2013 INTER-SESSIONAL MEETING OF THE SHARKS SPECIES GROUP

(Mindelo, Cape Verde –April 8 to 12, 2013)

1. Opening, adoption of Agenda and meeting arrangements

Mr. Óscar David Fonseca Melício, President of the National Institute for Fisheries Development (INDP) of Cape Verde, welcomed the participants to Mindelo and was thanked by the Chairman of the SCRS, Dr. Josu Santiago for hosting the meeting at the Institute. Dr. Paul de Bruyn, on behalf of the ICCAT Executive Secretary, then opened the meeting. The meeting was chaired by Dr. Andrés Domingo, the Shark Species Group Rapporteur. Dr. Domingo welcomed Species Group participants and addressed the terms of reference for the meeting.

After opening the meeting, the Agenda was reviewed and adopted with minor 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	P. de Bruyn, A. Perry, A. Domingo
3	P. de Bruyn
4	E. Cortés, R. Coelho, G. Burgess, B. Seret
5	Species Group participants
6	J. Santiago, A. Domingo
7	J. Santiago, A. Domingo
8	P. de Bruyn

2. Review of the documents

In SCRS/2013/044 it was identified that, to date, changes in target species have been incorporated in stock assessments at two different levels in the analysis. First, these changes are taken into account during the parameterization of generalized linear models used to compute the CPUE index standardization. Second, continuously time-varying catchabilities are directly incorporated during the fitting of the dynamic model used for the assessment. The latter step models the annual catchabilities as random draws from a stationary distribution of catchabilities. Empirical evidence, however, suggests that models in which large, one-time changes in catchabilities could very well describe the temporal changes in various fisheries. Here was presented a suite of Bayesian state-space production models fitted to the time series of South Atlantic blue shark (*Prionace glauca*) stock, in which a single change point in the stationary distribution of catchabilities is specified, with two catchability parameters being estimated, one before and another after the changing point. Despite the models introducing a single extra parameter, they resulted in an improved fit over the one-parameter catchability modelling approach. The models resulted in different estimates of reference points and harvest quotas. However, they all indicated that blue shark stock is above B_{MSY} and that fishing mortality levels are still below F_{MSY}. Although accounting for a single change point in catchability had no significant impact on the status of this particular fish population, it provides a robust way of taking into account changes in catchability as result of changing fisheries dynamics, and can be implemented to model other fish stocks.

The Group discussed whether the assumption that the changes in catches over the study time period were due to changes in selectivity or catchability. Changes could also be attributed to the market demand. In the logbooks, there is information on landings not discards. It was noted that according to the logbooks provided by the fishermen, there has been changes in targeting over time, but these are hard to quantify.

In SCRS/2013/045 it was noted that pelagic sharks are faced with complex movement decisions while residing in a relatively featureless and oligotrophic environment. They are also a common by-catch in pelagic fisheries, raising concerns about over-harvesting. Developing management plans and effective stock assessments requires understanding how these animals utilize entire ocean environments, as trans-oceanic movements are common. Here satellite telemetry and random mixed models were utilised to quantify the factors driving movement patterns in blue shark, *Prionace glauca*, across the South Atlantic Ocean. The majority of sharks showed residency to core areas, although there were individuals that made long distance movements, including two trans- Atlantic dispersal events. Habitat selection was primarily explained by sea surface temperature (SST) and the depth of the mixed layer (DML), but this varied by region. In areas hypothesized to be locations of gestation, adult female sharks selected shallower and warmer waters than males. The South Atlantic blue shark population should be treated as a single stock, although it is unlikely that they utilize a clockwise migration cycle across the Atlantic Ocean.

The Group discussed the sensitivity of the model to assumptions of movement as other spatially explicit models are based on a large number of conventional tags, whereas this model uses a very limited number of satellite tags. It was explained that although there may be some differences in the precise location of the individuals tagged, they would always have been in the same "zone" as defined by the model.

SCRS/2013/037 presented information for Portuguese longliners targeting swordfish in the Atlantic Ocean which regularly capture several elasmobranch species as by-catch, including currently protected species such as the bigeye thresher and the smooth hammerhead. This paper presents preliminary results from bigeye threshers and smooth hammerheads tagged with pop-up archive satellite transmitting tags during 2012 in the NE tropical region of the Atlantic. Strong diel vertical migration patterns were observed for the bigeye threshers with the most occupied depths being 360-390 m during the day and 30-60 m during the night, corresponding to water temperatures of 8-10ºC and 22-24ºC, respectively. For the smooth hammerhead no major differences were detected between the day/nighttime periods, with most of the time spent in the 30-40 m depth range. While the data presented in this paper is still limited and part of ongoing projects, the preliminary results are useful to increase the knowledge on these species biology, ecology and habitat utilization patterns, and can serve as inputs for ongoing and future Ecological Risk Assessments analysis.

The Group noted that the tagging study was able to collect information at depths greater than are normally exploited by the longline fishery and thus provides us with information that would not normally be obtained from the fishery. This information could be very important for the elaboration of the sharks research plan to be developed during the meeting. It was also noted that research is also ongoing for the oceanic whitetip shark

Document SCRS/2013/038 discussed the bigeye thresher shark, *Alopias supercilious*, which is commonly caught as by-catch in pelagic longline fisheries targeting swordfish. As part of an ongoing program for fisheries and biological data collection, fishery observers have been placed onboard fishing vessels, collecting a set of information which includes size, sex and maturity stage, aiming to investigate the maturity of the bigeye thresher shark. A total of 1006 bigeye threshers were recorded throughout the Atlantic Ocean. Size of the specimens ranged from 94 to 264 cm FL (fork length). In the northern regions, there was a higher proportion of females (> 63%) and the observed modal size class was lower than that of the southern regions, where the largest specimens were found. Maturity ogives were fitted for 642 specimens with maturity data available. Size at first maturity was estimated at 208.6cm FL for females (corresponding to 13-14 years) and 159.7 cm FL for males (corresponding to 5- 6 years).

The Group noted that there are potentially different strategies between thresher shark species.

SCRS/2013/042 identified that for the improvement of future stock assessment of shortfin mako (*Isurus oxyrinchus*) in the Atlantic Ocean, it is important to review biological parameters. In the last stock assessment meeting, the uncertainty about catch statistics, catchability and biological parameter was discussed regarding the poor fitting of estimated biomass trend to the observed trend on CPUE. Even granting that there may be un-ignorable amount of unreported catch, it cannot explain the increase of CPUE consistently observed in many fleets by itself. It is valuable to reassess the existing assumption that intrinsic rate of natural increase (r) of this species is quite low, rounding up existing knowledge on the biological parameter. This document provides information on the current status of biological studies for the populations in the North Pacific, focusing on the growth analysis, because we have latest study in this area and, needless to say, growth parameter plays an integral role in the population dynamics among various biological parameters. Important points to be taken into account in the preparation of future research plan are also discussed.

SCRS/2013/040 provided a presentation of at-vessel mortality, post-release survival rate, and total mortality of silky sharks in the French tropical tuna purse seine fishery operating in the Indian Ocean. Currently, French tropical purse seiners in the Indian Ocean release all sharks and rays that are caught incidentally. Through participation in two commercial fishing trips and one chartered research cruise, we first recorded the number of sharks (primarily silky sharks, *Carcharhinus falciformis*) that were alive or dead, once they had been sorted by the crew on the upper and lower decks. More sharks were observed in the lower deck (73%) than in the upper deck. The silky sharks observed on the upper deck were significantly larger than the ones found in the lower deck. The immediate mortality (sharks that were dead at the time of observation) rates appeared to be linked with the location of the individual, as more sharks were found dead on the lower deck than the upper deck. The at-vessel mortality rates also increased with the set size (tonnage). 20 silky sharks were tagged with MiniPATs (Wildlife Computers, Redmond, Washington, USA) to study their survival after release. In addition, 12 silky sharks were tagged with the same type of electronic tags during a scientific cruise. Of a sub sample of 32 silky sharks assessed alive upon retrieval and monitored for periods of up to 100-150 days after release, 8 tags clearly showed mortality directly after release, while data from four tags suggested delayed mortality after 2 to 35 days and one in poor condition died after 3 days, eaten. In all, 16 tags showed that the sharks survived. Two tags failed to report data and one was incorrectly initiated. This document provides the first estimates, for silky sharks (length >85 cm TL) of at-vessel mortality and post-release mortality, respectively, of around 67% and 58%. The overall mortality rate of silky sharks by-caught by this fleet was concluded to be about 81%. A 'best practices' manual for fishers has been prepared to increase rates of survival of sharks caught by purse seine vessels. However, other methods prior to the sharks being brought onboard must also be investigated.

The Group requested additional clarification as to how the sharks were selected for study. It was stated that, each shark was assessed according to the following scale:

1) Good: very active behaviour, biting, kicking;
2) Fair: little movement but still clear signs of life;
3) Poor: low response to external stimuli;
4) Dead.

Then, 32 sharks that were showing signs of life (scale 1 and 2) were randomly selected. The high level of at-vessel mortality was discussed and it was noted that the protocols for release currently in place had not yet been adopted at the time of the study.

SCRS/2013/039 provided an overview of the elasmobranchs catch-at-size and sex-ratios on the Portuguese pelagic longline fishery in the Atlantic Ocean. The analysis was based on data collected from fishery observers, port sampling and from skippers logbooks (self-sampling), collected between 1997 and 2012. Data was analysed in terms of by-catch-at-size and compared between years, seasons (quarters), stocks (North and South, separated at 5ºN) and major fishing areas of operation for the Portuguese fleet (North, Tropical North, Equatorial and South). For the blue shark a general increasing trend on mean sizes was observed for both hemispheres with a decrease in the more recent years. For the shortfin mako the mean size has remained stable in the North and tended to decrease in the South. Some variability was noted in the seasonal and spatial comparisons. The sex-ratios proportions were compared between regions and seasons, and for the main species significant differences were found. The data presented in this working document is still preliminary, but provides new and important information on the catch-at-size trends and sex-ratios for the major pelagic sharks captured by the Portuguese pelagic longline fishery in the Atlantic Ocean.

A brief explanation of the EU Portugal self-sampling was provided. The programme is based on a MS Excel spreadsheet, which allows skippers to calculate total catch weight from individual samples. It is useful to the skippers for compliance purposes and provides information for scientific purposes. It was noted that VMS information is difficult to obtain due to confidentiality issues. Efforts are being made to get this data from the fisheries management department in a form that is aggregated enough for distribution.

SCRS/2013/046 reported length-length relationships between Fork Length, Precaudal Length and Total Length for the main six pelagic species (*Prionace glauca, Carcharhinus brachyurus*, *Carcharhinus signatus*, *Sphyrna zygaena, Isurus oxyrinchus* and *Lamna nasus*) captured by the Uruguayan pelagic longline fleet in the south-western Atlantic Ocean between 1998 and 2010. The length-length relationships provided in this contribution covers an extended portion of the reported full size spectrum of each species considered, and represents the first length-length conversions ever reported for them species in the area.

Document SCRS/2013/047 evaluated the catches of sharks in the artisanal driftnet fishery off Abidjan (Côte d'Ivoire) for the period 2008-2011, using weight and size data collected for every shark species on 3 landing sites, and the proportion of sampled pirogues. During this period, the number of day trips decreased of half and the catches varied between 92 and 203 t. However, the proportion of sharks in the total catches varied from 2.1 % in 2008 to 31% in 2011. The most important species were the blue shark (*Prionace glauca*) and the shortfin mako (*Isurus oxyrinchus*), whose CPUEs (kg/day trip) were slightly increasing. The catches were composed of juveniles of 145-235 cm TL for the blue shark and 115-185 cm TL for the mako shark.

The author clarified that the length measurement provided in the document was precaudal length. It was noted that the gear type described in the study was gillnet and that these were set 2 miles from the shore, potentially close to canyons or the continental drop-off. This could explain the relatively large number of sharks reported.

SCRS/2013/041 noted that currently the reduction of by-catch mortality is an objective of the ecosystem approach to fisheries and a request made by consumers. The involvement and participation of resource users is necessary to develop efficient and practical mitigation techniques. Fishers handle animals as part of their job duties and it is essential to identify good practices that ensure the safety of the crews and optimize the survival of released animals. Combining scientific observations and empirical knowledge from fishers of the French purse-seine fleet, handling and release guidelines are proposed for sharks and rays, including large ones, like whale sharks and manta rays incidentally caught by tropical tuna purse-seine fisheries. A good practices manual has been prepared to raise the fishers’ awareness of the preservation and conservation of biodiversity and encourage their participation in the sustainable management of marine resources. Bringing these best practices onto the decks of fishing vessels should contribute to the reduction of the fishing mortality of some vulnerable species. It would be positively viewed by consumers as an act that reduces fishing’s footprint on the environment and promoting the animal welfare which would improve the image of fishing industry. New ideas emerging from exchanges between scientists and fishers are also proposed although not yet tested. Mitigation research is by definition an iterative process and different complementary methods must be carried out at different levels of the fishing process to significantly reduce the mortality of these animals.

SCRS/2013/049 indicated that the lack of reliable fishery-dependent data and fundamental understanding of the biology of most shark species causes concern for the Sustainable management of shark populations in the Mediterranean Sea. The study aims at investigating on habitat occupancy, residency times and migratory pathways as well as providing behavioural data on temperature experience and swimming depth of the large pelagic shark mainly the blue shark (*Prionace glauca*). This study strives to also determine when and where sharks are most vulnerable and will assist in the conservation of the species. The use of satellite tag is proposed to investigate on the ecology of the large pelagic sharks. The preliminary results of the first SPOT (Smart position or temperature transmitting) tag deployed of a female blue shark are presented.

SCRS/2013/048 noted that in 2010, the EC zero TAC for the porbeagle shark caused the closure of the seasonal targeted fishery traditionally performed by a small fleet of five long-liners of Yeu Island (Bay of Biscay). In order to improve knowledge on porbeagle, the French Ministry of Fisheries supported a scientific program aimed determining the movements of this shark in the NE Atlantic using pop-up satellite tags (PSAT). In summer 2011, three PSATs could be deployed on adult and sub-adult porbeagle females during a tagging cruise carried out in the Bay of Biscay with a longliner of Yeu Island. The three tags popped-up, one at 8 months and two at 12 months (i.e., original setting duration). Although the data transmitted by the tags need to be re-processed with various filters, preliminary analysis shows that the tagged sharks exhibited three different patterns of movements in the NE Atlantic. A mature female of 2.34 TL tagged off Quiberon Peninsula stayed a month in the vicinity, then moved north up to the Shetland shelf where it stayed about 2.5 months, to finally reach the Sea of Norway in November; then it moved to Iceland to return to Norway in February where the tag popped-up. During this migration, this shark did regular dives to 500 m depth, reaching a maximum of 1000 m depth. The second shark, a sub-adult female of 1.9 m TL was tagged off Noirmoutier Island. This shark did a large triangular trajectory in the Atlantic going north-west, reaching close to Greenland in November, then going straight south to the Azores in February-March, before coming back to almost the original tagging position, 12 months later. This shark also did regular dives down to about 1000 m depth. The third shark, a sub-adult female of 1.9 m TL was tagged off the Penmarch Peninsula, also moved north-west, did a return trip to the North Sea in October-November, before going back to the Bay of Biscay (off southern Ireland) in June with a jigsaw trajectory; it dived down to 800 m depth when it was off the continental shelf. Although limited, these observations show that the porbeagle shark uses large areas of the NE Atlantic and the water column down to 1000 m depth.

A brief presentation of an on-going project carried out by EU Institutes was provided to the Group. The general objective of the project is to obtain scientific advice for the purpose of implementing the EU Plan of Action for the Conservation and Management of Sharks, as regards the facilitation of monitoring high seas fisheries and shark stock assessment on a species-specific level. The study is focused on 18 major elasmobranch species on a worldwide basis. In order to achieve the project goals, the team has been: collating and examining historical fisheries data, especially in terms of species composition, catches and effort; estimated global shark catches; identifying gaps in the current knowledge of fisheries, and also on the biology and ecology of sharks. In order to fill the gaps, and to support advice from RFMO on sustainable management of elasmobranch fisheries, a number of proposals are being prepared, namely in terms of designing observer programs, identifying scientific research priorities and the integration of information on t-RFMOs.

The Group welcomed the initiative and requested the authors to facilitate the outcomes of the project as soon as the information is available.

3. Presentation of Task I, Task II and tagging data

The Secretariat presented a summary of the information on sharks submitted by the CPCs. Task I and Task II catch-effort and size samples were presented in the form of data catalogues for the purpose of identifying gaps in the available data. It was noted that although Task I data are available for many species of sharks, these data are extremely incomplete and in many cases, Task I data have not been accompanied by the corresponding Task II data. This is particularly true for species other than blue shark, shortfin mako and porbeagle for which there is generally more information available. It was also noted that there is more information available for the North Atlantic than for the South Atlantic, with very little data available for the Mediterranean. The Group requested that the data be presented in a format to easily identify gaps in order to address these deficiencies in the research plan (**Appendices 4-6**).

The Secretariat also presented the available tagging information for blue shark, shortfin mako and porbeagle. The densities of tagging, recaptures as well as the tracks are provided in **Figures 1-3.** It was also suggested that an objective for the Group could be to develop a format for reporting the satellite tagging data to ICCAT. It was acknowledged that the dataset for each tag can be quite extensive and thus it is more likely feasible to report metadata for the electronic tags (such as the tagging and pop-up locations).

4. Current status of knowledge and research on pelagic sharks in the Atlantic and Mediterranean

This information is dealt with extensively in the research plan detailed in Section 5 below.

5. Scientific research plan for sharks and the compilation of data

A presentation was given on the plan for the SCRS Strategic Research Plan in order to put the current discussions into their greater context within the work of the SCRS. Strategic Planning is recommended as a structured approach to guide the future workings of the SCRS (2011 SCRS Report and responsive to Res. 11-17 on Best Available Science). Document SCRS/2013/024 outlined an approach for identifying key research needs and components of and a roadmap for developing the 2015-2020 SCRS Strategic Plan. SCRS/2013/024 points out that Strategic Planning deals with three basic constructs: "What do we do?", "For whom do we do it?" and "How do we excel?" Furthermore, the key components of strategic planning include an understanding of the SCRS mission (our purpose), our vision for the future, values we shall apply in conduct of our work, our goals and strategies to achieve them. It was pointed out that Strategic Planning also provides a methodology to identify critical capacity and data gaps and prioritize research activities to address them. A roadmap and time-frame for developing the SCRS 2015-2020 Strategic Plan was proposed in SCRS/2013/024 which includes contracting a consultant to provide a framework for the specific methodology to be applied in developing the Strategic Plan and regular consultation and review by SCRS officers and SCRS Plenary prior to review and acceptance by the Commission..

5.1 Objectives and targets of the Shark Research and Data Collection Programme

A presentation was given on the general framework for the Shark Research and Data Collection Programme providing a template for discussion and elaboration. The Chairman then requested that the participants provide comments on the structure of the plan, potential content as well as identification of sections in which they are willing to contribute. This was conducted and a template was agreed on by the Group. The separate sections were then elaborated on by the participants.

5.2 Development of the programme

The proposed Shark Research and Data Collection Programme is presented in **Appendix 7.**

6. Other matters

Cape Verde scientists showed a description of the fishing activities impacting shark species within their EEZ by both the national fleet and foreign fleets (European Union, China) operating under different fishing agreements. The Cape Verde fleet does not target elasmobranchs although they constitute a component of the by-catch when targeting other species; and there are no specific licenses for sharks in Cape Verde for any fleet. In the case of the foreign longline fleets operating in the Cape Verde EEZ, they report a high percentage of sharks representing over 75% of their catches and which are mostly composed by *Prionace glauca* and *Isurus oxyrinchus*.

Considering the importance of shark species in the Cape Verde area, local scientists presented an initiative of developing a Data Collection Programme for their national fleet, for which technical assistance was required. Cape Verde again expressed its desire to obtain assistance to develop a Data Collection Programme, including sampling procedures and a data processing system on the shark species caught by its fleet.

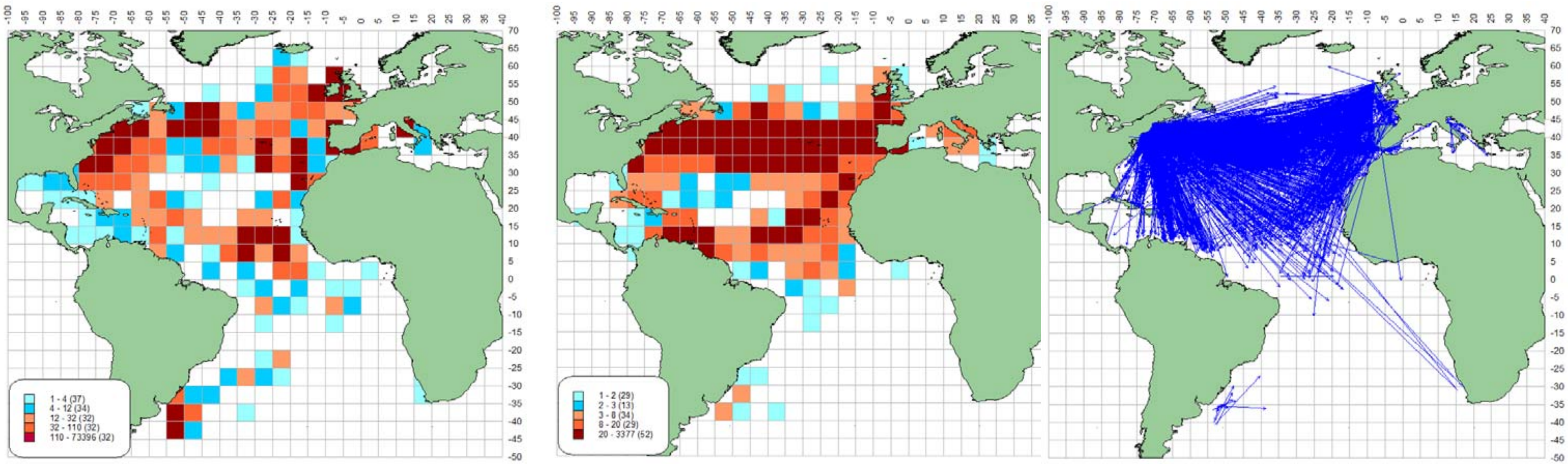
The Group acknowledged Cape Verde's initiative for the development of a Data Collection Programme for its national fleet with a special focus on shark species. Although sharks are not the target of the local fleet, these are an important component of their catch. The Group recommends that special funds from ICCAT be provided for this important initiative.

7. Recommendations

- The Species Group recommends that scientific observers be allowed to collect biological samples (vertebrae, tissues, reproductive tracts, stomachs, skin samples, spiral valves, jaws, whole and skeletonised specimens for taxonomic work and museum collections) from currently prohibited sharks species that are dead at haulback, provided that the samples are part of the research project approved by the SCRS. In order to obtain the approval, a detailed document outlining the purpose of the work, number and type of samples intended to be collected and the spatio-temporal distribution of the sampling work must be included in the proposal. Annual progress of the work and a final report on completion of the project shall be presented to the Sharks Species Group and the SCRS.
- Cape Verde expressed its desire to obtain assistance to develop a Data Collection Programme, including sampling procedures and a data processing system on the shark species caught by its fleet or landed in Cape Verde. Although sharks are not the target of the local fleet, these are an important component of their catch. The Group recommends that special funds from ICCAT be provided to this important initiative.
- The Group recommends that in 2014 a small group of SCRS scientist should be in charge of elaborating the biological sampling design for pelagic shark species in the Atlantic and Mediterranean. The expected budget of this action should be evaluated and proposed to SCRS for its approval.

8. Adoption of the report and closure

The Group expressed appreciation for all the arrangements and facilities provided by the INDP and its scientists for the more than satisfactory development of the meeting. The hospitality provided was extraordinary and the Species Group deeply acknowledged the unbelievable attention given to the participants by the Cape Verde scientists.

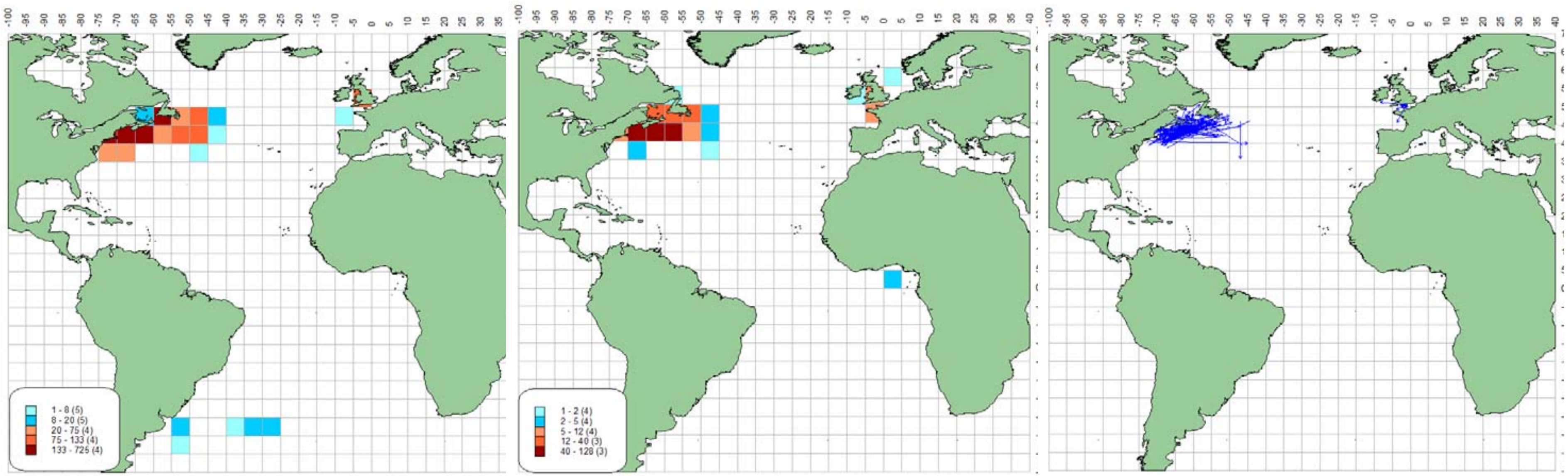


a)-Density of releases.

b)-Density of recoveries.

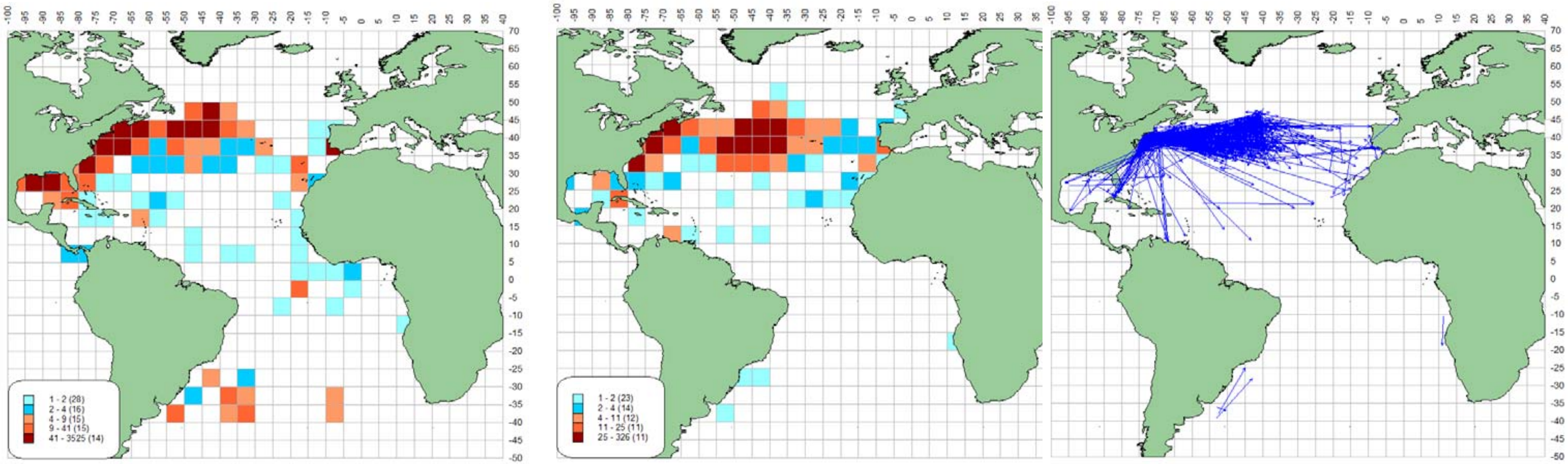
c)-Straight displacement between release and recovery locations.

Figure 1. Blue shark tagging information in the Atlantic and Mediterranean.



a)-Density of releases. b)-Density of recoveries. c)- Straight displacement between release and recovery locations.

Figure 2. Porbeagle tagging information in the Atlantic and Mediterranean.



a)-Density of releases.

b)-Density of recoveries.

c)-Straight displacement between release and recovery locations.

Figure 3.3. Shortfin mako tagging information in the Atlantic and Mediterranean.

Appendix 1

AGENDA

1. Opening, adoption of Agenda and meeting arrangements
2. Presentation of documents
3. Presentation of Task I, Task II and tagging data
4. Current status of knowledge and research on pelagic sharks in the Atlantic and Mediterranean
5. Scientific Research plan for sharks and the compilation of data

   Presentation of the SCRS strategic research plan

   5.1 Objectives and targets of the Shark Research and Data Collection Programme

   5.2 Development of the programme
6. Other matters
7. Recommendations
8. Adoption of the report and closure

Appendix 2

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Appendix 3

LIST OF DOCUMENTS

SCRS/2013/037 Preliminary results on habitat use of bigeye thresher (*Alopias superciliosus)* and smooth hammerhead (*Sphyrna zygaena*) sharks based on electronic taggings. Coelho R., Santos M.N. and Fernandez-Carvalho J.

SCRS/2013/038 Reproductive biology of bigeye thresher (*Alopias superciliosus*) in the Atlantic Ocean. Fernandez-Carvalho J., Coelho R and Santos M.N.

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SCRS/2013/039 Observations on the elasmobranchs by-catch composition and by-catch-at-size of the Portuguese pelagic longline fishery in the Atlantic Ocean. Santos M.N., Coelho R., Lino P.G. and Fernandez-Carvalho J.

SCRS/2013/040 At-vessel mortality, post-release survival rate and total mortality of silky sharks (*Carcharhinus falciformis*) in the French tropical purse seiners fishery. Poisson F., Filmalter J., Vernet A., Goujon M. and Dagorn L.

SCRS/2013/041 Good practices to reduce the mortality of sharks and rays caught incidentally by the tropical tuna purse seiners. Poisson F., Séret B., Vernet A., Goujon M. and Dagorn L.

SCRS/2013/042 Some information of shortfin mako growth analysis. Semba Y. and Yokawa K.

SCRS/2013/044 Incorporating changes in target species in a fisheries stock assessment model: An illustration of alternative methods applied to the blue shark (*Prionace glauca*) in the Atlantic. Carvalho, F., Ahrens, R., Murie, D., Ponciano, J. M., Aires-da-Silva, A., Maunder, M., and F. Hazin.

SCRS/2013/045 Habitat selection and trans-oceanic migration by blue sharks (*Prionace glauca*) in the South Atlantic Ocean and its implications for management. Carvalho, F., Murie, D., Parkyn, D., Ahrens, R., Ponciano, J. M., Da Silva, C., West, W. M., Kerwath, S. E., Wilke, C. G., Travassos, M., Martins, D., Travassos, P., Papastamatiou, Y., Aires-da-Silva, A., Maunder, M., Hazin, H., Montealegre, S., Burgess, G., and F. Hazin.

SCRS/2013/046 Length-length relationships for six pelagic shark species commonly caught in the southwestern Atlantic Ocean. Mas, F., Forselledo R. and A. Domingo.

SCRS/2013/047 Importance des requins dans les captures de la peche artisanale aux filets maillants derivants de Côte d'Ivoire. Konan, K. J., Diaha, N., Sylla, S., Amandè, M. J. and T. G. Joanny.

SCRS/2013/048 French tagging program on porbeagle shark (*Lamna nasus*) in the north-east Atlantic. Séret, B., Biais, G. and Y. Coupeau.

SCRS/2013/049 Ecology of the large pelagic sharks in the Mediterranean Sea: A pilot study. Poisson F., Banegue A. and Groul J.M., B .Séret.

Appendix 4

ANNUAL CATCH REPORT OF ALL SHARKS AND OTHER ELASMOBRANCHS IN THE TASK I DATABASE BY FLAG (MT)

Flag	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
Albania						1	15	13	13	13										50		0	
Algerie	2801	2406	2804	3171	3496	2343	2150	2172	4265	4320	4494	4302	3878	2251	2930	3403	3197	3595	4431	2369	2733	1797	69
Angola	802	985	500	452	291	366	396	241	554	324	337	336	336	48	520	3847		5796	98	3767	1933	2752	
Antigua and Barbuda				2																			
Argentina	1807	2276	2078	500	31	138	12698	11376	12617	11191	7967	10701	8161	9105	9889	10498				229	341	7	
Aruba	83	69	55	60	135	50	60	60	60	60	60	50	50										
Barbados	304	356	482	580	533	748	415	402	362	317	318	255	197	313	337	462	434	293	258	135	232	234	
Belize						4		4		36	23				37	302	201	1676	1431	1664	6852	14409	
Benin	346	343	315	333	317	308	307	683	652	366	287	287	276	2	5	3	3	4					
Brasil	31986	29884	33293	34775	36058	34913	40341	44904	43951	44430	52063	51676	49184	48418	44311	48283	41476	46715	34976	40943	41685	53081	
Cambodia										56													
Cameroon	3	3	6	6																			
Canada	2130	2674	4176	5527	5103	5525	3326	4184	3786	3670	3788	3231	3269	2821	3563	4190	3945	3365	2455	2138	2309	2357	
Cape Verde	3592	3976	2975	2939	3415	3655	2606	3278	2833	4143	3701	3405	3241	2962	5273	16009	18625	12244	17653	14930	13304	16011	
Chile					1			0															
China P.R.				357	971	1114	1091	807	2880	11358	9361	10143	8655	10908	8622	8969	9907	10845	7296	6358	6832	4997	
Chinese Taipei	41746	48886	46289	48005	65389	53991	60238	53872	46545	50133	50662	44926	47650	54053	43728	31626	22283	32479	25888	26783	29206	33346	
Colombia	478	159	4319	5092	4638	9246	804	46	46	46	46	46	46	46	46	46	46						
Congo	49	38	39	41	30	29	26																
Costa Rica				2						3	14			1									

Côte D'Ivoire	9004	10416	11554	622	648	622	628	557	430	444	2275	805	618	823	1389	2014	2872	2869	9630	5501	6697	2878	
Croatia		1493	1228	1118	1517	1263	1386	1131	967	1136	930	903	977	1139	828	1017	1022	825	838	622	470	470	
Cuba	4618	3940	3960	2381	2874	2951	2926	2392	1179	907	914	124	243	1061	1121	1111	1202	56					
Curaçao	620	550	570	605	560	510	13252	19072	19293	18971	19421	22230	12326	19548	16685		5547	3313	15993	18169	17750	20609	
Dominica	135	103	137	128	152	130	91	91	91	330	328	319	411	297	181	235	233	258	346	273	240	258	
Dominican Republic	2149	1637	1342	1260	2161	3287	3287	2465	1314	927	1053	749	905	524	370	391	359	147					
Egypt	598	574	518	640	648	697	985	725	724	1442	1442	1128	1128										64
EU.Bulgaria	17	17	20	8		25	33	16	51	20	35	35	35								93		
EU.Cyprus	206	197	87	141	192	109	69	80	101	151	211	240	266	180	422	635	664	787	413	267	240	293	
EU.Denmark	48	86	81	128	94	88	75	70	87	107	75	77	55	5	1						17		
EU.España	178215	190111	160444	165163	154752	159584	135340	153945	139941	145168	146817	132566	122917	137851	133972	112458	113072	111945	135961	153481	156506	168497	
EU.Estonia	276	657	1											4									
EU.France	82874	86204	81637	101253	102869	82698	83441	69088	68796	73266	69717	68922	67259	66823	70200	69889	45176	41884	38888	43100	53630	53218	
EU.Germany	91						717	417	42	0	17	1	679										
EU.Greece	6464	7184	7003	6608	6504	5610	6357	5838	4333	5908	6673	5731	5142	4488	3937	4146	3218	3992	2919	2750	2708	3080	
EU.Ireland	40	60	451	1970	2550	959	912	1974	4072	5154	3731	2657	1425	788	608	374	551	610	1529	2087	1292	4078	
EU.Italy	16140	15031	15657	14550	18113	17524	19523	19528	14039	16773	19611	18212	19306	24034	19461	16900	17899	16630	11455	14082	10551	11794	
EU.Latvia	660	696	58	16	3	74	452	1110	562	52	452	468	973	334	334	334	334						
EU.Lithuania	249	915	174	73	794								1307										
EU.Malta	500	561	365	542	1010	1038	825	846	966	1015	821	651	882	949	969	1195	1039	857	844	971	1011	1068	
EU.Netherlands																		435	818	686		2347	
EU.Poland			0	0	1		225																
EU.Portugal	16632	19018	18204	24161	20663	31461	26144	17780	17343	11871	11302	12398	15155	18483	19214	24440	31065	32878	26887	25524	38152	32242	
EU.Sweden	2	3	4	3	2	2	1	1	1	1	1	1											
EU.United Kingdom	9		59	501	617	210	359	50	119	368	38	24	17	5	160	36	3431	2021	1289	1813	1390	2257	

Falklands				0		0	0	0	1	2	1	0	1									
Faroe Islands	550	1189	1149	165	48	44	8	9	74	130	131											
FR.St Pierre et Miquelon										1			37	4	88	64		93	56	20	104	1
Gabon				18	331	557	2302	232	457	644	634	706	748	768	44	44	44					
Gambia	2	16	15																			
Georgia	34	25	22	10																		
Ghana	43989	42054	44175	38983	37917	34834	38105	54361	68238	84610	54292	90721	68012	66870	64077	83175	52395	68919	64808	67105	80868	70497
Grenada	1174	1364	1265	1570	846	792	871	671	1094	981	1036	1438	1241	1535	1052	1121	1141	1242	1441	1181	1027	336
Guatemala																10293	11213	9941	11127	7632	7164	5962
Guinea Bissau	3	3	3	5	5	6	6															
Guinea Ecuatorial	390	350	360	390	380	340	216	7												2189	2116	1267
Guinée Conakry					330																730	
Guyana							976	2924	3627	3716	1678	1366	1946	2590	3869	3809	2552	1590	485	602	534	191
Honduras			79			79	41	87	32	20												
Iceland			1	153	143	216	223	182	171	140	144	195	336	258	201	123	99	36	161	20	116	2
Israel	129	108	126	119	119	215	133	119	119	119	119	119	119									
Jamaica							239	275			79	85	48									
Japan	60620	55417	53498	54047	60225	58719	53107	40381	41460	34803	38329	28218	25962	31573	33843	27620	29764	37674	37094	31362	29490	26873
Korea Rep.	4268	1878	1282	837	1833	1931	2758	1924	285	299	284	180	97	404	2466	2864	2785	3678	4870	3589	3833	4487
Lebanon	130	150	150	175	200	500	500															
Liberia	256	250	286	106	79	205	319	278	925	635	927	351	352	302	106	122	118	115				
Libya	328	370	1356	1830	1922	1940	1788	1474	1794	1595	1961	2202	1308	1428	1302	1091	1347	1358	1318	1082	645	
Maroc	8941	7366	7956	5555	7939	11292	11282	17208	16284	12813	15956	13187	14427	13027	13942	13391	13707	12585	13501	14066	9621	8508
Mauritania	100	877	377	746	54	263	2479	2170	1304													
Mexico	11214	11149	13602	15005	13342	13292	17864	17903	11640	13882	10931	10353	11190	12444	10765	11123	10500	9790	9544	9946	9354	9626
Mixed flags	1080	2061	2268	3260	1766	1100	1821	1540	1674	2087	2723	2299	1540	9591	1008	8907	1008	6303	5405	6605	6819	6741

(FR+ES)	4	3	2	1	1	0	7	8	5	3	8	0	3		7		1					
Namibia					1885	1008	1061	1315	1449	2485	3535	4983	6526	6389	6579	11697	16126	7030	4834	5373	4618	7939
NEI (BIL)	18	20	38								412	799	670	409	278	49	369	503	681	404		
NEI (combined)					773	211		101	1030	1995	109	571	508	610	709							
NEI (ETRO)	25736	17448	25611	35199	31757	31162	32661	16777	17517	20256	16828	22304	19274	17740	17023	5285	1089	156				
NEI (Flag related)	9956	13545	10412	7431	13996	15837	18248	23993	34176	32088	20648	11402	706	578								
NEI (MED)	2416	3645	3236	1111	500	500	500	275	200	200												
NEI (UK.OT)					36																	
Nigeria	9	12	93	157	109	119	209															
Norway	1833	32	41	24	24	26	28	17	27	37	22	2026	1282	1516		1227	834		0		12	13
Palestina							140	161	153	160	160	62	129									
Panama	9481	26752	30398	35165	40694	40368	22376	8331	4025	3636	3692	944	1427		10928	20962	28664	34259	18726	19230	20511	20767
Philippines									1495	2498	1178	397	971	1062	2227	2048	2092	2685	2265	2209	1597	1549
Puerto Rico			106	146	150	216	194															
Rumania	150	561	157																			
Russian Federation	1032	9189	4748	3204	3668	4938	3185	5959	14516	6270	1622	1627	2283	667	174	307	780	1632	516	908	1647	3355
S. Tomé e Príncipe	1141	1082	1042	1068	1036	1071	1094	1130	1130	1138	1100	1100	1100	1100	1632	1503	1461	523	1800	1807	1854	1003
Saint Kitts and Nevis								7	16	24	24	23	13	29	17	9						
Senegal	8179	5839	7656	9628	10520	8739	8654	8249	10791	9212	9533	14893	10069	6583	9813	17556	12724	15602	12266	13526	14263	16674
Serbia & Montenegro		63	1	31	23	45	42	36	38	39	45	41										
Seychelles									0		137		182									
Sierra Leone	90	619	614	601	599	598	598				735	7097	542									
South Africa	6217	3554	6488	7245	7501	5432	5800	6841	8989	5653	4386	8560	8277	4960	6152	5520	5531	5538	4502	5902	5168	4848
St. Vincent and Grenadines	141	120	92	261	126	140	128	117	193	151	6300	10913	2136	4155	7990	1133	4135	4646	3363	3314	1788	1958

Sta. Lucia	295	345	474	521	554	445	468	484	869	639	714	633	566	649	654	654	656	378	732	550	998	441	
Suriname																							2045
Syria Rep.	127	110	156	161	156	155	270	350	417	390	370	370	330					435	328	250	263	240	
Togo	192	183	114	405	291	165	294	262	252	307	77	205	158	872	1982	1371	2476	71					
Trinidad and Tobago	6898	4515	7375	3379	3225	3013	4236	4395	4207	3159	2904	4109	5217	4336	5122	5597	3951	4325	4274	4196	4333	2619	
Tunisie	4168	4180	2735	3849	3698	3513	4357	4179	4226	5781	6568	8568	6674	3576	7998	4040	3494	3646	3690	2944	2058	1865	
Turkey	17039	21745	11816	23248	14169	13470	15220	13253	30849	20396	14506	16986	10022	9650	8499	74503	33908	10432	10244	12433	14028	16121	
U.S.A.	24018	32875	33656	35419	33376	33671	31603	32923	27480	28702	27692	27307	26007	27828	27619	24001	19353	29633	14515	21223	17677	20850	
U.S.S.R.	16331																						
UK.Bermuda	128	121	159	138	123	179	204	192	198	205	122	105	153	151	184	161	136	179	156	163	141	224	
UK.British Virgin Islands															7	4	18		3			7	
UK.Sta Helena	285	144	237	315	242	415	319	434	499	140	270	344	88	64	63	63	520	350	264	247	124	878	
UK.Turks and Caicos															0		2	2	0				
Ukraine		324	121	3	4		342	2786	2221	1150	496	444	1436	46									
Unclassified flag							50																
Uruguay	440	322	501	395	379	1163	1869	1261	1860	1315	1195	1174	1667	2254	2467	2370	1492	988	1036	2587	644	1067	
Vanuatu															1454	2303	2924	2266	2078	1385	1109	764	
Venezuela	25489	38892	32399	39867	46901	27233	31667	32060	31033	26291	22787	35793	23028	12482	11904	7414	9986	7095	5050	7103	8420	8042	
Yugoslavia Fed.	1051																						
total	711465	760927	729746	784998	797022	751327	758752	740720	757120	764056	720891	753490	649632	656763	662424	716335	616266	622218	583433	619842	649846	677793	2177

*2012 data are preliminary.

Appendix 5

ANNUAL CATCH REPORTED FOR SHARKS BY SPECIES AND AREA FROM TASK I (MT)

SpeciesGrp	Species	Stock	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
4-Sharks (major)	BSH	ATN	3028	4299	3536	9566	8084	8285	7258	29053	26510	25741	27965	21022	20037	22911	21740	22357	23215	26925	30722	35196	37178	38592	88
		ATS		8	107	10	1472	1341	2301	8409	7238	9332	11091	13378	12682	12650	14438	20642	16957	20068	23097	23459	27814	34821	
		MED					6	8	2	148	61	20	44	47	17	10	125	72	178	51	82	185	216	40	
	POR	ATN	1309	1990	2603	1909	2726	2136	1556	1833	1451	1393	1457	998	838	604	725	539	470	502	513	412	119	72	
		ATS		0	0	1	2	3	3	26	17	10	11	1	11	43	17	31	37	13	85	62	14	21	
		MED					0	0	1	0	1	0	1	1	0	0	3	2	1	0	2	1	1	0	
	SMA	ATN	785	797	953	2193	1526	3109	2019	3545	3816	2738	2568	2651	3395	3895	5174	3472	3370	4075	3559	4109	4181	3820	
		ATS	564	529	493	773	1446	1761	759	2019	1652	1355	2422	1996	1964	3426	2423	3130	2951	2834	1880	2034	2470	3237	
		MED								6	8	5	4	7	2	2	2	17	10	2	1	1	2	2	
4- Total			5686	7623	7692	14452	15262	16644	13898	45039	40754	40593	45564	40100	38945	43543	44646	50260	47188	54471	59940	65458	71995	80606	88
5-Sharks (other)	AGN	A+M															2	3	0	1	0	1	2	1	
	ALS	A+M																					0	0	
	ALV	A+M				2	7	9		30	45	1	14	25	136	30	65	104	109	158	70	148	51	41	
	API	A+M																			0	1	0	0	
	ASK	A+M																10	8	8	10	3	3	375	
	BLR	A+M																		0			0		
	BRO	A+M												1				1	2	3	8	1	51		
	BSK	A+M									0		1	200	135	319		224	8222	3680	2	0	0	2	
	BTH	A+M				20	18	39	14	185	114		43	108	114	133	121	74	83	131	108	135	50	35	
	CCA	A+M			5						1					0	43				0		0		
	CCB	A+M			1		1		22	7	5	6	3	1	0	0	19					0			
	CCE	A+M		0	19	3	8	7	1	0	0		7	0		375	138	1	0	0	11	0	0	9	
	CCG	A+M						10	5	4	6		10									1			

CCL	A+M	7	13	40	20	120	44	50	206	21	24	101	34	107	53	219	565	42	58	62	48	12	1
CCN	A+M															49							
CCO	A+M															0							
CCP	A+M	0	1	111	61	146	327	468	343	154	149	174	181	121	120	49	60	40	12	2	22	5	15
CCR	A+M								23			192	114	306			130	10		0	0		
CCS	A+M				0	3	1	0	21	23	27	91	30	9	24	0			13	42	35	47	9
CCT	A+M				0										2	0	5	0	1	52	4	3	7
CFB	A+M															56	4		6	133	90	81	0
CPL	A+M																0	0	218	274	438	271	434
CTK	A+M													1908									2
CVX	A+M														2279	232	148	127	1741	234	1262	825	692
CXX	A+M	218	204	199	112	483	289	177	98	154	22	32											
CYO	A+M												13			708	752	754	704	549	155	118	1
CYP	A+M															7	9	418	144	39	33	2	
DCA	A+M																153	97	46	74	27	4	1
DGH	A+M											13	40	10			5	309	300	222	2714	372	578
DGS	A+M				109	97	166	157	106	78	57	97	1826	1519	1321	1962	3253	2081	1372	749	1035	548	150
DGX	A+M	3	2			29	24	28	28	24	19	19	25	543	17	40	868	47	764	122	213	269	425
DGZ	A+M												564	14	58	108	0		20	19	19	70	17
DOP	A+M													379									0
DUS	A+M	2	1	64	36	270	80	52	48	54	38	48	1	2	0	0			19	2	15	0	34
ETR	A+M																			20	0	0	0
ETX	A+M																		8		1		1
FAL	A+M		13	341	139	92	127	531	343	33	140	118	42	358	476	316	74	7	232	31	70	1	157
GAG	A+M							93	100	90	89	110	66	38	141	862	1172	768	822	745	843	371	336
GAU	A+M																				0	7	0
GNC	A+M												0		2	30	2	3	4	1	3	3	
GNG	A+M																	0					
GSK	A+M				41	42	43	61	73	87	51	45	57	56	55	58	54	33	2	45	26	52	
GUP	A+M	44	8	5	11	12	18	5	5	4	4	4	95	9	0	65	143	264	312	183	27	7	2

GUQ	A+M												1			801	538	758	333	207	256	149	3
LES	A+M																						0
LMA	A+M	1	1	29	8	18	17	3	29	10	2	20	51	67	63	52	0	1	65	15	109	79	98
MSK	A+M											254								70	8		
NGB	A+M														0	53		0	0	0	0	0	
NTC	A+M																					0	
OCS	A+M	0	0	8	11	10	14	8	12	15	2	642	543	205	179	189	82	78	36	246	54	124	8
OXN	A+M																		1				
OXY	A+M																38	244	100	63	76	50	15
PTH	A+M																			7	3		
PTM	A+M																				17		
PXX	A+M					625	996	275	1011	123	489	727					15						
RHA	A+M	52	9	7	12	5	5	12		5	10	20	138	11	23	1	11	16	5		68		6
RHN	A+M																					0	0
RHT	A+M			2								22				144		1681	988		370	384	
RHZ	A+M																	0					
RSK	A+M	389	375	1034	1016	1720	998	1586	425	1084	1133	1714	2103	1669	1743	1874	5851	1454	1415	2114	517	609	1278
SBL	A+M					8	3	3	4	5	4	5	7	10	6	5	17	22	60	5	12	21	21
SCK	A+M					1	0										354	42	5	17	2	7	10
SCL	A+M															42	525	333	366	136	1928	643	411
SDP	A+M							10245	9956	11264	9786	7119	9613	7019	7900	7715	7744					0	
SDS	A+M																10	23	31	9	16	7	22
SDV	A+M												76		71	2477	2588	432	3180	3382	220	3605	3555
SHB	A+M																0	1	1	0	2	1	0
SHL	A+M																0	0				0	0
SHO	A+M					1	0	1	1	0	2	2	2	1	0	0	52	31	42	15	22	6	4
SHX	A+M	332	259	275	250	2180	2443	4949	3360	8371	8037	8073	9869	8123	9901	9591	8475	3503	3681	4554	2869	2371	71
SKH	A+M	36	23	295	310	2780	4658	3693	2889	4934	1726	265	74	13	64	4	3	2	3	40	2	17	504
SMD	A+M	398	462	386	437	690	379	596	158	100	155	255	4019	78	143	109	107	277	258	275	387	352	1178
SOR	A+M																				0	0	1

	SPJ	A+M															77								
	SPK	A+M			19	2	4	1			1						0		0	1	1	1	0		
	SPL	A+M			363	14	33	93	50	185	16	23	272	319	16	22	20	0		0	56	63	0	21	
	SPN	A+M	303	292	238	257	318	254	230	1009	889	166	690	2018	583	938	870	599	474	657	337	435	219	193	
	SPY	A+M														65	47				198			13	
	SPZ	A+M			4		3	1	42	83	48	38	40	38	44	58	40	56	360	57	6	17	9	190	
	SYC	A+M					1	1	1	1	2	1	1	1	0		5648	5792	141	5937	5422	3052	6152	5568	
	SYO	A+M																						0	
	SYR	A+M																		178	117	94	121	4	
	SYT	A+M															181	405	425	171	596	652	707	689	
	SYX	A+M															133		4	13	5	24	12	28	
	THR	A+M	62	42	60	38	65	60	98	140	102	112	172	90	32	70	47	90	36	58	109	26	69	120	
	TIG	A+M	4	7	13	11	10	20	5	5	9	1	13	10	4	4	22	1	8	65	65	69	23	426	
	TRK	A+M																0			0	1	0		
	WSH	A+M	2	3														8		177			18	92	
5- total			1853	1717	3516	2922	9797	11123	23459	20889	27870	22312	21426	32396	23638	26655	35289	41175	23768	28662	21877	18742	18986	17853	
Total			7539	9340	11208	17375	25060	27767	37357	65928	68625	62905	66990	72497	62583	70198	79935	91435	70956	83133	81817	84200	90981	98459	88

Appendix 6

CATALOGUE OF AVAILABLE SIZE INFORMATION FOR EACH SHARK SPECIES BY AREA

(A value of 1 indicates some information is available.)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
SH																		
ATN	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ATS							1	1	1	1	1	1	1	1	1	1	1	1
MED															1	1	1	1
MAK																		
ATN								1	1	1				1				1
ATS								1	1	1				1		1	1	1
POR																		
ATN									1	1	1	1	1	1	1	1	1	1
ATS															1			1
MED															1	1	1	1
SMA																		
ATN	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ATS							1		1	1	1	1	1	1	1	1	1	1
AGN																		
MED															1			
ALV																		
ATN																		1
MED															1		1	1
BTH																		
ATS													1					
CCB																		
ATS									1	1								
CCE																		
ATN										1		1			1			
CCL																		
ATN									1	1	1	1	1	1	1	1	1	1
CCP																		

ATN									1	1	1	1	1	1				
MED																		1
CCS																		
ATN									1	1								
DUS																		
ATN									1	1								
FAL																		
ATN									1	1	1	1	1	1	1	1	1	1
ATS									1	1	1	1	1	1				
GAG																		
MED																		1
OCS																		
ATN									1	1	1	1	1	1	1	1	1	1
ATS										1	1						1	1
SBL																		
MED															1	1	1	1
SDS																		
MED																	1	
SHX																		
ATN								1	1	1	1	1						
ATS									1	1	1							
SKH																		
ATN										1			1					
SMD																		
MED																	1	
SPL																		
ATS									1	1			1					
SPN																		
ATN									1	1	1	1	1	1	1	1	1	1
ATS										1								
SPZ																		
ATS									1	1			1					

SYT																		
MED																	1	
THR																		
ATN								1	1	1	1	1	1	1	1	1	1	1
TIG																		
ATN								1	1	1	1	1	1	1	1	1	1	

Appendix 7

SHARK RESEARCH AND DATA COLLECTION PROGRAM

A. INTRODUCTION

A great variety of shark species are found within the ICCAT Convention area, from coastal to oceanic species. Ninety-one species of sharks are currently present in the ICCAT databases. Biological strategies of these species are very diverse and they are highly adapted to their respective ecosystems and occupy a very high position in the trophic chain as active predators. Although diverse, the biological characteristics of these species share some general patterns that make them potentially more susceptible to overfishing.

Even though elasmobranchs are currently impacted by commercial and recreational fisheries, there is still limited information about these species life cycles, biological parameters, movement patterns and habitat utilization, and in the general impact of fisheries in their populations in the ICCAT Convention area. Moreover, the current state of knowledge on ICCAT fisheries capturing sharks is causing concerns regarding their conservation status and management due to the gaps in the available catch, effort and discard data. And it is evident that the limited quantity and quality of information available affects the provision of scientific advice to the Commission.

Numerous aspects of the biology of these species are still poorly understood or completely unknown, particularly for some regions, which contributes to increased uncertainty in quantitative and qualitative assessments. As regards information of fisheries activities of fleets capturing sharks (catch and by-catch), the reporting of Task I and Task II has improved in the recent years but this improvement is still insufficient to permit the Committee to provide quantitative advice on stock status with sufficient precision to guide fishery management toward optimal harvest levels for the majority of species. Therefore it is essential that the Committee advances in data collection and research on life history, together with describing the interactions with ICCAT fisheries, with the final objective of assessing the status of the stocks and provide adequate scientific advice for the sustainable management of elasmobranch fisheries in the ICCAT convention area. This step forward is critical for the evaluation of the efficacy of the management measures adopted by the Commission in recent years.

During the 2012 Shark Species Group meeting, the Group recommended the development of a Shark Research and Data Collection Program (SRDCP) focused on the reduction of the main sources of uncertainty in the formulation of scientific advice, including the improvement of data collection and reporting procedures. Following this recommendation the 2013 Species Group has elaborated the general guidelines of the SRDCP containing the following aspects: (a) a general background of existing fishery and biological data for the main pelagic Atlantic and Mediterranean sharks, highlighting the main gaps of knowledge; (b) the main general objectives of the Program; (c) priorities in fisheries data collection; (d) research priorities on biological information; (e) research priorities on mitigation measures; and (f) other considerations for the SRDCP.

The implementation of the SRDCP will be framed within the 2015-2020 SCRS Strategic Plan which will provide the overall framework for development and coordination of science and science-related activities needed to support provision of sound scientific advice as the centrepiece for the conservation and management of tuna and tuna-like species in the Atlantic and the Mediterranean. In the case of data poor stocks, as is the case with shark species, a precautionary approach to fisheries management could implicitly account for the unknown uncertainty by being more conservative. And any investment in research will increase the potential benefits of ICCAT fisheries while reducing the risk to the resources.

B. PELAGIC ATLANTIC AND MEDITERRANEAN SHARKS

Ninety-one species of sharks (sharks and rays) have been reported to ICCAT. Understanding the need to limit the scope of the program, the Species Group considered the species caught (sixteen species represent 95% of the total reported catches) and other species with high susceptibility for which little biological information is available. Species to consider are: (blue (*Prionace glauca*; BSH), shortfin mako (*Isurus oxyrinchus*; SMA), longfin mako (*Isurus paucus*; LMA), bigeye thresher (*Alopias superciliosus*; BTH), common thresher (*Alopias vulpinus*; ALV), oceanic whitetip (*Carcharhinus longimanus*; OCS), silky (*C. falciformis*; FAL), porbeagle (*Lamna nasus*; POR), scalloped hammerhead (*Sphyrna lewini*; SPL), smooth hammerhead (*Sphyrna zygaena*; SPZ), great hammerhead (*Sphyrna mokarran*; SPK), sandbar (*Carcharhinus plumbeus*; CCP), dusky (*Carcharhinus obscurus*; DUS), night (*Carcharhinus signatus*; CCS), narrowtooth (*Carcharhinus brachyurus*, BRO), tiger (*Galeocerdo cuvier*; TIG), crocodile (*Pseudocarcharias kamoharai*; PSK), and white (*Carcharodon carcharias*; WSH) sharks, and the pelagic stingray (*Pteroplatytrygon violacea*; PLS) and manta rays (Mobulidae, MAN).

a) Current biological knowledge

Basic life history information required to assess the status of Atlantic shark stocks is most abundant for the North Atlantic area. There is considerably less information for the Equatorial and South Atlantic areas, and very little data for the Mediterranean. Thus, more than half of all studies on age and growth dynamics, reproduction, stock identification, and movement and migration patterns were conducted in the North Atlantic, with the majority corresponding to the northwest Atlantic. Similarly, most of the studies from the South Atlantic correspond to the Southwest Atlantic**. Appendix 8-Table 1** summarizes studies conducted for all species combined in each of nine areas in the Atlantic Ocean and the Mediterranean Sea (**Appendix 7-Figure 1**). **Appendix 8-Tables 2-17** show the same information on a species-specific basis for 16 species. The WGSHK will generate similar summary tables for additional species (narrowtooth shark, white shark, crocodile shark, and manta rays). Appendix 9 lists all the references used to generate **Appendix 8-Tables 2-17**. **Appendix 8** also provides additional references that were used to generate biological profiles for shark and ray species provided by the group.

We collapsed all the life history and other parameters listed in the appendix tables into four data categories (reproduction, age and growth, stock ID, and movements and migratory patterns) most relevant for stock assessments and the ten geographical areas into four main areas (North Atlantic, South Atlantic, Equatorial Atlantic, and Mediterranean Sea) and examined that information on a species-specific basis. We used a traffic light approach to identify the degree of knowledge of those categories by general area and species, with: (1) red indicating no studies available at all; (2) yellow, 1 or 2 studies; (3) green, 3+ studies; and (4) white indicating that the species does not occur in a particular area (**Appendix 7-Table 1**). The following general conclusions can be drawn: the North Atlantic is the most data-rich area, but there are still 25% of cells with no information; the South and Equatorial Atlantic have almost identical levels of data availability, with over 75% of red cells; the Mediterranean Sea is the most data-poor region with about 90% of red cells.

Individual species were classified according to the degree of "data poorness" (i.e., the number of red cells or with no information as a proportion of the total number of cells for that species as depicted in **Appendix 7-Table 1**) and "data richness" (i.e., the number of green cells or with 3+ studies as a proportion of the total number of cells for that species as depicted in **Appendix 7-Table 1**) (**Appendix 7-Table 2**). The most data-poor species was the longfin mako, followed by the great hammerhead, dusky, and tiger sharks and the pelagic stingray, whereas the least data-poor species was by far the blue shark. In contrast, blue shark, shortfin mako, and sandbar sharks were the most data-rich species and there were no occurrences of "data richness" for longfin mako, smooth and great hammerheads, and night shark.

b) Fisheries information

Pelagic sharks form an important part of the catch of the longline fisheries that target tuna, billfish and swordfish. The ICCAT SCRS Sub-Committee on By-catches began to assess pelagic sharks in 2004. Pelagic sharks are caught by various gears in the Atlantic Ocean, Gulf of Mexico, Mediterranean Sea and the Caribbean Sea, including longline, purse seine, gillnet, handline, rod and reel, trawl, troll, and harpoon, but they are mostly caught as by-catch in the pelagic longline fisheries or as target species. There are also important recreational fisheries in some countries. Several shark species, such as blue and shortfin mako, are captured and landed in large volumes by these fleets. During the period 2001-2011 a total of 476 834 and 66 887 tonnes of blue shark and shortfin mako, respectively, were declared in the Atlantic Ocean with a maximum combined catch for both species in 2010 (71 861 tonnes) and a minimum combined catch in 2011 (33 217 tonnes) (Anonymous 2012). Others groups of pelagic sharks and rays are discarded, either due to ICCAT recommendations prohibiting retention (Recommendations 09-07, 10-07 and 10-08, 11-08), or their low market value.

Information on sharks has been submitted by CPCs since 1950, but only since 1982 has data been submitted for shark species other than BSH, SMA and POR. Data prior to 1990 is very limited for most species and so Task I data is only presented here after this date. **Appendix 4** provides annual catch reported for all sharks and other elasmobranchs in the Task I database by flag (2012 data are preliminary) while **Appendix 5** provides annual catch reported by species and area from Task I. Task II SZ data reporting has only occurred since 1994. In order to identify what data are available, this information is presented as a data catalogue in **Appendix 6**.

The first shark assessment meeting was conducted in 2004 and only in 2007 was the independent Shark Species Group formalized. Except for 2010, every year to date there has been an inter-sessional Shark Species Group meeting, with a significant presence of scientists and work on these species. **Appendix7-Figure 2** shows the evolution of the number of papers presented at the inter-sessional meetings.

c) Species stock assessments

The Shark Species Grouphas conducted stock assessments for three species to date: blue, shortfin mako, and porbeagle. Blue and shortfin mako sharks were first assessed in 2004 and subsequently in 2008, and 2012 (shortfin mako only). Porbeagle sharks were assessed cooperatively with ICES in 2009. In general, all these assessments are considered preliminary owing to limitations on quantity and quality of the information available and have focused only on Atlantic stocks; Mediterranean Sea stocks have not been assessed owing to lack of data. One important recommendation that consistently emerges from the Species Group meetings is that greater investments in monitoring and research directed at sharks are needed if improved advice on the status of these and other by-catch species is desired.

−Blue shark

Based mostly on tagging information, three separate stocks of blue shark have been assumed to exist, but only two have been assessed (North and South Atlantic) because there was no information on the Mediterranean stock. For both North and South Atlantic stocks, although results continue to be considerably uncertain, biomass is believed to be above the biomass that would support MSY and current harvest levels below F_{MSY}.

− Shortfin mako

Because shortfin makos have a distribution similar to that of blue sharks, the same two hypothetical North and South Atlantic stocks have also been considered for this species. The 2012 assessment of the status of North and South Atlantic stocks included additional time series of relative abundance and increased coverage of Task I catch data with respect to the previous stock assessments conducted in 2008 and 2004. The available CPUE series showed increasing or flat trends for the finals years of each series (since the 2008 stock assessment) for both North and South stocks, hence the indications of potential overfishing shown in the previous stock assessment diminished and the current level of catches may be considered sustainable.

For the North Atlantic stock, results of the two stock assessment model runs used indicated almost unanimously that stock abundance in 2011 was above B_{MSY} and F was below F_{MSY}. For the South Atlantic stock, all model runs indicated that the stock was not overfished and overfishing was not occurring. Although these results indicated that both the North and South Atlantic stocks are relatively healthy and the probability of overfishing is low, they also showed inconsistencies between estimated biomass trajectories and input CPUE trends, which resulted in wide confidence intervals in the estimated biomass and fishing mortality trajectories and other parameters. Particularly in the South Atlantic an increasing trend in the abundance indices since the 1970s was not consistent with the increasing catches. 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.

−Porbeagle

The Group attempted assessing the status of four porbeagle stocks (Northwest, Northeast, Southwest and Southeast) in conjunction with the ICES Working Group on Elasmobranch Fishes in 2009. In general, data for southern hemisphere porbeagle were too limited to provide a robust indication on the status of the stocks. For the Southwest, limited data indicated a decline in CPUE in the Uruguayan fleet, with models suggesting a potential decline in abundance to levels below MSY and fishing mortality rates above those producing MSY. But catch and other data were generally too limited to allow definition of sustainable harvest levels. For the Southeast, information and data were too limited to assess their status.

The northeast Atlantic stock has the longest history of commercial exploitation, but a lack of CPUE data for the peak of the fishery added considerable uncertainty in identifying current status relative to virgin biomass. Exploratory assessments indicated that current biomass (for 2008) was below B_{MSY} and that recent fishing mortality was near or above F_{MSY}. Recovery of this stock to B_{MSY} under no fishing mortality was estimated to take ca. 15-34 years. A Canadian assessment of the northwest Atlantic stock presented at the meeting indicated that biomass was depleted to well below B_{MSY}, but recent fishing mortality was below F_{MSY} and recent biomass appeared to be increasing. Additional surplus production modelling conducted at the meeting indicated a similar view of stock status, i.e., depletion to levels below B_{MSY} and current fishing mortality rates also below F_{MSY}. The Canadian assessment projected that with no fishing mortality, the stock could rebuild to B_{MSY} level in approximately 20-60 years, whereas surplus-production based projections indicated 20 years would suffice. Under the Canadian strategy of a 4% exploitation rate, the stock was expected to recover in 30 to 100+ years.

−Ecological Risk Assessment (ERA)

Ecological Risk Assessments (ERAs) were conducted by the Shark Species Group in 2008 and 2012. The 2012 ERA included 16 species (20 stocks) and was generally believed to be more robust than the 2008 ERA. The ERA consisted of a risk analysis to evaluate the biological productivity of these stocks and a susceptibility analysis to assess their propensity to capture and mortality in Atlantic pelagic longline fisheries or ICCAT longline fisheries. Three metrics were used to calculate vulnerability (Euclidean distance, a multiplicative index, and the arithmetic mean of the productivity and susceptibility ranks). The five stocks with the lowest productivity were the bigeye thresher, sandbar, longfin mako, night, and South Atlantic silky shark. The highest susceptibility values corresponded to shortfin mako, North and South Atlantic blue sharks, porbeagle, and bigeye thresher. Based on the results, the bigeye thresher, longfin and shortfin makos, porbeagle, and night sharks were the most vulnerable stocks. In contrast, North and South Atlantic scalloped hammerheads, smooth hammerhead, and North and South Atlantic pelagic stingray had the lowest vulnerabilities. The information derived from the ERA allows identification of those species that are most vulnerable to prioritize research and management measures.

It is apparent from the conclusions of the stock assessments summarized above that there is a lot of uncertainty surrounding the stock assessment results. The SRDCP will address some of the information deficits related to the biology, ecology, and fisheries of Atlantic sharks to reduce the uncertainties of stock assessments and improve the biological and ecological basis for managing and rebuilding some of the stocks. The research plan will also allow a more appropriate evaluation of the efficacy of the ICCAT management measures adopted in recent years.

d) Current management

−ICCAT Recommendations and Resolutions

There are currently 12 active ICCAT Recommendations and two active Resolutions that relate specifically to sharks (**Appendix 7-Table 3**). One additional Recommendation concerning sharks enters into force in May 2013 [Rec. 12-05].

Since 2009, four Recommendations have been adopted that prohibit the onboard retention, transhipment, and landing of some shark species that are considered to be vulnerable to overfishing: silky sharks (*C. falciformis*; [Rec. 11-08]), hammerhead sharks (family Sphyrnidae, with the exception of *S. tiburo*; [Rec. 10-08]), oceanic whitetip sharks (*C. longimanus*; [Rec. 10-07]), and bigeye thresher sharks (*A. superciliosus*; [Rec. 09-07]). CPCs are required to record releases and discards of these species, and to report these data to ICCAT. In the case of hammerheads, oceanic whitetips, and bigeye threshers, storing, selling, or offering for sale of any parts or whole carcasses is also prohibited with some exceptions for certain species. Specific exceptions to the above prohibitions apply to certain species. Recommendation 09-07 also establishes that CPCs should endeavour that vessels flying their flag do not undertake a directed fishery for any thresher sharks (*Alopias* spp.).

Several other ICCAT management measures are currently in place for sharks. CPCs are required to reduce fishing mortality levels for shortfin makos and porbeagles [Rec. 05-05; Rec. 07-06], to encourage the live release of incidentally caught sharks, particularly juveniles [Rec. 04-10], and to consider time and area closures and other measures for pelagic sharks in general [Rec. 07-06], and specifically for hammerheads [Rec. 10-08] and threshers [Rec. 09-07]. In 2013, the SCRS will assess potential management options for silky sharks [Rec. 11-08].

Shark finning is prohibited within ICCAT under Recommendation 04-10, which established that vessels should not have fins on-board weighing more than 5% of the weight of shark carcasses on-board, up to the first point of landing.

CPCs are required to collect and submit Task I and Task II data for sharks, in accordance with ICCAT data reporting procedures, and also emphasised through multiple Recommendations [Rec. 03-10; Rec. 04-10; Rec. 07-10; Rec. 10-06; Rec. 11-10]. In the case of Atlantic shortfin mako (*I. oxyrinchus*), retention of the species became conditional upon the fulfilment of Task I data reporting obligations, from 2013 onwards [Rec. 10-06]. From 2014, this condition applies more broadly to other ICCAT species, including sharks [Rec. 11-15].

In addition to Task I and Task II data reporting, CPCs are required to report on steps taken to mitigate and reduce levels of by-catch and discards [Rec. 11-10]. In 2013, CPCs will also be required to report on their compliance with shark conservation and management measures [Rec. 12-05].

Additional Recommendations call upon CPCs to undertake research, where possible, to identify shark nursery areas, and determine ways to increase the selectivity of fishing gear [Rec. 04-10; Rec. 09-07; Rec. 10-08]. CPCs are also encouraged to fully implement national plans of action for sharks [Res. 03-10], in accordance with the FAO IPOA-Sharks.

−*Other international measures*

Sharks and rays captured in association with ICCAT fisheries are subject to management and conservation measures under various international conventions and agreements. Below are examples of such measures, with the relevant species for the Shark Research Program listed in **Appendix 7-Table 4.**

a) Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona Convention). Species listed under Annex II of the Barcelona Convention SPA/BD Protocol are to be granted maximum protection. Measures include controlling/prohibiting taking, possessing, killing, commercial trading, transporting, and commercial exhibition. Sharks and rays listed under Annex III must be maintained in a favourable state of conservation, through regulation of exploitation and other appropriate measures.

b) Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention). Sharks and rays listed under CMS Appendix I are to be strictly protected, with retention prohibited, and efforts made to conserve or restore habitats, mitigate obstacles to migration, and control other threats. Signatories to a specific agreement known as the Memorandum of Understanding on the Conservation of Migratory Sharks have committed to implementing measures to conserve and sustainably manage migratory sharks and their habitat, including measures for fisheries research and management,

c) Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Sharks and rays listed under Appendix II of CITES are subject to controls on their international trade. Export permits or re-export certificates are required, and may be issued only if specimens are legally obtained and if exports will not be detrimental to the survival of the species. For specimens introduced from the sea, export permits are issued by state into which the specimens are being brought.

d) General Fisheries Commission for the Mediterranean (GFCM). Recommendation GFCM/36/2012/3 prohibits shark finning, and bans the retention, transhipment, landing, transfer, storage, sale, or display for sale of species listed under Annex II of the Barcelona Convention. The Recommendation also requires the recording and reporting of data about fishing activities, catches, by-catch, release, and discards for species listed under Annex II or Annex III of the Barcelona Convention.

e) Past research recommendations by the Shark Species Group

Over time, there has been a clear evolution in the scope of shark research recommendations put forward by the Sub-Committee on By-catch (1995-2006), and later by the Species Group (2007-present). Early recommendations focused mainly on the need for better data on catches (particularly incidental catches) and landings, including data on discards. This need has been emphasized repeatedly, with similar recommendations made every year. Since 1997, the Group has also regularly highlighted the need for improved Task II data for sharks.

Since the first ICCAT shark stock assessments in 2004, recommendations have also been made for research to improve the quality of output from these assessments. The group has noted the need for increased research into stock structure, life histories, population movements, and dynamics of all ICCAT fisheries that catch sharks, particularly to resolve inconsistent signals among CPUE series. The need for estimating historical catches and size frequencies has also been highlighted, as well as further analyses to assess the sensitivity of assessment outcomes to assumptions. The use of alternative methods for providing management advice has also been recommended, such as ERAs for vulnerable species for which fewer data are available. Since 2006, the Group has called for research to improve the data needed for ERAs. Following the shortfin mako assessment in 2012, the Group also recommended the development and evaluation of hierarchical models that can make use of information from multiple stocks or fleets.

The Group has also recommended research to investigate the potential benefits of fishing gear modifications to reduce by-catch, measures for reducing discard mortality, restrictions on fishing areas and times, and minimum/maximum sizes for retention.

Broadly, the Group has noted that in order to provide the advice requested of them, and particularly to provide quantitative advice on optimal harvest levels, there is a need for the Commission to make a larger research investment into improved data and facilitating better participation by national scientists and other experts in assessments.

C) SHARK RESEARCH PROGRAM

General objectives

Although efforts are being made in recent years to improve shark data collection and research, the current knowledge on many fisheries and basic biology is still limited. These gaps in knowledge are responsible for much of the uncertainty in stock assessments, and have caused constraints to the provision of scientific advice. Therefore, the present proposal for a Shark Research and Data Collection Program (SRDCP) represents a further step to align with ICCAT Res. 11-17 on Best Available Science, to fill knowledge gaps on fisheries and biology issues by improving data collection, cooperation and capacity building.

In order to achieve these goals, the SRDCP aims to provide guidance to SCRS researchers, by prioritizing those issues related to data collection and research lines on species biology/ecology, fisheries and mitigation measures. Finally, by promoting coordination between SCRS researchers, the SRDCP aims to improve the quality and reduce the uncertainty of the scientific advice on sharks provided to the Commission, and to better assess the impact of management measures on these species.

1. Fisheries data collection

1.1 Fleet and gear characterisation

Accurate information about the gear characteristics and specifications at which species are captured is fundamental to understanding the impacts of fisheries. The fishing power, selectivity and catchability of fishing gear respond to several variables that must be analysed to understand the evolution of catches. Here are some of these variables:

− *Longline*

Gear-fish interactions:
- Time-depth-temperature at depth of hooks (TDRs)
- Positions of fish regarding other neighbouring fish caught in the longline
- Fighting time of fish, once hooked (e.g., hook timers)

Gear data:
- Number of baskets along mainline.
- Number of hooks per basket
- Type and size of hook
- Presence or absence of lightsticks (also, color differences?)
- Location (Latitude and Longitude) of the longline set
- Time of set and haulback (e.g., daylight vs. nighttime)
- Use of lead weights on gangions
- Type of gangion

Bait type:
- Live or dead bait
- Species (e.g., squid vs. mackerel)

−Purse seine

The Minimum data requirements for PS were defined during the KOBE III By-catch Joint Technical Working Group Harmonisation of Purse-seine Data Collected by Tuna-RFMOs Observer Programmes. The main items are the following: vessel identification, vessel trip information, observer information, crew information, vessel and gear attributes, daily activities, school and set information, catch information, length information, species of special interest:

- Vessel and gear characteristics
- Fishing strategy
- Gear-fish interactions

−Gillnet

- Locations (Latitude and Longitude) and time at setting and hauling for each set
- Gillnet configuration

−Pelagic trawlers

- Locations (Latitude and Longitude) and time at setting and hauling for each tow
- Towing speed
- Characteristics of the net

−Recreational fisheries

- Gear type and characteristics
- Bait
- Chumming

1.2 Fleet dynamics

As sharks are mostly caught as by-catch in ICCAT fisheries, a change in the dynamics of the fleets targeting those resources might have major implications on shark catches. Such changes are related to different issues, such as technological development (e.g., change from traditional longline to semi-automatic Florida style gear; use of high-tech FADs on the purse seine fisheries); shifts on target species as a result of their abundance; changes in the markets, management or piracy (e.g., some fleets change between deep setting for tunas and shallow setting for swordfish throughout the year, and consequently might change the fishing gear characteristics – hook style, bait type, gangion material, etc., and fishing regime – from day to night setting; while the purse seine fleets might impact differently sharks, when changing from free schools to FADs fishing); fleet movement between fishing areas throughout the year (e.g. due to the migratory behaviour of the target species, communication between skippers related with the occurrence of higher catches, exploitation costs related to bait or fuel prices, piracy, etc.).

1.3 Data necessary for assessment and management advice

- Catch (landings + discards)

- Effort
- Catch per effort (indices of relative abundance)
- Gear selectivity (if not fitted within the model)
- Size information

Catches: Catch inputs for stock assessment can vary from highly aggregated information (e.g., catch of "sharks") to different levels of disaggregation and detail, ranging from nominal catches by species to species-specific catch series by gear, geographical area, and size.

Dead discards: Estimation of dead discards can also be based on expansion to total numbers from a low number of observations to expansion to total numbers based on a high degree of observer coverage of the fleet and "fine" level of stratification (season or month, small areas of observation). Typically logbook and observer data are used to generate estimates of dead discards.

Effort: Effort series by gear (e.g., number of hooks) and geographical area can also be used in several assessment methodologies.

Indices of relative abundance: Indices of relative abundance can also vary from simple, nominal CPUE time series of short duration (few years) and with little contrast (one-way ticket) to (preferably fishery-independent) CPUE time series standardized through different statistical techniques (GLM, GLMM, GAM). Ideally these indices should be of long duration and wide geographical coverage and have good contrast (increasing and decreasing trend resulting from various levels of fishing).

Selectivity: When sufficient length or age information is not available to estimate selectivity within the model, selectivity curves for the different abundance indices have to be generated based on auxiliary information externally to the model and then imputed as functional forms in age-structured models.

Size information: No catch-at-age is available for sharks caught in ICCAT fisheries, but limited length-frequency information is available for some species.

2. Data poor assessment models

Because of the lack of total catch information in some cases and some key biological information in other cases, traditional stock assessment models cannot be consistently applied to all species. There is a need for development of innovative methods of assessment of shark resources, particularly methods applicable to data-poor situations. Fortunately, a number of such methods that require different types and amounts of data have recently been developed (**Appendix 7-Table 5**).

2.1 Ecological Risk Assessment (ERA)

Ecological Risk Assessments (ERAs), also known as Productivity and Susceptibility Analyses (PSAs), were originally developed to assess the vulnerability of stocks of species caught as by-catch in the Australian prawn fishery (Stobutzki et al. 2001a, b; Milton 2001), and although they only appeared about a little over a decade ago they have now been used rather extensively to assess vulnerability to fishing of elasmobranch fishes and other marine taxa. Ecological risk assessments are in fact a family of models that can range from purely qualitative analyses in their simplest form to more quantitative analyses, depending on data availability (Walker 2005b; Hobday et al. 2007). Most PSAs have been semi-quantitative approaches where the vulnerability of a stock to fishing is expressed as a function of its productivity, or capacity to recover after it has been depleted, and its susceptibility, or propensity to capture and mortality from fishing (Stobutzki et al. 2001a). Each of these two components, productivity and susceptibility, are in turn defined by a number of attributes which are given a score on a predetermined scale. Scores are then typically averaged for each index and displayed graphically on an X-Y plot (PSA plot). Additionally, vulnerability can be computed, for example, as the Euclidean distance of the productivity and susceptibility scores on the PSA plot. Applications to elasmobranch fishes have ranged from semi-quantitative PSAs (Stobutzki et al. 2002; Griffiths et al. 2006; Rosenberg et al. 2007; Patrick et al. 2010) to different degrees of quantitative analyses where the productivity component was estimated directly as r (maximum rate of population growth) in stochastic demographic models (Braccini et al. 2006; Zhou and Griffiths 2008; Simpfendorfer et al. 2008; Cortés et al. 2010; Tovar-Avila et al. 2010). The main advantages of PSAs can be summarized as: (1) being a practical tool to evaluate the vulnerability of a stock to becoming overfished based on its biological characteristics and susceptibility to the fishery or fisheries exploiting it, (2) they can be used to help management bodies identify which stocks are more vulnerable to overfishing so that they can monitor and adjust their management measures to protect the viability of these stocks, and (3) they can also be used to prioritize research efforts for species that are very susceptible but for which biological information is too sparse.

2.2 Length-based models: SEINE (Survival Estimation in Non-Equilibrium Situations)

One of the simplest data-poor methods is based on the premise that fishing pressure proportionally removes larger and older fish from the population and that increases (or decreases) in mortality rates are reflected by decreases (or increases) in mean length. These approaches generally have minimal data requirements and are therefore appealing for use in many elasmobranchs, but they have stringent assumptions which can sometimes be difficult to meet in long-lived species. The SEINE method (Gedamke and Hoenig 2006) is a reformulation of the widely used Beverton-Holt (1956, 1957) method, which only requires von Bertalanffy growth parameters, a size at full vulnerability, and mean length of fully vulnerable animals, and relaxes the assumptions that growth, recruitment, and mortality have been in equilibrium for a time period equal to at least the maximum age of the species of the Beverton-Holt method.

This non-equilibrium formulation allows for trends to be inspected through a time series analysis of mean length data and provides the ability to estimate multiple mortality rates and the year(s) in which mortality changed. However, application of length-based approaches to relatively long-lived elasmobranchs should be done cautiously and model assumptions should be carefully considered prior to application an when interpreting results and producing management advice.

2.3 Age-structured Demographic Models (Life Tables/Euler-Lotka equation; Leslie Matrices) and Elasticity Analysis

Demographic analyses of elasmobranch populations can be undertaken as (1) life tables based on a discrete implementation of the Euler-Lotka equation or (2) age-based Leslie matrix population models. These models are typically based on deterministic, density-independent population growth theory, whereby populations grow at an exponential rate r and converge to a stable age distribution. Data requirements include maximum age, survival from natural mortality, age-specific fecundity (the number of offspring produced per breeding female of age x), sex ratio at birth, frequency of parturition, proportion of mature or breeding females at age, and some associated information such as growth function parameters and a length-mass relationship. Elasticity analysis is an extension of age-based Leslie matrices or stage-based models that allows one to identify which vital rates influence population growth rate the most and thus which life stages (or ages) are more important for population growth.

2.4 Analytical Reference Points

Methodology to analytically calculate reference points without an assessment model was first introduced in Brooks et al. (2006) and Brooks and Powers (2007), where it was demonstrated that reference points corresponding to maximum excess recruitment (MER; Goodyear 1980) could be derived simply from biological parameters and an assumption about the form of the stock recruit function. Brooks et al. (2010) re-derived those analytical solutions to calculate the Spawning Potential Ratio (SPR) at MER, then demonstrated how stock status could be determined given auxiliary information, and illustrated the method for 11 shark stocks. Although only vital rates are necessary to derive these analytical reference points, an estimate of current biomass or a time series of relative abundance is needed to evaluate the overfished criterion. Although this methodology has to be further tested, initial results are encouraging. Brooks et al. (2010) compared results for overfished status from stock assessments with predictions from the analytical method and found total agreement for the nine stocks of sharks for which an estimate derived from a more data-rich stock assessment method was available.

2.5 DCAC (Depletion-Corrected Average Catch)

The DCAC is based on the potential yield formula of Alverson and Pereyra (1969) and Gulland (1970) where $B_{MSY} = 0.5B_0$, $F_{MSY} = M$, and $Y_{pot} = 0.5M_{B0}$. If abundance is reduced from B_0 to B_{MSY}, a "windfall" harvest can be calculated as $W = 0.5_{B0}$ and Y_{pot} can be considered a sustainable annual yield. The windfall ratio expresses the magnitude of the windfall harvest relative to a single year of potential yield. This windfall ratio forms the basis for a depletion correction of average catch. For a catch series of n years, the total cumulative catch consists of n years of sustainable production plus a windfall equivalent to W/Y_{pot} years of potential yield.

The DCAC ultimately provides an estimate of the yield that could have been sustained during a period of n years.

2.6 AIM (An Index Method)

The AIM (An Index Method, NOAA Fisheries Toolbox 2011) model is an analytical framework for interpreting abundance trends, which relates survey trends to fishery removals. The AIM model estimates a relative fishing mortality rate from a ratio of catch to a smoothed index of abundance. The second calculated quantity is the replacement ratio, which is obtained by taking the abundance index values divided by a moving average of the abundance index. The idea behind the replacement ratio is that values greater than one indicate that the population increased while values less than one suggest negative population growth. A regression of the natural logarithm of the replacement ratio against the natural logarithm of relative F can be solved for the relative F value that produces ln(replacement ratio)=0, i.e. stable population growth. The F producing stable growth can be considered as an F reference point, against which the relative F time series can be compared to evaluate overfishing. Implicit in this approach is that the catch and abundance index have the same selectivity. This methodology fundamentally assumes linear (density-independent) population growth. Furthermore, there is no age structure, thus biological parameters that have strong age trends or long time lags in population dynamics owing to late, protracted maturation and generation time are ignored.

2.7 Surplus Production Models

Biomass dynamic models, also known as (surplus) production models, have been and still are fairly widely used in the assessment of teleost stocks. Use of these models in assessment of elasmobranch stocks, however, has been criticized because of violation of the underlying assumptions, notably the presupposition that r responds immediately to changes in stock density and that it is independent of the age structure of the stock (Holden 1977; Walker 1998). In general, production models trade biological realism for mathematical simplicity, combining growth, recruitment, and mortality into one single “surplus production” term. However, they are useful in situations where only catch and effort data on the stock are available and for practical stock assessments because they are easy to implement and provide management parameters, such as maximum sustainable yield (MSY) and virgin biomass (Meyer and Millar 1999a).

The biomass dynamic models used in the last decade have characterized uncertainty through the use of either Bayesian inference or classical frequentist methods. Typically, in stock assessment work two stochastic components must be taken into consideration (Hilborn and Mangel 1997): natural variability affecting the annual change in population biomass (also known as process error) and uncertainty in the observed indices of relative abundance owing to sampling and measurement error (observation error). Bayesian surplus production models have been used by a number of researchers to assess the status of shark populations. The Bayesian Surplus Production model (BSP; McAllister et al. 2001; McAllister and Babcock 2006), a Schaefer production model that uses the SIR (Sampling Importance Resampling) algorithm for numerical integration, has now been used in numerous assessments of shark stocks in the Atlantic Ocean (McAllister et al. 2001, 2008; Cortés 2002b; Cortés et al. 2002, 2006 to cite a few). The BSP considers observation error only, which is integrated along with q (catchability coefficient) from the joint posterior distribution using the analytical approach described by Walters and Ludwig (1994).

Both process and observation errors can be incorporated when using a dynamic state-space modelling framework of time series (Meyer and Millar 1999a). This approach relates observed states (CPUE observations) to unobserved states (biomasses) through a stochastic model. State-space models allow for stochasticity in population dynamics because they treat the annual biomasses as unknown states, which are a function of previous states, other unknown model parameters, and explanatory variables (e.g., catch). The observed states are in turn linked to the biomasses in a way that includes observation error by specifying the distribution of each observed CPUE index given the biomass of the stock in that year. A Bayesian approach to state-space modeling has only been applied fairly recently to fisheries (Meyer and Millar 1999a). One advantage of using a Bayesian approach is that it allows fitting nonlinear and highly parameterized models that are more likely to capture the complex dynamics of natural populations. Meyer and Millar (1999a, b) advocated the use of the Gibbs sampler, a special Markov chain Monte Carlo (MCMC) method, to compute posterior distributions in nonlinear state-space models. This Bayesian nonlinear state-space surplus production model has been adapted and applied in several assessments of Atlantic shark stocks (Cortés et al. 2002, 2006). Additionally, Jiao et al. (2009) compared hierarchical and non-hierarchical Bayesian production models applied to a complex of three hammerhead species (*Sphyrna lewini, S. mokarran*, and *S. zygaena*) to address the problem of assessing fish complexes for which there are no species-specific data. They found that the fit of the Bayesian hierarchical models was better than that of the traditional Bayesian models possibly due to the addition of multilevel prior distributions, among which was a multilevel prior of r intended to capture the variability of intrinsic rates of increase across species and populations of the hammerhead shark complex.

3. Recovery of historical data

Recently, The ICCAT Small Tunas Research Program was adopted by the SCRS and the first phase of that research program is to recover historical SMT datasets, available in various scientific institutions of ICCAT CPCs and currently not available in the ICCAT database. The data recovery includes:

- Task I nominal catch series by species, gear, area, flag and year
- Task II catch and effort statistics by species, month, 1ºx1º square or area
- Task II size (and/or weight) samples by species, gear, time strata and area

In order to address this issue, a call for tenders was drafted with the specific objective of recovering historical time series from all fisheries in the ICCAT Convention area, either fisheries targeting small tunas or those catching them as by-catch. A similar procedure was followed in the context of the special research programme of Bluefin tuna (GBYP). These processes should be repeated for recovering historical datasets on shark species. The group can build on the experience obtained during those exercises in order to streamline and facilitate this important initiative.

4. Trade data

Trade data are a potentially useful complementary source of information for the management and assessment of shark species caught in association with ICCAT fisheries. Identifying trends and changes in the trade of shark products (e.g., trade routes, volumes, values) may in turn help our understanding of the dynamics of fisheries capturing sharks. In the specific context of shark assessments, historical and current trade data may be used to identify potential gaps in reported catches and to develop proxy indices for estimating historical catches.

Trade data have been used in one ICCAT shark assessment meeting. At the 2004 assessment of blue shark and shortfin mako, the group discussed an analysis of the Hong Kong shark fin trade that provided rough annual estimates of the capture of sharks in the Atlantic. In view of these estimates and the very incomplete nature of catch reporting to the Secretariat for blue sharks and shortfin makos, the assessment group explored the use of an alternative approach for estimating catch histories, based on the ratio of shark to tuna landings. Following the 2004 assessments, the group recommended that broader use be made of trade statistics, particularly for extending historical time series of catch estimates.

5. Observer Programmes

As stated by FAO (1995) in order to have a responsible and sustainable management of fisheries, fishing countries need to assure the timely, complete and reliable collection of fishery statistics on catch and fishing effort. Such data needs to be updated regularly and submitted to the relevant RFMO to be used in the fishery assessment and for the provision of the scientific advice. The FAO Code of Conduct for Responsible Fisheries also states that fishing countries should implement effective fisheries monitoring, control, surveillance and law enforcement measures including, where appropriate, observer programmes, in order to collect basic fishery statistics. In the case of pelagic sharks, which are often caught as a by-catch (and discarded) within ICCAT fisheries, it is essential to implement Observer Programmes. In fact, whether fisheries management objectives include conservation issues, knowledge of shark fishing mortality is essential for any management framework, and observer programmes are the most reliable source of information for these species. Moreover, observer programmes are the only available method to accurately collect data on a number of important issues, such as: individual at-haulback mortality, fate and status when discarded; samples for less common or rare species; etc.

ICCAT recommendations regarding the observer programs (GFCM adopts ICCAT resolutions in relation to sharks in the Mediterranean Sea, although the adoption by GFCM is usually carried out with a time lag) and current coverage are presented in **Appendix 7-Table 6**.

When designing an observer program the level of coverage required is a key element. It depends on the objectives of the observer program (e.g. desired precision levels for by-catch rates, and the variability of the by-catch events, which depend on specific taxa and fishery combinations). In the case of the tuna fisheries impacting shark, the observer program should collect data aiming at the: (i) improvement of catch data collection for population assessments; (ii) estimation of by-catch and discards levels; (iii) collection of basic biological data; and (iv) gear and fisheries strategy.

In most cases by-catch estimates are highly imprecise for observer coverage below 5-10%, therefore observer coverage rates above those levels will be required. By-catch estimates will remain highly imprecise for low occurrence species, for which a much higher level of coverage may be warranted.

In general, the species composition of the sharks captures is similar amongst the different tuna fisheries in the convention area. However, the different fisheries may impact differently the shark species: Longline (*sensu lato*) impacts mainly blueshark (BSH) and shortfin mako (SMA), and to a minor extent hammerhead, threshers, silky and oceanic whitetip sharks; Gillnet (*sensu lato*) are impacting mainly silky (FAL), thresher (THR), oceanic whitetip (OCS), and shortfin mako (SMA) sharks; Purse seine are impacting mostly oceanic whitetip (OCS) and silky (FAL) sharks.

Industrial fleets are amongst those that mostly impact shark stocks within the scope of tuna fisheries. The implementation of scientific observer programmes designed to improve shark data collection should focus on the two major fleets: pelagic longliners, namely those targeting swordfish or tropical tunas; and purse-seiners targeting tropical tunas. Although artisanal fleets may have considerable impact over some protected species, the small size of the vessels is an important constraint for an observer program. Therefore, other data collection schemes should be implemented for these fisheries.

6. Biological information

6.1 Stock structure

To better understand the impact of fishing activities on elasmobranch populations and promote a more efficient management of their fisheries, it is first necessary to know whether elasmobranchs are migrating between regions that can be undergoing different types and levels of fishing activity. However, and even though those issues are of great importance, there is still very limited information on the stock structure of most pelagic elasmobranchs at an ocean wide level, and therefore promoting those types of studies is of utmost importance. Using incorrect assumptions about the stock structure and movements can lead to biased conclusions about the level of fishing that is sustainable in a given region, and thus information about these processes should be incorporated into stock assessments.

Different approaches can be used in identifying and classifying stocks. However, given the difficulties and possible limitations of each of the techniques, and in order to provide the most accurate identification of stocks possible, scientific knowledge should gather different sources of information and consequently, a multidisciplinary approach using a combination of techniques is recommended.

6.1.1 Genetic studies

Studying the genetic structure of a population can be a very useful tool for helping to determine whether there is migration between geographic areas. When the individuals of a species segregate into several reproductive stocks, the allele frequencies at neutral genetic markers diverge such that the variance in gene frequencies reflects the magnitude of reproductive isolation among these stocks (Heist, 2004). However, there also difficulties with the population genetics studies in the open ocean species as, for example, a small number of migrants per generation may be sufficient to render two populations genetically indistinguishable (Camhi et al., 2008).

Several types of molecular markers have been used to estimate the stock structure in marine populations in the last decades (Utter, 1991). The choice of the technique to use depends on the research team capabilities, preferences, type of equipment available and quality of tissue available for analysis. In general, the molecular markers that have been used include allozymes, mitochondrial DNA and microsatellites, even though other techniques are also available. Each technique has its own distinct strengths and weaknesses, and reviews of those are presented in Heist (1999, 2004, 2008). A final consideration regarding genetic studies on pelagic sharks is that these species may undergo large scale seasonal migrations, and may segregate by sex and/or maturity stage. As such, careful planning of where and when to sample and collect tissues is very important.

6.1.2 Biometric analysis

The biometric analysis, including meristic and morphometric characters, provides a powerful complement to genetic stock identification approaches. Meristic characters generally include serially repeated measurements such as counts of vertebrae. Experimental work has shown that environmental factors such as temperature, salinity and oxygen tension can modify the expression of the genes responsible for meristic characters. In certain studies meristics have provided evidence of stock structure that is concordant with genetic information.

6.1.3 Population parameters

Typical population parameters that are useful for population dynamics studies include age, growth and reproductive parameters that can then be used to estimate mortalities and intrinsic population growth rates. Different populations from one same species may show different biological parameters, and those should be taken into account during population dynamics studies and stock assessments. Further, as different populations from the same species may be subjected, through time, to different fishing pressures and mortalities, density-dependent mechanisms may also produce changes in the biological parameters and affect the dynamics of the populations.

Those differences may be observed through comparative studies on the biological parameters across several populations of one species, and may serve as verifications from other stock structure methodologies. Some studies have used this approach for sharks, trying to determine possible stock separations based on life history parameters, but most have been carried out in coastal sharks. Examples are the works by Carlson and Parsons (1997), Yamaguchi et al. (2000) and Coelho et al. (2010).

These comparative techniques have not commonly been applied to pelagic sharks, even though their importance is recognized and for stock assessment purposes (including ecological risk assessments) different biological parameters are used for each of the stocks (North Atlantic, South Atlantic and Mediterranean). In terms of methodologies, details on data collection and analysis for using such parameters for eventual comparison between regions are specified in Section 6.2 (life history information) of this research plan. This component of the plan may help to separate stocks, and may produce important biological parameters for using for each of the stocks.

6.1.4 Tagging

The conventional approach of mark-recapture can be used. Recoveries through time provide ranges and patterns of movement, which can assist in inferring the degree of mixing among stocks. However, the success of such techniques depends largely on tagging and recapture efforts, and such studies are generally constrained by higher costs. The use of satellite tagging technology is encouraged as this type of tag transmits data on animal location without animal recapture, making them completely fishery-independent. Furthermore, these tags provide locations on intermediate positions and not only two observations in space-time (capture and terminal recapture) as with the conventional mark-recapture approach. A shortcoming of some types of satellite tags (e.g., pop-up tags) is that light-based location estimates can have substantial errors, and this can limit their advantage over conventional tags. These tags are electrically powered (by batteries, solar power, kinetic energy, etc.) leading to shorter times at-liberty on average than conventional tags.

6.1.5 Parasites (biological tags)

Information on geographic distribution patterns, migrations and feeding habits of fish can be obtained through the study of parasites. The investigation of hosts and their parasites has improved the knowledge about the spatial distribution of the host's population (Abaunza et al., 2008). Lester and MacKenzie (2009) provide a guideline on how to use parasites as biological tags in fish population studies. In the Atlantic, for example, Garcia (2011) used parasites, as a complement to other techniques, to discriminate between stocks of swordfish (*Xiphias gladius*).

6.2 Life-history information

6.2.1 Age and growth

An understanding of the age structure and growth dynamics of a population is crucial for the application of biologically realistic stock assessment models and, ultimately, for effective conservation and management. Information on age and growth is also often used to estimate natural mortality or total mortality, which are crucial components of stock assessment models, and in the calculation of important population and demographic parameters, such as population growth rates and generation times. Successful fisheries management thus requires precise and accurate age information to make informed decisions, because inaccurate age estimates can lead to serious errors in stock assessments and possibly to overexploitation (Campana 2001). Despite their importance, published age and growth studies of sharks are still scarce and only a few have provided validation of the ageing method used (i.e., ratification through a direct method, such as injection of a chemical marker, that the growth bands on the structure being aged are deposited with a given periodicity, generally annually).

Because sharks lack hard parts, such as large scales and otoliths, information on age and growth in sharks is usually derived from counts of opaque and translucent bands on vertebral centra or spines. Processing of samples is laborious and requires many hours in the laboratory. Preparation of vertebrae for ageing involves several steps. To enhance visibility of growth bands, vertebrae can be cut in half sagitally or sliced at varying thicknesses. Depending on the species, sections can be stained with various chemicals to enhance the growth bands (e.g. crystal violet, alizarin red). Opaque and translucent bands are counted by placing a section under a dissecting microscope interfaced with an image analysis system. Generally, two biologists read samples blindly (i.e., no knowledge of length or sex of specimen) and age estimates for which the readers agree are re-read using digitally stored images.

Historically, the von Bertalanffy growth model (von Bertalanffy, 1938) has been the model applied to most elasmobranchs (Cailliet and Goldman, 2004), but alternative growth models have also been applied in recent years (Carlson and Baremore 2005; Neer et al. 2005, Coelho and Erzini, 2007, 2008). Many of these models still lack age validation and suffer from small sample sizes for some age groups. To resolve these issues, collaborations among scientists from several ICCAT CPCs and institutions are encouraged to develop more complete models.

Another promising means of age validation for long-lived species is bomb radiocarbon dating. This technique focuses on the well-documented increase in radiocarbon (C^{14}) in the world's oceans, caused by the atmospheric testing of atomic bombs in the 1960s (Druffel and Linick 1978). The increase in atmospheric and oceanic radiocarbon was found to be synchronous with marine organisms containing carbonate, such as bivalves, corals, and fish bones (Kalish 1993, Weidman and Jones 1993, Campana 1997). This synchrony allows the period of increase to be used as a dated marker in calcified structures exhibiting growth bands, such as teleost otoliths and shark vertebrae (Campana et al. 2002a). This technique has been successfully used to validate the age estimation of the porbeagle shark (*Lamna nasus*), and has met with some success for a single shortfin mako (*Isurus oxyrinchus*, Campana et al. 2002b), and two great hammerheads (S*phyrna mokarran*, Passerotti et al. 2010). Some previous work by Kerr at al. (2004) on the white shark (*Carcharodon carcharias*) also showed promise. This technique could further aid in the age validation and population assessment of many long-lived elasmobranch species. Funding would enable collaboration with colleagues that are experts in the application of this specific technique.

6.2.2 Reproductive biology

Knowledge on the reproductive biology is essential for stock assessment models that attempt to accurately capture the biology of a species, such as age- and sex-structured models. Minimum size limits, for example, are usually set after consideration of the size at which most individuals become sexually mature. Female sharks tend to mature at a later age and larger size and reach a larger size and older age than their male counterparts. This pattern is reflected in the respective growth curves of each sex, and needs to be taken into account in stock assessments. Length of the reproductive cycle (specifically, how often females reproduce), the number of offspring per litter for females of different sizes or ages, and the proportion of mature and pregnant females at each size or length, are all needed to calculate fecundity, which is one of the main inputs to any demographic analysis or stock assessment. Incorrect estimation of any of these reproductive parameters will affect estimates of fecundity, biasing ensuing demographic analyses and stock assessments.

In elasmobranch fishes reproductive patterns are commonly characterized by late sexual maturity, reproduction every one, two or even three years, long gestation periods, reduced fecundity, and well-developed, highly mobile offspring with relatively low natural mortality. But information on the reproductive biology of many species, even some commonly exploited, is still fragmentary. Funding would allow us to conduct studies on the reproductive biology of several important species in Atlantic waters, with the ultimate goal of providing information for stock assessments. Funds are needed to increase sampling efforts and expand the number of species currently being examined.

6.2.3 Mortality

There are few direct estimates of instantaneous natural mortality rate (M) or instantaneous total mortality rate (Z) for elasmobranchs based on mark-recapture techniques or catch curves. Direct estimates of natural mortality have been obtained in mark-depletion experiments for juvenile lemon sharks only and estimates of M derived from Z or Z directly, in mark-recapture studies for a few species. The majority of population modelling studies for elasmobranchs has relied, however, on indirect estimates of mortality obtained through methods based on predictive equations of life history traits. Most of these methods make use of parameters estimated from the von Bertalanffy growth (VBG) equation, including those of Pauly (1980), Hoenig (1983), Chen and Watanabe (1989), and Jensen (1996) (see Roff 1992; Cortés 1998, 1999; Simpfendorfer, 1999a, 2005 for reviews of these methods) amongst others. These equations do not yield age-specific estimates of natural mortality, except for the Chen and Watanabe (1989) method. In contrast, methods proposed by Peterson and Wroblewski (1984) and Lorenzen (1996, 2000) allow estimation of size-specific natural mortality, which can then be transformed into age-specific estimates through the VBG function. The use of U-shaped curves (Walker 1998) has also been advocated to account for the fact that individuals must die off in their terminal year of life. A modified U-shape curve, the so-called "bathtub" curve (Chen and Watanabe 1989; Siegfried 2006) has been proposed for elasmobranch fishes because the initial decrease in natural mortality (M) at young ages is followed by a flatter profile, and M only increases sharply towards the oldest ages, possibly due to senescence.

6.3 Ecosystem-based approaches

6.3.1 Shark Trophic Studies, Foraging Ecology and Bioenergetics

Fisheries management bodies (FMBs) have, in recent years, stressed the need for an ecosystem approach to management. The current work carried out so far for sharks gives little consideration to ecosystem function because there are few quantitative species-specific data on competition, predator-prey interactions, and habitat requirements of sharks. To fully understand how sharks utilize ecosystems and interact with other species, more studies on diet, habitat use, and ecosystem modelling, are needed.

To fully evaluate the impacts of sharks within the ecosystem, diet data incorporating published metabolic rate information (see review in Carlson et al. 2004) and excretion and egestion information (see review in Wetherbee and Cortés 2004) can be used to construct bioenergetic models for shark populations. Bioenergetic models can be used to assess shark predatory effects (i.e., consumption rates) on prey abundance, and the consequences of the reduction in predation rates through an increase in fishing mortality on shark populations. An example is the bioenergetics model constructed for cownose ray *Rhinoptera bonasus*, which was used to determine the relative effects of variation in different environmental variables on growth (Neer et al. 2004). Individual growth from the bioenergetics model can also be used for developing matrix projection models, which are designed to simulate the long-term population dynamics of, and examine how, various harvesting strategies would affect long-term stock status.

Although it is commonly accepted that sharks are apex predators in many marine communities (Wetherbee and Cortés 2004), there are very few estimates of trophic levels (Cortés 1999). An alternative to estimating trophic level based on stomach contents is the use of stable isotopes of nitrogen and carbon from tissues of marine consumers. This approach is being increasingly used to estimate the trophic position of sharks in marine food webs, and potentially provides a viable alternative to diet-based estimation of trophic levels.

6.3.2 Habitat use

Quantifying fish habitat use is important for management of fish populations and conservation planning. Habitat use studies are used to document habitat quality and its specificity to life history stages. Knowledge of movement patterns (i.e. use of space and activity patterns) is essential in understanding the behaviour of a species as well as defining essential habitat for that animal. An animal's movement patterns can have profound effects on its energetics, reproductive fitness, and survival (Matthews, 1990).

Unlike animals in coastal marine environments, which may be able to utilize more definitive landmarks for navigation (e.g. bathymetry), pelagic predators have to rely on cues, which may be more difficult to define (e.g., geomagnetic gradients). Despite these limitations, there can still be predictable locations of abundant prey, such as within thermal fronts, and these have long been known as areas of high fish abundance (Block et al. 2011; Queiroz et al. 2012). Oceanographic conditions are likely to be strong drivers of the movements and distribution of pelagic sharks (Queiroz et al. 2012).

To better understand the influence of the marine ecosystem on species habitat use, the collection of oceanographic information (e.g., sea surface temperature, chlorophyll concentration, current velocity, depth of the thermocline, oceanic fronts, and upwelling) is necessary. This information can be collected *in situ* or through remote sensing techniques. The ability to collect data on pelagic fish movement and its relationship with the environment has greatly increased with the latest advancements in technology, as is evidenced by a vast array of satellite telemetry and other types of research (Campana et al. 2011).

6.3.3 Essential fish habitat and migratory patterns

Better management of shark populations through habitat protection is the goal of the mandate to describe and identify essential fish habitat. This recognizes that all stages in a species life cycle are important, not just those stages vulnerable to exploitation. However, because of their migratory nature, identifying essential fish habitat (EFH) for pelagic sharks is very challenging.

Using advanced technology can improve identification and quantification of EFH for sharks. This includes using acoustic listening stations to monitor the movements of some stages of sharks, even though the application of such techniques in the open ocean has severe limitations. Still, some work using this system may provide information on home range size and changes in habitat use through time, shark distribution in relation to prey density, timing of immigration and emigration, observation of philopatric behaviours (i.e., whether sharks return to their natal grounds), examination of intraspecific relationships (e.g. aggregation, competition, and group dynamics), and assessment of mortality rates within the population.

Stable isotope analysis and microchemistry are also two expanding fields of research. While stable isotopes such as N^{15} and C^{15} have traditionally been used to study food web structure and estimate trophic level (see previous section), researchers are now using stable isotopes also to track movement of individual fish using these chemical signals as natural markers. Hardpart microchemistry of rare elements such as strontium can also be used to examine fish movements between natal and breeding grounds. Both techniques have shown promise for bony fishes, while research in elasmobranchs is still very preliminary. The Group can move to support investigation on these techniques and to gain insight into the migratory patterns, stock structure, and mixing rates of important shark species, all factors important to improve stock assessments.

6.3.4 Habitat and ecosystem-based modelling

Several approaches have been used to predict potential fish distributions based on models of a species habitat use. For example, ecological niche modelling has been used to predict the potential ecological and geographic distribution to a variety of wildlife species. A niche is an ecological construct defining the optimum environment for growth, reproduction and survival of a species. One way to investigate species response to habitat is through examination of habitat preferences by constructing environmental niche models.

Information on fish vertical movement in the water column collected by satellite tags can also be incorporated in habitat-based standardization (HBS) models (Bigelow et al. 1999). In HBS models effective effort is modelled as a function of the probability of interaction between the depth distribution of hooks and species in the water column. This model also requires information on gear configuration (e.g. hook depth).

Ecosystem models are also being developed to provide some insight into the function of marine ecosystems and their potential responses to natural and anthropogenic disturbance. One particular important question is evaluating how the removal of apex predators through fishing and other sources of mortality will affect the overall ecosystem function. This question takes on increasing importance in light of the observation on the reductions of higher trophic level species and fishing down food webs proposed by Pauly et al. (1998). On the other hand, recent modelling work on a small scale coastal area found that reduction of abundance of certain sharks as a result of increases in fishing mortality did not cause considerable structural changes in the overall system (Carlson 2007). Some additional modelling work in the North Pacific Ocean also found that reducing one or a few shark groups does not cause "top-down" effects because of complementary increases in other apex predator groups, which were apparently filling empty niches (Kitchell et al. 2002). However, modelling work of a rocky reef system indicated that sharks might be strong shapers of that marine community and that considerable modifications might already have transpired due to removal of sharks by Galápagos fisheries (Okey et al. 2004). Such studies should also be investigated in the pelagic environment, aiming at the development of methods to further test similar hypotheses. In addition, a number of hypotheses related to the effectiveness, size and design of possible marine reserves in the open seas could be evaluated.

7. By-catch mitigation

Several research projects are being developed to mitigate by-catch, primarily for birds, turtles and mammals. Some of this research includes bird scaring (tori) lines, the use of dyed bait, testing underwater hook setting devices, devices to avoid entanglement of seabirds in trawl warp cables, the use of circular hooks, the use of equipment for the release of wildlife after capture, studies on habitat use, and possible application of TEDs in trawl fisheries. Also modifications of fishing gear for turtles, use of reflecting nets and acoustic alarms for mammals, and studies on the behaviour and habitat use of sharks. Conducting ecosystem-level studies on the collateral effects of fishing, such as the removal of species with high trophic value remains a priority. Research is also being conducted on ways to reduce shark by-catch (benefits of banning wireleaders, hooks that repel sharks, changing soak depth, hook type, bait type, etc.).

A current practice on-board fishing vessels is to dump unwanted sharks and rays overboard in different ways. Indeed, sharks, and to a lesser extent rays, are usually considered by fishers as tough animals and they assume that they can easily survive when returned to the sea. Nevertheless, there are uncertainties about the post release fate of these individuals and survival rates of sharks and rays are likely to be variable among species within a fishery. Developing and promoting practices that maximize the health of sharks and rays when they are handled and released is fully justified. For the major gears impacting sharks and rays, good practices identified should be transferred to fishers and the implementation of these practices on-board monitored.

8. Other Considerations for the shark research programme

8.1Capacity building

One of the largest challenges facing enlightened fishery management is the procurement of accurate and robust catch, effort, landings, location and depth data. Although there have been improvements, in many areas of the Atlantic and Mediterranean such data collection is lacking or incompletely gathered. A concerted effort to enhance data gathering abilities in these regions should be a priority with the goal of bringing the quality and quantity of data up to currently accepted standards.

Accurate identification and quantification at the species level is a fundamental imperative. Identification of species often is a difficult task as many species of elasmobranchs are similar in appearance and errors in identification are readily made, even by experts. Although identification guides have been produced for many key areas, learning to differentiate species is markedly enhanced by a hands-on learning experience. Led by recognised identification specialists, workshops for indigenous biologists held in their home areas using local biota are invaluable in producing quality control in this most basic of data gathering steps.

An understanding of prioritized gathering of data categories is essential and details such as use of standardized length measures (TL, FL, PCL, DW), external sex determination, morphological signs of maturity, etc. must be established and recorded uniformly. The availability of pre-existing field-tested data-sheets and knowledge of when and where to modify fields as needed for local conditions can be shared, saving local scientists from going through trial-and-error periods which result in faulty or sub-par data collection. Archival of old data is to be encouraged along with notations describing the methodologies employed. As with species identification, a workshop setting involving well-trained instructors and local biologists has proven to be a profitable approach to build capacity in this arena.

Knowledge of basic laboratory techniques is often poor or absent in many regions. Use of sectioned morphological hard parts and validation techniques to determine age and modern approaches to document reproductive biology must be employed as these life history parameters can vary locally and are essential in the assessment process. Hands-on training sessions involving veteran instructors and local biologists are important capacity builders for acquiring these key life history parameters.

Modern analytical tools involving basic fishery assessment and management programs are infrequently employed in many areas and more advanced analyses built upon knowledge of the former are largely ignored. The more complex the analyses, the fewer number of individuals that have appropriate background training. Thus bringing people up to these levels requires a graded approach of insuring comfort at previous levels prior to initiating the learning curve for the next level.

A discussion of context is always important. A lecture summarizing the activities of major players in regional and international management and conservation, such as ICCAT, CITES, GFCM, ICES, FAO, IUCN, provides a review of current conditions of Atlantic and Mediterranean stocks, what actions are in effect and planned, and an update on the quality of extant regional biodiversity. Major stumbling blocks can be identified, potentially leading to regional efforts that can be aimed at rectifying such targets.

Periodic production of workshops focusing on the matter at hand will significantly increase the quality and quantity of data. Equally importantly, these activities will result in the training of one or more instructors who can carry back the knowledge and disseminate it in similar workshops in their home countries ("teach the teachers"), a strategy that keeps giving. Parenthetically, having the opportunity "to give back" is as satisfying to the instructors as it is to the students.

Funding requirements for a multi-day workshop include travel, housing and food for all participants, including educators, and minimal amounts for in-country group travel (visits to fishery landing beaches, markets, etc.), acquisition of specimens for ID lab, and classroom/lab rental (latter perhaps can be used for free).

Long-distance education and outreach are mechanisms employed to reach the non-scientist focus group, but it also can attract scientists unable to attend one of the workshops. Posting of Workshop activities and supplementary documents on an established internet site allows for a larger scientific audience than a workshop can physically and fiscally handle - however the hands-on learning approach is always the best way to go. The non-scientist group, including fishers, particularly will benefit from the development and posting of signs encouraging the safe return to water of endangered species, such as sea turtles (Chelonia), sawfishes (Pristidae), and other CITES listed elasmobranchs, as well as locally and regionally prohibited elasmobranchs and bony fishes. Lack of enforcement is a fundamental problem in virtually all regions, so development of an education campaign leading to the development and posting of signs and delivery of developed educational brochures at ports, fishing beaches, fish markets, etc., will promote self-enforcement by fishers.

One-day training workshops bringing together local fishers, fishery observers, and scientists could be organized to review current mitigation methods and best fishing practices aimed at reducing shark mortality. Implementation of good handling/release guidelines could enhance crew safety and optimize survival of released animals.

As noted in the 2011 Meeting of the Working Group on the Organization of the SCRS, the number of CPCs acceding to the ICCAT agreement has increased rapidly in the last decade. Unfortunately, the level of participation of scientists from CPCs in the work of SCRS has not kept pace. Particularly given the acknowledged data limitations for many shark species, the SRDCP should continue to build on the efforts of ICCAT to promote increased participation of CPC scientists in the work of SCRS (i.e., data collection, contribution to stock assessment, calculation of local fishery indicators, participation at working groups, etc).

8.2 Collaboration and coordination

Collaboration and cooperation are essential actions that build the base of any transnational research activity. In the case of pelagic sharks species occurring in the Atlantic and Mediterranean any research plan and efficient data collection focused on these widely distributed species requires the enforcement of mechanisms to strengthen relations between the scientific teams involved in the process. The areas of collaboration that should be reinforced within this collective action that were identified by the Group include:

- elaboration of common protocols for the collection and analysis of biological samples
- protocols for the storage and preservation of biological samples
- capacity building and training in data collection and analysis
- equitable distribution of the biological sampling effort framed in a predefined scientifically sampling scheme
- promotion of visiting opportunities and interchanges for scientists at national laboratories prioritize multilateral collaboration for specific projects to promote collaboration among scientific teams consistently involved in sharks research with in the SCRS.

With regards to collaboration with other organisations, it is important for ICCAT to continue to interact with other RFMOs that conduct scientific studies and provide management for shark species of interest in this research plan (e.g., tRFMOs, GFCM, NAFO and ICES). The joint assessment of porbeagle with ICES in 2009 and the KOBE Joint Tuna RFMO By-catch Working Group provide good examples as to how this collaboration can be facilitated. On-going collaboration to improve the scientific advice necessary for management of these species is crucial.

In terms of collaboration with other groups, a wide variety of seabirds, turtles, marine mammals and sharks (comprehensively including sharks, and batoids) are likely to be incidentally captured in various fisheries. These four taxa comprise top predators whose role in the ecosystem is believed to be of great importance. Several initiatives at a national and regional scale aimed at minimizing the effects of by-catch are being developed.

Research associated with these efforts is the most relevant source of information about the affected species and has allowed for collection of valuable information on various aspects of their biology and behaviour, particularly as it relates to their interaction with fishing vessels. We have seen that some mitigation measures developed for some of these taxa could result in an increase in shark catches. In this context, it is important to identify and contact organizations and working groups that will address a multi taxon approach and analysis in order to optimize the results and benefits of research.

8.3 Funding

The Group briefly discussed the potential sources of funding to support the SRDCP. It was agreed that at this stage of the definition of this ambitious research action it is not possible to estimate the required funds to accomplish the different elements identified in the program. The Group considered that the best approach to conduct an appropriate estimation of the required budget is through a group of SCRS scientists familiarized with elasmobranch fisheries that would be responsible to accomplish this task. Funding support for a short contract would be required for this purpose.

Implementation of the SRDCP will be framed within the 2015-2020 SCRS strategic plan which will provide the overall framework for the required coordination and for the development of the plan. In any case, in the interest of supporting its on-going activities, the Group concluded that there is an urgent need for combining efforts to build a joint coordinated biological sampling scheme for the whole Atlantic and Mediterranean. This aspect was considered critical to gain efficacy and synergies in the context of the multiple national observer programs currently in place. The definition of biological sampling protocols, time-area-size-sex strata for the different SHK species, and equitative distribution of sampling effort among different teams are aspects that need to be defined in the immediate future. Consequently, the Group recommends that a small group of SCRS scientists should be in charge of elaborating the biological sampling design; the Group also recommends that this task be conducted in 2014 and the corresponding costs funded by ICCAT. The expected budget of this action should be evaluated and proposed to SCRS for its approval.

References

Abaunza, P., Murta, A.G., Campbell, N., Cimmaruta, R., Comesana, A.S., Dahle, G.,Garcia-Santamaria, M.T., et al. 2008. Stock identity of horse mackerel (*Trachurus trachurus*) in the northeast Atlantic and Mediterranean Sea: integrating the results from different stock identification approaches. Fisheries Research, 89: 187-196.

Bigelow, K.A., Hampton, J., Miyabe, N. 2002. Application of a habitat-based model to estimate effective longline fishing effort and relative abundance of Pacific bigeye tuna (*Thunnus obesus*). Fisheries Oceanography, 11: 143-155.

Block B.A., and Jonsen I.D. 2011. Tracking apex marine predator movements in a dynamic ocean. Nature. 475: 86-90.

Cailliet, G.M., and K.J. Goldman. 2004. Age determination and validation in chondrichthyan fishes. In: Biology of sharks and their relatives. J.C. Carrier, J.A. Musick, and M.R. Heithaus, (eds.), pp. 399-448. CRC Press, Boca Raton, FL.

Campana, S.E. 2001. Accuracy, precision and quality control in age determination, including a review of the use and abuse of age validation methods. Journal of Fish Biology 59: 197-242.

Campana, S.E., L.J. Natanson, S. Myklevoll. 2002a. Bomb dating and age determination of large pelagic sharks. Canadian Journal of Fisheries and Aquatic Sciences 59: 450-455.

Campana, S.E., W. Joyce, L. Marks, L.J. Natanson, N.E. Kohler, C.F. Jensen, J.J. Mello, H.L. Pratt Jr., and S. Myklevoll. 2002b. Population dynamics of the porbeagle shark in the northwest Atlantic. North American Journal of Fisheries Management 22: 106-121.

Campana S.E., Dorey A., Fowler M., Joyce W., Wang Z., Wright D., and Yashayaev I. 2011. Migration pathways, behavioural thermoregulation and overwintering grounds of blue sharks in the Northwest Atlantic. PLoS One 6: e16854.

Camhi, M.D., Pikitch, E.K., Babcock, E.A (Eds). 2008. Sharks of the Open Ocean: Biology, Fisheries and Conservation. Blackwell Publishing. 502 pp.

Campana, S.E. 1997. Use of radiocarbon from nuclear fallout as a dated marker in the otoliths of haddock, *Melanogrammus aeglefinus*. Marine Ecology Progress Series, 150: 49-56.

Carlson, J.K., Parsons, G.R. 1997. Age and growth of the bonnethead shark, Sphyrna tiburo, from northwest Florida, with comments on clinal variation. Environmental Biology of Fishes, 50: 331–341.

Carlson, J.K, K.J. Goldman, and C. Lowe. 2004. Metabolism, energetic demand, and endothermy. In: Biology of Sharks and Their Relatives. J. Carrier, J. Musick, M. Heithaus (eds.), pp. 203-224. CRC Press, Boca Raton, FL.

Carlson, J.K., and I.E. Baremore. 2005. Growth dynamics of the spinner shark, Carcharhinus brevipinna, off the United States Southeast and Gulf of Mexico coasts: a comparison of methods. Fishery Bulletin 103: 280-291.

Chen SB, Watanabe S. 1989. Age dependence of natural mortality coefficient in fish population dynamics. Nip Suisan Gak 55: 205-208

Coelho, R., Erzini, K. 2007. Population parameters of the smooth lanternshark*, Etmopterus pusillus*, in southern Portugal (NE Atlantic). Fisheries Research, 86: 42-57.

Coelho, R., Erzini, K. 2008. Life history of a wide-ranging deepwater lantern shark in the north-east Atlantic, *Etmopterus spinax* (Chondrichthyes: Etmopteridae), with implications for conservation. Journal of Fish Biology, 73: 1419-1443.

Coelho, R., Rey, J., Gil-De-Sola, L., Fernandez-Carvalho, J., Erzini, K. 2010. Comparing Atlantic and Mediterranean populations of the velvet belly lanternshark*, Etmopterus spinax*, with comments on the efficiency of density-dependent compensatory mechanisms. Marine Biology Research, 6: 373-380.

Cortés E (1998) Demographic analysis as an aid in shark stock assessment and management. Fish Res 39: 199-208.

Cortés E. 1999a. A stochastic stage-based population model of the sandbar shark in the western North Atlantic. In: Musick JA (ed) Life in the slow lane: ecology and conservation of long-lived marine animals. Symposium 23, American Fisheries Society, Bethesda, Maryland, pp 115-136.

Cortés, E. 1999b. Standardized diet compositions and trophic levels of sharks. ICES Journal of Marine Science 56:707-717.

Druffel, E.M. and T.W. Linick. 1978. Radiocarbon in annual coral rings of Florida. Geophysical Research Letters, 94: 3271-3285.

Garcia A., Mattiucci S., Damiano S., Santos M.N., Nascetti G. 2011. Metazoan parasites of *Xiphias gladius* (Linnaeus, 1758) (Pisces: Xiphiidae) from Atlantic Ocean: implications for host stock identification. ICES Journal of Marine Science, 68: 175-182.

Heist, E.J. 1999. A review of population genetics in sharks. American Fisheries Society Symposium, 23:161-168.

Heist, E.J. 2004. Genetics: Stock indetification. In: Elasmobranch Fisheries Management Techniques, Misick, J.A., Bonfil, R (Eds.). APEC Secretariat. 79-96 pp.

Heist, E.J. 2008. Molecular markers and genetic population structure of pelagic sharks. In: Sharks of the Open Ocean: Biology, Fisheries and Conservation, Camhi, M.D.

Pikitch, E.K., Babcock, E.A (Eds). Blackwell Publishing. 323-333 pp.

Hoenig JM. 1983. Empirical use of longevity data to estimate mortality rates. Fish Bull 82:898-903.

Jensen AL (1996) Beverton and Holt life history invariants result from optimal trade-off of reproduction and survival. Can J Fish Aquat Sci 53:820-822.

Kalish, J.M. 1993. Pre- and post-bomb radiocarbon in fish otoliths. Earth Planet Science Letters, 114:549-554.

Kerr, L., T. Brown, A. Andrews, G. Cailliet, and K. Coale. 2004. Investigations of radiocarbon in the white shark (*Carcharodon carcharias*) from the eastern Pacific. Published abstract. Third International Symposium on Fish Otolith Research and Application. Townsville, Queensland, Australia.

Kitchell, J.F., T.E. Esssington, C. Boggs, D.E. Schindler, and C.J. Walters. 2002. The role of sharks and longline fisheries in a pelagic ecosystem of the central Pacific. Ecosystems 5:202-216.

Lester, R.J.G. and MacKenzie, K. 2009. The use and abuse of parasites as stock markers for fish. Fisheries Research, 97: 1-2.

Lorenzen K. 1996. The relationship between body weight and natural mortality in juvenile and adult fish: a comparison of natural ecosystems and aquaculture. J Fish Biol 49: 627-647.

Lorenzen K. 2000. Allometry of natural mortality as a basis for assessing optimal release size in fish-stocking programmes. Can J Fish Aquat Sci 57:2374-2381.

Matthews, K.R. 1990. An experimental study of the habitat preferences and movement patterns of copper, quillback, and brown rockfishes (Sebustes spp.). Env. Biol. Fish. 29: 161-178.

Neer, J.A., K.A. Rose, and B.A. Thompson. 2004. Bioenergetics modeling of the cownose ray, *Rhinoptera bonasus,* in the northern Gulf of Mexico. Abstract: American Society of Ichthyologists and Herpetologists/American Elasmobranch Society Annual Meeting. Norman, OK.

Neer, J.A., B.A. Thompson, and J.K. Carlson. 2005. Age and growth of *Carcharhinus leucas* in the northern Gulf of Mexico: incorporating variability in size at birth. Journal of Fish Biology 66:1-14.

Okey, T.A., S. Banks, A.F. Born, R.H. Bustamante, M. Calvopiña, G.J. Edgar, E. Espinoza, J.M. Fariña, L.E. Garske, G.K. Reck, S. Salazar, S. Shepherd, V. Toral-Granda, and P. Wallem. 2004. A trophic model of a Galápagos subtidal rocky reef for evaluating fisheries and conservation strategies. Ecological Modeling 172: 389-407.

Pauly D. 1980. On the interrelationship between natural mortality, growth parameters, and mean environmental temperature in 175 fish stocks. J Cons Int Explor Mer 39:175-192.

Pauly, D., V. Christensen, J. Dalsgaard, R. Froese, and F. Torres. 1998. Fishing down marine food webs. Science, 279: 860-863.

Passerotti, M.S., Carlson, J.K., Piercy, A.N., Campana, S.E. 2010. Age validation of great hammerhead shark (*Sphyrna mokarran*), determined by bomb radiocarbon analysis. Fishery Bulletin, 108: 346-351.

Peterson I, Wroblewski JS (1984) Mortality rates of fishes in the pelagic ecosystem. Can J Fish Aquat Sci 41:1117-1120.

Queiroz N., Humphries N.E., Noble L.R., Santos A.M., and Sims D.W. 2012. Spatial dynamics and expanded vertical niche of blue sharks in oceanographic fronts reveal habitat targets for conservation. PLoS One 7: e32374.

Roff D.A. 1992. The evolution of life histories: theory and analysis. Chapman and Hall, New York

Shivji, M., Clarke, S., Pank, M., Natanson, L., Kohler, N., Stanhope, M. 2002. Genetic identification of pelagic shark body parts for conservation and trade monitoring. Conservation Biology, 16: 1036-1047.

Siegfried K.I. 2006. Fishery management in data-limited situations: applications to stock assessment, marine reserve design and fish by-catch policy. PhD Dissertation (University of California, Santa Cruz)

Simpfendorfer C.A. 1999a. Mortality estimates and demographic analysis for the Australian sharpnose shark, *Rhizoprionodon taylori*, from northern Australia. Fish Bull 97:978-986.

Simpfendorfer C.A. 2005. Demographic models, life tables, matrix models and rebound potential. In: Musick JA, Bonfil R (eds.) Elasmobranch fisheries management techniques. Asia-Pacific Economic Cooperation Secretariat, pp. 187-203.

Utter, F.M. 1991. Biochemical genetics and fishery management: an historical perspective. Journal of Fish Biology, 39: 1-20.

von Bertalanffy, L. 1938. A quantitative theory of organic growth (inquiries on growth laws II.) Human Biology, 10: 181-213.

Walker PA, Hislop J.R.G. 1998. Sensitive skates or resilient rays? Spatial and temporal shifts in ray species composition in the central and north-western North Sea between 1930 and the present day. ICES J Mar Sci 55:392-402.

Ward P., 2008. Empirical estimates of historical variations in the catchability and fishing power of pelagic longline fishing gear. Rev Fish Biol Fisheries 18:409–426

Weidman, C.R. and G.A. Jones. 1993. A shell-derived time history of bomb 14C on Georges Bank and its Labrador Sea implications. Journal of Geophysical Research, 98: 14577-14588.

Wetherbee, B.M. and E. Cortés. 2004. Food consumption and feeding habits. In: Biology of sharks and their relatives. J.C. Carrier, J.A. Musick, and H.R. Heithaus (eds.), pp.225-246. CRC Press, Boca Raton, FL.

Yamaguchi, A., Taniuchi, T., Shimizu. M. 2000. Geographic variations in reproductive parameters of the starspotted dogfish, Mustelus manazo, from five localities in Japan and in Taiwan. Environmental Biology of Fishes, 57: 221-233.

Appendix 7-Table 1. Traffic light approach used to categorize the level of information (expressed as number of studies) available by topic in four geographical areas for 16 species of Atlantic sharks. Red = no studies available; yellow = 1 or 2 studies; green = 3+ studies; white = species does not occur in the area.

Area	NORTH ATLANTIC				SOUTH ATLANTIC				EQUATORIAL ATLANTIC				MEDITERRANEAN			
Species	Reproduction	Age and growth	Stock ID	Movement and migration	Reproduction	Age and growth	Stock ID	Movement and migration	Reproduction	Age and growth	Stock ID	Movement and migration	Reproduction	Age and growth	Stock ID	Movement and migration
BSH	Green	Green	Red	Green	Green	Yellow	Yellow	Yellow	Green	Yellow	Yellow	Red	Yellow	Yellow	Red	Yellow
SMA	Green	Green	Green	Green	Yellow	Red	Yellow	Red	Yellow	Red	Red	Red	Yellow	Red	Red	Red
LMA	Yellow	Red	Red	Yellow	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
POR	Green	Green	Red	Yellow	Yellow	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
SPZ	Yellow	Red	Red	Yellow	Yellow	Red	Red	Red	Red	Yellow	Red	Red	Red	Red	Red	Red
SPK	Yellow	Yellow	Red	Yellow	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
SPL	Green	Yellow	Yellow	Yellow	Green	Yellow	Yellow	Red	Green	Red	Red	Red	Red	Red	Red	Red
ALV	Green	Yellow	Yellow	Yellow	Yellow	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
BTH	Green	Yellow	Yellow	Green	Yellow	Yellow	Red	Red	Yellow	Red	Red	Red	Red	Red	Red	Red
FAL	Green	Green	Red	Yellow	Red	Red	Red	Red	Yellow	Red	Red	Yellow	White	White	White	White
OCS	Green	Yellow	Red	Green	Red	Red	Red	Red	Green	Yellow	Red	Red	Red	Red	Red	Red
DUS	Green	Yellow	Red	Green	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
CCP	Green	Green	Green	Green	Red	Red	Red	Red	Yellow	Red	Red	Red	Yellow	Red	Red	Red
CCS	Yellow	Red	Red	Yellow	Red	Red	Red	Red	Yellow	Yellow	Red	Red	White	White	White	White
TIG	Green	Yellow	Red	Yellow	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
PLS	Yellow	Red	Red	Red	Green	Red	Red	Red	Red	Red	Red	Red	Yellow	Red	Red	Red

Appendix 7-Table 2. Classification of species according to "data poorness" (proportion of red cells in Table 1, i.e. with no information) and "data richness" (proportion of green cells in Table 1, i.e., with 3+ studies). For data poorness, species are listed from worst to best; for data richness, species are listed from best to worst. Values indicate the number of (red or green) cells as a proportion of the total number of cells for each species.

ranked	red
LMA	0.88
SPK	0.81
DUS	0.81
TIG	0.81
PLS	0.81
POR	0.75
SPZ	0.75
ALV	0.69
OCS	0.69
CCP	0.69
CCS	0.67
FAL	0.58
BTH	0.56
SMA	0.50
SPL	0.50
BSH	0.19

ranked	green
BSH	0.31
SMA	0.25
CCP	0.25
SPL	0.19
OCS	0.19
FAL	0.17
POR	0.13
BTH	0.13
DUS	0.13
ALV	0.06
TIG	0.06
PLS	0.06
LMA	0.00
SPZ	0.00
SPK	0.00
CCS	0.00

Appendix 7-Table 3. Recommendations and Resolutions adopted by ICCAT that relate specifically to sharks.

Number	*Name (EN)*	*Status*
12-05	Recommendation by ICCAT on compliance with existing measures on shark conservation and management	Active May 2013
11-10	Recommendation by ICCAT on information collection and harmonization of data on by-catch and discards in ICCAT fisheries	Active
11-08	Recommendation by ICCAT on the conservation of silky sharks caught in association with ICCAT fisheries	Active
10-08	Recommendation by ICCAT on hammerhead sharks (family Sphyrnidae) caught in association with fisheries managed by ICCAT	Active
10-07	Recommendation by ICCAT on the conservation of oceanic whitetip shark caught in association with fisheries in the ICCAT convention area	Active
10-06	Recommendation by ICCAT on Atlantic shortfin mako sharks caught in association with ICCAT fisheries	Active
09-07	Recommendation by ICCAT on the conservation of thresher sharks caught in association with fisheries in the ICCAT convention area	Active
08-08	Resolution by ICCAT on porbeagle shark (*Lamna nasus*)	*Inactive*
08-07	Recommendation by ICCAT on the conservation of bigeye thresher sharks (*Alopias superciliosus*) caught in association with fisheries managed by ICCAT	*Inactive*
07-06	Supplemental Recommendation by ICCAT concerning sharks	Active
06-10	Supplementary Recommendation by ICCAT concerning the conservation of sharks caught in association with fisheries managed by ICCAT	Active
05-05	Recommendation by ICCAT to amend Recommendation 04-10 concerning the conservation of sharks caught in association with fisheries managed by ICCAT	Active
04-10	Recommendation by ICCAT concerning the conservation of sharks caught in association with fisheries managed by ICCAT	Active
03-10	Resolution by ICCAT on the shark fishery	Active
01-11	Resolution by ICCAT on Atlantic sharks	*Inactive*
95-02	Resolution by ICCAT on cooperation with the Food & Agriculture Organization of the United Nations (FAO) with regard to study on the status of stocks and by-catches of shark species	Active

Appendix 7-Table 4. International measures that apply to elasmobranchs within the proposed ICCAT Shark Research and Data Collection Programme.

Convention	*Measure*	*Species*
Barcelona Convention	Annex II	*Carcharodon carcharias*
		Isurus oxyrinchus
		Lamna nasus
		Mobula mobular
		Sphyrna lewini
		Sphyrna mokarran
		Sphyrna zygaena
	Annex III	*Alopias vulpinus*
		Carcharhinus plumbeus
		Prionace glauca
CITES	Appendix II	*Carcharodon carcharias*
		Carcharhinus longimanus [a]
		Lamna nasus [a]
		Manta alfredi [a]
		Manta birostris [a]
		Sphyrna lewini [a]
		Sphyrna mokarran [a]
		Sphyrna zygaena [a]
CMS	Appendix I	*Carcharodon carcharias*
		Manta birostris
	Memorandum of Understanding	*Carcharodon carcharias*
		Isurus oxyrinchus
		Isurus paucus
		Lamna nasus
GFCM	Rec. GFCM/36/2012/3	Barcelona Convention Annex II and Annex III species (above)

[a] Listing enters into effect September 2014.

Appendix 7-Table 5. Biological and fishery data requirements and output provided by a suite of data-poor methods that could potentially be used to assess the status of Atlantic sharks and generate management advice and research recommendations.

METHOD	DATA REQUIREMENTS		REFERENCE POINTS	MANAGEMENT ADVICE	RESEARCH RECOMMENDATIONS
	Biology	Fishery			
PSA level I, II	qualitative	qualitative	No	Qualitative	Yes
Length-based methods (SEINE)	VBGF parameters	mean recruitment length, time series of lengths	Changes in Z	Qualitative	Yes
PSA level III;Demographic models; Elasticity analysis	age & growth, reproduction, M	several (PSA only)	No	Mostly qualitative (e.g., size limits), but also F	Yes
Analytical benchmarks	age & growth, reproduction, M	Index of relative abundance	B/Bmsy	Quantitative	Yes
DCAC	M	catch, index of relative abundance	Sustainable catch	Quantitative	Yes
AIM		catch, index of relative abundance	F/Fmsy	Quantitative (sustainable F)	Yes
Surplus production (ASPIC, BSP, others)	r	catch, index of relative abundance	B/Bmsy and F/Fmsy	Quantitative, projections	Yes

Appendix 7-Table 6. ICCAT recommendations regarding the observer programs

Recommendation	*Objective*	*% Coverage*	*Shark data collection*	*Current coverage*
Rec. 2011-10 - Recommendation by ICCAT on Information Collection and Harmonization of Data on By-catch and Discards in ICCAT Fisheries	By-catch and discard data	Not defined	By-catch/discards	n/a
Rec. 2011-01 - On a Multi-annual conservation and management program for bigeye and yellowfin tunas	The ICCAT Regional Observer Program shall be established in 2013 to ensure observer coverage of 100% of all surface fishing vessels 20 meters LOA or greater fishing bigeye and/or yellowfin tunas in the area/time closure.	100 % of PS	By-catch/discards	n/a
Rec. 2012-03 - Recommendation amending the Rec. to establish a multi-annual recovery plan for Bluefin tuna	Bluefin catch compliance	100 % PS, 100 % tranfers from PS, 100 % tranfers from traps to cages, 100 % farms, traps and towing vessels, 20 % active BB, LL and pelagic trawlers.	By-catch/discards	≈ 100%
Voluntary PS implementation	Tuna catch and by-catch data	100 % from 2013	By-catch/discards	Not yet evaluated

Appendix 8

TABLES WITH SUMMARIES OF LIFE HISTORY INFORMATION

Appendix 8-Table 1. Summary of the number of studies presenting life history parameters that are available in each region across the Atlantic Ocean and Mediterranean Sea for 16 species combined (see text for details).

	RESUMEN (numero de especies)										
	Med.	Atlant.	SWA	SCA	SEA	NWA	NCA	NEA	WEcA	CEcA	EEcA
Reproduccion											
L_{mat} (♂)	1		4			10		4	3	2	2
T_{mat} (♂)			3			9			2	1	
L_{mat} (♀)	1		3			13		3	3	2	2
T_{mat} (♀)			3			10			2	1	
Frec. Reprod.	3	1	2			8		3	1	1	
Gestacion	3	1	3			8		1	2	2	
L_{nac}	3	1	3			11		4	2	1	
Fec. Uterina	3	2	8	1	1	13	1	7	5	2	3
Period. Paricion	1	1	5			13		6	2	2	
Period. Copula			1			8			2	2	
Edad y Crecim.											
L_{inf}			2			6		1	3		
k			2			7		1	3		
T_o / L_o			2			6		1	3		
T_{max}			2			10		1	3		1
Longev			2			8			1		
L_{inf} (♂)			3			9					1
k (♂)			3			9					1
T_o / L_o (♂)			3			9					1
T_{max} (♂)			3			11		1	2		1
Longev (♂)			3			5					
L_{inf} (♀)			3			9					1
k (♀)			3			9					1
T_o / L_o (♀)			3			9					1
T_{max} (♀)			3			11		1	2		1
Longev (♀)			3			6					
Dieta											
Clasico	2	14	5			14		3	3		
Isotopos						3					
Genetica											
mtADN		2	2			4	3	2			
nADN		1	3		1	3	1	1	1		
Track. y Desp.											
Marc. / Recap.	1		1		1	15	1	1			
Telemet. Satel.			1			9		2	1		
Telemet. Acust.						1					
Pref. Ambientales											
Temp. Superf.			6			7		1			
Temp.			1			8		3			
Prof.			1			9		3			
Sal.						2					
Ox. Dis.											
Varios											
Haulback Mort.		10				10					
conv. Talla - Talla	4		5			11		5	1		2
conv. Peso - Talla	3		6			12		3	2	4	5

Appendix 8-Table 2. Summary of the studies focusing on blue shark (BSH, *Prionace glauca*) life history parameters in each of the regions across the Atlantic Ocean and Mediterranean Sea. Each value in each table cell refers to a particular study, with the abbreviated references provided as a footnote to the table.

	Prionace glauca (BSH)											
	Med.	**Atlant.**	**SWA**	**SCA**	**SEA**	**NWA**	**NCA**	**NEA**	**WEcA**	**CEcA**	**EEcA**	**Total**
Reproduccion												
L_{mat} (♂)	45		21,22,24			18			10			**6**
T_{mat} (♂)	45		22,24			12,18			10,19			**7**
L_{mat} (♀)	45		16,22,24			18			10			**6**
T_{mat} (♀)	45		22,24			12,18			10			**6**
Frec. Reprod.			24			18						**2**
Gestacion			22,24			18			19,22			**5**
L_{nac}			21			18		35	10			**4**
Fec. Uterina		23	7,23,24	23	23	18,23,37	23	23	23	23	17,23	**15**
Period. Paricion			24			18			19,22			**4**
Period. Copula			24			18			19			**3**
Total	**4**	**1**	**19**	**1**	**1**	**14**	**1**	**2**	**12**	**1**	**2**	**58**
Edad y Crecim.												
L_{inf}						11,12,20		13,35	10			**6**
k						11,12,20		13,35	10			**6**
T_o / L_o						11,12,20		13,35	10			**6**
T_{max}			24			11,12		13,35	10			**6**
Longev			24			12						**2**
L_{inf} (♂)	45		24			12						**3**
k (♂)	45		24			12						**3**
T_o / L_o (♂)			24			12						**2**
T_{max} (♂)	45		24			12		35	10			**5**
Longev (♂)	45		24			12						**3**
L_{inf} (♀)	45		24			12						**3**
k (♀)	45		24			12						**3**
T_o / L_o (♀)			24			12						**2**
T_{max} (♀)	45		24			12		35	10			**5**
Longev (♀)	45		24			12						**3**
Total	**8**	**0**	**12**	**0**	**0**	**22**	**0**	**10**	**6**	**0**	**0**	**58**
Dieta												
Clasico		5	7,9			6		8,35	9			**7**
Isotopos						44						**1**
Total	**0**	**1**	**2**	**0**	**0**	**2**	**0**	**2**	**1**	**0**	**0**	**8**
Genetica												
mtADN			14									**1**
nADN			15						15			**2**
Total	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**3**
Track. y Desp.												
Marc. / Recap.	38		27		27	3,38,39	38	28,29,31,34,38				**12**
Telemet. Satel.			30			25		32,33				**4**
Telemet. Acust.						26						**1**
Total	**1**	**0**	**2**	**0**	**1**	**5**	**1**	**7**	**0**	**0**	**0**	**17**
Pref. Ambientales												
Temp. Superf.			36,43			25,26		33				**5**
Temp.			30			25,26		32,33				**5**
Prof.			30			25,26		32,33				**5**
Sal.												**0**
Ox. Dis.												**0**
Total	**0**	**0**	**4**	**0**	**0**	**6**	**0**	**5**	**0**	**0**	**0**	**15**
Varios												
Haulback Mort.		2				1						**2**
conv. Talla - Talla	40		7,43			4		42			17	**6**
conv. Peso - Talla	40		16,24,41			4		13,41		41	41	**9**
Total	**2**	**1**	**5**	**0**	**0**	**3**	**0**	**3**	**0**	**1**	**2**	**17**

1=Beerkircher et al. (2002); 2=Coelho et al. (2012); 3=Kohler & Turner (2001); 4=Kohler et al. (1995); 5=Cortes (1999); 6=Bowmant et al. (2000); 7=Bornatowski & Schwingel (2008); 8=Calrke et al. (1996); 9=Vaske Junior et al. (2009b); 10=Lessa et al. (2004); 11=MacNeil & Campana (2002); 12=Skomal & Natanson (2003); 13=Stevens (1975); 14=Texeira (2011); 15=Ussami (2011); 16=Bodas & Amorim (2009); 17=Castro & Mejuto (1995); 18=Pratt (1979); 19=Hazin et al. (2000); 20=Aasen (1966); 21=Kotas et al. (2010); 22=Legat & Vooren (2004); 23=Mejuto & Garcia-Cortes (2005); 24=Montealegre-Quijano (2007); 25=Campana et al. (2011); 26=Carey & Scharold (1990); 27=da Silva et al. (2010); 28=Fitzmaurice et al. (2005); 29=Matsunaga (2009); 30=Miller et al. (2011); 31=Queiroz et al. (2005); 32=Queiroz et al. (2010); 33=Queiroz et al. (2012); 34=Stevens (1976); 35=Henderson et al. (2001); 36=Montealegre-Quijano & Vooren (2010); 37=Tavares et al. (2012); 38=Kohler et al. (2002); 39=Burnett et al. (1987); 40=Megalofonou et al. (2005); 41=Garcia-Cortes & Mejuto (2002); 42=Buencuerpo et al. (1998); 43=Mas (2012); 44=MacNeil et al. (2005); 45=Megalofonou et al. (2009).

Appendix 8-Table 3. Summary of the studies focusing on shortfin mako (SMA, *Isurus oxyrinchus*) life history parameters in each of the regions across the Atlantic Ocean and Mediterranean Sea. Each value in each table cell refers to a particular study, with the abbreviated references provided as a footnote to the table.

	Isurus oxyrinchus (SMA)											
	Med.	**Atlant.**	**SWA**	**SCA**	**SEA**	**NWA**	**NCA**	**NEA**	**WEcA**	**CEcA**	**EEcA**	**Total**
Reproduccion												
L_{mat} (♂)						16		21				**2**
T_{mat} (♂)						16,25						**2**
L_{mat} (♀)						16,22						**2**
T_{mat} (♀)						16,25						**2**
Frec. Reprod.	22	22				22						**3**
Gestacion	22	22				22						**3**
L_{nac}	22	22				16						**3**
Fec. Uterina	22		20,22			1,11,22		29			22	**8**
Period. Paricion		22				22		21				**3**
Period. Copula												**0**
Total	**4**	**4**	**2**	**0**	**0**	**14**	**0**	**3**	**0**	**0**	**1**	**28**
Edad y Crecim.												
L_{inf}												**0**
k												**0**
T_o / L_o												**0**
T_{max}						15,16						**2**
Longev						16,25						**2**
L_{inf} (♂)						16						**1**
k (♂)						16						**1**
T_o / L_o (♂)						16						**1**
T_{max} (♂)						16						**1**
Longev (♂)						16						**1**
L_{inf} (♀)						16						**1**
k (♀)						16						**1**
T_o / L_o (♀)						16						**1**
T_{max} (♀)						16						**1**
Longev (♀)						16						**1**
Total	**0**	**0**	**0**	**0**	**0**	**14**	**0**	**0**	**0**	**0**	**0**	**14**
Dieta												
Clasico	4	5	12			14		13				**5**
Isotopos						28						**1**
Total	**1**	**1**	**1**	**0**	**0**	**2**	**0**	**1**	**0**	**0**	**0**	**6**
Genetica												
mtADN			17			17,19	17					**4**
nADN			18		18	18	18	18				**5**
Total	**0**	**0**	**2**	**0**	**1**	**3**	**2**	**1**	**0**	**0**	**0**	**9**
Track. y Desp.												
Marc. / Recap.						2,3,23						**3**
Telemet. Satel.						24						**1**
Telemet. Acust.												**0**
Total	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**4**
Pref. Ambientales												
Temp. Superf.			27			23,24						**3**
Temp.						24						**1**
Prof.						24						**1**
Sal.												**0**
Ox. Dis.												**0**
Total	**0**	**0**	**1**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**5**
Varios												
Haulback Mort.		7				6						**2**
conv. Talla - Talla	8		27			5,25		10,21	26			**7**
conv. Peso - Talla			9			1,5,25		9,21		9	9	**8**
Total	**1**	**1**	**2**	**0**	**0**	**6**	**0**	**4**	**1**	**1**	**1**	**17**

1=Guitart-Manday (1975); 2=Burnett et al. (1987); 3=Kohler et al. (2002), 4=Cortes (1999), 5=Bowman et al. (2000); 6=Beerkircher et al. (2002), 7=Coelho et al. (2012), 8=Megalofonou et al. (2005);9=Garcia-Cortes & Mejuto (2002); 10=Buencuerpo et al. (1998); 11=Gilmore (1993); 12=Gorni et al. (2012); 13=Maia et al. (2006); 14=Wood et al. (2009), 15=Ardizzone et al. (2006); 16=Natanson et al. (2006); 17=Heist et al. (1996); 18=Schrey & Heist (2003); 19=Taguchi et al. (2011); 20=Costa et al. (2002); 21=Maia et al. (2007); 22=Mollet et al. (2000, 2002); 23=Casey & Kohler (1992); 24=Loefer et al. (2005); 25=Campana et al. (2005); 26=Freitas et al. (2009); 27=Mas (2012); 28=MacNeil et al. (2005); 29=Castro & Mejuto (1995).

Appendix 8-T able 4. Summary of the studies focusing on longfin mako (LMA, *Isurus paucus*) life history parameters in each of the regions across the Atlantic Ocean and Mediterranean Sea. Each value in each table cell refers to a particular study, with the abbreviated references provided as a footnote to the table.

	Isurus paucus (LMA)											
	Med.	**Atlant.**	**SWA**	**SCA**	**SEA**	**NWA**	**NCA**	**NEA**	**WEcA**	**CEcA**	**EEcA**	**Total**
Reproduccion												
L_{mat} (♂)												**0**
T_{mat} (♂)												**0**
L_{mat} (♀)												**0**
T_{mat} (♀)						6						**1**
Frec. Reprod.												**0**
Gestacion												**0**
L_{nac}						6						**1**
Fec. Uterina						1,5,6						**3**
Period. Paricion												**0**
Period. Copula												**0**
Total	**0**	**0**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**5**
Edad y Crecim.												
L_{inf}												**0**
k												**0**
T_o / L_o												**0**
T_{max}												**0**
Longev												**0**
L_{inf} (♂)												**0**
k (♂)												**0**
T_o / L_o (♂)												**0**
T_{max} (♂)												**0**
Longev (♂)												**0**
L_{inf} (♀)												**0**
k (♀)												**0**
T_o / L_o (♀)												**0**
T_{max} (♀)												**0**
Longev (♀)												**0**
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Dieta												
Clasico						2						**1**
Isotopos												**0**
Total	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Genetica												
mtADN												**0**
nADN												**0**
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Track. y Desp.												
Marc. / Recap.						4						**1**
Telemet. Satel.												**0**
Telemet. Acust.												**0**
Total	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Pref. Ambientales												
Temp. Superf.												**0**
Temp.												**0**
Prof.												**0**
Sal.												**0**
Ox. Dis.												**0**
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Varios												
Haulback Mort.		3										**1**
conv. Talla - Talla												**0**
conv. Peso - Talla												**0**
Total	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

1=Guitart-Manday (1975), 2=Bowman et al. (2000); 3=Coelho et al. (2012); 4=Kohler & Turner (2001); 5=Gilmore (1983, 1993); 6=Guitart-Manday (1966).

Appendix 8-Table 5. Summary of the studies focusing on porbeagle (POR, *Lamna nasus*) life history parameters in each of the regions across the Atlantic Ocean and Mediterranean Sea. Each value in each table cell refers to a particular study, with the abbreviated references provided as a footnote to the table.

	Lamna nasus (POR)											
	Med.	Atlant.	SWA	SCA	SEA	NWA	NCA	NEA	WEcA	CEcA	EEcA	Total
Reproduccion												
L_{mat} (♂)			6			7,11,15		16				5
T_{mat} (♂)						11,15						2
L_{mat} (♀)						7,11,15						3
T_{mat} (♀)						11,15						2
Frec. Reprod.						7,11		17				3
Gestacion						7,11						2
L_{nac}			6			7,11						3
Fec. Uterina			6			11		17				3
Period. Paricion			6			7,11		17				4
Period. Copula						7,11						2
Total	0	0	4	0	0	21	0	4	0	0	0	29
Edad y Crecim.												
L_{inf}						7,8,15						3
k						7,8,15						3
T_o / L_o						7,8,15						3
T_{max}						7,8,15						3
Longev						7,8						2
L_{inf} (♂)												0
k (♂)												0
T_o / L_o (♂)												0
T_{max} (♂)						8						1
Longev (♂)												0
L_{inf} (♀)												0
k (♀)												0
T_o / L_o (♀)												0
T_{max} (♀)						7,8						2
Longev (♀)						7						1
Total	0	0	0	0	0	18	0	0	0	0	0	18
Dieta												
Clasico		2				3		16,17				4
Isotopos												0
Total	0	1	0	0	0	1	0	2	0	0	0	4
Genetica												
mtADN		9										1
nADN												0
	0	1	0	0	0	0	0	0	0	0	0	1
Track. y Desp.												
Marc. / Recap.						1						1
Telemet. Satel.						10		13,14				3
Telemet. Acust.												0
Total	0	0	0	0	0	2	0	2	0	0	0	4
Pref. Ambientales												
Temp. Superf.			6			10,12						3
Temp.						10,12		13,14				4
Prof.						10,12		13,14				4
Sal.												0
Ox. Dis.												0
Total	0	0	1	0	0	6	0	4	0	0	0	11
Varios												
Haulback Mort.		4										1
conv. Talla - Talla			6			5,8,11,15						5
conv. Peso - Talla						1,5,15		17,18				5
Total	0	1	1	0	0	7	0	2	0	0	0	11

1=Kohler et al. (2002); 2=Cortes (1999); 3=Bowman et al. (2000); 4=Coelho et al. (2012); 5=Kohler et al. (1995); 6=Forselledo (2012); 7=Aasen (1963); 8=Natanson et al. (2002b); 9=Kitamura & Matsunaga (2010); 10=Campana et al. (2010); 11=Jensen et al. (2002); 12=Campana & Joyce (2004); 13=Pade et al. (2009); 14=Saunders et al. (2011); 15=Cassoff et al. (2007); 16=Ellis & Schakley (1995); 17=Gauld (1989); 18=Jung (2009).

Appendix 8-Table 6. Summary of the studies focusing on smooth hammerhead (SPZ, *Sphyrna zygaena*) life history parameters in each of the regions across the Atlantic Ocean and Mediterranean Sea. Each value in each table cell refers to a particular study, with the abbreviated references provided as a footnote to the table.

	Sphyrna zygaena (SPZ)											
	Med.	**Atlant.**	**SWA**	**SCA**	**SEA**	**NWA**	**NCA**	**NEA**	**WEcA**	**CEcA**	**EEcA**	**Total**
Reproduccion												
L_{mat} (♂)												0
T_{mat} (♂)												0
L_{mat} (♀)												0
T_{mat} (♀)												0
Frec. Reprod.												0
Gestacion												0
L_{nac}			12									1
Fec. Uterina			10					11				2
Period. Paricion			12			13						2
Period. Copula												0
Total	0	0	3	0	0	1	0	1	0	0	0	1
Edad y Crecim.												
L_{inf}												0
k												0
T_o / L_o												0
T_{max}											7	1
Longev												0
L_{inf} (♂)											7	1
k (♂)											7	1
T_o / L_o (♂)											7	1
T_{max} (♂)											7	1
Longev (♂)												0
L_{inf} (♀)											7	1
k (♀)											7	1
T_o / L_o (♀)											7	1
T_{max} (♀)											7	1
Longev (♀)												
Total	0	0	0	0	0	0	0	0	0	0	9	9
Dieta												
Clasico		1	5,6			3						4
Isotopos												0
Total	0	1	2	0	0	1	0	0	0	0	0	4
Genetica												
mtADN												0
nADN												0
Total	0	0	0	0	0	0	0	0	0	0	0	0
Track. y Desp.												
Marc. / Recap.						4						1
Telemet. Satel.												0
Telemet. Acust.												0
Total	0	0	0	0	0	1	0	0	0	0	0	1
Pref. Ambientales												
Temp. Superf.			10									1
Temp.												0
Prof.												0
Sal.												0
Ox. Dis.												0
Total	0	0	1	0	0	0	0	0	0	0	0	1
Varios												
Haulback Mort.		2										1
conv. Talla - Talla			10					9			7,8	4
conv. Peso - Talla												0
Total	0	1	1	0	0	0	0	1	0	0	2	5

1=Cortes (1999); 2=Coelho et al. (2012); 3=Bowman et al. (2000); 4=Kohler & Turner (2001); 5=Bornatowski & Schwingel (2009); 6=Bornatowski et al. (2007); 7=Coelho et al. (2011); 8=Garcia-Cortes & Mejuto (2002); 9=Buencuerpo et al. (1998); 10=Mas (2012); 11=Castro & Mejuto (1995); 12=Vooren et al. (2005); 13=Bigelow & Schroeder (1984).

Appendix 8-Table 7. Summary of the studies focusing on great hammerhead (SPK, *Sphyrna mokarran*) life history parameters in each of the regions across the Atlantic Ocean and Mediterranean Sea. Each value in each table cell refers to a particular study, with the abbreviated references provided as a footnote to the table.

	Sphyrna mokarran (SPK)											
	Med.	Atlant.	SWA	SCA	SEA	NWA	NCA	NEA	WEcA	CEcA	EEcA	Total
Reproduccion												
L_{mat} (♂)												0
T_{mat} (♂)												0
L_{mat} (♀)						7						1
T_{mat} (♀)												0
Frec. Reprod.								6				1
Gestacion								6				1
L_{nac}								6				1
Fec. Uterina						7						1
Period. Paricion						7		6				2
Period. Copula												
Total	0	0	0	0	0	3	0	4	0	0	0	7
Edad y Crecim.												
L_{inf}												0
k												0
T_o / L_o												0
T_{max}						3,4						2
Longev												0
L_{inf} (♂)						4						1
k (♂)						4						1
T_o / L_o (♂)						4						1
T_{max} (♂)						4						1
Longev (♂)												0
L_{inf} (♀)						4						1
k (♀)						4						1
T_o / L_o (♀)						4						1
T_{max} (♀)						4						1
Longev (♀)												0
Total	0	0	0	0	0	10	0	0	0	0	0	10
Dieta												
Clasico		1										1
Isotopos												0
Total	0	1	0	0	0	0	0	0	0	0	0	1
Genetica												
mtADN												0
nADN												0
Total	0	0	0	0	0	0	0	0	0	0	0	0
Track. y Desp.												
Marc. / Recap.						2						1
Telemet. Satel.						5						1
Telemet. Acust.												0
Total	0	0	0	0	0	2	0	0	0	0	0	2
Pref. Ambientales												
Temp. Superf.						5						1
Temp.												0
Prof.												0
Sal.												0
Ox. Dis.												0
Total	0	0	0	0	0	1	0	0	0	0	0	1
Varios												
Haulback Mort.												0
conv. Talla - Talla						4						1
conv. Peso - Talla												0
Total	0	0	0	0	0	1	0	0	0	0	0	1

1=Cortes (1999); 2=Kohler & Turner (2001); 3=Passerotti et al. (2010); 4=Piercy et al. (2010); 5=Hammerschlag et al. (2011); 6=Cadenat & Balche (1981); 7=Clark & von Schimdt (1965).

Appendix 8-Table 8. Summary of the studies focusing on scalloped hammerhead (SPL, *Sphyrna lewini*) life history parameters in each of the regions across the Atlantic Ocean and Mediterranean Sea. Each value in each table cell refers to a particular study, with the abbreviated references provided as a footnote to the table.

	Sphyrna lewini (SPL)											
	Med.	**Atlant.**	**SWA**	**SCA**	**SEA**	**NWA**	**NCA**	**NEA**	**WEcA**	**CEcA**	**EEcA**	**Total**
Reproduccion												
L_{mat} (♂)			3			1			6			3
T_{mat} (♂)			2			1,4						3
L_{mat} (♀)			3			1,25			6			4
T_{mat} (♀)			2			1,4						3
Frec. Reprod.						24			2			2
Gestacion			3			1						2
L_{nac}						24			2			2
Fec. Uterina		9	3			24,25					7	5
Period. Paricion			21,22			1,8,24			2			6
Period. Copula												0
Total	0	1	8	0	0	15	0	0	5	0	1	30
Edad y Crecim.												
L_{inf}			5			1						2
k			5			1						2
T_o / L_o			5			1						2
T_{max}			2			1,4						3
Longev			2									1
L_{inf} (♂)			2			4						2
k (♂)			2			4						2
T_o / L_o (♂)			2			4						2
T_{max} (♂)			2			4						2
Longev (♂)			2									1
L_{inf} (♀)			2			4						2
k (♀)			2			4						2
T_o / L_o (♀)			2			4						2
T_{max} (♀)			2			4						2
Longev (♀)			2									1
Total	0	0	15	0	0	13	0	0	0	0	0	28
Dieta												
Clasico		13				1			12			3
Isotopos												0
Total	0	1	0	0	0	1	0	0	1	0	0	3
Genetica												
mtADN		15,16										2
nADN		15	18			17						3
Total	0	3	1	0	0	1	0	0	0	0	0	5
Track. y Desp.												
Marc. / Recap.						10						1
Telemet. Satel.						11						1
Telemet. Acust.												0
Total	0	0	0	0	0	2	0	0	0	0	0	2
Pref. Ambientales												
Temp. Superf.												0
Temp.						11						1
Prof.						11						1
Sal.												0
Ox. Dis.												0
Total	0	0	0	0	0	2	0	0	0	0	0	2
Varios												
Haulback Mort.		20				19						2
conv. Talla - Talla						1,4						2
conv. Peso - Talla			14			1			2		23	4
Total	0	1	1	0	0	4	0	0	1	0	1	8

1=Branstetter (1987); 2=Kotas et al. (2011); 3=Vooren et al. (2005); 4=Piercy et al. (2007); 5=Mazzoleni et al. (2004); 6=Hazin et al. (2001); 7=Capape et al. (1998); 8=Adams & Paperno (2007); 9=Cadenat & Blache (1981); 10=Kohler & Turner (2001); 11=Hoffmeyer et al. (2011b); 12=Vaske Junior et al. (2009); 13=Cortes (1999); 14=Amorim et al. (2011); 15=Daly-Engle et al. (2012); 16=Duncan et al. (2006); 17=Quattro et al. (2006); 18=Pinhal et al. (2012); 19=Beerkircher et al. (2002); 20=Coelho et al. (2012); 21=Doño (2008); 22=Gadig et al. (2002); 23=Garcia-Cortes & Mejuto (2002); 24=Castro (1983, 1993, 2009); 25=Berkeley & Campos (1988).

Appendix 8-T able 9. Summary of the studies focusing on common thresher (ALV, *Alopias vulpinus*) life history parameters in each of the regions across the Atlantic Ocean and Mediterranean Sea. Each value in each table cell refers to a particular study, with the abbreviated references provided as a footnote to the table.

	Alopias vulpinuss (ALV)											
	Med.	**Atlant.**	**SWA**	**SCA**	**SEA**	**NWA**	**NCA**	**NEA**	**WEcA**	**CEcA**	**EEcA**	**Total**
Reproduccion												
L_{mat} (♂)												0
T_{mat} (♂)						5						1
L_{mat} (♀)								8				1
T_{mat} (♀)						5						1
Frec. Reprod.												0
Gestacion												0
L_{nac}						12		8,9				3
Fec. Uterina			10					8				2
Period. Paricion			10					8				2
Period. Copula												0
Total	0	0	2	0	0	3	0	5	0	0	0	10
Edad y Crecim.												
L_{inf}												0
k												0
T_o / L_o												0
T_{max}						5						1
Longev						5						1
L_{inf} (♂)						5						1
k (♂)						5						1
T_o / L_o (♂)						5						1
T_{max} (♂)						5						1
Longev (♂)						5						1
L_{inf} (♀)						5						1
k (♀)						5						1
T_o / L_o (♀)						5						1
T_{max} (♀)						5						1
Longev (♀)						5						1
Total	0	0	0	0	0	12	0	0	0	0	0	12
Dieta												
Clasico		2				3						2
Isotopos						11						1
Total	0	1	0	0	0	2	0	0	0	0	0	3
Genetica												
mtADN						1	1	1				3
nADN												0
Total	0	0	0	0	0	1	1	1	0	0	0	3
Track. y Desp.												
Marc. / Recap.						4						1
Telemet. Satel.												0
Telemet. Acust.												0
Total	0	0	0	0	0	1	0	0	0	0	0	1
Pref. Ambientales												
Temp. Superf.												0
Temp.												0
Prof.												0
Sal.												0
Ox. Dis.												0
Total	0	0	0	0	0	0	0	0	0	0	0	0
Varios												
Haulback Mort.												0
conv. Talla - Talla	7					6,12		9				4
conv. Peso - Talla	7					6						2
Total	2	0	0	0	0	3	0	1	0	0	0	6

1=Trejo (2005); 2=Cortes (1999); 3=Bowman et al. (2000); 4=Kohler & Turner (2001); 5=Gervelis (2005); 6=Kohler et al. (1995); 7=Megalofonou et al. (2005); 8=Moreno et al. (1989); 9=Buencuerpo et al. (1998); 10=Mancini & Amorim (2006); 11=MacNeil et al. (2005); 12=Natanson et al. (2002a).

Appendix 8-Table 10. Summary of the studies focusing on bigeye thresher (BTH, *Alopias superciliosus*) life history parameters in each of the regions across the Atlantic Ocean and Mediterranean Sea. Each value in each table cell refers to a particular study, with the abbreviated references provided as a footnote to the table.

	Alopias superciliosus (BTH)											
	Med.	**Atlant.**	**SWA**	**SCA**	**SEA**	**NWA**	**NCA**	**NEA**	**WEcA**	**CEcA**	**EEcA**	**Total**
Reproduccion												
L_{mat} (♂)						9		8			7	3
T_{mat} (♂)												0
L_{mat} (♀)						9,18		8			7	4
T_{mat} (♀)												0
Frec. Reprod.												0
Gestacion												0
L_{nac}								8				1
Fec. Uterina			11			10,17,18		8,16				6
Period. Paricion								8				1
Period. Copula												0
Total	0	0	1	0	0	6	0	6	0	0	2	15
Edad y Crecim.												
L_{inf}			6									1
k			6									1
T_o / L_o			6									1
T_{max}			6					5				2
Longev												0
L_{inf} (♂)			6					5				2
k (♂)			6					5				2
T_o / L_o (♂)			6					5				2
T_{max} (♂)			6					5				2
Longev (♂)			6									1
L_{inf} (♀)			6					5				2
k (♀)			6					5				2
T_o / L_o (♀)			6					5				2
T_{max} (♀)			6					5				2
Longev (♀)			6									1
Total	0	0	14	0	0	0	0	9	0	0	0	23
Dieta												
Clasico		1				2						2
Isotopos												0
Total	0	1	0	0	0	1	0	0	0	0	0	2
Genetica												
mtADN						14	14	14				3
nADN												0
Total	0	0	0	0	0	1	1	1	0	0	0	3
Track. y Desp.												
Marc. / Recap.						19						1
Telemet. Satel.						12,13						2
Telemet. Acust.												0
Total	0	0	0	0	0	3	0	0	0	0	0	3
Pref. Ambientales												
Temp. Superf.						9						1
Temp.						12,13						2
Prof.						12,13						2
Sal.												0
Ox. Dis.												0
Total	0	0	0	0	0	5	0	0	0	0	0	5
Varios												
Haulback Mort.		4				3						2
conv. Talla - Talla								5,16				2
conv. Peso - Talla			6,15			9,10						4
Total	0	1	2	0	0	3	0	2	0	0	0	8

1=Cortes (1999); 2=Bowman et al. (2000); 3=Beerkircher et al. (2002); 4=Coelho et al. (2012); 5=Fernandez-Carvalho et al. (2011); 6=Mancini (2005); 7=Fernandez-Carvalho et al. (2012); 8=Moreno & Moron (1992); 9=Stilwell & Casey (1976); 10=Guitart-Manday (1975); 11=Amorim et al. (1998); 12=Weng & Block (2004); 13=Carlson & Gulak (2012); 14=Trejo (2005); 15=Garcia-Cortes & Mejuto (2002); 16=Buencuerpo et al. (1998); 17=Gilmore (1983); 18=Berkeley & Campos (1988); 19=Kohler & Turner (2001).

Appendix 8-Table 11. Summary of the studies focusing on silky shark (FAL, *Carcharhinus falciformis*) life history parameters in each of the regions across the Atlantic Ocean and Mediterranean Sea. Each value in each table cell refers to a particular study, with the abbreviated references provided as a footnote to the table.

	Carcharhinus falciformis (FAL)											
	Med.	Atlant.	SWA	SCA	SEA	NWA	NCA	NEA	WEcA	CEcA	EEcA	Total
Reproduccion												
L_{mat} (♂)						1,3,4			6	2		5
T_{mat} (♂)						1,3,4						3
L_{mat} (♀)						1,3,14			6	2		5
T_{mat} (♀)						1,3						2
Frec. Reprod.						3				2		2
Gestacion						1,3				2		3
L_{nac}						1,3,4,9,11						5
Fec. Uterina						3,9,11,14		13	6	2		7
Period. Paricion						1,3,11				2		4
Period. Copula						3				2		2
Total	0	0	0	0	0	27	0	1	3	7	0	38
Edad y Crecim.												
L_{inf}						1,3						2
k						1,3,9						3
T_o / L_o						1,3						2
T_{max}						1,3						2
Longev						1,3						2
L_{inf} (♂)												0
k (♂)												0
T_o / L_o (♂)												0
T_{max} (♂)						1,3						2
Longev (♂)												0
L_{inf} (♀)												0
k (♀)												0
T_o / L_o (♀)												0
T_{max} (♀)						1,3						2
Longev (♀)												0
Total	0	0	0	0	0	15	0	0	0	0	0	15
Dieta												
Clasico		15				1						2
Isotopos												0
Total	0	1	0	0	0	1	0	0	0	0	0	2
Genetica												
mtADN												0
nADN												0
Total	0	0	0	0	0	0	0	0	0	0	0	0
Track. y Desp.												
Marc. / Recap.						10						1
Telemet. Satel.						5			6			2
Telemet. Acust.												0
Total	0	0	0	0	0	2	0	0	1	0	0	3
Pref. Ambientales												
Temp. Superf.												0
Temp.						5			6			2
Prof.						5			6			2
Sal.												0
Ox. Dis.												0
Total	0	0	0	0	0	2	0	0	2	0	0	4
Varios												
Haulback Mort.		8				7						2
conv. Talla - Talla						3						1
conv. Peso - Talla						1,11,14				12	12	5
Total	0	1	0	0	0	5	0	0	0	1	1	8

1=Brasntetter (1987); 2=Hazin et al. (2007); 3=Bonfil et al. (1993); 4=Springer (1960); 5=Hoffmeyer et al. (2011); 6=Lana et al. (2012); 7=Beerkircher et al. (2002); 8=Coelho et al. (2012); 9=Brasntetter (1990); 10=Kohler & Turner (2011); 11=Guitart-Manday (1975); 12=Garcia-Cortes & Mejuto (2002); 13=Bane (1966); 14=Berkeley & Campos (1988); 15=Cortes (1999).

Appendix 8-Table 12. Summary of the studies focusing on oceanic whitetip (OCS, *Carcharhinus longimanus*) life history parameters in each of the regions across the Atlantic Ocean and Mediterranean Sea. Each value in each table cell refers to a particular study, with the abbreviated references provided as a footnote to the table.

	Carcharhinus longimanus (OCS)											
	Med.	Atlant.	SWA	SCA	SEA	NWA	NCA	NEA	WEcA	CEcA	EEcA	Total
Reproduccion												
L_{mat} (♂)									1,3,4			3
T_{mat} (♂)									1			1
L_{mat} (♀)						15			1,3,4			4
T_{mat} (♀)									1			1
Frec. Reprod.												0
Gestacion									3,4			2
L_{nac}						6			2			2
Fec. Uterina						5,6,13			2,3,4			6
Period. Paricion						5			3,4			3
Period. Copula						5			3,4			3
Total	0	0	0	0	0	7	0	0	18	0	0	25
Edad y Crecim.												
L_{inf}									1			1
k						6			1			2
T_o / L_o									1			1
T_{max}									1			1
Longev												0
L_{inf} (♂)												0
k (♂)												0
T_o / L_o (♂)												0
T_{max} (♂)									1			1
Longev (♂)												0
L_{inf} (♀)												0
k (♀)												0
T_o / L_o (♀)												0
T_{max} (♀)									1			1
Longev (♀)												0
Total	0	0	0	0	0	1	0	0	6	0	0	7
Dieta												
Clasico		1				5						2
Isotopos												0
Total	0	1	0	0	0	1	0	0	0	0	0	2
Genetica												
mtADN												0
nADN												0
Total	0	0	0	0	0	0	0	0	0	0	0	
Track. y Desp.												
Marc. / Recap.						11						1
Telemet. Satel.						7,8						2
Telemet. Acust.												0
Total	0	0	0	0	0	3	0	0	0	0	0	3
Pref. Ambientales												
Temp. Superf.						5						1
Temp.						7,8						2
Prof.						7,8						2
Sal.						5						1
Ox. Dis.												0
Total	0	0	0	0	0	6	0	0	0	0	0	6
Varios												
Haulback Mort.		10				9						2
conv. Talla - Talla												0
conv. Peso - Talla			14			13			1	14	14	5
Total	0	1	1	0	0	2	0	0	1	1	1	7

1=Lessa et al. (1999a); 2=Lessa et al. (1999b); 3=Coelho et al. (2009); 4=Tambourgi (2010); 5=Backus et al. (1956); 6=Branstetter (1990); 7=Howey-Jordan et al. (2013); 8=Carlson & Gulak (2012); 9=Beerkircher et al. (2002); 10=Coelho et al. (2012); 11=Kohler & Turner (2001); 12=Cortes (1999); 13=Guitart-Mandat (1975); 14=Garcia-Cortes & Mejuto (2002); 15=Berkeley & Campos (1988).

Appendix 8-T able 13. Summary of the studies focusing on dusky shark (DUS, *Carcharhinus obscurus*) life history parameters in each of the regions across the Atlantic Ocean and Mediterranean Sea. Each value in each table cell refers to a particular study, with the abbreviated references provided as a footnote to the table.

	Carcharhinus obscurus (DUS)											
	Med.	Atlant.	SWA	SCA	SEA	NWA	NCA	NEA	WEcA	CEcA	EEcA	Total
Reproduccion												
L_{mat} (♂)						7						1
T_{mat} (♂)						7						1
L_{mat} (♀)						7						1
T_{mat} (♀)						7						1
Frec. Reprod.						9,12						2
Gestacion						9,10,12						3
L_{nac}						12						1
Fec. Uterina						9,10						2
Period. Paricion						9,10						2
Period. Copula						9,10						2
Total	0	0	0	0	0	16	0	0	0	0	0	16
Edad y Crecim.												
L_{inf}												0
k												0
T_o / L_o												0
T_{max}						7						1
Longev						7						1
L_{inf} (♂)						7						1
k (♂)						7						1
T_o / L_o (♂)						7						1
T_{max} (♂)						7						1
Longev (♂)												0
L_{inf} (♀)						7						1
k (♀)						7						1
T_o / L_o (♀)						7						1
T_{max} (♀)						7						1
Longev (♀)												0
Total	0	0	0	0	0	10	0	0	0	0	0	10
Dieta												
Clasico		1				6,8,10						4
Isotopos												0
Total	0	1	0	0	0	3	0	0	0	0	0	4
Genetica												
mtADN												0
nADN												0
Total	0	0	0	0	0	0	0	0	0	0	0	0
Track. y Desp.												
Marc. / Recap.						1,11						2
Telemet. Satel.						2						1
Telemet. Acust.												0
Total	0	0	0	0	0	3	0	0	0	0	0	3
Pref. Ambientales												
Temp. Superf.												0
Temp.						2						1
Prof.						2						1
Sal.												0
Ox. Dis.												0
Total	0	0	0	0	0	2	0	0	0	0	0	2
Varios												
Haulback Mort.						4,9						2
conv. Talla - Talla						5,7						2
conv. Peso - Talla						5						1
Total	0	0	0	0	0	5	0	0	0	0	0	5

1=Kohler & Turner (2001); 2=Hoffmayer et al. (2011); 3=Cortes (1999); 4=Beerkircher et al. (2002); 5=Kohler et al. (1995); 6=Gelsleichter et al. (1999); 7=Natanson et al. (1995); 8=Bowman et al. (2000); 9=Romine et al. (2009); 10=Clark & von Schmidt (1965); 11=Burnett et al. (1987); 12=Castro (1993, 2009).

Appendix 8-Table 14. Summary of the studies focusing on sandbar shark (CCP, *Carcharhinus plumbeus*) life history parameters in each of the regions across the Atlantic Ocean and Mediterranean Sea. Each value in each table cell refers to a particular study, with the abbreviated references provided as a footnote to the table.

	Carcharhinus plumbeus (CCP)											
	Med.	**Atlant.**	**SWA**	**SCA**	**SEA**	**NWA**	**NCA**	**NEA**	**WEcA**	**CEcA**	**EEcA**	**Total**
Reproduccion												
L_{mat} (♂)	14,18					5,6,15,16,19					17	8
T_{mat} (♂)						6,19,24						3
L_{mat} (♀)	14,18					5,6,15,16,19					17	8
T_{mat} (♀)						6,19,24						3
Frec. Reprod.	14					15,23			12			4
Gestacion	14					15,19,25			12			5
L_{nac}	14					15,19,20,23,25						6
Fec. Uterina	14					13,15,16,19,23			12			7
Period. Paricion	14					3,13,15,19,23			12			7
Period. Copula						15,19			12			3
Total	9	0	0	0	0	38	0	0	5	0	2	54
Edad y Crecim.												
L_{inf}						5,6,24,25						4
k						5,6,24						3
T_o / L_o						5,6,24						3
T_{max}						5,6,20						3
Longev						1,6,24						3
L_{inf} (♂)						5,6,20						3
k (♂)						5,6,20						3
T_o / L_o (♂)						5,6,20						3
T_{max} (♂)						5,6,20						3
Longev (♂)						6						1
L_{inf} (♀)						5,6,20						3
k (♀)						5,6,20						3
T_o / L_o (♀)						5,6,20						3
T_{max} (♀)						5,6,20						3
Longev (♀)						6						1
Total	0	0	0	0	0	42	0	0	0	0	0	42
Dieta												
Clasico		11				15,16,21						4
Isotopos												0
Total	0	1	0	0	0	3	0	0	0	0	0	4
Genetica												
mtADN						7,8,9						3
nADN						9,13						2
Total	0	0	0	0	0	5	0	0	0	0	0	5
Track. y Desp.												
Marc. / Recap.						3,4,22						3
Telemet. Satel.												0
Telemet. Acust.												0
Total	0	0	0	0	0	3	0	0	0	0	0	3
Pref. Ambientales												
Temp. Superf.						3						1
Temp.												0
Prof.						3						1
Sal.						3						1
Ox. Dis.												0
Total	0	0	0	0	0	3	0	0	0	0	0	3
Varios												
Haulback Mort.						10						1
conv. Talla - Talla						2,24						2
conv. Peso - Talla						2						1
Total	0	0	0	0	0	4	0	0	0	0	0	4

1=Andrews et al. (2011); 2=Kohler et al. (1995); 3=Merson & Pratt (2001); 4=Kohler & Turner (2001); 5=Sminkey & Musick (1995); 6=Casey et al. (1985); 7=Heist et al. (1995); 8=Heist et al. (1999); 9=Portnoy et al. (2010); 10=Beerkircher et al. (2002); 11=Cortes (1999); 12=Hazin et al. (2007b); 13=Portnoy et al. (2007); 14=Saidi et al. (2005); 15=Springer (1960); 16=Calrk & von Schmidt (1965); 17=Cadenat & Blache (1981); 18=Capape (1984); 19=Baremore & hale (2010); 20=Hale & Baremore (2010); 21=Bowman et al. (2000); 22=Burnett et al. (1987); 23=Castro (1983, 1993); 24=Casey & Natanson (1992); 25=Branstetter (1990).

Appendix 8-T able 15. Summary of the studies focusing on night shark (CCS, *Carcharhinus signatus*) life history parameters in each of the regions across the Atlantic Ocean and Mediterranean Sea. Each value in each table cell refers to a particular study, with the abbreviated references provided as a footnote to the table.

	Carcharhinus sigantus (CCS)											
	Med.	**Atlant.**	**SWA**	**SCA**	**SEA**	**NWA**	**NCA**	**NEA**	**WEcA**	**CEcA**	**EEcA**	**Total**
Reproduccion												
L_{mat} (♂)									6			1
T_{mat} (♂)									5			1
L_{mat} (♀)						11			6			2
T_{mat} (♀)									5			1
Frec. Reprod.												0
Gestacion												0
L_{nac}									5			1
Fec. Uterina						9,11			6			3
Period. Paricion						9						1
Period. Copula												0
Total	0	0	0	0	0	4	0	0	6	0	0	10
Edad y Crecim.												
L_{inf}									5			1
k									5			1
T_o / L_o									5			1
T_{max}									5			1
Longev									5			1
L_{inf} (♂)												0
k (♂)												0
T_o / L_o (♂)												0
T_{max} (♂)												0
Longev (♂)												0
L_{inf} (♀)												0
k (♀)												0
T_o / L_o (♀)												0
T_{max} (♀)												0
Longev (♀)												0
Total	0	0	0	0	0	0	0	0	5	0	0	0
Dieta												
Clasico		3				4			8			3
Isotopos												0
Total	0	1	0	0	0	1	0	0	1	0	0	3
Genetica												
mtADN												0
nADN												0
Total	0	0	0	0	0	0	0	0	0	0	0	0
Track. y Desp.												
Marc. / Recap.						2						1
Telemet. Satel.												0
Telemet. Acust.												0
Total	0	0	0	0	0	1	0	0	0	0	0	1
Pref. Ambientales												
Temp. Superf.			10									1
Temp.												0
Prof.												0
Sal.												0
Ox. Dis.												0
Total	0	0	1	0	0	0	0	0	0	0	0	1
Varios												
Haulback Mort.						1						1
conv. Talla - Talla			10			7						2
conv. Peso - Talla						7,11						2
Total	0	0	1	0	0	4	0	0	0	0	0	5

1=Beerkircher et al. (2002); 2=Kohler & Turner (2001); 3=Cortes (1999); 4=Bowman et al. (2000); 5=Santan & Lessa (2004); 6=Hazin et al. (2000); 7=Kohler et al. (1995); 8=Vaske Junior et al. (2009a); 9=Guitart-Manday (1975); 10=Mas (2012); 11=Bekeley & Campos (1988).

Appendix 8-Table 16: Summary of the studies focusing on tiger shark (TIG, *Galeocerdo cuvier*) life history parameters in each of the regions across the Atlantic Ocean and Mediterranean Sea. Each value in each table cell refers to a particular study, with the abbreviated references provided as a footnote to the table.

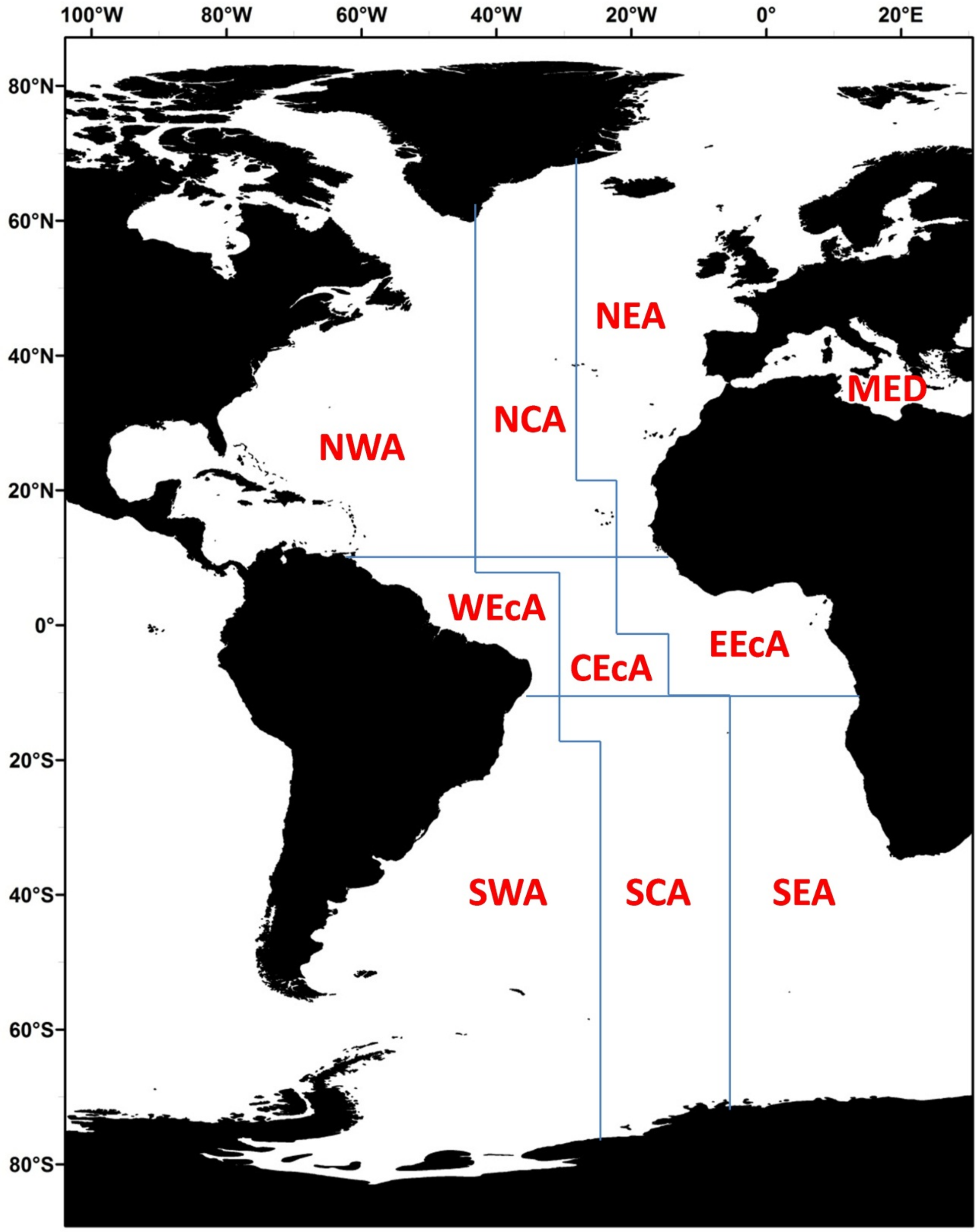
	Galeocerdo cuvier (TIG)											
	Med.	Atlant.	SWA	SCA	SEA	NWA	NCA	NEA	WEcA	CEcA	EEcA	Total
Reproduccion												
L_{mat} (♂)						7,11						2
T_{mat} (♂)						11						1
L_{mat} (♀)						7,11						2
T_{mat} (♀)						11						1
Frec. Reprod.						7,13						2
Gestacion						7,13						2
L_{nac}						14						1
Fec. Uterina						7,12						2
Period. Paricion						7						1
Period. Copula												0
Total	0	0	0	0	0	14	0	0	0	0	0	14
Edad y Crecim.												
L_{inf}						11						1
k						11						1
T_o / L_o						11						1
T_{max}						11,14						2
Longev						11,14						2
L_{inf} (♂)						14						1
k (♂)						14						1
T_o / L_o (♂)						14						1
T_{max} (♂)						11,14						2
Longev (♂)						14						1
L_{inf} (♀)						14						1
k (♀)						14						1
T_o / L_o (♀)						14						1
T_{max} (♀)						11,14						2
Longev (♀)						14						1
Total	0	0	0	0	0	19	0	0	0	0	0	19
Dieta												
Clasico		4	8,9,10			5						5
Isotopos												0
Total	0	1	3	0	0	1	0	0	0	0	0	5
Genetica												
mtADN												0
nADN												0
Total	0	0	0	0	0	0	0	0	0	0	0	0
Track. y Desp.												
Marc. / Recap.						3						1
Telemet. Satel.												0
Telemet. Acust.												0
Total	0	0	0	0	0	1	0	0	0	0	0	1
Pref. Ambientales												
Temp. Superf.												0
Temp.												0
Prof.												0
Sal.												0
Ox. Dis.												0
Total	0	0	0	0	0	0	0	0	0	0	0	0
Varios												
Haulback Mort.		2				1						2
conv. Talla - Talla						6						1
conv. Peso - Talla						6						1
Total	0	1	0	0	0	3	0	0	0	0	0	4

1=Beerkircher et al. (2002); 2=Coelho et al. (2012); 3=Kohler & Turner (2001); 4=Cortes (1999); 5=Bowman et al. (2000); 6=Kohler et al. (1995); 7=Calrk & von Schmidt (1965); 8=Bornatowski et al. (2007a); 9=Bornatowski et al. (2012); 10=Miller & Domingo (2011); 11=Branstetter (1987b); 12=Guitart-Manday (1975); 13=Castro (2009); 14=Kneebone et al. (2008).

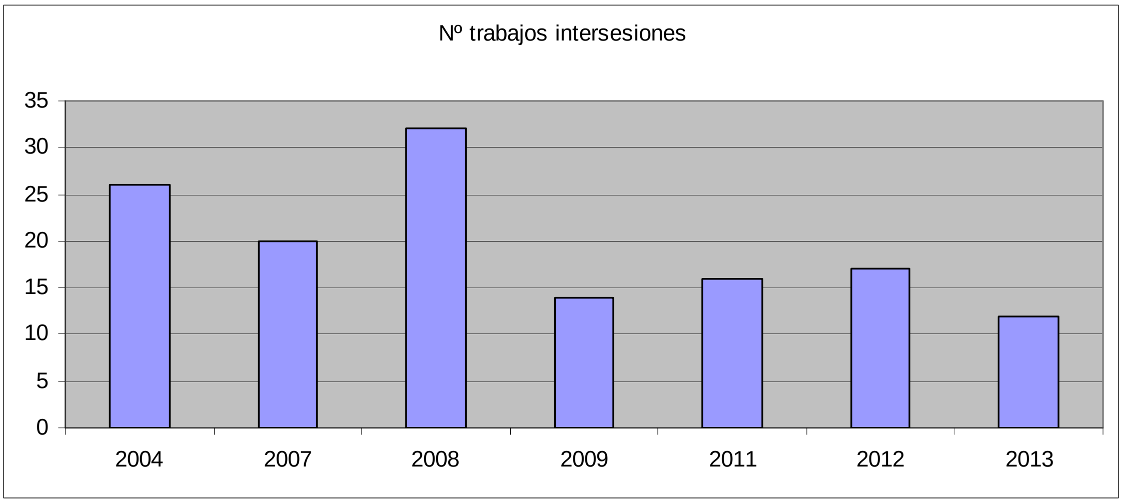
Appendix 8-Table 17. Summary of the studies focusing on pelagic stingray (PLS, *Pteroplatytrygon violacea*) life history parameters in each of the regions across the Atlantic Ocean and Mediterranean Sea. Each value in each table cell refers to a particular study, with the abbreviated references provided as a footnote to the table.

	Pteroplatytrygon violacea (PLS)										
	Med.	**Atlant.**	**SWA**	**SCA**	**SEA**	**NWA**	**NCA**	**NEA**	**WEcA**	**CEcA**	**EEcA**	**Total**
Reproduccion												
L_{mat} (♂)			2,3			7						3
T_{mat} (♂)			4									1
L_{mat} (♀)			2,3			7						3
T_{mat} (♀)			4									1
Frec. Reprod.	5		1									2
Gestacion	5		1									2
L_{nac}	5											1
Fec. Uterina	5		1,2									3
Period. Paricion						7						1
Period. Copula						7						1
Total	4	0	10	0	0	4	0	0	0	0	0	18
Edad y Crecim.												
L_{inf}												0
k												0
T_o / L_o												0
T_{max}												0
Longev												0
L_{inf} (♂)												0
k (♂)												0
T_o / L_o (♂)												0
T_{max} (♂)												0
Longev (♂)												0
L_{inf} (♀)												0
k (♀)												0
T_o / L_o (♀)												0
T_{max} (♀)												0
Longev (♀)												0
Total	0	0	0	0	0	0	0	0	0	0	0	0
Dieta												
Clasico	8		3,6,10			7						5
Isotopos												0
Total	1	0	3	0	0	1	0	0	0	0	0	5
Genetica												
mtADN												0
nADN												0
Total	0	0	0	0	0	0	0	0	0	0	0	0
Track. y Desp.												
Marc. / Recap.												0
Telemet. Satel.												0
Telemet. Acust.												0
Total	0	0	0	0	0	0	0	0	0	0	0	0
Pref. Ambientales												
Temp. Superf.			9									1
Temp.												0
Prof.												0
Sal.												0
Ox. Dis.												0
Total	0	0	1	0	0	0	0	0	0	0	0	0
Varios												
Haulback Mort.												0
conv. Talla - Talla	5											1
conv. Peso - Talla	5		3									2
Total	2	0	1	0	0	0	0	0	0	0	0	3

1=Forselledo et al. (2008); 2=Veras et al. (2009a); 3=Ribeiro-Prado & Amorim (2008); 4=do Passo & Lessa (2008); 5=Hemida et al. (2003); 6=Veras et al. (2009b); 7=Wilson & Becket (1970); 8=Mavric et al. (2004), 9=Domingo et al. (2005); 10=Vaske Junior & Rotundo (2012).



Appendix 7-Figure 1. Map showing the geographical areas considered in the evaluation of the current state of biological knowledge as summarized in the appendix tables.



Appendix 7-Figure 2. Evolution of number of documents presented at shark inter-sessional working group meetings.

Appendix 9

REFERENCES

AASEN, O. 1963.Length and growth of the porbeagle (*Lamna nasus*, Bonnaterre) in the North West Atlantic. Fiskerdirektoratets Skrifter, Serie Havundersøkelser 13: 20–37.

AASEN, O. 1966. Blahaien, *Prionace glauca* (Linnaeus), 1758. FiskenogHavet 1: 1–15.

ADAMS, D.H. & R. Paperno. 2007. Preliminary Assessment of a Nearshore Nursery Ground for the Scalloped Hammerhead off the Atlantic Coast of Florida. American Fisheries Society Symposium 50: 165–174.

ARDIZZONE, D., G.M. Cailliet, L. J. Natanson, A. H. Andrews, L. A. Kerr & T. A. Brown. 2006. Application of bomb radiocarbon chronologies to shortfin mako (*Isurus oxyrinchus*) age validation. Environmental Biology of Fishes 77: 355–366.

AMORIM, A.F., C.A. Arfelli & L. Fagundes. 1998. Pelagic elasmobranchs caught by longliners off southern Brazil during 1974-97: an overview. Marine Freshwater Research 49: 621–632.

AMORIM, A.F., N. Della-Fina & N. Piva-Silva.2011. Hammerheads sharks, *Sphyrna lewini* and *S. zyganea* caught by longliners off southern Brazil, 2007-2008. Collect. Vol. Sci. Papers, ICCAT 66: 2121–2133.

ANDREWS, A.H., L.J. Natanson, L. A. Kerr, G. H. Burgess & G. M. Cailliet. 2011. Bomb radiocarbon and tag-recapture datingof sandbar shark (*Carcharhinus plumbeus*).Fishery Bulletin 109:454–465.

BACKUS, R.H., Springer, S. and Arnold Jr., E. L. 1956. A contribution to the natural history of the white-tip shark, *Pterolamiops longimanus* (Poey). Deep-Sea Research 3: 178–188.

BANE Jr., G.W. 1966. Observations on the silky shark, *Carcharhinus falciformis*, in the Gulf of Guinea. Copeia 1966: 354–356.

BAREMORE, I. & L. Hale. 2010. Reproduction of the sandbar shark *Carcharhinus plumbeus* in the U.S. Atlantic Ocean and Gulf of Mexico. SEDAR21-DW-06. 30p.

BEERKIRCHER, L.R., E. Cortés & M. Shivji. 2002. Characteristics of shark by-catch observed on pelagic longlines off the southeastern United States, 1992–2000. Marine and Fisheries Review 64: 40–49.

BERKELEY, S.A. & W.L. Campos. 1988. Relative abundance and fishery potential of pelagic sharks along Florida's East coast. Marine Fisheries Review 50: 9–16.

BIGELOW, H.B. & W.C. Schroeder. 1948. Sharks, volume 1 de Memoir. New Haven: Sears Foundation for Marine Research. 546p.

BODAS, M. & A. Amorim. 2009. Desenvolvimentoembrionário de cação-azul, *Prionace glauca* (Linnaeus, 1758), no Sudeste e Suldo Brasil. Revista Ceciliana 1: 101–106.

BONFIL, R., R. Mena & D. de Anda. 1993. Biological parameters of commercially exploited silky sharks, *Carcharhinus falciformis*, form the Campeche Bank, Mexico. NOAA Technical report NMFS 115:73-86.

BORNATOWSKI, H., M.C. Robert & L. Costa.2007a. Dados sobre a alimentação de jovens de tubarão-tigre, *Galeocerdo cuvier*(Péron & Lesueur) (Elasmobranchii, Carcharhinidae), do sul do Brasil. Pan-American Journal of Aquatic Sciences 2: 10–13.

BORNATOWSKI, H., L. Costa, M. de Castro Robert & J. Ventura da Pina. 2007b. Hábitos alimentares de tubarões-martelo jovens, *Sphyrna zygaena* (Carcharhiniformes: Sphyrnidae), no litoral sul do Brasil. Biota Neotropica 7: 213-216.

BORNATOWSKI, H. & P.R. Schwingel. 2008. Alimentação e reprodução do tubarão-azul, *Prionace glauca* (Linnaeus, 1758), capturado nacosta Sudeste e Sul do Brasil. Arquivos de Ciências do Mar 41: 98–103.

BORNATOWSKI, H. & P.R. Schwingel. 2009.Sobre a alimentação do tubarão-martelo, *Sphyrna zygaena* (Linneus, 1758), capturado por espinhel pelágico no sudeste e sul do Brasil. Arquivos de Ciências do Mar 42: 1–4.

BORNATOWSKI, H., M.R. Heithaus, C. M.P. Batista& R.Mascarenhas. 2012. Shark scavenging and predation on sea turtles in northeastern Brazil. Amphibia-Reptilia 33: 495–502.

BOWMAN, R.E., C.E. Stillwell, W. L. Michaels & M. D. Grosslein. 2000. Food of northwest Atlantic fishes and two common species of squid. NOAA Technical Memorandum, NMFS-NE-155, 138 p.

BRANSTETTER, S. 1987. Age, growth and reproductive biology of the silky shark, *Carcharhinus falciformis*, and the scalloped hammerhead, *Sphyrnalewini*, from the northwestern Gulf of Mexico. Environmental Biology of Fishes 19: 161–173.

BRANSTETTER, S., J.A. Musick & J. A. Colvocoresses. 1987. A comparison of the age and growth of the tiger shark, *Galeocerdocuvieri*, from off Virginia and from the northwestern Gulf of Mexico. Fishery Bulletin 85: 269–279.

BRANSTETTER, S. 1990. Early life-history implications of selected carcharhinoid and lamnoidsharks of the northwest Atlantic. *In:* Elasmobranchs As Living Resources: Advances in Biology, Ecology, Systematics, and the Status of the Fisheries (eds. H.L. Pratt Jr., S.H. Gruber and T. Taniuchi). NOAA Technical Report NMFS 90. NOAA/NMFS, Silver Spring, MD, pp. 17–28.

BUENCUERPO, V., S. Rios & J. Morón. 1998. Pelagic sharks associated with the swordfish, *Xiphias gladius*, fishery in the eastern North Atlantic Ocean and the Strait of Gibraltar. Fishery Bulletin 96: 667–685.

BURNETT, C.D., J.S. Beckett, C.A. Dickson, P.C.F. Hurley & T.D. Iles. 1987. A summary of releases and recaptures in the Canadian large pelagic fish tagging program 1961–1986. Canadian Data Report of Fisheries and Aquatic Sciences 673: 1–99.

CADENAT, J. & J. Blanche. 1981. Requins de Méditerranée et d'Atlantique (Plus Particuliérement de la Côte Occidentale d' Afrique). Faune Tropicale XXI. ORSTROM, Paris. pp 145-149.

CAMPANA, S.E. &W.N. Joyce. 2004. Temperature and depth associations of porbeagle shark (*Lamna nasus*) in the Northwest Atlantic. Fisheries Oceanography 13: 52–64.

CAMPANA, S.E., L. Marks & W. Joyce. 2005. The biology and fishery of shortfin mako sharks (*Isurus oxyrinchus*) in Atlantic Canadian waters. Fisheries Research 73: 341–352.

CAMPANA, S.E., W. Joyce & M. Fowler. 2010. Subtropical pupping ground for a cold-water shark. Canadian Journal of Fisheries and Aquatic Sciences 67: 769–773.

CAMPANA, S. E., A. Dorey, M. Fowler, W. Joyce, Z. Wang, D. Wright & I. Yashayaev. 2011. Migration Pathways, Behavioural Thermoregulation and Overwintering Grounds of Blue Sharks in the Northwest Atlantic. PLoS ONE 6(2): e16854. doi:10.1371/journal.pone.0016854.

CAPAPÉ, C. 1984. Nouvellesdonnées sur lamorphologie et la biologie de la reproduction de *Carcharhinus plumbeus* (Nardo, 1827) (Pisces, Carcharhinidae) des côtestunisiennes. Investigación Pesqera 48: 115–137.

CAPAPÉ, C., M. Diop & M. N'Dao. 1998. Record of four pregnant females of the scalloped hammerhead, *Sphyrnalewini* (Sphrynidae) in Senegalese waters. Cybium 22: 89–93.

CAREY, F.G. & J. V. Scharold. 1990. Movements of blue sharks (*Prionace glauca*) in depth and course. Marine Biology 106: 329–342.

CARLSON, J.K., & S. Gulak. 2012. Habitat use and movement patterns of oceanic whitetip, bigeye thresher and dusky sharks based on archival satellite tags. ICCAT Collect. Vol. Sci. Papers, ICCAT 68: 1922–1932.

CASEY, J.G., H.L. Pratt Jr. & C. Stillwell.1985. Age and growth of the sandbar shark (*Carcharhinus plumbeus*) from the western North Atlantic. Canadian Journal of Fisheries and Aquatic Sciences 42:963–975.

CASEY, J.G. & L.J. Natanson.1992. Revised estimates of age and growth of the sandbar shark (*Carcharhinus plumbeus*) from the western North Atlantic. Canadian Journal of Fisheries and Aquatic Sciences 49:1474–1477.

CASEY, J.G. & N.E. Kohler. 1992. Tagging studies on the shortfin mako (*Isurus oxyrinchus*) in the western North Atlantic. *In:* Sharks: Biology and Fisheries (ed. J. G. Pepperell). Australian Journal of Marine and Freshwater Research 43: 45–60.

CASSOFF, R.M., S.E. Campana & S. Myklevoll. 2007. Changes in baseline growth and maturation parameters of northwest Atlantic porbeagle, *Lamna nasus*, following heavy exploitation. Canadian Journal of Fisheries and Aquatic Sciences 64: 19–29.

CASTRO, J. 1983. The sharks of North American waters. Texas A&M Univ. Press, College Station, TX, 180p.

CASTRO, J.I. 1993. The nursery of Bull Bay, South Carolina, with a review of the shark nurseries of the southeastern coast of the United States. Environmental Biology of Fishes 38: 37–48.

CASTRO, J.A. & J. Mejuto.1995. Reproductive parameters of blue shark, *Prionace glauca*, and other sharks in the Gulf of Guinea. Marine and Freshwater Research 46: 967–973.

CASTRO, J.I. 2009. Observations on the reproductive cycles of some viviparous North American sharks. aqua, International Journal of Ichthyology 15: 205−222.

CLARK, E. & K. von Schmidt. 1965. Sharks of the central Gulf Coast of Florida. Bulletin of Marine Science 15: 13–83.

CLARKE, M.R., D.C. Clarke, H.R. Martins & H.M. da Silva. 1996. The diet of the blue shark (*Prionace glauca* L.) in Azorean waters. Arquipélago Life and Marine Sciences 14: 41–56.

COELHO, R., Hazin, F.H.V., Rego, M., Tambourgi, M., Oliveira, P., Travassos, P., Carvalho, F., Burgess, G. 2009. Notes on the reproduction of the oceanic whitetip shark, Carcharhinus longimanus, in the Southwestern Equatorial Atlantic Ocean. Collect. Vol. Sci. Papers, ICCAT 64: 1734–1740.

COELHO, R., J. Fernandez-Carvalho, S. Amorim & M.N. Santos. 2011. Age and growth of the smooth hammerhead shark, *Sphyrna zygaena*, in the eastern Equatorial Atlantic Ocean, using vertebral sections. Aquatic Living Resources 24: 351–357.

COELHO, R., J. Fernandez-Carvalho, P.G. Lino & M.N. Santos. 2012. An overview of the hooking mortality of elasmobranchs caught in a swordfish pelagic longline fishery in the Atlantic Ocean. Aquatic Living Resources 25: 311–319.

CORTÉS, E. 1999.Standardized diet compositions and trophic levels of sharks. ICES Journal of Marine Science. 56: 707–717.

COSTA, F.E.S., F.M.S. Braga, C.A. Arfelli & A.F. Amorim. 2002. Aspects of the reproductive biology of the shortfin mako, *Isurus oxyrinchus*, (Elasmobranchii Lamnidae), in the southeastern region of Brazil. Brazilian Journal of Biology 62: 239–248.

DA SILVA, C., S.E. Kerwath, C.G. Wilke, M. Meyër & S.J. Lamberth. 2010. First documented southern transatlantic migration of a blue shark *Priona ceglauca* tagged off South Africa. African Journal of Marine Science 32: 639–642.

DALY-ENGEL, T.S., K.D. Seraphin, K.N. Holland, J.P. Coffey, H.A. Nance, R.J. Toonen & B.W. Bowen. 2012. Global Phylogeography with Mixed-Marker Analysis Reveals Male-Mediated Dispersal in the Endangered Scalloped Hammerhead Shark (*Sphyrna lewini*). PLoS ONE 7: e29986. doi:10.1371/journal.pone.0029986.

DOMINGO, A., R.C. Menni & R. Forselledo. 2005. By-catch of the pelagic stingray *Dasyatis violacea* in Uruguayan longline fisheries and aspects of distribution in the southwestern Atlantic. Scientia Marina 69: 161–166.

DOÑO, F. 2008. Identificación y caracterización de áreas de cría del tiburón martillo (*Sphyrna* spp.) en las costas de Uruguay. Tesis de Licenciatura en Ciencias Biológicas, Facultad de Ciencias, UDELAR, Montevideo, Uruguay. 34p.

DO PASSO, M.A.G. & R. Lessa. 2008. Análise do número de anéis de crescimento nas vértebras da raiaroxa, *Pteroplatytry gonviolacea* (Bonaparte, 1832), capturada noAtlânticoSul Equatorial. Resumo SBEEL. pp. 58–59.

DUNCAN, K.M., A.P. Martin, B.W. Bowen & H.G. De Couet. 2006. Global phylogeography of the scalloped hammerhead (*Sphyrna lewini*). Molecular Ecology 15: 2239–2251.

ELLIS, J.R. & S.E. Shackley. 1995. Notes on porbeagle sharks, *Lamna nasus*, from the Bristol Channel. Journal of Fish Biology 46: 368–370.

FERNADEZ-CARVALHO, J., R. Coelho, K. Erzini& M. Neves Santos. 2011a. Age and growth of the bigeye thresher shark, *Alopias superciliosus*, from the pelagic longline fisheries in the tropical northeastern Atlantic Ocean, determined by vertebral band counts. Aquatic Living Resources 24: 359–368.

FITZMAURICE, P., P. Green, G. Keirse, M. Kenny & M. Clarke. 2005. Stock discrimination of the blue shark, based on Irish tagging data. ICCAT Collective Volume of Scientific Papers 58: 1171–1178.

FORSELLEDO, R., M. Pons, P. Miller & A. Domingo. 2008. Distribution and population structure of the pelagic stingray, *Pterolamiops longimanus* (Poey). (Dasyatidae), in the south-western Atlantic. Aquatic Living Resources: 21: 357–363.

FORSELLEDO, R. 2012. Estructura poblacional y aspectos reproductivos de *Lamna nasus* (Bonnaterre, 1788) en el Atlántico Sudoccidental. Tesis de Licenciatura en Ciencias Biológicas, Facultad de Ciencias, UDELAR, Montevideo, Uruguay. 43p.

FREITAS, D., R. Barreto, I. Fernandes & R.Lessa. 2009.Composição de tamanhos e relações biométricas do tubarãomako (*isurus oxyrinchus*) capturados no AtlânticoSul Equatorial Ocidental. IX Jornada de Ensino, Pesquisa e Extensão (JEPEX) 1408-1.

GADIG, O.B.F., F.S. Motta & R.C. Namora. 2002. ProjetoCacão: a study on small coastal sharks in São Paulo southeast Brazil. En: Proceedings of the International Conference on Sustainable Management of Coastal Ecosystem. P. Duarte (Ed.). Porto, Portugal. pp. 239–246.

GARCÍA-CORTÉS B. & J. Mejuto. 2002. Size-weight relationships of the swordfish (*Xiphias gladius*) and several pelagic shark species caught in the Spanish surface longline fishery in the Atlantic, Indian and Pacific oceans. Collect. Vol. Sci. Papers, ICCAT 54: 1132–1149.

GAULD, J.A. 1989. Records of porbeagles landed in Scotland, with observations on the biology, distribution and exploitation of the species. Report No. 45. Fisheries Research Services, Aberdeen, Scotland. 15p.

GERVELIS, B.J. 2005. Age and growth of the thresher shark, *Alopias vulpinus*, in the northwest Atlantic Ocean. Master's Thesis. University of Rhode Island, Kingston, Rhode Island. 92p.

GILMORE, R.G. 1983. Observations on the Embryos of the Longfin Mako, *Isurus paucus*, and the Bigeye Thresher, *Alopias superciliosus*.Copeia 1983: 375–382.

GILMORE, R.G. 1993. Reproductive biology of lamnoid sharks. Environmental Biology of Fishes 38: 95–114.

GORNI, G.R., S. Loibel, R. Goitein & A.F. Amorim. 2012. Stomach contents analysis of shortfin mako (*Isurus oxyrinchus*) caught off Southern Brazil: A bayesian analysis. Collect. Vol. Sci. Papers, ICCAT 68: 1933–1937.

GUITART MANDAY, D. 1975. Las pesquerías pelágico-oceánicas de corto radio de acción en la región Noroccidental de Cuba. Academia de Ciencias de Cuba Serie Oceanológica 31. 26p.

HALE, L. & I. Baremore. 2010. Age and growth of the sandbar shark, *Carcharhinus plumbeus*, from the Gulf of Mexico and the United States southern Atlantic Ocean. SEDAR21-DW-21. 25p.

HAMMERSCHLAG, N., A.J. Gallagher, D.M. Lazarre, & C. Slonim. 2011. Range extension of the Endangered great hammerhead shark *Sphyrna mokarran* in the Northwest Atlantic: preliminary data and significance for conservation. Endangered Species Research 13: 111–116.

HAZIN, F.H.V., F.M. Lucena, T.A. Souza, C.E. Boeckman, M.K. Broadhurst & R.C. Menni.2000a. Maturation of the night shark, *Carcharhinus signatus*, in the southwestern Equatorial Atlantic Ocean. Bulletin of Marine Science 66: 173–185.

HAZIN, F.H.V., P.B. Pinheiro & P.B. Broadhurst. 2000b. Further notes on reproduction of the blue shark, *Prionace glauca*, and a postulated migratory pattern in the South Atlantic Ocean. Ciência e Cultura 52: 114–120.

HAZIN, F.H.V., A. Fischer & M. Broadhurst. 2001. Aspects of reproductive biology of the scalloped hammerhead shark, *Sphyrna lewini*, off northeastern Brazil. Environmental Biology of Fishes 61: 151–159.

HAZIN, F.H.V., P.G.V. Oliveira & B.C.L. Macena. 2007a. Aspects of the reproductive biology of the silky shark, *Carcharhinus falciformis* (Nardo, 1827), in the vicinity of archipelago of Saint Peter and Saint Paul, in the equatorial Atlantic Ocean. Collect. Vol. Sci. Pap. ICCAT, 60: 648–651.

HAZIN, F.H.V., P.G.V. Oliveira & B.C.L. Macena. 2007b. Aspects of the reproductive biology of the sandbar shark, *Carcharhinus plumbeus* (Nardo, 1827), in coastal waters off Pernambuco, Brazil. ICCAT Collective Volume of Scientific Papers 60: 629–635.

HEIST, E.J., J.E. GRAVES & J.A. Musick. 1995. Population genetics of the sandbar shark (*Carcharhinus plumbeu*s) the Gulf of Mexico and mid-Atlantic Bight. Copeia 1995:555–562.

HEIST, E.J., J.A. Musick & J.E. GRAVES. 1996. Genetic population structure of the shortfin mako (*Isurus oxyrinchus*) inferred from restriction fragment length polymorphism analysis of mitochondrialDNA. Canadian Journal of Fisheries and Aquatic Sciences 53: 583–588.

HEIST, E.J. & J.R Gold. 1999. Microsatellite DNA Variation in Sandbar Sharks (*Carcharhinus plumbeus*) from the Gulf of Mexico and Mid-Atlantic Bight. Copeia 1999: 182–186.

HEMIDA, F., R. Seridji, S. Ennajar, M. N. Bradai, E. Collier, O. Guélorget& C. Capapé.2003. New observations on the reproductive biology of the pelagic stingray, *Dasyatis violacea* Bonaparte, 1832 (Chondrichthyes: Dasyatidae) from the Mediterranean Sea. Acta Adriatica 44: 193–204.

HENDERSON, A.C., K. Flannery & J. Dunne. 2001. Observations on the biology and ecology of the blue shark in the North-east Atlantic. Journal of Fish Biology 58: 1347–1358.

HOWEY-JORDAN, L.A., E.J. Brooks, D.L. Abercrombie, L.K.B. Jordan, A. Brooks, S. Williams, E. Gospodarczyk & D.D. Chapman. 2013. Complex Movements, Philopatry and Expanded Depth Range of a Severely Threatened Pelagic Shark, the Oceanic Whitetip (*Carcharhinus longimanus*) in the Western North Atlantic. PLoS ONE 8(2): e56588. doi:10.1371/journal.pone.0056588.

JENSEN, C.F., L.J. Natanson, H.L. Pratt, N.E. Kohler & S.E. Campana. 2002. The reproductive biology of the porbeagle shark, *Lamna nasus*, in the western North Atlantic Ocean. Fishery Bulletin 100: 727–738.

JOYCE, W., S.E. Campana,L. J. Natanson, N.E. Kohler, H.L. Pratt & C.F. Jensen. 2002. Analysis of stomach contents of the porbeagle shark in the Northwest Atlantic Ocean. ICES Journal of Marine Science 59: 1263–1269.

JUNG, A. 2009. Preliminary results on the French fishery that targeted porbeagle shark (*Lamna nasus*) in the Northeast Atlantic Ocean: biology and catch statistics. Collect. Vol. Sci. Pap. ICCAT, 54: 1693–1702.

KITAMURA, T. & H. Matsunaga. 2010. Population structure of porbeagle (*Lamna nasus*) in the Atlantic Ocean as inferred from mitochondrial DNA control region sequences. Collect. Vol. Sci. Pap. ICCAT, 65: 2082–2087.

KNEEBONE, J., L.J. Natanson, A.H. Andrews & W.H. Howell. 2008. Using bomb radiocarbon analyses to validate age and growth estimates for the tiger shark, *Galeocerdo cuvier*, in the western North Atlantic. Marine Biology 154:423–434.

KOHLER, N.E., J.G. Casey & P.A. Turner. 1995. Length-weight relationships for 13 species of sharks from the western North Atlantic. Fishery Bulletin 93: 412–418.

KOHLER, N.E. & P.A. Turner. 2001. Shark tagging: a review of conventional methods and studies. Environmental Biology of Fishes 60: 191–223.

KOHLER, N.E., P.A. Turner, J.J. Hoey, L.J. Natanson & R. Briggs. 2002. Tag and recapture data for three pelagic sharks species: blue shark (*Prionace glauca*), shortfin mako (*Isurus oxyrinchus*) and porbeagle (*Lamna nasus*) in the North Atlantic Ocean. Collect. Vol. Sci. Pap. ICCAT, 54: 1231–1260.

KOTAS, J.E., D. Tames & A.L.M. Moreira. 2010. Espermatogênese e maturação sexual nosmachos do tubarão-azul, *Prionace glauca* Linnaeus (Elasmobranchii: Carcharhinidae), nasregiõesSudeste e Sul do Brasil. Arquivos de Ciências do Mar 43: 38–51.

KOTAS, J.E., V. Mastrochirico & M. Petrere Junior. 2011. Age and growth of the scalloped hammerhead shark, *Sphyrna lewini* (Griffith and Smith, 1834), from the southern Brazilian coast. Brazilian Journal of Biology 71: 755–761.

LANA, F., F. Hazin, P. Oliveira, M. Rego & P. Roque. 2012. Reproductive Biology, Relative Abundance and Distribution of Silky Shark, *Carcharhinus falciformis* (Muller & Henle, 1939), in the Southwestern and Equatorial Atlantic Ocean. Abstract/Vancouver 2012 AESA.

LEGAT, J.F.A. & C.M. Vooren. 2004. Reproductive cycle and migration of the blue shark (*Prionace glauca*) in South Atlantic Ocean. In: Fish Communities and Fisheries. de Carvalho, C.E., Petrere Jr. M., Rivas A.A.F. & MacKinlay D. (Eds.). Symposium proceedings, International Congress on the Biology of Fish, Manaus, Brazil. pp. 25–35.

LESSA, R., R. Paglerani & F M. Santana. 1999a. Biology and morphometry of the oceanic whitetip shark, *Carcharhinus longimanus* (Carcharhinidae), off North-esastern Brazil.Cybium 23: 353–368.

LESSA, R., F.M. Santana & R. Paglerani. 1999b. Age, growth and stock structure of the oceanic whitetip, *Carcharhinus longimanus*, from the southwestern equatorial Atlantic. Fisheries Research 42: 21–30.

LESSA, R., F.M. Santana & F.H. Hazin. 2004. Age and growth of the blue shark *Prionace glauca* (Linnaeus, 1758) off northeastern Brazil. Fisheries Research 66: 19–30.

LIPEJ, L., B. Mavrič, D. Paliska & C. Capapé. 2013. Feeding habits of the pelagic stingray, *Pterolamiops longimanus*. (Chondrichthyes: Dasyatidae) in the Adriatic Sea. Journal of the Marine Biological Association of the United Kingdom 93: 285–290.

LOEFER, J.K., G. R. Sedberry & J. C. McGovern. 2005. Vertical movements of a shortfin mako in the western North Atlantic as determined by pop-up satellite tagging. Southeastern Naturalist 4:237–246.

MACNEIL, M.A. & S.E. Campana. 2002. Comparison of whole and sectioned vertebrae for determining the age and growth of young blue shark (*Prionace glauca*). Journal of Northwest Atlantic Fishery Science 30: 77-82.

MACNEIL, M.A., G.B. Skomal & A.T. Fisk.2005. Stable isotopes from multiple tissues reveal diet switching in sharks. Marine Ecology Progress Series 302: 199–206.

MAIA, A., N. Queiroz, J.P. Correia & H.N. Cabral. 2006. Food habits of the shortfin mako, *Isurus oxyrinchus*, off the southwest coast of Portugal. Environmental Biology of Fishes 77:157–167.

MAIA, A., N. Queiroz, H.N. Cabral, A.M. Santos & J.P. Correia. 2007. Reproductive biology and population dynamics of the shortfin mako, *Isurus oxyrinchus* Rafinesque, 1810, off the southwest Portuguese coast, eastern North Atlantic. Journal of AppliedIchthyolgy 23: 246–251.

MANCINI, P. 2005. Estudo biológico-pesquero do tubarão-raposa, *Alopias superciliosus* (Lamniformes, Alopiidae) capturado no Sudeste-sul do Brasil. Dissertação do Mestre em Ciências Biológicas, Universidade Estadual Paulista "Júlio de Mesquita Filho", São Paulo. 195 pp.

MANCINI, P.L. & A.F. Amorim. 2006. Embryos of common thresher shark *Alopias vulpinus* in southern Brazil, South Atlantic Ocean. Journal of FishBiology 69: 318–321.

MAS, F. 2012. Biodiversidad, abundancia relativa y estructura poblacional de los tiburones capturados por la flota de palangre pelágico en aguas uruguayas durante 1998-2009.Tesis de Licenciatura en Ciencias Biológicas, Facultad de Ciencias, UDELAR, Montevideo, Uruguay. 95p.

MATSUNAGA, H. 2009. Tag and release of pelagic shark species by the observers on the Japanese tuna longline vessels in the Atlantic Ocean. Collect. Vol. Sci. Pap. ICCAT, 64: 1690–1692.

MAVRIČ, B., R. Jenko, T. Makovec & L. Lipej. 2004. On the occurrence of the pelagic stingray, *Dasyatias violacea* (Bonaparte, 1832), in the Gulf of Trieste (northern Adriatic). ANNALES Series HistoriaNaturalis 14: 181–186.

MAZZOLENI, R.C., M.L.D. de Oliveira & J.E. Kotas. 2004. Estudo da idade e crescimento do tubarão-martelo, *Sphyrna lewini* (Griffith& Smith, 1834), no Sudeste e Sul do Brasil, atrevés de cortes em vértebras inteiras. *En:* Resumos da IV Reunião da Sociedade Brasileira para o Estudo dos Elasmobrânquios. SBEEL, 2004.pp 118–119.

MEGALOFONOU, P., D. Damalas & C. Yannopoulos C. 2005.Composition and abundance of pelagic shark by-catch in the eastern Mediterranean Sea. Cybium 29: 135–140.

MEGALOFONOU, P., D. Damalas & De Metrio G. 2009. Biological characteristics of blue shark, *Prionace gl*auca, in the Mediterranean Sea. Journal of the Marine Biological Association of the United Kingdom, 89(6), 1233–1242.

MEJUTO, J. & B. García-Cortés. 2005. Reproductive and distribution parameters of the blue shark *Prionace glauca*, on the basis of on-board observations at sea in the Atlantic, Indian and Pacific Oceans. Collect. Vol. Sci. Pap. ICCAT, 58: 951–973.

MERSON, R.R. & H.L. Pratt. 2001. Distribution, movements and growth of young sandbar sharks, *Carcharhinus plumbeus*, in the nursery grounds of Delaware Bay. Environmental Biology Fishes 61: 13–24.

MOLLET, H.F., G. Cliff, H.L. Pratt & J.D. Stevens.2000. Reproductive biology of the female shortfin mako, *Isurus oxyrinchus* Rafinesque, 1810, with comments on the embryonic development of lamnoids. Fishery Bulletin 98: 299–318.

MOLLET, H.F., A.D. Testi, L.J.V. Compagno, & M.P. Francis. 2002. Re-identification of a lamnid shark embryo. Fishery Bulletin 100: 865–875.

MONTEALEGRE-QUIJANO, S. 2007. Biologiapopulacional do tubarão-azul, *Prionace glauca* (Linnaeus, 1758) (Carcharhinidae), naregião sudoeste do océano Atlântico. Tesis de doutorado, Universidade Federal do Rio Grande, Brasil.189p.

MONTEALEGRE-QUIJANO, S. & C.M. Vooren. 2010. Distribution and abundance of the life stages of the blue shark *Prionace glauca* in the southwest Atlantic. Fisheries Research 101: 168–179.

MORENO, J.A., J.I. Parajúa & J. Morón.1989. Biología reproductiva y fenología de *Alopias vulpinus* (Bonnaterre, 1788) (Squaliformes: Alopiidae) en el Atlántico nor-oriental y Mediterráneo occidental. Scientia Marina 53: 37–46.

MORENO, J.A. & J. Morón.1992. Reproductive biology of the bigeye thresher shark, *Alopias superciliosus* (Lowe, 1839). Australian Journal of Marine and Freshwater Research 43: 77–86.

NATANSON, L.J., J.G. Casey & N.E. Kohler. 1995. Age and growth estimates for the dusky shark, *Carcharhinus obscurus*, in the western North Atlantic Ocean. Fishery Bulletin93:116–126.

NATANSON, L.J., J.G. Casey, N.E. Kohler & T. Colket. 1998. Growth of the tiger shark, *Galeocerdo cuvieri*, in the western North Atlantic based on tag returns and length frequencies; and a note on the effects of tagging. Fishery Bulletin 97:944–953.

NATANSON, L.J. 2002a. Preliminary investigations into the age and growth of the shortfin mako, *Isurus oxyrinchus*, white shark, *Carcharodon carcharias*, and the thresher shark, *Alopias vulpinus*, in the western North Atlantic Ocean. Collect. Vol. Sci. Pap. ICCAT, 54: 1280–1293.

NATANSON, L.J., J.J. Mello & S.E. Campana. 2002b. Validated age and growth of the porbeagle shark, *Lamna nasus*, in the western North Atlantic Ocean. Collect. Vol. Sci. Pap. ICCAT, 54: 1261–1279.

NATANSON, L.J., N.E. Kohler, D. Ardizzone, G.M. Cailliet, S.P. Wintner & H.F. Mollett. 2006. Validated age and growth estimates for the shortfin mako, *Isurus oxyrinchus*, in the North Atlantic Ocean. Environmental Biology of Fishes 77: 367–383.

PADE, N.G., N. Queiroz, N.E. Humphries, M.J. Witt, C.S. Jones, L.R. Noble & D.W. Sims. 2009. First results from satellite-linked archival tagging of porbeagle shark, *Lamna nasus*: area fidelity, wider-scale movements and plasticity in diel depth changes. Journal of Experimental Marine Biology and Ecology 370: 64–74.

PASSEROTTI, M.S., J.K. Carlson, A.N. Piercy & S.E. Campana. 2010. Age validation of great hammerhead shark (*Sphyrna mokarran*), determined by bomb radiocarbon analysis. Fishery Bulletin 108: 346–351.

PIERCY, A.N., J.K. Carlson, J.A. Sulikowski, & G. Burgess. 2007. Age and growth of the scalloped hammerhead shark, *Sphyrna lewini*, in the north-west Atlantic Ocean and Gulf of Mexico. Marine and Freshwater Research 58: 34–40.

PIERCY, A.N., J.K. Carlson, & M.S. Passerotti. 2010. Age and growth of the great hammerhead shark, *Sphyrna mokarran*, in the north-western Atlantic Ocean and Gulf of Mexico. Marine and Freshwater Research 61: 992–998.

PINHAL, D., M.S. Shivji, M. Vallinoto, D.D. Chapman, O.B.F. Gadig & C. Martins. 2012. Cryptic hammerhead shark lineage occurrence in the western South Atlantic revealed by DNA analysis. Marine Biology 159: 829–836.

PORTNOY, D.S., A.N. Piercy, J.A. Musick, G.H. Burgess & J.E. Graves. 2007. Genetic polyandry and sexual conflict in the sandbar shark, *Carcharhinus plumbeus*, in the western North Atlantic and Gulf of Mexico. Molecular Ecology 16: 187–197.

PORTNOY, D.S., J.R. Mcdowell, E.J. Heist, J.A. Musick & J.E. Graves. 2010. World phylogeography and male-mediated gene flow in the sandbar shark, *Carcharhinus plumbeus*.Molecular Ecology 19: 1994–2010.

PRATT, H.W. 1979. Reproduction in the blue shark, *Prionace glauca*. Fishery Bulletin 77: 445–470.

QUATTRO, J.M., D.S. Stoner, W.B. Driggers, C.A. Anderson, K.A. Priede, E.C. Hoppmann, N.H. Campbell, K.M. Duncan & J.M. Grady. 2006. Genetic evidence of cryptic speciation within hammerhead sharks (Genus *Sphyrna*). Marine Biology 148: 1143–1155.

QUEIROZ, N., F.P. Lima, A. Maia, P.A. Ribeiro, J.P.S. Correia & A.M. Santos.2005. Movements of blue shark, *Prionace glauca*, in the north-east Atlantic based on mark-recapture data. Journal of the Marine Biological Association of the United Kingdom 85:1107–1112.

QUEIROZ, N., N.E. Humphries, L.R. Noble, A.M. Santos & D.W. Sims. 2010. Short-term movements and diving behavior of satellite-tracked blue sharks *Prionace glauca* in the northeastern Atlantic Ocean. Marine Ecology Progress Series 406: 265–279.

QUEIROZ, N., N.E. Humphries, L.R. Noble, A.M. Santos & D.W. Sims. 2012. Spatial Dynamics and Expanded Vertical Niche of Blue Sharks in Oceanographic Fronts Reveal Habitat Targets for Conservation. PLoS ONE 7(2): e32374. doi:10.1371/journal.pone.0032374.

RIBEIRO-PRADO, C.C. & A.F. Amorim. 2008. Fishery biology on pelagic stingray *Pteroplatytrygon violacea* caught off southern Brazil by longliners settled in São Paulo State (2006-2007). Collect. Vol. Sci. Pap. ICCAT, 62: 1883–1891.

ROMINE J.G., J.A. Musick & G.H. Burgess. 2009. Demographic analyses of the dusky shark, *Carcharhinus obscurus*, in the Northwest Atlantic incorporating hooking mortality estimates and revised reproductive parameters. Environmental Biology of Fishes 84:277–289.

SAÏDI, B., M.N. Bradaï, A. Bouaïn, O. Guélorget & C. Capapé. 2005. The reproductive biology of the sandbar shark,*Carcharhinus plumbeus* (Chondrichthyes: Carcharhinidae),from the Gulf of Gabès (southern Tunisia, central Mediterranean). Acta Adriatica 46: 47–62.

SANTANA, F.M. & R.P. Lessa. 2004. Age determination and growth of the night shark (*Carcharhinus signatus*) off the northeastern Brazilian coast. Fishery Bulletin 102: 156–167.

SAUNDERS, R.A., F. Royer & M.W. Clarke. 2011. Winter migration and diving behaviour of porbeagle shark, *Lamna nasus*, in the northeast Atlantic. ICES Journal of Marine Science 68: 166–174. doi:10.1093/icesjms/fsq145

SCHREY, A.W. & E.J. Heist. 2003. Microsatellite analysis of population structure in the shortfin mako *Isurus oxyrinchus*. Canadian Journal of Fisheries and Aquatic Sciences 60: 670–675.

SKOMAL, G.B. & L.J. Natanson. 2003. Age and growth of the blue shark (*Prionace glauca*) in the North Atlantic Ocean. Fishery Bulletin 101: 627–639.

SMINKEY, T.R. & J.A. Musick.1995. Age and growth of the sandbar shark, *Carcharhinus plumbeus*, before and after population depletion. Copeia1995:871–883.

SPRINGER, S. 1960. Narural history of the sandbar shark *Eulamiamiberti*. Fishery Bulletin 61:1–38.

STEVENS, J.D. 1975. Vertebral rings as a means of age determination in the blue shark (*Prionace glauca* L.). Journal of the Marine Biological Association of the United Kingdom 55: 657–665.

STEVENS, J.D. 1976.First results of shark tagging in the north-east Atlantic. Journal of the Marine Biological Association of the United Kingdom 56: 929–937.

STILLWELL, C.D and J.G. Casey. 1976. Observations on the bigeye thresher shark, *Alopias superciliosus*, in the western North Atlantic. Fishery Bulletin 74: 221–225.

TAMBOURGI, M.R. 2010. Biologia reproductiva do tubarão galha-branca oceánico, *Carcharhinus longimanus*, no Atlantico Sudoeste e Equatorial. Universidade Federal Rural de Pernambuco, Departamento de Pesca e Aqüicultura, Programa de pos-graduação em recursos pesqueiros e aqüicultura. 55 p.

TAVARES, R., M. Ortiz & F. Arocha. 2012. Population structure, distribution and relative abundance of the blue shark (*Prionace glauca*) in the Caribbean Sea and adjacent waters of the North Atlantic. Fisheries Research 129-130: 137–152.

TEIXEIRA, A.F. 2011. Análise da variabilidade e estruturação genética do tubarão azul, *Prionace glauca* (Chondrichthyes, Carcharhinidae) no OceanoAtlântico Sul Ocidental utilizando marcador molecular do DNA mitocondrial. MScThesis, Universidade Estadual Paulista, Botucatu, Brasil. 50p.

TREJO, T. 2005. Global population structure of thresher sharks (*Alopias* spp.) based upon mitochondrial DNA control region sequences. M.Sc. dissertation. Moss Landing Marine Laboratories, California State University, Monterey Bay, CA. 76 p.

USSAMI, L.E.F. 2011. Análise da Variabilidade e Estruturação Genética do Tubarão-Azul, *Prionace glauca* (Chondrichthyes, Carcharhinidae) na Costa Brasileira, Utilizando Marcadores Microssatélites.MScThesis, Universidade Estadual Paulista, Botucatu, Brasil. 68p.

VASKE JÚNIOR, T., C.M. Vooren & R.P. Lessa.2009a. Feeding strategy of the night shark (*Carcharhinus signatus*) and scalloped hammerhead shark (*Sphyrna lewini*) near seamounts off northeastern Brazil. Brazilian Journal of oceanography 57: 97–104.

VASKE JÚNIOR, T., R.P. Lessa & O.B.F. Gadig. 2009b. Feeding habits of the blue shark (*Prionace glauca*) off the coast of Brazil. Biota Neotropica 9: 55–60.

VASKE JÚNIOR, T. & M.M. Rotundo. 2012. Inshore occurrences of the pelagic stingray, *Pteroplatytrygon violacea* (Bonaparte, 1832) (Elasmobranchii: Dasyatidae), in São Paulo State, southeastern Brazil. Pan-American Journal of Aquatic Sciences 7:182–186.

VAUDO, J., B. Wetherbee, P. Howey & M. Shivji. 2012. Vertical movements of tiger sharks (*Galeocerdo cuvier*) tagged in the US Virgin Islands. Abstract/Vancouver 2012 AESA.

VÉRAS, D.P., I.S.L. Branco, F.H.V. Hazin, C. Wor & M. Travassos Tolotti. 2009a. Preliminary analysis of the reproductive biology of pelagic stingray (*Pteroplatytrygon violacea*) in the southwestern Atlantic. Collect. Vol. Sci. Pap. ICCAT, 64: 1755–1764.

VÉRAS, D.P., T. VaskeJúnior, F.H.V. Hazin, R.P. Lessa, P.E. Travassos, M.T. Tolotti & T.M. Barbosa. 2009b. Stomach contents of the pelagic stingray (*Pteroplatytrygon violace)* (Elasmobranchii: Dasyatidae) from the tropical Atlantic. Brazilian Journal of Oceanography 57: 339–343.

VOOREN, C.M., S. Klippel & A.B. Galina. 2005. Biologia e status conservação dos tubarão-martelo *Sphyrnalewini* e *S. zygaena*. En: Vooren C.M. & Klippel S. (eds.), Ações para a conservação de tubarões e raias no sul do Brasil. Igaré, Porto Alegre. pp. 97–112.

WENG, K.C. & B.A. Block. 2004. Diel vertical migration of the bigeye thresher shark (*Alopiass superciliosus*), a species possessing orbital retia mirabilia. Fishery Bulletin 102: 221–229.

WILSON, P.C. & J.S. Beckett. 1970. Atlantic Ocean distribution of the pelagic stingray, *Dasyatis violacea*. Copeia1970: 696–707.

WOOD, A.D., B.M. Wetherbee, F. Juanes, N.E. Kohler & C.Wilga. 2009. Recalculated diet and daily ration ofthe shortfin mako (*Isurus oxyrinchus*), with a focus on quantifying predation on bluefish (*Pomatomus saltatris*) in the northwest Atlantic Ocean. Fishery Bulletin 107:76–88.

References to Tables in Appendix8 of Documents Presented at ICCAT to Provide Information to the Shark Working Group During Their Meeting in 2011 That Were Subsequently Withdrawn by the Authors

FERNADEZ-CARVALHO, J., R. Coelho, S. Amorim & M. Neves Santos. 2011b. Maturity of the bigeye thresher, *Alopias superciliosus*, in the Atlantic Ocean (SCRS/2011/086).

HOFFMAYER, E.R., J.S. Franks & W.B. Driggers. 2011a. Habitat use patterns and environmental preferences of juvenile silky sharks, *Carcharhinus falciformis*, in the Northern Gulf of Mexico (SCRS/2011/102).

HOFFMAYER, E.R., J.S. Franks & W.B. Driggers.2011b. Habitat, seasonal movements and environmental preferences of dusky sharks, *Carcharhinus obscurus*, in the Northern Gulf of Mexico (SCRS/2011/101).

HOFFMAYER, E.R., J.S. Franks & W.B. Driggers. 2011c. Diel vertical movements of a scalloped hammerhead, *Sphyrna lewini*, in the northern Gulf of Mexico based on high-rate archival pop-off tag data (SCRS/2011/100).

MILLER, P. & A. Domingo. 2011. Ítems alimenticios del tiburón tigre (*Galeocerdo cuvier*) en aguas sub-tropicales del Océano Atlántico Sur occidental (SCRS/2011/094).

MILLER, P., E. Cortés, J. Carlson, S. Gulak & A. Domingo. 2011. Movimientos y uso de hábitat del tiburón azul (*Prionace glauca*) en el Océano Atlántico Suroccidental: resultados obtenidos mediante telemetría satelital. (SCRS/2011/092).

TAGUCHI, M., T. Kitamura & K. Yokawa. 2011. Genetic population structure of shortfin mako (*Isurus oxyrinchus*) inferred from mitochondrial DNA on interoceanic scale. ISC/11/SHARKWG-1/02.

Additional References Provided During the Meeting But Not Considered to Elaborate the Tables in Appendix 8

BIERY, L. & D. Pauly. 2012. A global review of species-specific shark fin to body mass ratios and relevant legislations. J. Fish. Biol., 80: 1643-1677.

BONFIL, R., S. Clarke & H. Nakano. 2008. The biology and ecology of the oceanic whitetip shark, *Carcharhinus longimanus*. Pp. 129-139. *In*: Camhi M., Pikitch E., Babcock E. (eds.), Sharks of the open ocean; biology, fisheries and conservation. Blackwell Publishing Ltd.

BRANCO, V., J. Canario, C. Vale, J. Raimundo & C. Reis C. 2004. Total and organic mercury concentrations in muscle tissue of the blue shark (*Prionace glauca* L.1758) from the Northeast Atlantic. Mar. Pol. Bull., 49 (9–10): 871–874.

BRUCE, B. 2008. The biology and ecology of the white shark, *Carcharodon carcharias*. Pp. 69-81. *In*: Camhi M., Pikitch E., Babcock E. (eds.) Sharks of the open ocean; biology, fisheries and conservation. Blackwell Publishing Ltd.

CAILLET, G., L. Natanson, B. Welden & D. Ebert. 1985. Preliminary studies on the age and growth of the white shark, *Carcharodon carcharias*, using vertebral bands. Mem. S. Calif. Acad. Sci., 9: 49-60.

Campana S., Marks L., Joyce W., Hurley P., Showell M., Kulka D., 1999. An analytical assessment of the porbeagle shark (*Lamna nasus*) population in the northwest Atlantic. CSAS. Res. Doc. 99/158.

CAMPANA, S., L. Marks, W. Joyce & N. Kohler. 2004. Influence of recreational and commercial fishing on the blue shark (*Prionace glauca*) population in Atlantic Canadian Waters. Canadian Science Advisory Secretariat Research Document 2004/069: 67 p.

CAMPANA, S., L. Marks, W. Joyce & N. Kohler. 2005. Catch, by-catch and indices of population status of blue shark (*Prionace glauca*) in the Canadian Atlantic. Collect. Vol. Sci. Pap. ICCAT, 58(3): 891-934.

CASEY, J. & H. Jr Pratt. 1985. Distribution of the white shark, *Carcharodon carcharias*, in the western North Atlantic. Mem. Southern Calif. Acad. Sci., 9: 2-14.

COELHO, R. & G. Burgess. 2009. Notes on the reproduction of the oceanic whitetip shark, *Carcharhinus longimanus* in the south-western equatorial Atlantic Ocean. Collect. Vol. Sci. Pap. ICCAT, 64(5): 1734-1740.

CORTÉS, E. 2000; Life history patterns and correlations in sharks. Rev. Fish. Sci., 8(4): 299-344.

CORTÉS, E. & J. Neer. 2006. Preliminary reassessment of the validity of the 5% fin to carcass weight ratio for sharks. Collect. Vol. Sci. Pap. ICCAT, 59: 1025-1036.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2006. Assessment and Status Report on the Blue Shark, *Prionace glauca*, Atlantic Population, Pacific Population, in Canada. COSEWIC, Ottawa, Ontario.

COULL, K., A. Jermyn, A. Newton, G. Henderson G. & W. Hall.1989. Length/weight relationships for 88 species of fish encountered in the North Atlantic. *Scottish Fish. Res. Rep.,* 43: 1-80.

CRUZ-RAMIREZ, A., S. Soriano-Velásquez, H. Santana-Hernández, C. Ramírez-Santiago & D. Acal-Sánchez. 2012. Aspectos reproductivos del tiburón azul *Prionace glauca* capturado por la flota palangrera de mediana altura del Puerto de Manzanillo, Colima. Ciencia Pesquera, 20(1): 39-48.

DE METRIO, G., M. Cacucci, M. Deflorio, S. Desnatis & N. Santamaria. 2000. Incidenza della pesca ai grandi pelagici sulle catture di squali. Biol. Mar. Medit., 7(1): 334-345.

FRANCIS, M.1996. Observations on a pregnant white shark with a review of reproductive biology. Pp. 157-172. *In*: Klimley A., Ainley D. (eds.), Great White Sharks: the biology of *Carcharodon carcharias*. Academic Press, Inc., New York.

FRANCIS, M., L. Natanson & S. Campana. 2008. The biology and ecology of the porbeagle shark, *Lamna nasus*. Pp. 105-113. *In*: Sharks of the open ocean. Fish and Aquatic Ressourcces Series 13.

FROTA, L., P. Costa & A. Braga. 2004. Length-weight relationships of marine fishes from the central Brazilian coast. NAGA WorldFish Center Q., 27(1&2): 20-26.

GARCIA-ARTEAGA, J., R. Claro & S. Valle. 1997. Length-weight relationships of Cuban marine fishes. NagaICLARM Q., 20(1): 38-43

GARRICK, J. 1967. Revison of sharks of genus *Isurus*with description of a new species (Galeoidae, Lamnidae). Proc. U.W. Natl. Mus., 118: 663-690.

GRUBER, S. & L.J.V. Compagno. 1981. Taxonomic status and biology of the bigeye thresher *Alopias superciliosus*. Fisher. Bull., 79: 617-40.

GUITART-MANDAY, D. 1966. Nuevo nombre para una especie de tihuron del genro *Isurus* (Elasmobranchii: Isuridae) de aguas Cubanas. Poeyana, 15: 1-9.

HAZIN, F., C. Boeckman, E. Leal, R. Lessa, K. Kihara K. & K. Otsuka.1994. Distribution and relative abundance of the blue shark, *Prionace glauca*, in the southwestern equatorial Atlantic Ocean. Fish. Bull., 92 : 474-480.

HAZIN, F., R. Lessa, M. Ishio, K. Otsuka & K. Kihara. 1991. Morphometric description of the blue shark, *Prionace glauca*, from the southwestern equatorial Atlantic. Tokyo Suisandai Kempo,78: 137-144.

IGFA. 2001. Database of IGFA angling records. IGFA, Fort Lauderdale, USA.

KOHLER, N.E. 1987. Aspects of the feeding ecology of the blue shark, *Prionace glauca*, in the western North Atlantic. PhD Dissertation, University of Rhode Island, Kingston, 163p.

KOTAS, J. & M. Petrere. 2002. Análise da distribuição e abundância relativa dos tubarões-martelo (*Sphyrna lewini* e *Sphyrna zygaena*) através do modelo linear generalizado (GLM). Capítulo da tese de doutoramento. Escola de Engenharia de São Carlos. CRHEA-USP.

McCORD, M., S. Campana. 2003. A quantitative assessment of the diet of the blue shark (*Prionace glauca)* off Nova Scotia, Canada. J. Nthwest. Atl. Fisher. Sci., 32: 57–63.

MEGALOFONOU, P., C. Yannopoulos, D. Damals, G. De Metrio, M. Delflorio, J. De La Serna & D. Macias. 2005. Incidental catch and estimated discards of pelagic sharks from the swordfish and tuna fisheries in the Mediterranean Sea. Fish. Bull., 103: 620-634.

MOLLET, H. & G. Cailliet. 1996. Using allometry to predict body mass from linear measurements of the white shark. Pp. 81-90. *In*: Klimley A., Ainley D. (eds.) Great white sharks. The biology of *Carcharodon carcharias*. Academic Press, Inc., San Diego.

NAKANO, H. & M. Seki. 2002. Synopsis of biological data on the blue shark, *Prionace glauca* Linnaeus. Bull. Fish. Res., 6: 18-55.

NAKANO, H. & J. Stevens. 2008. The biology and ecology of the blue shark, *Prionace glauca*. *In*: Camhi M., Pikitch E., Babcock E. (Eds.). Sharks of the open Ocean. Blackwell Scientific UK., 536 p.

NEVES DOS SANTOS, M. & A. Garcia. 2005. Factors for conversion of fin weight into round weight for the blue shark (*Prionace glauca*). Collect. Vol. Sci. Pap. ICCAT, 58(3): 935-941.

O'BOYLE, R., G. Fowler, P. Hurle, W. Joyce & M. Showell. 1998. Update on the status of NAFO SA 3–6. Porbeagle shark (*Lamna nasus*). Canadian Stock Assessment Secretariat Research Document: 98/41: 2-58.

OLIVEIRA, P., F. Hazin, F. Carvalho, M. Rego, R. Coelho, A. Piercy & G. Burgess. 2010. Reproductive biology of the crocodile shark *Pseudocarcharias kamoharai*. J. Fish. Biol., 76(7): 1655-1670.

PRATT, H.W. Jr., 1996. Reproduction in the male white shark. Pp. 131-138. *In*: Klimley A., Ainley D. (eds.) Great white sharks: the biology of *Carcharodon carcharias*. Academic Press, Inc.

RANDALL, J. 1973. Size of the great white shark (*Carcharodon*). Science, 181: 169-170.

RANDALL, J. 1992. Review of the biology of the tiger shark (*Galeocerdo cuvier*). Aust. J. Mar. Freshw. Res., 43: 21–31.

RIVERA-LOPEZ, J. 1970. Studies on the biology of the nurse shark, *Ginglymostoma cirratum* Bonnaterre, and the tiger shark, *Galeocerdo cuvieri* Peron and Le Sueur. MS thesis, Mayaguez, Puerto Rico.

SANZO, L. 1912. Embrione di *Carcharodon rondeletii* M. Hie. (?) con particolare disposizione del sacco vitellino. Regio Comitate Talassografico Italiano, Memoria, 11: 1-12.

SHANKS, A. 1988. Whole weight/length and gutted weight/length relationships for porbeagles. DAFS Marine Laboratory Internal Report.

SMITH, J.1951. A juvenile of the man-eater *Carcharodon carcharias* Linn. Ann. Mag. Nat. Hist., 4: 729-736.

SMITH, S., D. Au & C. Show. 1998. Intrinsic rebound potentials of 26 species of Pacific sharks. Aust. J. Mar. Freshw. Res., 49: 663–678.

SMITH, S., R. Rasmussen, D. Ramon & G. Cailliet. 2008. The biology and ecology of thresher sharks (Alopiidae). Pp 60-68. *In*: Camhi M., Pikitch E., Babcock E. (eds.), Sharks of the open ocean: biology, fisheries and conservation. Blackwell Science.

STEVENS, J.D. 1983. Observation on reproduction in the shortfin mako *Isurus oxyrinchus*. Copeia, 1983(1): 126-130.

STEVENS, J. & B. Brown.1974. Occurrence of heavy metals in the blue shark (*Prionace glauca)* and selected pelagic in the N.E. Atlantic Ocean. Mar. Biol., 26: 287–293.

STORELLI, M., R. Giacominelli-Stuffer & G. Marcotrigiano. 2001. Total mercury and methyl mercury in tuna fish and sharks from the South Adriatic Sea. Ital. J. Food Sci., 13 (1): 101–106.

SUDA, A. 1953. Ecological study on the Blue shark *(Prionace glauco* Linne). South Sea Area Fish. Res. Lab. Rep., 26: 1-11.

TAGUCHI, M., T. Kitamura & K. Yokawa. 2011. Genetic population structure of shortfin mako (*Isurus oxyrinchus*) inferred from mitochondrial DNA on interoceanic scale. ISC/11/SHARKWG-1/02.

TANAKA, S., G. Cailliet & K. Yudin. 1990. Differences in growth of the blue shark, *Prionace glauca*: technique or population? Pp. 177-187. *In*: Pratt H. Jr., Gruber S., Taniuchi T. (eds.), Elasmobranchs as Living Resources: Advances in the Biology, Ecology, Systematics, and Status of the Fisheries. NOAA Tech. Rep., 90.

TELLES, A. 1970. Presence de *Alopias superciliosus* (Lowe) dans les mers du Portugal. Remarques sur les *Alopias* (Selachii) recents et fossiles. Arquivos do Museu Bocage, 11(19) : 363-78.

TORRES, F. Jr. 1991. Tabular data on marine fishes from southern Africa, Part I. Length-weight relationships. Fishbyte, 9(1): 50-53.

TRICAS, T. & J. McCosker. 1984. Predatory behavior of the white shark (*Carcharodon carcharias*), with notes on its biology. Proc. Calif. Acad. Sci., 43: 221-238.

UCHIDA, S., F. Yasuzumi, M. Toda & N. Okura.1987. On the observations of reproduction in *Carcharodon carcharias* and *Isurus oxyrinchus.* Rep. Japanese Group for Elasmobranch Studies, 24: 5-6.