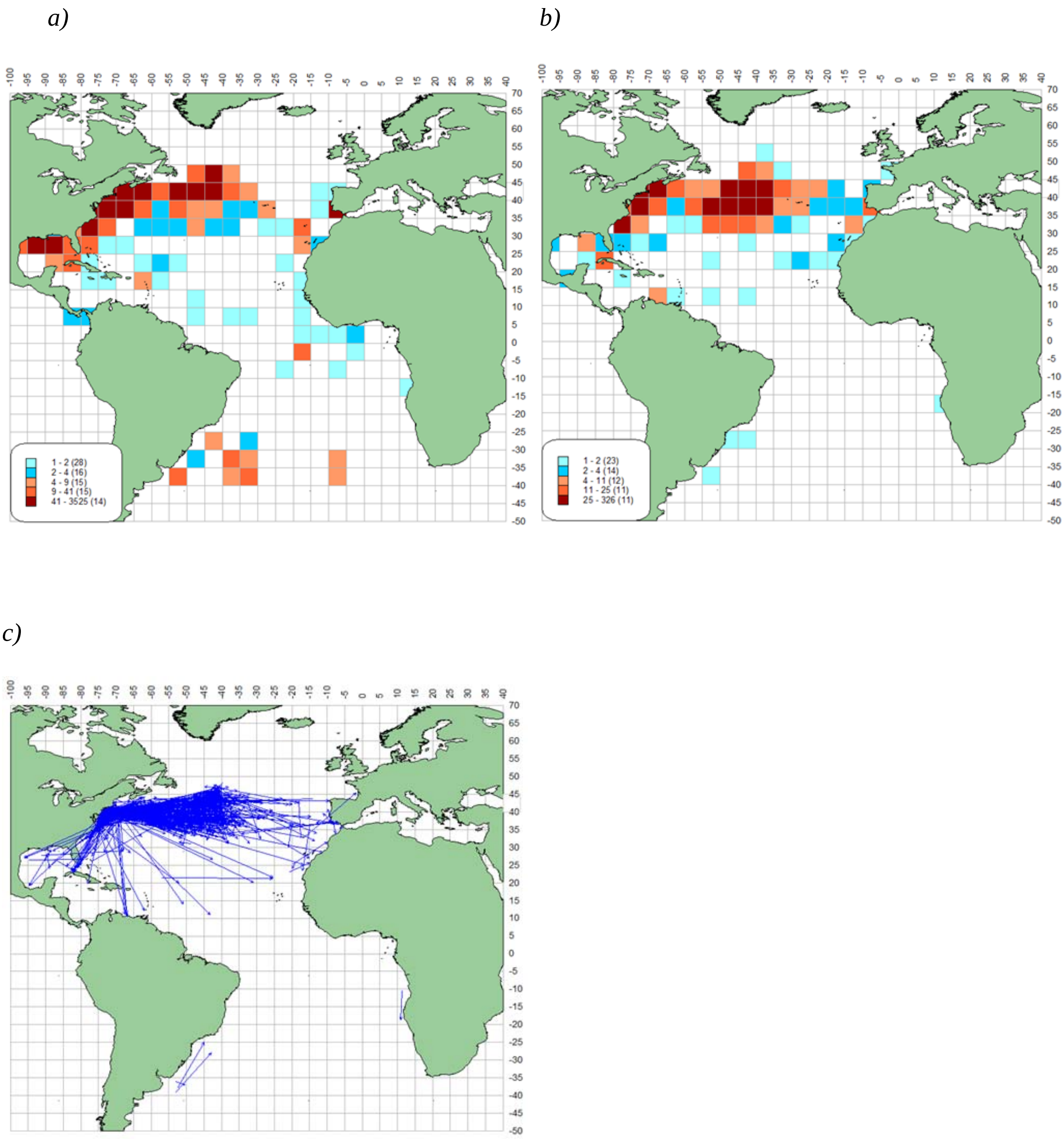
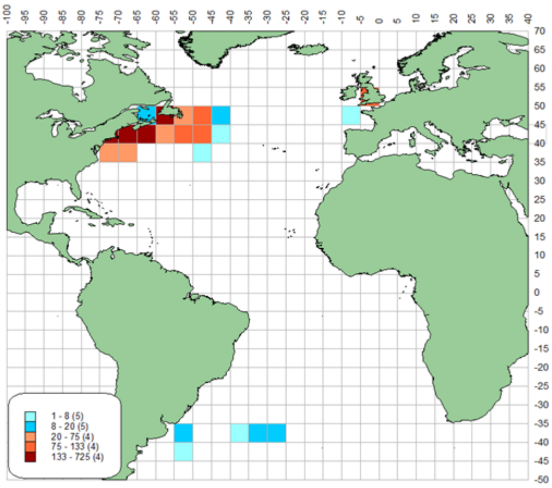
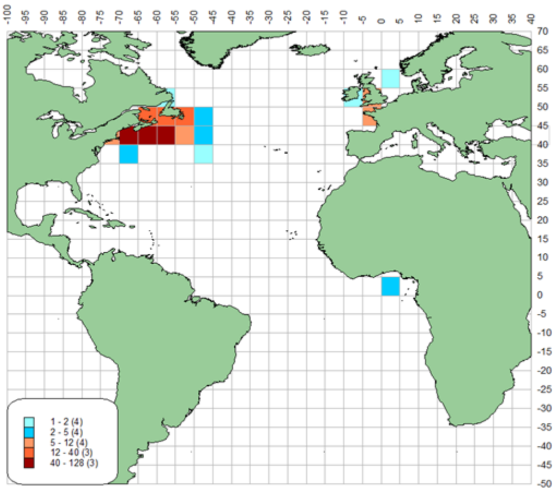


Figure: 29. Tag and Release distributions for Shortfin Mako in the Atlantic Ocean (a = Density of releases, b = Density of recoveries, c = Straight displacement between release and recovery locations).

a)



b)



c)

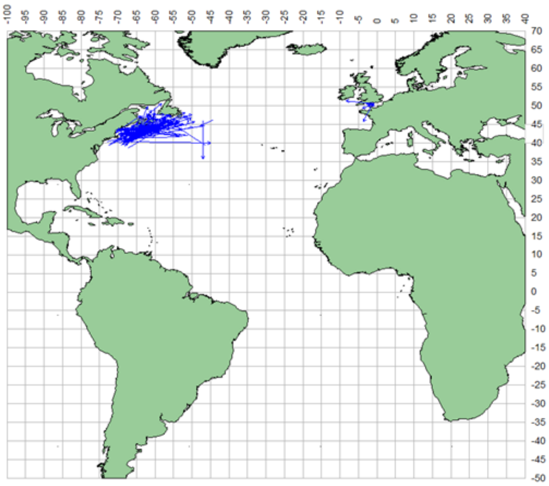
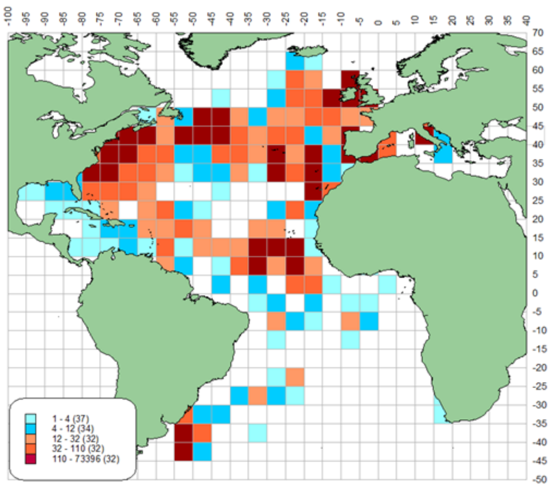
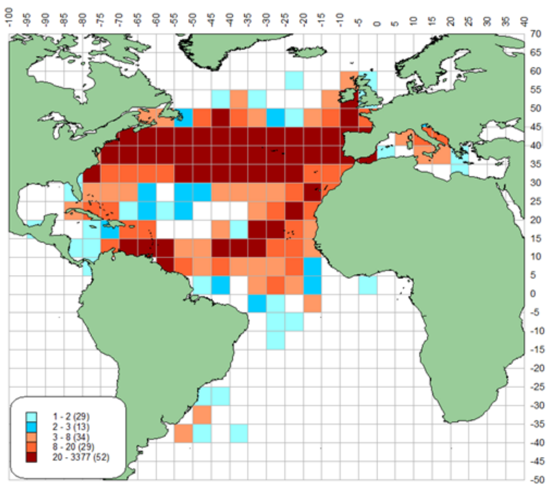


Figure: 30. Tag and Release distributions for Porbeagle in the Atlantic Ocean (a = Density of releases, b = Density of recoveries, c = Straight displacement between release and recovery locations).

a)



b)



c)

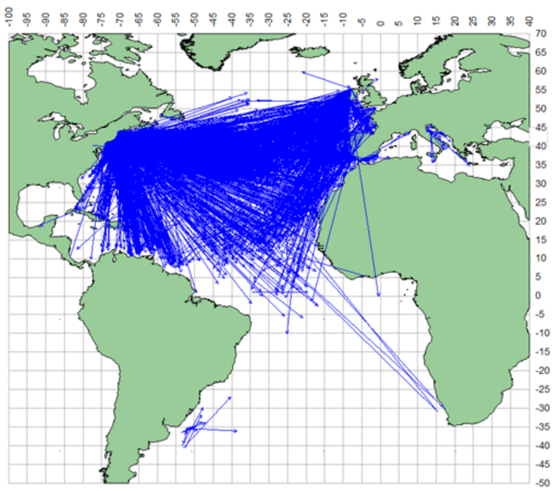


Figure: 31. Tag and Release distributions for Blue Shark in the Atlantic Ocean (a = Density of releases, b = Density of recoveries, c = Straight displacement between release and recovery locations).

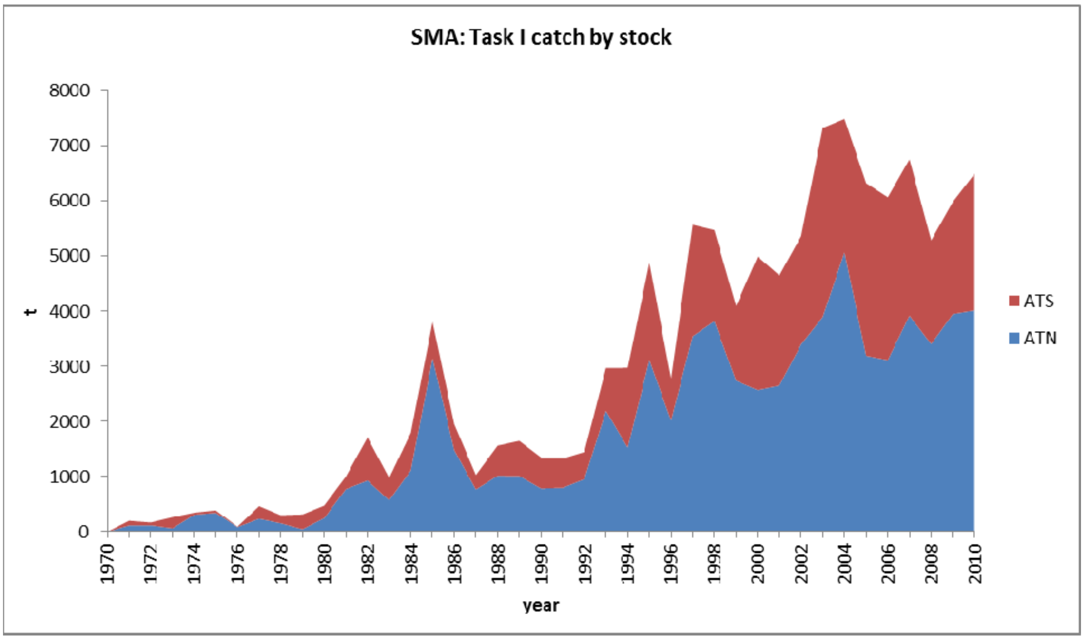


Figure 32. Cumulative shortfin mako Task I catch by stock.

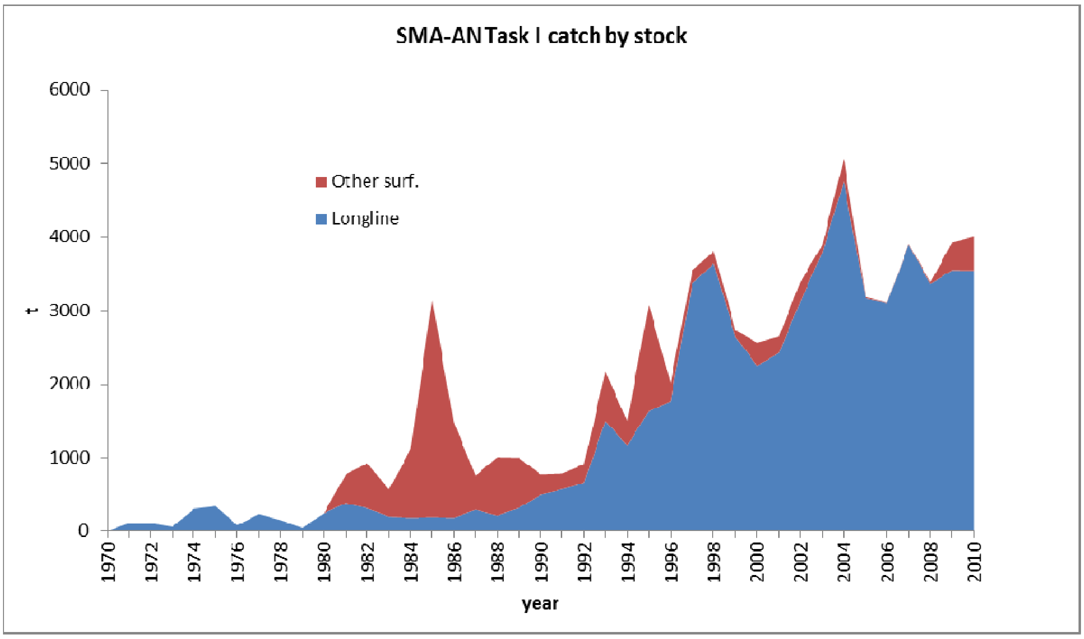


Figure 33. Cumulative shortfin mako Task I catch for the northern region by major fishing gear.

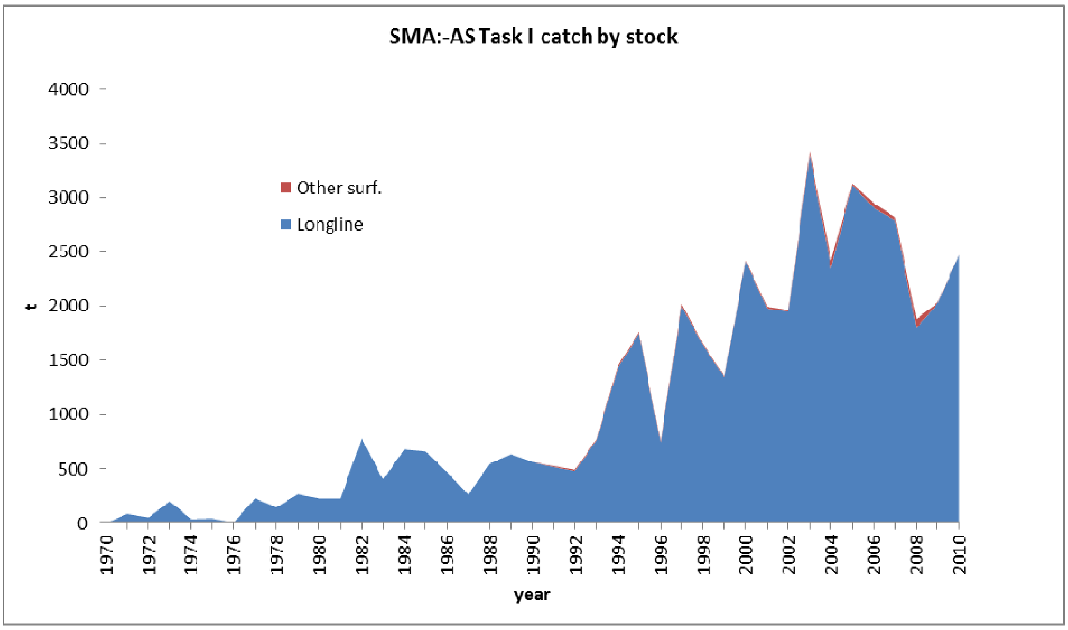


Figure 34. Cumulative shortfin mako Task I catch for the southern region by major fishing gear.

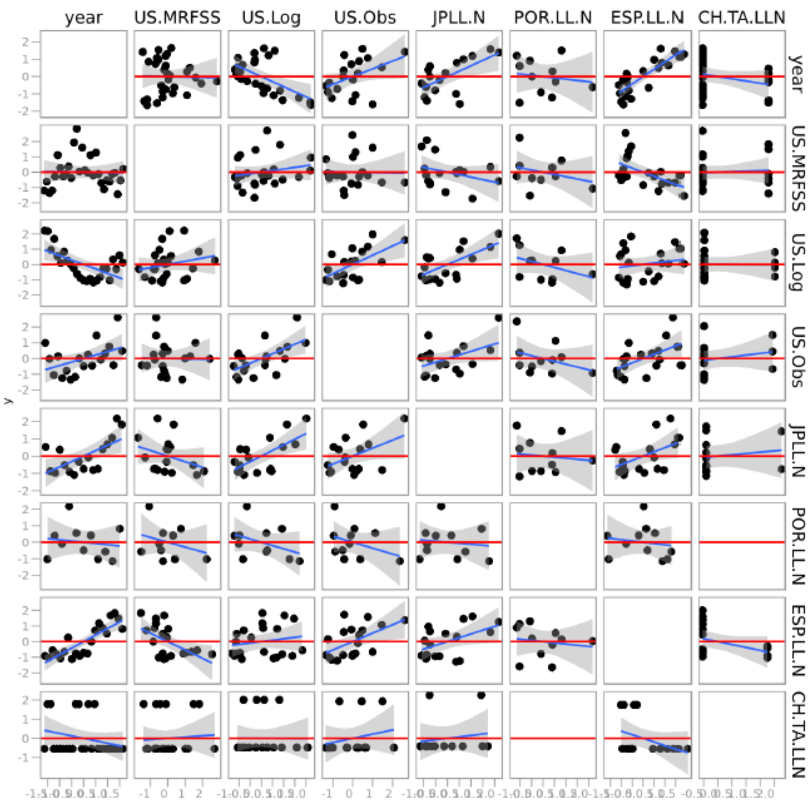


Figure 35. Scatter plots of the northern CPUE indices; indices have been scaled to lie between 0 and 1 for ease of comparison. Blue lines are linear regressions and the shaded areas the 95% confidence intervals of the regressions.

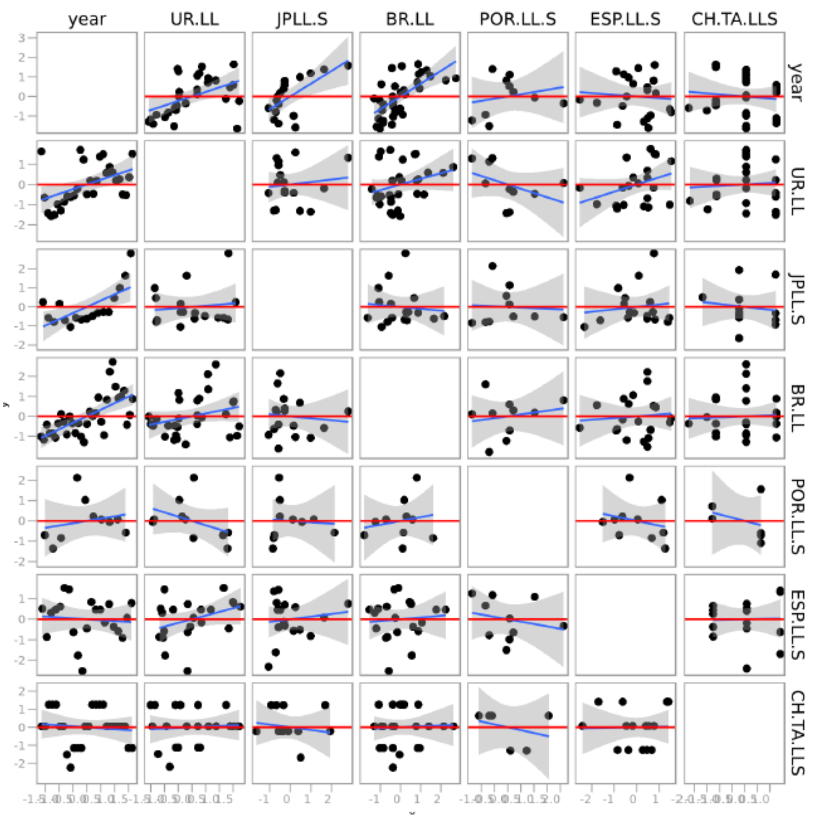


Figure 36. Scatter plots of the southern CPUE indices; indices have been scaled to lie between 0 and 1 for ease of comparison. Blue lines are linear regressions and the shaded areas the 95% confidence intervals of the regressions.

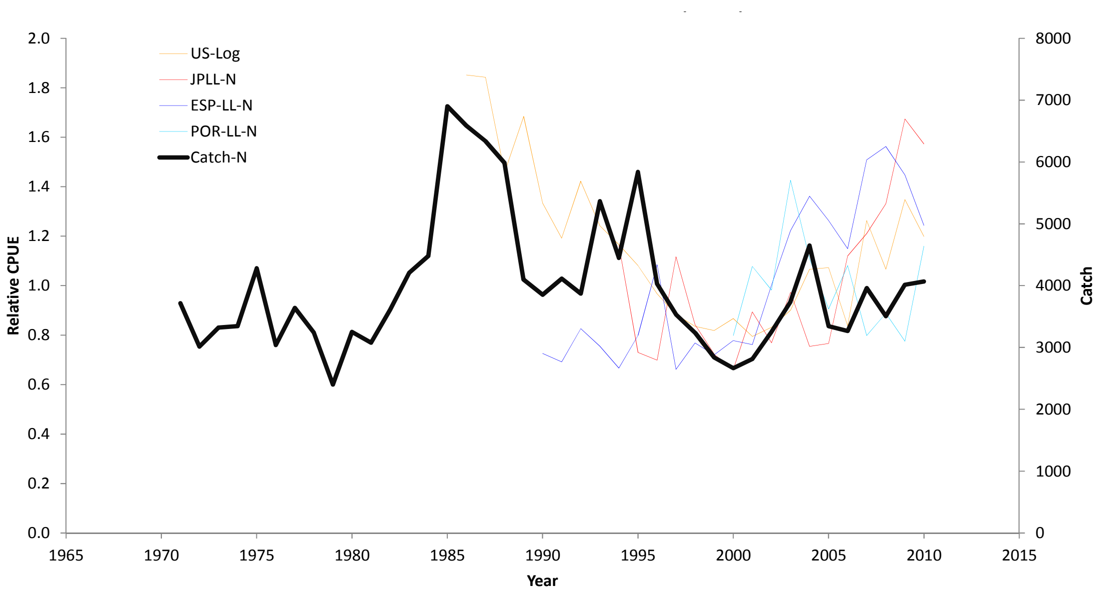


Figure 37. Indices of abundance for North Atlantic shortfin mako shark, along with total catches input into the BSP model.

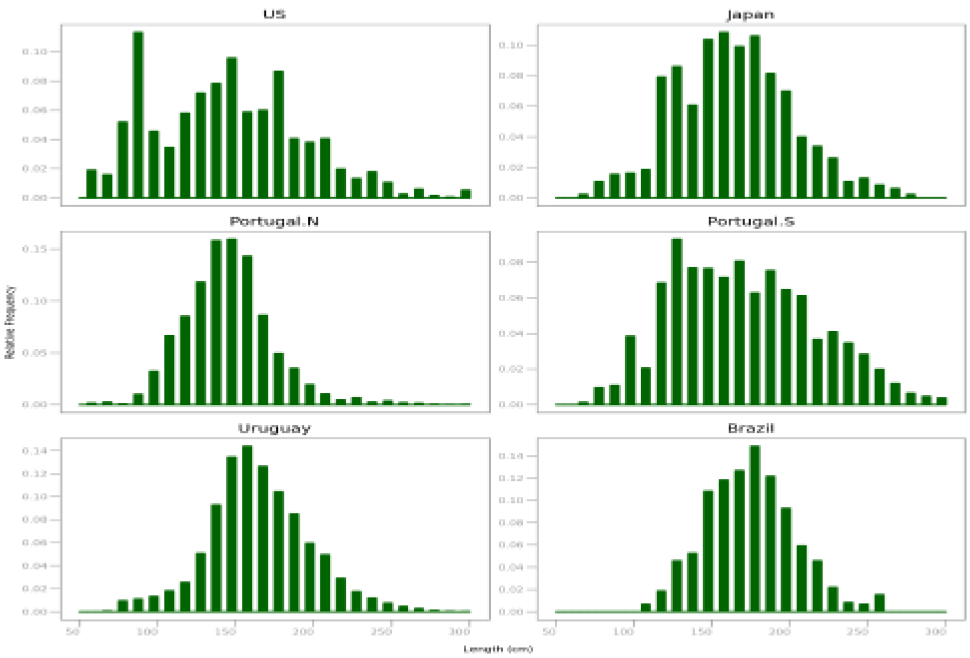


Figure 38. Length frequency distribution by indices.

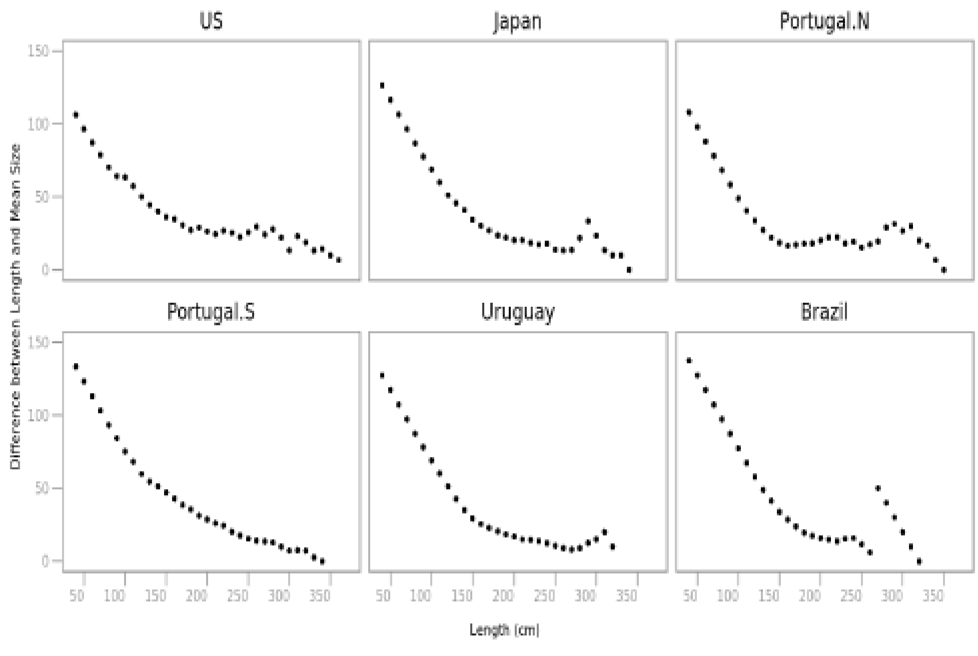


Figure 39. Powell- Wetherall plots by index.

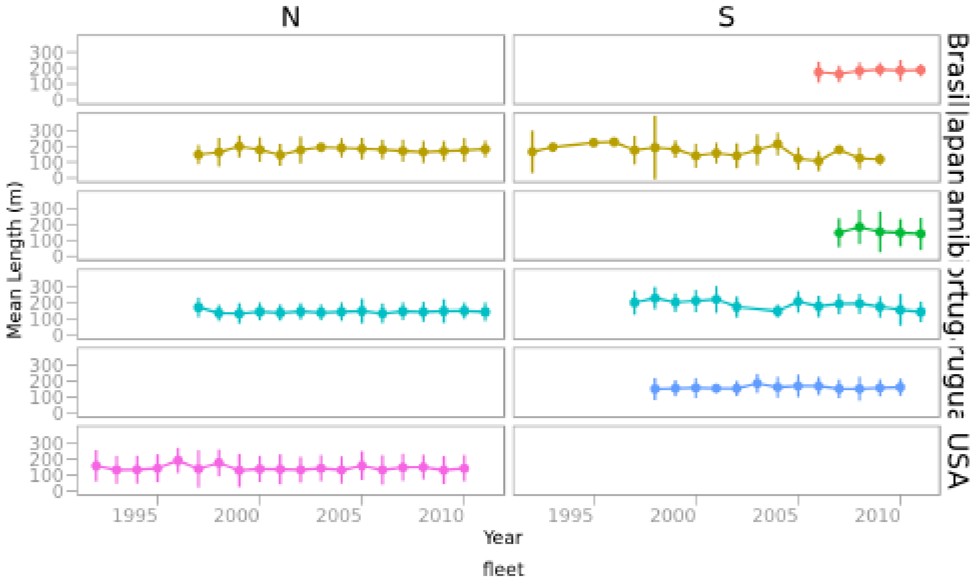


Figure 40. Unstandardised time series of mean size by stock (column) and fleet (row).

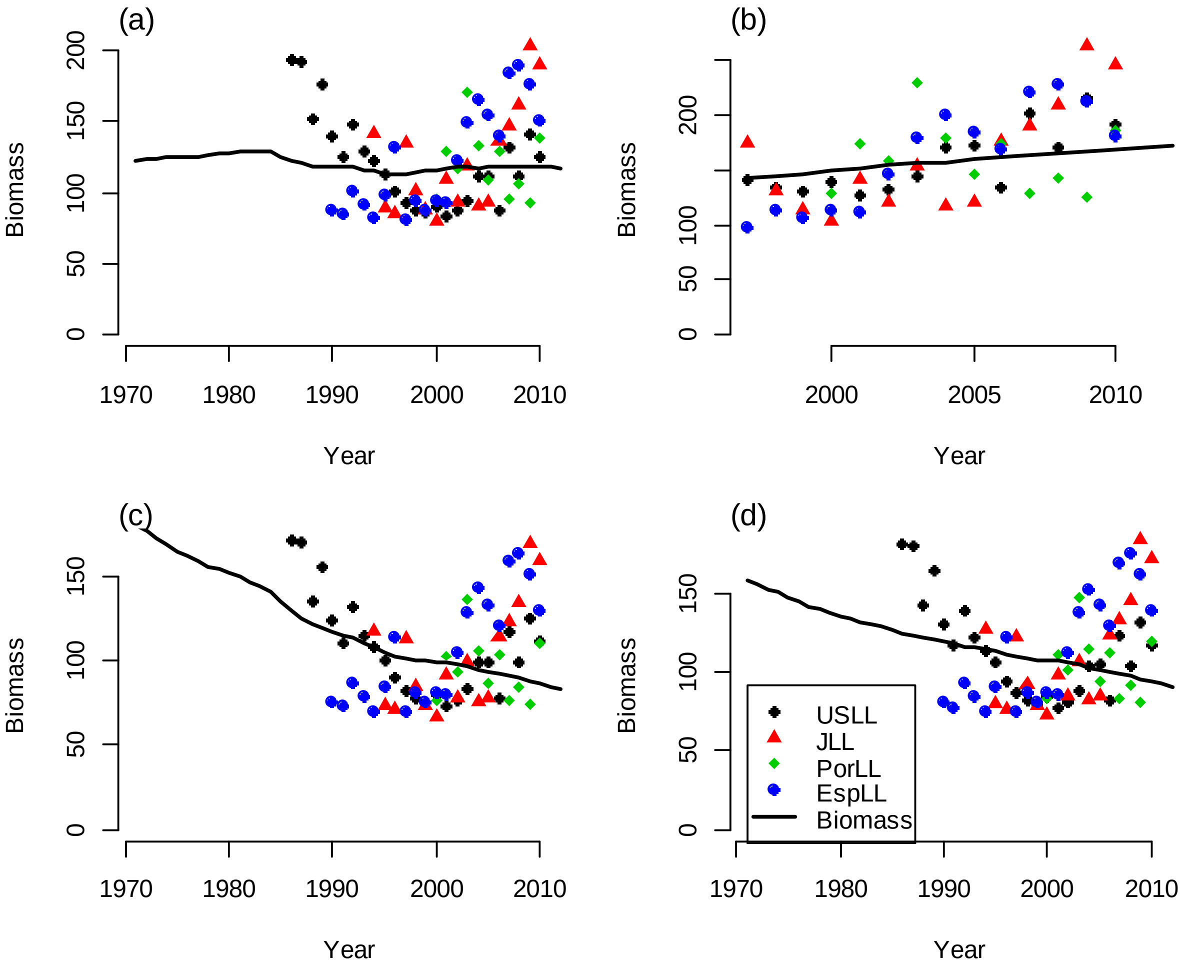


Figure 41. Fits of the CPUE indices to the biomass trend at the mode of the posterior distribution, for North Atlantic shortfin mako shark in the BSP model, for runs (a) 1:equal weighting starting in 1971, (b) 3:starting in 1997, (c) 6: area weighting starting in 1971, and (d) 13:catch estimated from effort through 1996.

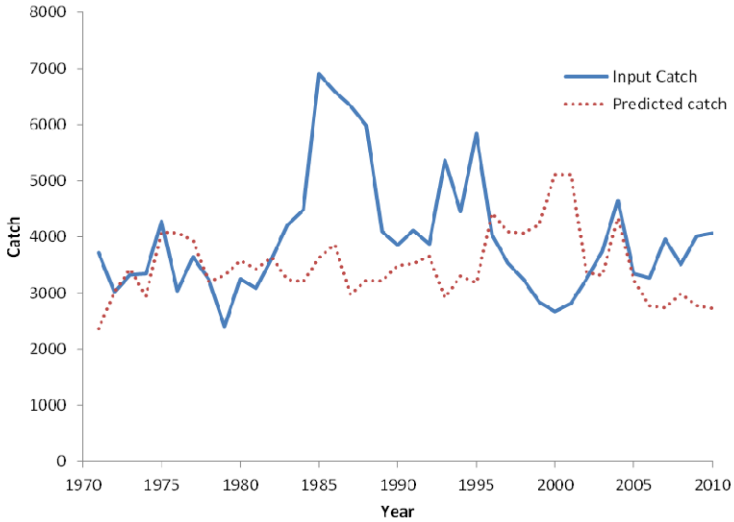


Figure 42. Predicted versus input catch for North Atlantic shortfin mako shark, for run 13 of the BSP, in which catch was estimated from effort in the years 1971 to 1996. Catchability was estimated by fitting observed catches to catches predicted from effort in 1997 to 2010.

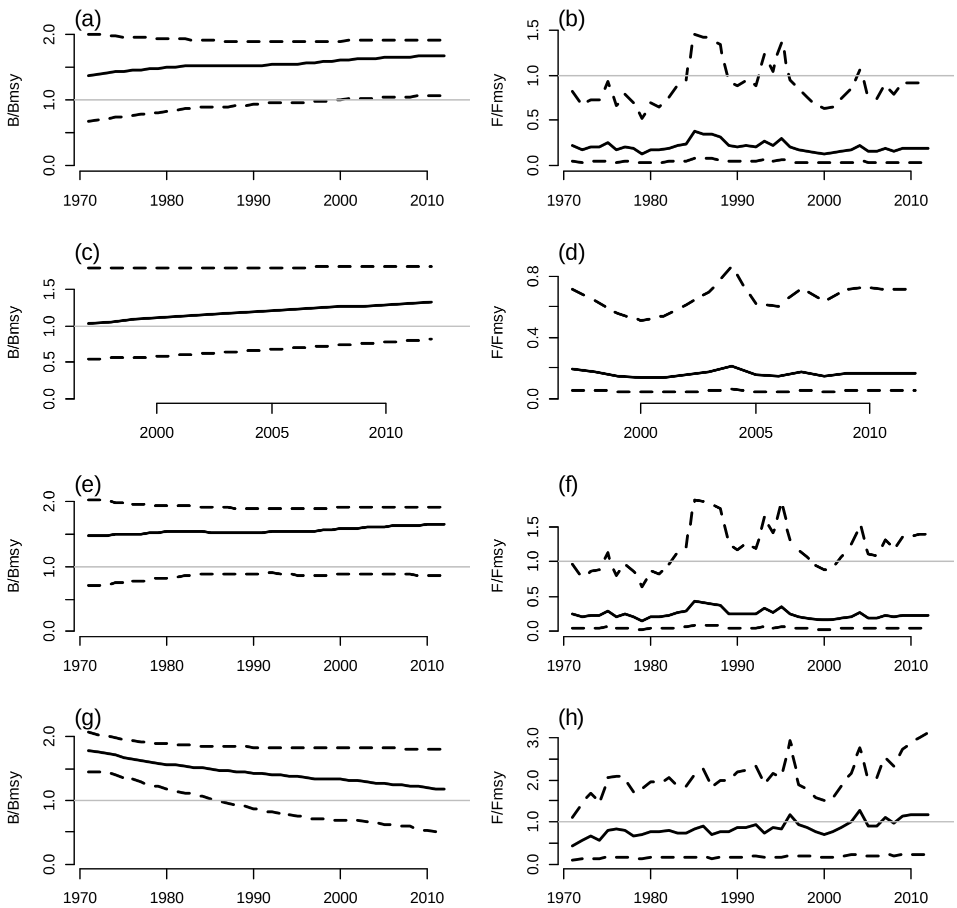


Figure 43. Median of the current biomass relative to B_{MSY} and current F relative to F_{MSY}, with 80% credibility intervals for BSP runs (a,b) 1:equal weighting starting in 1971, (c,d) 3:starting in 1997, (e,f) 6: area weighting starting in 1971, and (g,h) 13:catch estimated from effort through 1996.

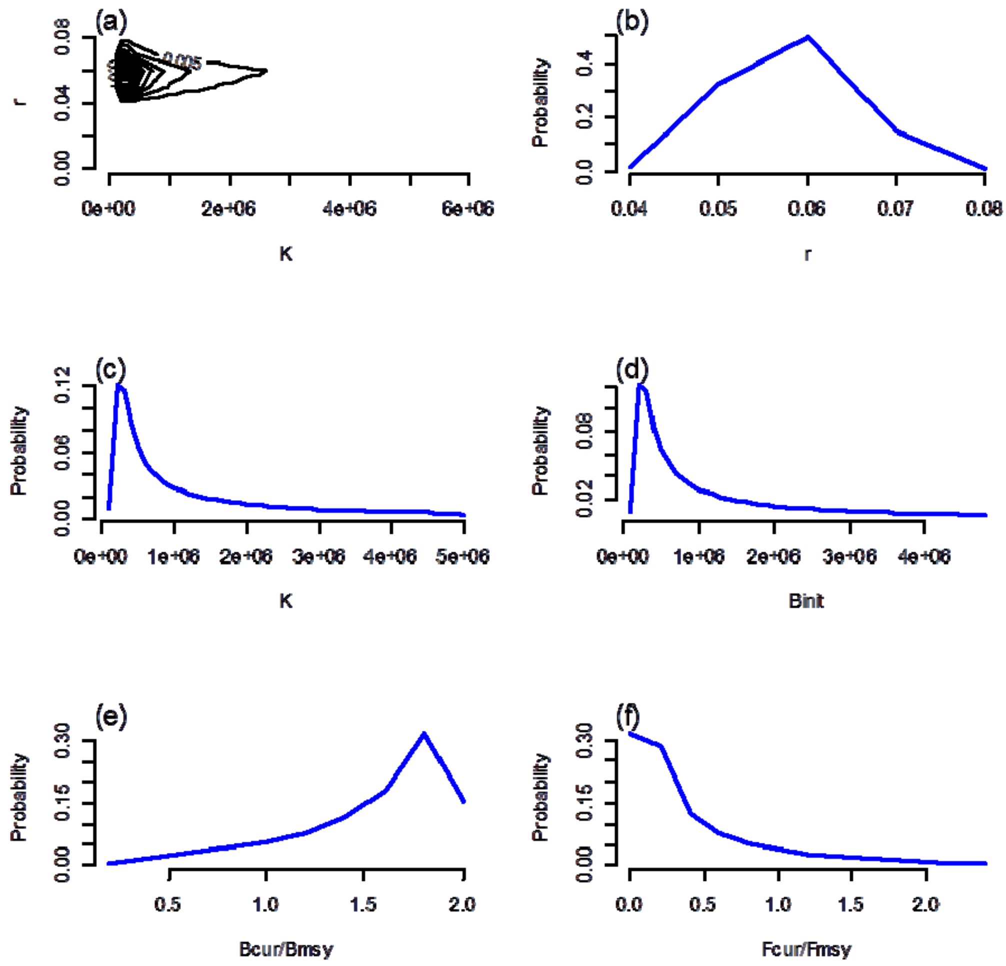


Figure 44. Posterior distributions of model parameters for a typical run of the BSP model in the North Atlantic (run 6, area weighting), for (a) the joint posterior of r and K, (b) r, (c) K, (d) initial biomass, (e) current biomass relative to B_{MSY}, and (f) current fishing mortality rate relative to F_{MSY}.

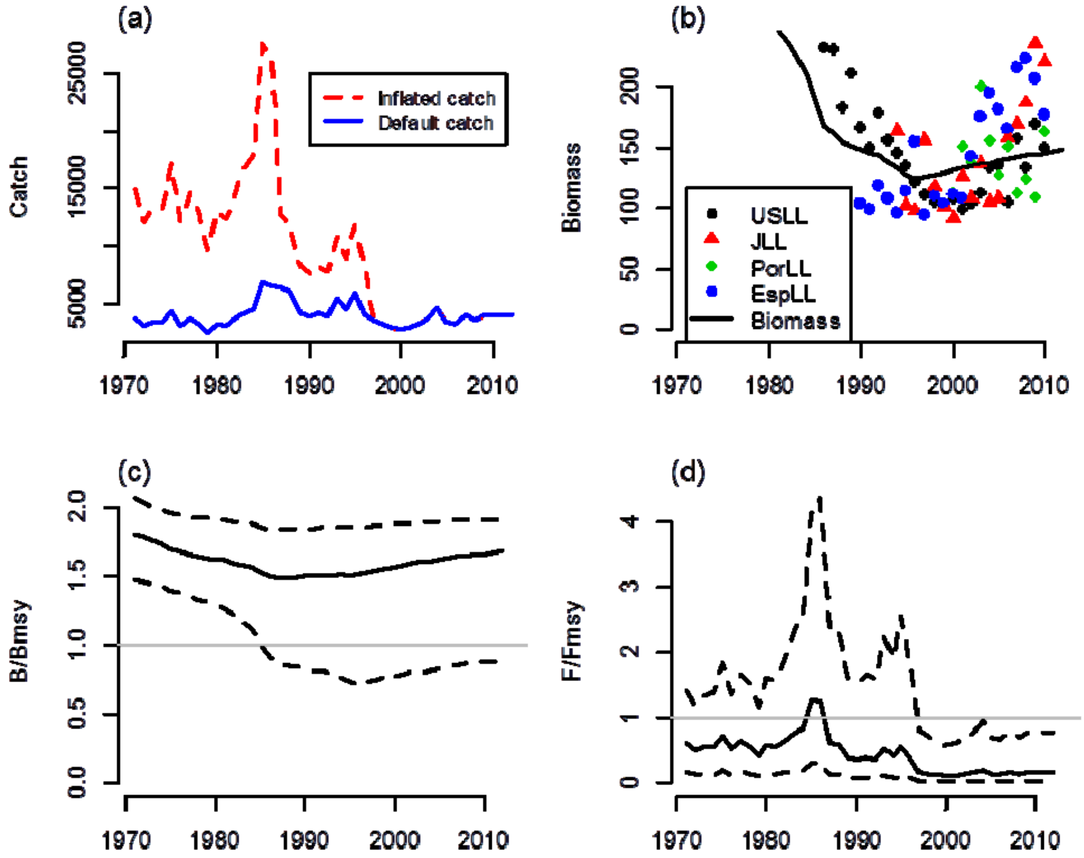


Figure 45. Alternative BSP model for North Atlantic shortfin mako sharks (run 15), in which catches were assumed to be much higher than the base estimates (a) catches, (b) fit to the CPUE data at the mode, (c) B/B_{MSY} with 80% credibility intervals, and (d) F/F_{MSY} with 80% credibility intervals.

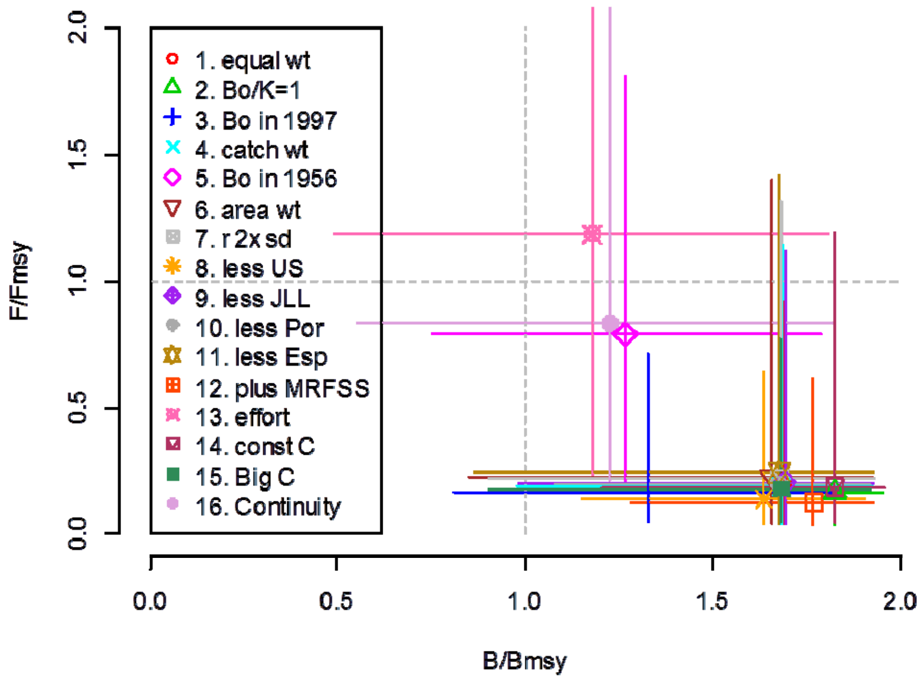


Figure 46. For North Atlantic shortfin mako sharks, median biomass relative to B_{MSY} and median fishing mortality rate relative to F_{MSY}, with 80% credibility intervals, from BSP model.

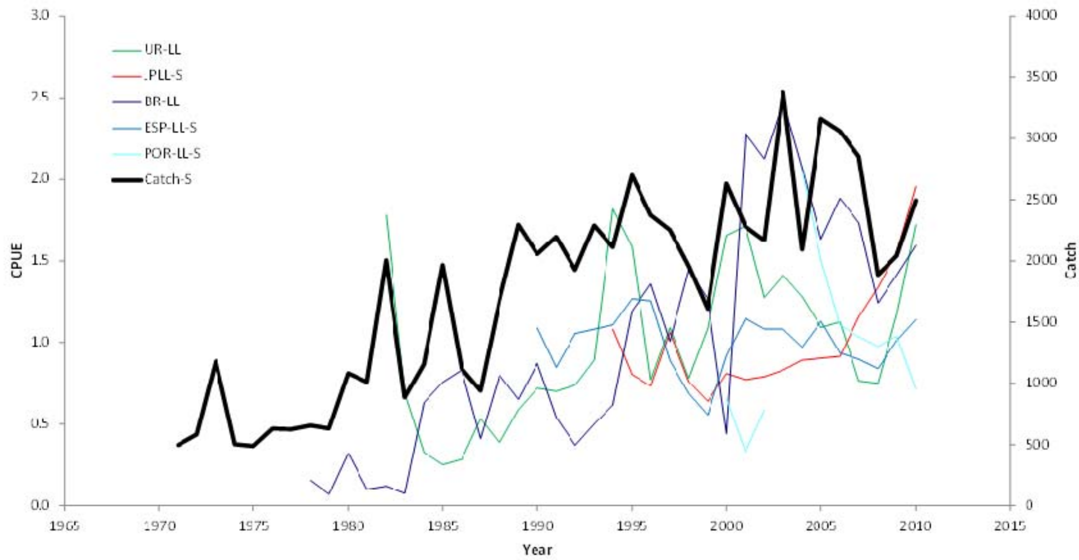


Figure 47. South Atlantic catches and indices input to the BSP model.

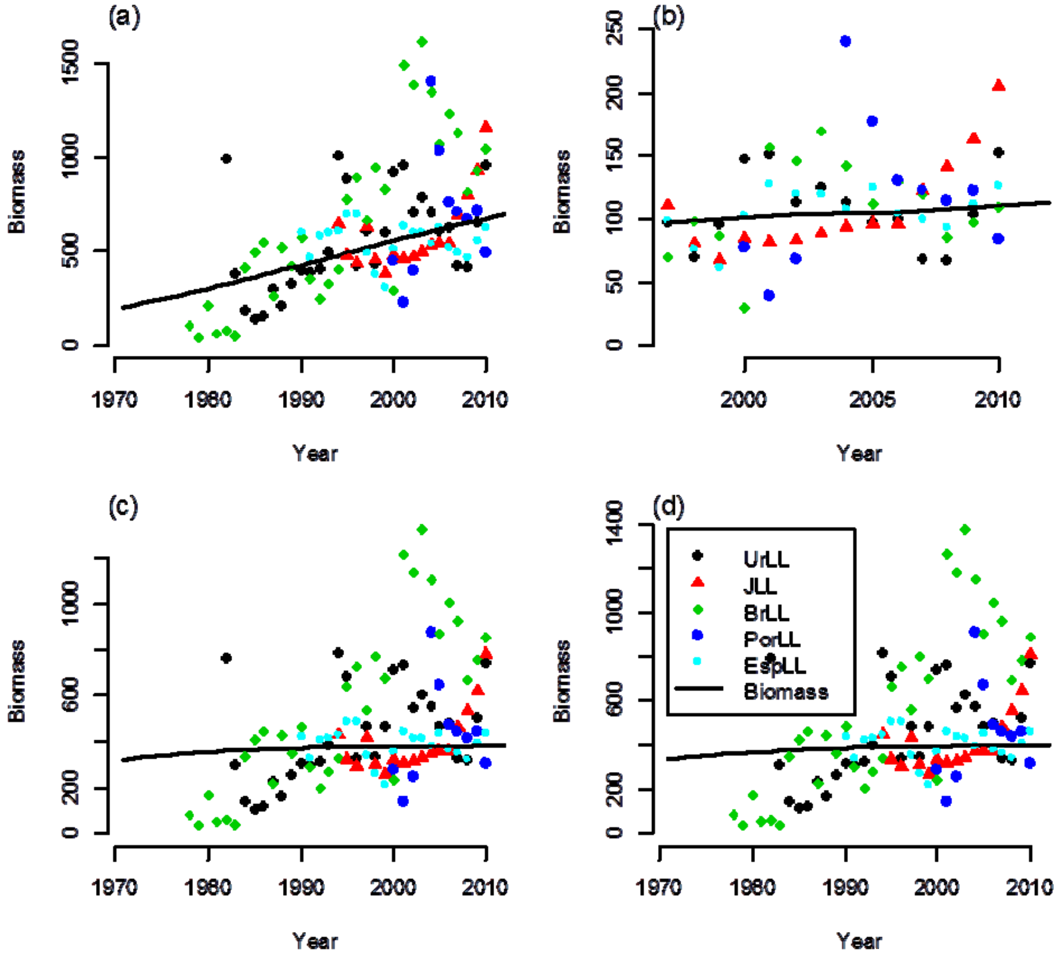


Figure 48. Fits of the CPUE indices to the biomass trend at the mode of the posterior distribution, for South Atlantic shortfin mako shark in the BSP model, for runs (a) 1:equal weighting starting in 1971, (b) 4:starting in 1997, (c) 5: area weighting starting in 1971, and (d) 6:catch estimated from effort through 1996.

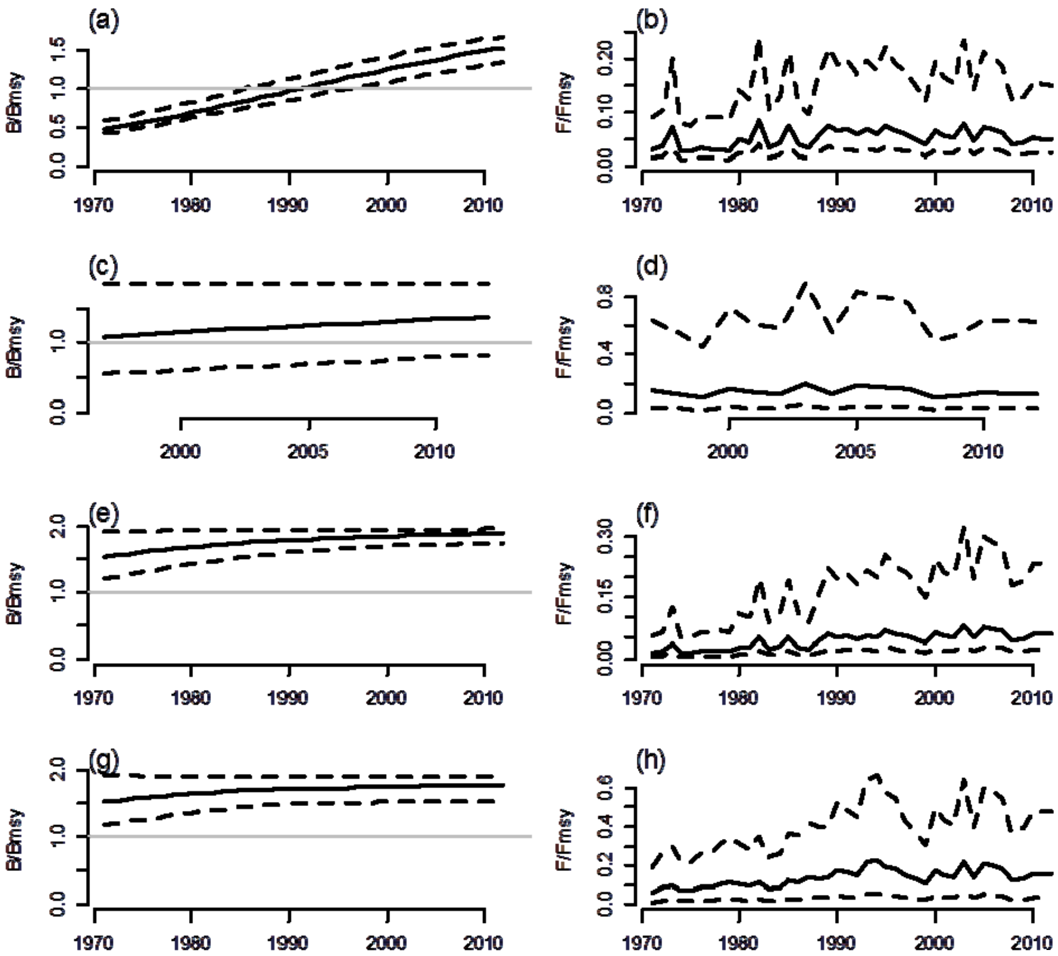


Figure 49. Trend in biomass relative to B_{MSY} and F relative to F_{MSY} with 80% credibility intervals, for South Atlantic shortfin mako shark in the BSP model, for runs (a-b) 1:equal weighting starting in 1971, (c-d) 4:starting in 1997, (e-f) 5: area weighting starting in 1971, and (g-h) 6:catch estimated from effort through 1996.

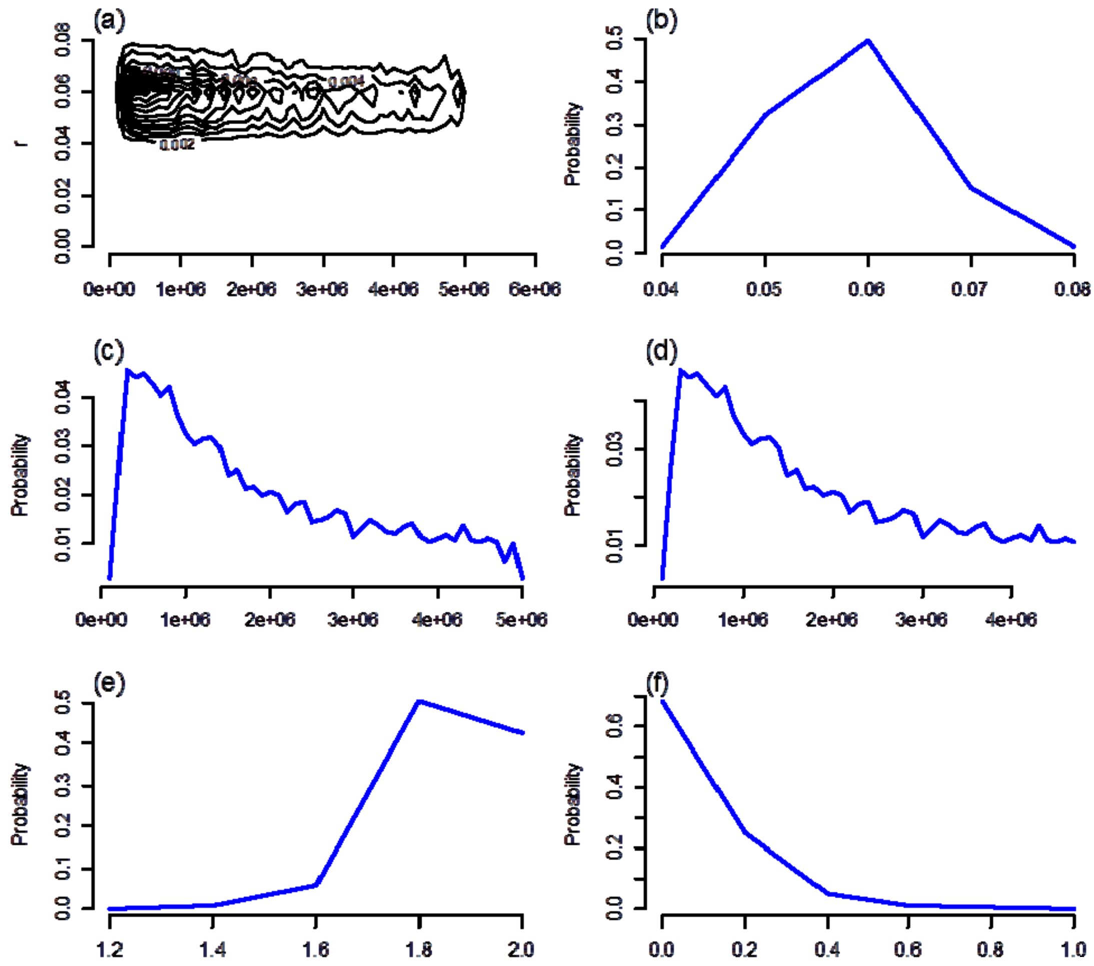


Figure 50. Posterior distributions of model parameters for a typical run of the BSP model in the South Atlantic (run 5, area weighting), for (a) the joint posterior of r and K, (b) r, (c) K, (d) initial biomass, (e) current biomass relative to B_{MSY}, and (f) current fishing mortality rate relative to F_{MSY}.

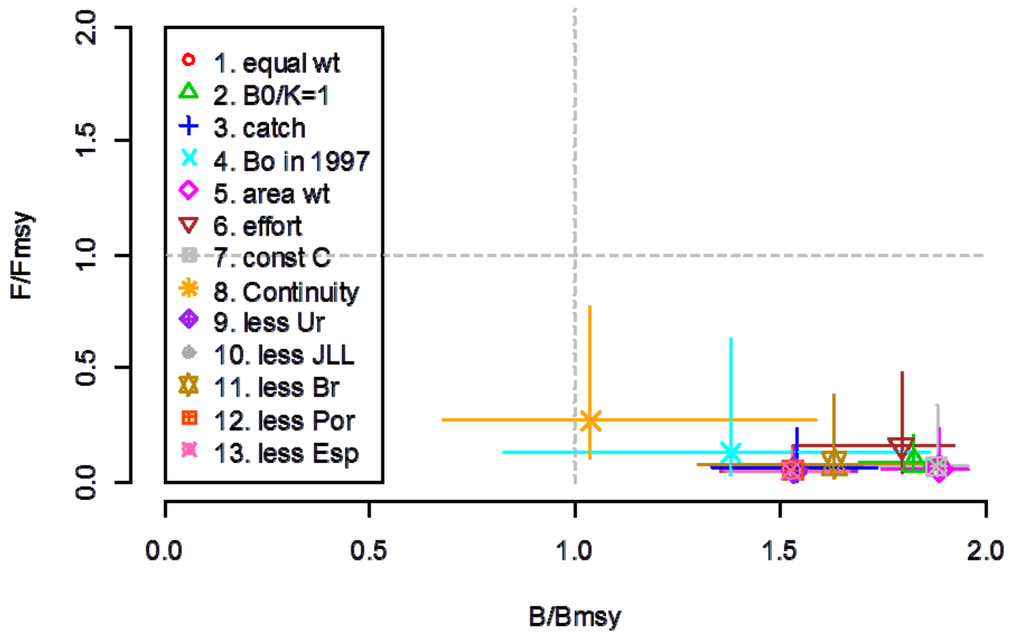


Figure 51. For South Atlantic shortfin mako sharks, median biomass relative to $B_{MS}y$ and fishing mortality rate relative to F_{MSY}, with 80% credibility intervals.

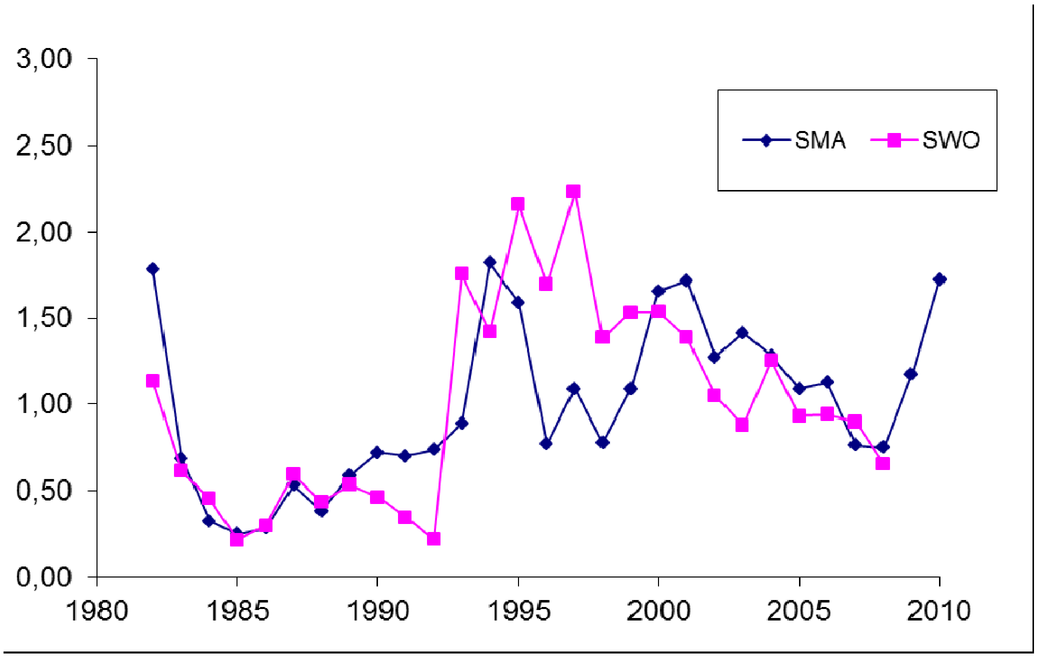
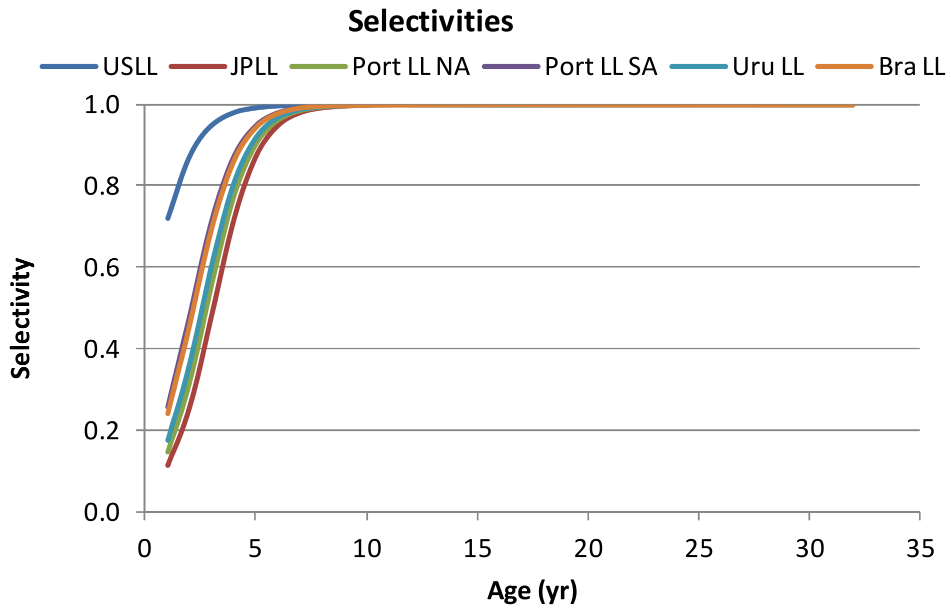


Figure 52. Shortfin mako (SMA) and swordfish (SWO) standardized CPUEs from the Uruguayan longline fleet.



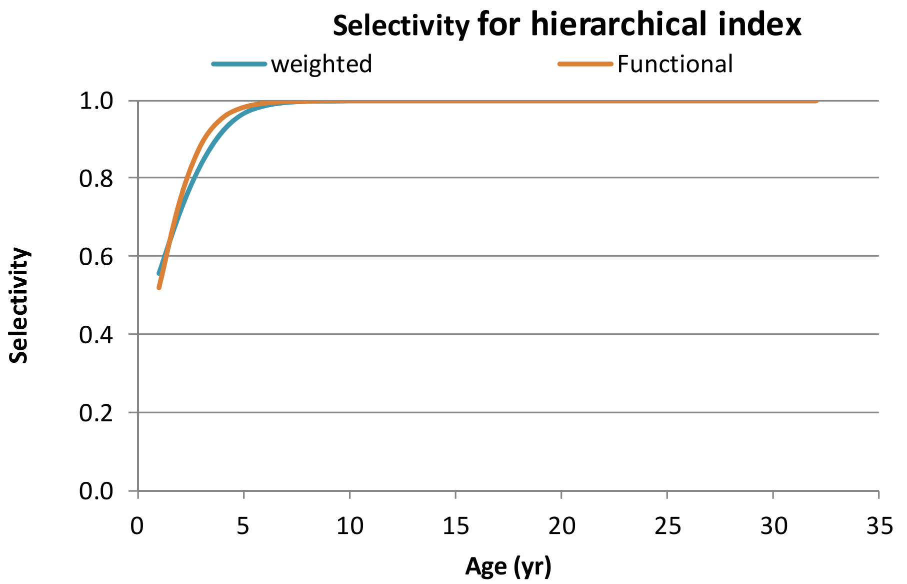
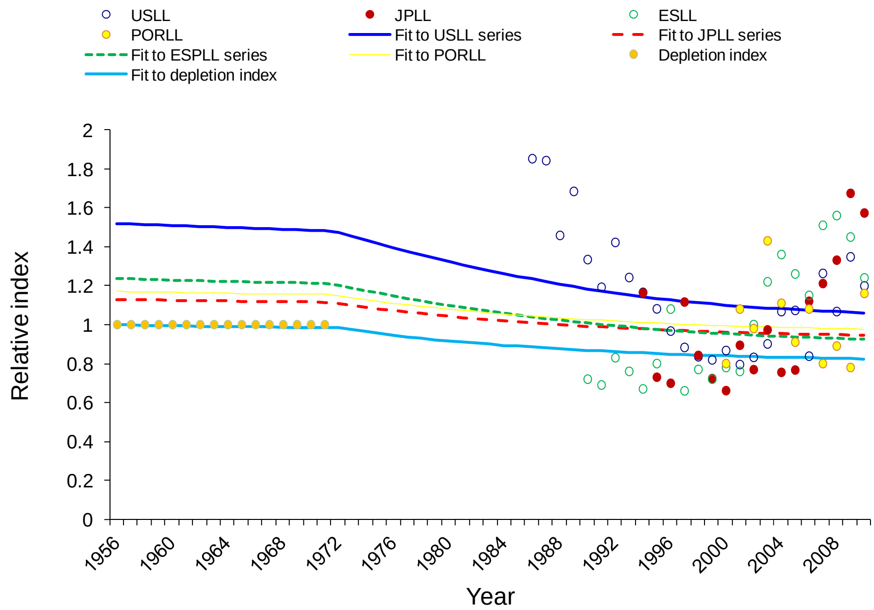


Figure 53. Selectivities used in the CFASPM for the different fleets (top) and for run 9 (hierarchical index).



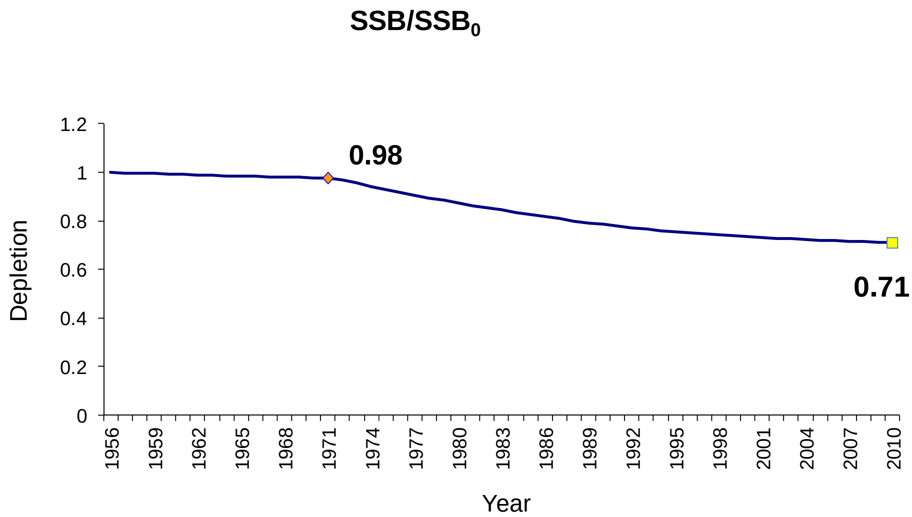
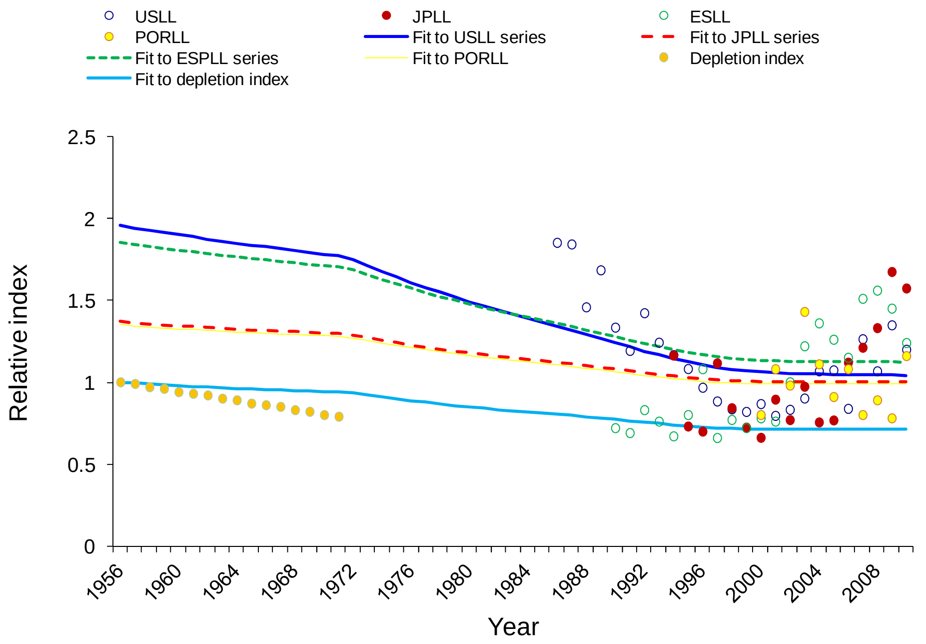


Figure 54. Model fit to the indices of relative abundance and the historical depletion index (a) and relative SSB depletion (b) for the North Atlantic shortfin mako shark (run 1).



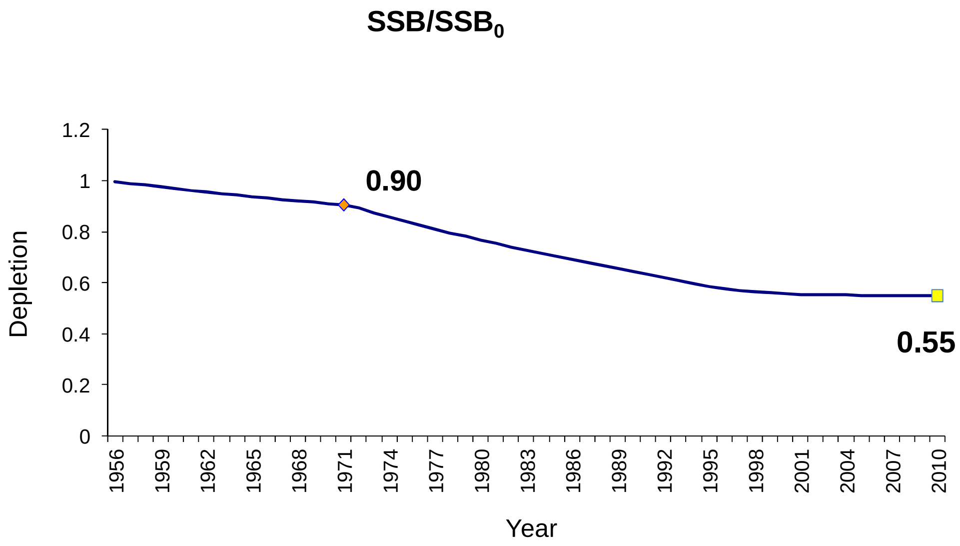


Figure 55. Model fit to the indices of relative abundance and the historical depletion index (a) and relative SSB depletion (b) for the North Atlantic shortfin mako shark (run 4).

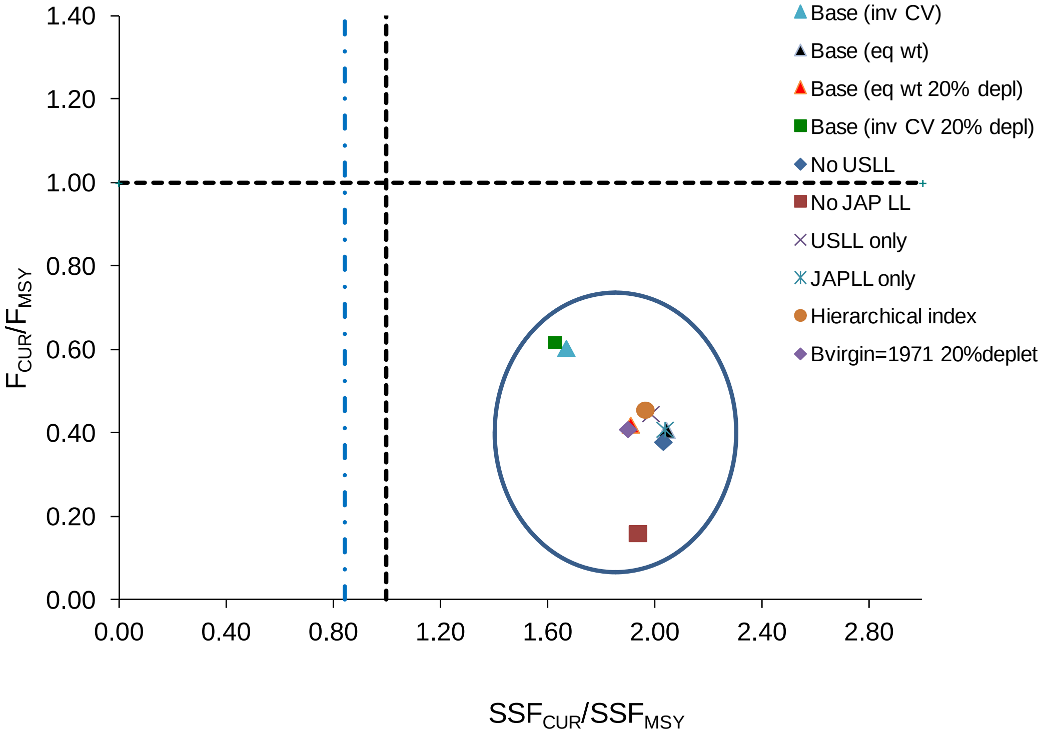
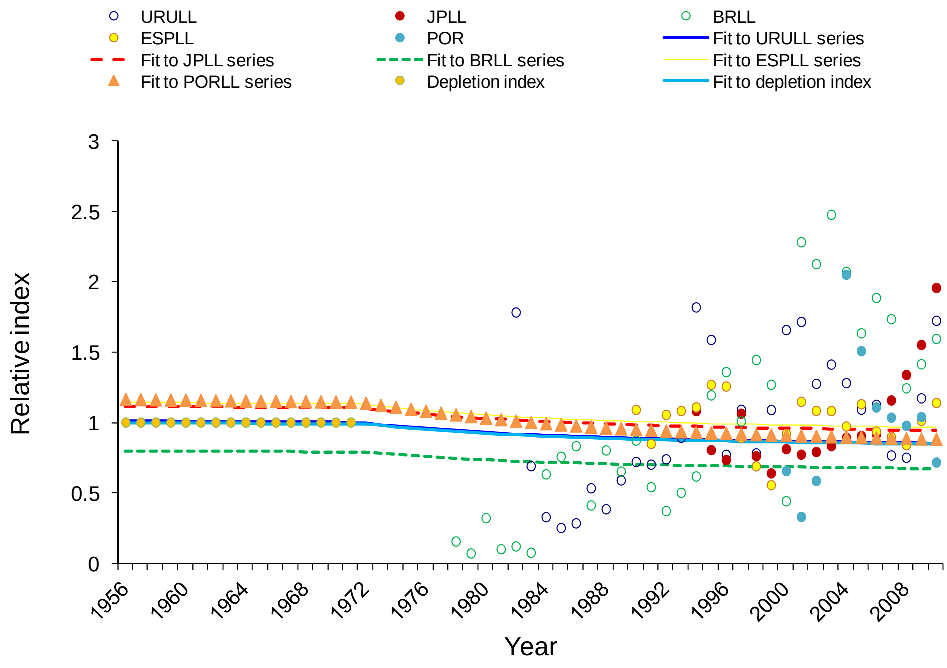


Figure 56. Phase plot of all runs explored for the North Atlantic shortfin mako shark showing current (for 2010) values of SSB and F relative to MSY. The labels in the legend correspond to runs 1 to 10 (in that order) described in the text.



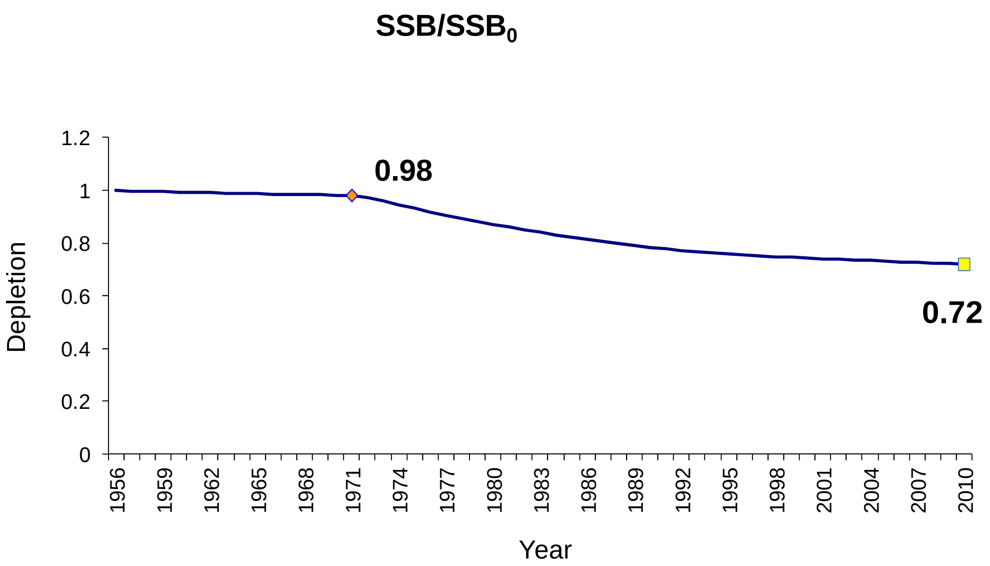


Figure 57. Model fit to the indices of relative abundance and the historical depletion index (a) and relative SSB depletion (b) for the South Atlantic shortfin mako shark.

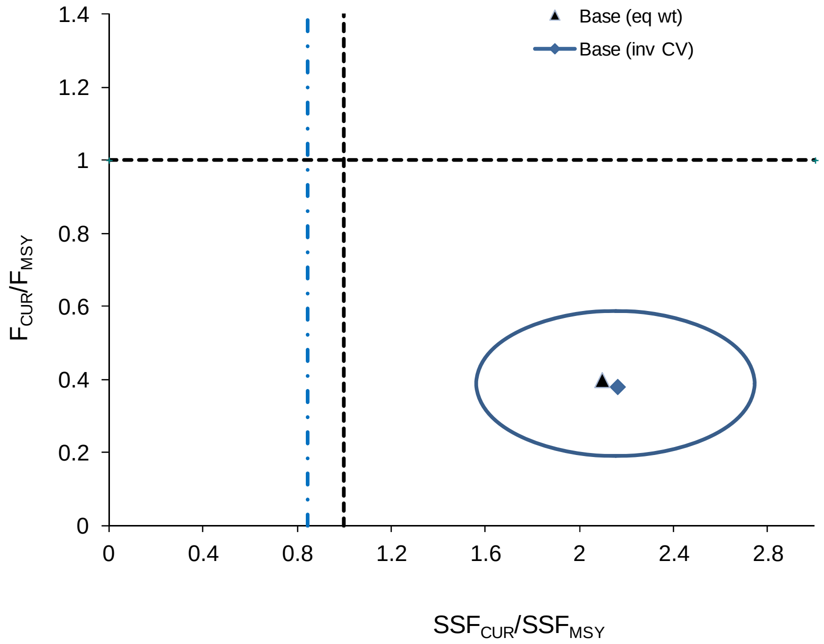


Figure 58. Phase plot of all runs explored for the North Atlantic shortfin mako shark showing current (for 2010) values of SSB and F relative to MSY. The labels in the legend correspond to runs 11 and 12 (in that order) described in the text.

Appendix 1

AGENDA

1. Opening, adoption of Agenda and meeting arrangements
2. Review of the information for the Ecological Risk Assessment (ERA)
   2.1. Productivity
   2.2. Susceptibility
3. Ecological Risk Assessment (ERA)
4. Review of the data for the Shortfin mako assessment
   4.1. Biological data, including tagging data
   4.2. Catch estimates
   4.3. Task II data (catch-effort and size samples)
   4.4. Selectivity
   4.5. Estimates of relative abundance indices
5. Methods and other pertinent data for stock assessment
6. Results of the stock status
7. Projections for different management scenarios including those specified in ICCAT Rec. 10-06
8. Recommendations
   8.1. Research recommendations
   8.2. Management recommendations
9. Other matters
10. Adoption of the report and closure

Appendix 2

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Appendix 3

LIST OF DOCUMENTS

SCRS/2012/040	Enhanced monitoring of large pelagic fishes caught by the Venezuela artisanal off-shore fleet targeting tuna and tuna-like species in the Caribbean Sea and adjacent northwestern Atlantic waters: A preliminary Analysis. Arocha, F., Pazos, A., Larez, A., Marcano J., and Gutierrez, X.
SCRS/2012/071	Preliminary observations on the biology and movements of porbeagle, *Lamna nasus*, around the British Isles. Bendall V.J., Ellis J.R., Hetherington S.J., McCully S.R., Righton D. and Silva J.F.
SCRS/2012/064	The use of life history theory for elasmobranch stock assessment. de Bruyn P. and Kell L.

SCRS/2012/066	The current status of the ICCAT Meta-database with regards to elasmobranch species, with suggestions for future development and activation. de Bruyn P. and Kell L.
SCRS/2012/033	Shortfin mako shark (*Isurus oxyrhincus*) in the catch from the Venezuelan pelagic longline fleet in the Caribbean Sea and adjacent waters: period 1994-2011. Arocha F., Silva J. and Marcano L.A.
SCRS/2012/046	Standardized catch rates of shortfin mako (*Isurus oxyrinchus*) caught by the Spanish surface longline fishery targeting swordfish in the Atlantic Ocean during the period 1990-2010. Mejuto J., García-Cortés B., Ramos-Cartelle A., De la Serna J.M. and González-González I.
SCRS/2012/063	An evaluation of the relative importance of biological parameters when providing management advice: A shortfin mako case study. Kell, L. and de Bruyn, P.
SCRS/2012/070	Standardized catch rates of mako sharks from the pelagic longline logbook and observer programs using a generalized linear mixed model. Cortés, E.
SCRS/2012/072	Standardized CPUE for the shortfin mako (*Isurus oxyrinc*hus) caught by the Portuguese pelagic longline fishery. Neves dos Santos M.
SCRS/2012/073	Observations on the catch-at-size of the shortfin mako (*Isurus oxyrinchus*) caught by the Portuguese pelagic longline fishery. Neves dos Santos M.
SCRS/2012/074	Standardized CPUE of shortfin mako (*Isurus oxyrinchus*) caught by the Japanese tuna longline fishery in the Atlantic Ocean; Semba Y., Yokawa K. and Hiraoka Y.
SCRS/2012/075	Estimation of catches for shortfin mako (Isurus oxyrinchus) by the Japanese tuna longline fishery in the Atlantic Ocean from 1994 to 2010; Semba Y. and Yokawa K.
SCRS/2012/076	Update of standardized catch rates of shortfin mako, Isurus oxyrinchus, caught by Uruguayan longline fleet (1982-2010). Pons M and Domingo A.
SCRS/2012/077	Updated index of abundance for shortfin mako sharks from the U.S. marine recreational fisheries statistics survey. Babcock B.
SCRS/2012/078	Building a consolidated database to crosscheck ICCAT Task I nominal catch, against EUROSTAT and FAO equivalent statistic. Palma C., Ortiz M., De Bruyn P. and Kell L.
SCRS/2012/079	Productivity and susceptibility analysis: Application and suitability for data pPoor assessment of UK Elasmobranchs. McCully,S.R, Scott,F., Ellis,J.M. and Pilling,G.M
SCRS/2012/080	Standardized CPUE series of Shortfin Mako caught by Brazilian tuna longline fisheries in the equatorial and Southwestern Atlantic Ocean (1978- 2012). Hazin, H. G., Hazin, F., Lucena, F. and Carvalho, F.

Appendix 4

ALGORITHM USED TO ESTIMATE SELECTIVITIES (IMPLEMENTED IN MS EXCEL)

1. Obtain age-frequencies

2. Identify age of full selectivity. You should expect to see the age frequency bar chart increase with age to a modal age (*age_full*), after which it begins to decline again. One can assume that *age_full* is the age which is fully selected.

3. Calculate the observed proportion at age: Obs[prop.CAA] = freq(age)/Total_samples.

4. Take the natural log of observed proportion at age, plot age against it, and fit a trend line through the fully selected ages.

5. Use the fitted trend line to predict expected proportion at age, E[prop.CAA]=exp(trend line).

6. Use the ratio of Obs[prop.CAA]/E[prop.CAA] to estimate the non-fully selected ages (i.e. selectivity of ages < *age_full*).

7. Normalize the column of Obs/Exp by dividing by the ratio value for *age_full* (this will scale ages so that the maximum selectivity will be 1 for *age_full*).

8. The age frequency for ages > *age_full* should decline as a result of natural mortality alone. If natural mortality is relatively constant for those ages, this should be a linear decline when you look at the log(Obs[prop.CAA]). If that decline departs severely from a linear trend, it may be that true selectivity is dome-shaped. Also, you may know because of gear characteristics that selectivity is lower for older animals. In this instance, a double exponential could be estimated to capture the decline in selectivity for the older animals.

9. Fit a logistic curve by least squares by minimizing the sum of squared residuals of the expected value and the normalized Obs/Exp value.

10. If fulcrum age=1 (fully selected), fit a double exponential curve by eye by manipulating parameter values to ensure coverage of all ages represented in the sample.