

WORKSHOP ON THE SHARK RESEARCH AND DATA COLLECTION PROGRAM (SRDCP)

(Hybrid/Madrid (Spain), 13-15 July 2023)

Anonymous

SUMMARY

The workshop was held in Madrid, in hybrid format, from 13 to 15 July 2023. The main objectives of the workshop were to review the 10 years of the Shark Research and Data Collection Program (SRDCP), to present and discuss the results obtained and the ongoing activities, and discuss the perspectives for the coming years. The difficulties faced by the program and possible ways to overcome them were discussed. Future steps for the next phase of the program were also discussed, including new species that are part of the ICCAT agreement, advances in available information on pelagic sharks outside of the SRDCP, activities to be continued, and new activities to be included.

RÉSUMÉ

L'atelier s'est tenu à Madrid, dans un format hybride, du 13 au 15 juillet 2023. Les principaux objectifs de cet atelier visaient à passer en revue les 10 années du Programme de recherche et de collecte de données sur les requins (SRDCP), à présenter et discuter des résultats obtenus et des activités en cours et à débattre des perspectives pour les prochaines années. Les difficultés rencontrées par le programme et les éventuels moyens pour les surmonter ont été discutés. Les futures étapes de la prochaine phase du programme ont également été discutées, y compris les nouvelles espèces qui font partie de l'accord ICCAT, les progrès dans les informations disponibles sur les requins pélagiques en dehors du SRDCP, la poursuite de certaines activités et l'inclusion de nouvelles autres.

RESUMEN

El taller se celebró en Madrid, en formato híbrido, del 13 al 15 de julio de 2023. El objetivo principal del taller era hacer un balance de los 10 años del Programa de recopilación de datos e investigación sobre tiburones (SRDCP), presentar y debatir los resultados obtenidos y las actividades en curso, así como las perspectivas para los próximos años. Se debatieron las dificultades a las que se enfrenta el programa y las posibles formas de superarlas. También se presentaron y debatieron los pasos que llevar a cabo para la siguiente fase del programa, incluidas las nuevas especies que forman parte del acuerdo de ICCAT, los avances en la información disponible sobre tiburones pelágicos fuera del SRDCP, las actividades que deben continuarse y las nuevas actividades que deben incluirse.

Introduction

This document presents the activities and conclusions of the workshop on the Shark Research and Data Collection Program (SRDCP) held from 13 to 15 July. The aim of the workshop was to review the 10 years of the SRDCP, present and discuss the results obtained and the ongoing activities and discuss the perspectives for the coming years. A historical view of the SRDCP was presented. The activities carried out were addressed: age and growth studies; genetics; movements and habitat utilization; post-release mortality; reproduction studies; improvement of available information for population assessment; other activities. The difficulties faced by the program and possible ways to overcome them were discussed. Future steps for the next phase (phase 2) of the program were also discussed, including new species that are part of the ICCAT agreement, advances in available information on pelagic sharks outside of the SRDCP, activities to be continued, and new activities to be included. In order to establish the outline of the SRDCP and following what was done in 2013, participants agreed to develop a data gap analysis to guide research and data collection in the coming years.

Other discussions focused on the need for greater flexibility and more efficient mechanisms for the submission of samples of CITES-listed species, taking into account that currently 92% of shark species in the ICCAT Convention are listed under CITES. This aspect was considered crucial, as the feasibility to continue the SRDCP and to contribute to the advice of the SCRS and Commission partly depends on CITES regulations. During the workshop, it was also deemed necessary to promote the activities of the ICCAT tagging group and for scientists to put more emphasis on conventional shark tagging.

1. Opening, adoption of agenda and meeting arrangements.

The Shark Species Group Rapporteur and meeting Chairman, Rodrigo Forselledo, opened the meeting and welcomed the participants (the Group). The Assistant Executive Secretary, Miguel Neves dos Santos, greeted the participants. The meeting agenda was adopted and is contained in **Appendix 1**. The List of participants is included in **Appendix 2**. The following participants served as rapporteurs:

<i>Section</i>	<i>Rapporteur</i>
Item 2	Cortés E., Domingo A, Forselledo R.
Item 3.a	Coelho R.
Item 3.b	Semba Y., Junge C.
Item 3.c	Coelho R., Carlson J.
Item 3.d	Bowlby H.
Item 3.e	Cortés E., Forselledo R.
Item 3.f	Cortés E., Cardoso G.
Item 4	Coelho R., Forselledo R.
Item 5.a	Santos M., Kerwath S., Domingo A.
Item 5.b	Bowlby H., Mas F., Cardoso G., Carlson J.
Item 5.c	Coelho R., Bowlby H.
Item 5.d	Coelho R., Forselledo R.
Item 6	Coelho R., Domingo A., Cortés E., Forselledo R.

2. History and overview of the Shark Research and Data Collection Program (SRDCP)

Presentation SCRS/P/2023/089 provided an overview of the background and history of the Shark Research and Data Collection Program (SRDCP).

During 2007 a meeting of the shark species group was held to review the available information, including tagging data and biological parameters, to carry out the assessment of the shark stocks scheduled for 2008 (BSH and SMA) and to define a work plan to be carried out prior to the assessments. In addition, in the same year, the group set out to conduct a rapid assessment of the vulnerability of other pelagic shark species to overfishing, based on demographic data and risk analysis, and to assess their susceptibility to fisheries based on available observer data.

In 2008, the first ERA (SRCS/2008/140) was carried out through collaborative work between several ICCAT scientists who were involved in the shark group. That same year, the first conservation recommendation resulting from this work was issued for one of the species included in the analysis, Rec. 08-07 for bigeye thresher shark (*Alopias superciliosus*). This was also the first conservation recommendation for pelagic sharks originating from the tuna RFMOs.

In 2009 a joint meeting was held with ICES for the assessment of Porbeagle, the first meeting of ICCAT in conjunction with another RFMO for the assessment of a species distributed in both regions (ICCAT-ICES). This meeting resulted in recommendations from the group to develop research projects on a regional scale and collaboratively among scientists. During 2009 and 2010, the Commission extended the Conservation Recommendations to additional shark species (Rec. 09-07 Thresher sharks, Rec. 10-07 Oceanic whitetip shark (*Carcharhinus longimanus*), Rec. 10-08 Hammerhead sharks), basing them on the 2008 ERA.

In 2011 the group set out to advance the ERA and during the preparatory meeting compiled information and recommendations on different aspects that were considered necessary for research and future assessments. That same year the Commission approved, based on the 2008 ERA, the inclusion of the Silky shark (*Carcharhinus falciformis*) in the conservation measures (Rec. 11-08).

In 2012, in conjunction with the submission of a new and improved ERA, the Shark Species Group recommended the elaboration of a Special Research Program on sharks focused on the reduction of the main sources of uncertainty in the formulation of scientific advice. The program was to be defined during 2013 and framed within the SCRS Science Strategic Plan foreseen for 2014-2020.

The SRDCP was included as Appendix 7 of the 2013 Shark Intersessional Meeting report. It included the following items: A) Introduction; B) Pelagic sharks In the Atlantic Ocean and Mediterranean Sea: current biological knowledge; fisheries information; species stock assessments; current management; previous research recommendations of the Shark Species Group; and C) the Shark Research Program itself consisting of: 1) Fisheries data collection; 2) Data-poor assessment models; 3) Recovery of historical data; 4) Trade data; 5) Observer programs; 6) Biological information; 7) Bycatch mitigation; and 8) Other considerations for the Shark Research Program.

One of the products of the SRDCP was to apply a traffic light approach to categorize the level of information (expressed as number of studies) available by topic in four geographical areas. The results of this approach is presented in **Table 1**.

Furthermore, species were classified in terms of “data poorness” (proportion of red cells in the above table; i.e. with no information) and “data richness” (proportion of green cells in the above table; i.e. with 3+ studies) (**Table 2**).

The SRDCP also included detailed tables summarizing the availability of life history parameters in 11 areas of the Atlantic and Mediterranean for the 16 ERA species, but only the references for the original studies were included in the table (**Table 3**).

During the 2014 Sharks Species intersessional meeting held in Piriápolis, Uruguay, the Group agreed to collapse the areas presented in those tables to three main areas (North Atlantic, South Atlantic, Mediterranean) and populate them with the actual parameter values or inputs when possible, to facilitate use in future assessments. Tables were produced for the 16 ERA species. As an example, the blue shark table is presented in **Table 4**.

At the Tenerife, Spain, 2015 intersessional meeting the Group presented four project proposals for funding covering different aspects of the life history, stock structure, and fisheries of the shortfin mako: 1) a pan-Atlantic age and growth study; 2) a population genetics study to estimate stock structure and phylogeography; 3) a movement, stock boundaries, and habitat use study; and 4) a post-release mortality (archival tagging) study focusing on pelagic longline fisheries.

The next year (2016), at the Madeira, Portugal intersessional meeting these four projects initiated in 2015 were continued. As part of the work, an Age and Growth workshop was held in Narragansett, Rhode Island, USA, where a reference set based on 60 vertebrae was established, digital imaging enhancing techniques discussed, and ageing methodologies standardized. This work was continued in 2017 and three new projects focusing on porbeagle were proposed: 1) a reproductive study; 2) a population genetics study; and 3) a movement and habitat use study. As part of this work, a two-day, hands-on training session on determination of reproductive maturity of porbeagle sharks was held at the Narragansett, Rhode Island, NOAA Fisheries NEFSC Laboratory. During this training, scientists from the participating laboratories (NOAA SEFSC and NEFSC) worked together to collect reproductive organ samples to aid in determining reproductive habits and maturity for the species. The training was aimed at establishing standardized dissecting and sampling practices among researchers for more consistent collection of life history data.

In 2018, a movement, stock boundaries, and habitat use study on silky sharks was added to the research portfolio. A new approach using mitochondrial-genome sequencing was also proposed to investigate the genetic population structure of shortfin mako, which the Group welcomed because it could help elucidate the stock delimitation of this species in the Atlantic, particularly the differences between the southwest and southeast Atlantic related to the high heterogeneity and low genetic diversity from the Uruguayan samples.

In 2019, the movement, stock boundaries, and habitat use study added two other priority species (oceanic whitetip shark and scalloped hammerhead) to the list of species to be electronically tagged. In 2020, all activities continued but were severely impaired by the onset of the Covid-19 pandemic. There was also discussion on the use of Close-Kin Mark Recapture (CKMR) for the South Atlantic stock of shortfin mako.

In 2020 a workshop on reproductive and other life history aspects of the porbeagle and other pelagic sharks in the Atlantic Ocean was held in Olhão, Portugal.

All these activities continued during 2021 and in 2022, and the longfin mako was included.

Table 5 summarizes the timeline of biological and other activities by topic and species conducted under the SRDCP since 2015 (with the addition of the two ERAs that were conducted in 2008 and 2012 as a precursor to work of the plan).

All this work is also reflected in the numerous SCRS papers and peer-reviewed articles that have been produced as a result of SRDCP activities (**Table 6**). At least 26 documents were submitted to the SCRS, and 8 peer-reviewed publications were produced under the SRDCP between 2014 and 2022. Most of these documents are included in the References section.

During the workshop, some aspects of the activities developed to date within the SRDCP were highlighted by the group: 1) the independence of the group, generating proposals to improve the conservation of these species; 2) the generation of collaborative work between ICCAT scientists with a scientific perspective, which can then lead to management measures; and 3) proposing and holding meetings independently from the assessments, focused on reflecting and elaborating processes, without the pressure of stock assessments.

3. Main results obtained and ongoing activities.

3.1 Age and growth

Presentation SCRS/P/2023/082 provided an overview of the age and growth studies within the SRDCP. To date, most efforts have been made for shortfin mako ageing, with the work for the North Atlantic completed in 2017 and used for the stock assessment, while the South Atlantic work is ongoing. Ageing for other species, as well as age validation, has been done by some research groups but not within the SRDCP, and that can be planned now for future activities.

After the presentation, several national scientists from various CPCs highlighted that they have stored and, in some cases, keep collecting vertebral samples from several shark species that they can contribute to the SRDCP work.

The template for a summary table was prepared that can be filled out online by the national scientists, with the numbers of samples that are available and could be used for such collaborative ageing studies. Additionally, a meta-database will also be prepared, to fill out with the actual sample characteristics (e.g., size, sex, location, collection date). That information will be used to establish priorities for species/stocks to perform the ageing studies, and also to check for samples that might be suited for age validation with bomb-radiocarbon techniques. These tables are available online, and the national scientists are asked to fill them out with their available samples for this summary and planning work. This form has two specific tables, one with the summary data on numbers of vertebrae and another with the actual samples meta-data.

Participants inquired about sampling on species for which an ICCAT Recommendation prohibits retention. It was highlighted that ICCAT has a Recommendation that allows CPCs to sample tissues, including vertebrae, on no-retention sharks under certain conditions [See Rec 13-10]. A brief comment was also made on CITES given that many pelagic sharks are now listed in CITES. In that case the CPCs will have to coordinate with their national CITES authorities the permits to export/import the samples collected on those species.

Within the specific case of the North Atlantic Porbeagle shark, the group noted that it would be useful to coordinate with ICES, as they have also been doing biological work on that species. For the South, it was noted that it would be useful to coordinate with Argentina, that even though it is not a member of ICCAT, porbeagle specimens are caught in their trawl fisheries.

With regards to the SE Atlantic, the group noted that along the South Africa coast there is a continuity of many pelagic species, including shortfin mako, that depending on yearly environmental conditions can move between ICCAT and IOTC management regions. In these cases, it would be useful to include samples from the IOTC region along that area, that are likely from the same population that also moves to SE Atlantic.

The group made a comment about the general lack of information and samples from the Mediterranean shark stocks. It would be important to reach CPCs from that region to verify if some work can be started there. A comment was made on the marine turtle initiative of the Sub-Committee on Ecosystems and Bycatch in the Mediterranean Sea, which could perhaps serve as a link with the activities of the shark group.

Presentation SCRS/P/2023/083 provided the status of the work and ongoing activities of the age and growth of shortfin mako shark in the North and South Atlantic. The presenter summarized that the work for the North Atlantic SMA was done mostly between 2015-2017 and used for the latest SMA stock assessment. With regards to the South, efforts on sampling have continued, and currently all available vertebrae have been sectioned and digitally photographed. The workplan is to have all ages estimated by December 2023, and then fit growth models in 2024.

The group noted that there is a SMA stock assessment planned for 2024, so it would be important to have that growth work in time for the stock assessment.

Some CPCs have also noted that they continue to sample SMA. In the specific cases of Brazil and South Africa, they would have samples of larger specimens, which would be particularly useful for growth work. The group noted that with regards to SMA, we still do not have a good understanding of their size structure. In some cases, like in the South African protective nets and in the USA sports fisheries there are catches of larger adults, but the vast majority of catches and samples from the industrial fisheries are smaller specimens. This poses a problem not only for the ageing and other scientific work, but also for the stock assessments.

A comment was made about the ageing methods. Some brief comments were also made about the use of alternative or additional methods, such as back-calculation or Bayesian approaches, in those cases where parts of the size structure are missing.

3.2 Genetics

The presentation SCRS/P/2023/087 gave an overview of the genetic work carried out in the framework of the SRDCP. Genetic work in the framework of the SRDCP started in 2015, with SMA as the main target species to investigate its population structure and phylogeography. The SMA approach was based on the importance of the species from a fisheries point of view, as well as on the fact that the DNA markers used in surveys to date were limited and that the stock structure results based on the approach used had a high uncertainty in the estimated structure. During 2016-2017 the sampling area and the number of microsatellite DNA markers were improved. Mt DNA (mitochondria DNA) analysis suggested the existence of multiple populations in the South Atlantic (SW, SC and SE), while Ms DNA (microsatellite DNA) analysis suggested that there was no genetic differentiation. During 2019-2020, whole mitochondrial genome analysis and nuclear-genome-wide SNP (GBS) genotyping approach using NGS were started. In 2021, mitogenome and nuclear-genome-wide SNP were analyzed, and nuclear genome analysis suggested 2 genetically different groups (α & β) in the Atlantic. These results supported 2 distinct clades in the Atlantic for both of these DNA markers for the first time. In 2022, additional analyzes were carried out for SE Atlantic, SE Pacific and SW Indian Ocean. Based on the dataset covering global distribution, mitogenome analysis suggested 6 sub-clades in the extended area and nuclear genome analysis indicated two distinct genetic group (α & β) occurs with predominant occurrence of β type in the tropical area and α type in other areas of the Atlantic Ocean.

During this period of the SRDCP, the resolution of analysis (i.e., information derived from DNA) was largely improved. Based on mitochondrial DNA, 2 distinct clades occurs in the Atlantic (6 sub clades suggested for more extended areas including southern Indian Ocean and Pacific) and at least, separate management of North and South population would be practical. Regarding the interpretation of the results, especially for that of nuclear DNA suggesting predominant occurrence of β type mostly in the central Atlantic (tropical area) and α type in other areas, further work is necessary.

In this context, three main aspects were raised about what remains to be done on genetic issues with the SMA: 1. Refinement of SMA reference genome (nuclear genome) and re-analysis of nuclear genome SNP data based on the derived reference genome 2. Further understanding of spatio-temporal composition of population in the tropical area by ontogenetic stage and sex. 3. Integrating the knowledge from other areas of study (e.g., migration, distribution pattern). Some of these further works left in SMA, including the extension of sampling area will be done by Japanese colleagues who will then relate results to the SRDCP. Additional results will be presented in future ICCAT species group meetings.

Presentation SCRS/P/2023/088 presented advances on the porbeagle (*Lamna nasus*) genetics study. Currently there is a high uncertainty in the population structure of Porbeagle because its estimation was based on limited genetic information. During 2022 results of the analysis based on mitochondrial genome sequencing (mitogenomics) for 96 sharks were reported. The samples were collected in three localities of the Atlantic Ocean (NW; NE; SE). Some results of the Phylogenetic tree based on mitogenome data sets of Atlantic porbeagle show the existence of two distinct mitogenome clades (i.e., NA clade and SA clade). A degree of divergence between two sub-clades within the SA clade was deeper than that within the NA clade and individuals from NE and from NW did not show monophyletic clade each other, and those individuals were found to be nested in both sub-clades of the NA clade. The degree of divergence revealed based on mitogenomic (this study) was larger than those of past analyses with small portion of mitochondrial genome. In 2023, the analysis using genotyping-by-sequencing—genotyping by random amplicon sequencing – direct (GRAS-Di method) are being conducted and the results is to be presented in the species group meeting. In addition, the ongoing work plan aims to check DNA quality of Uruguay samples and samples with good quality will be used for the analysis. The integrated results of nuclear genome analysis for all samples (NW, NE, SW, SE) are planned to be reported in the future meeting.

The group discussed the extension of samples used for future analysis and Norway and the U.S. offered providing additional samples or joint analysis by sharing the sequence data in the NW and NE Atlantic, respectively. It was mentioned that there was a plan to take a similar approach with SMA where a reference genome will be developed to increase the resolution of the analysis using nuclear genome SNP data. It was mentioned that future sampling in other seasons (i.e., spring and summer) would be necessary. The question of a potentially separate Icelandic stock was raised referring to discussions in 2020. There was no update on this question. It was pointed out that if the group wanted, Icelandic colleagues could be consulted regarding potential samples. Ongoing population genetic efforts in France and Norway were pointed out and the need to jointly discuss sequencing strategies among labs to ensure that generated data is usable for comparison across areas.

3.3 Movements and habitat use

Presentation SCRS/P/2023/080 provided an overview of the tagging efforts within the SRDCP. The major efforts in the initial years of the program were directed towards SMA, and more recently other species have been included, namely POR, BTH, OCS, SPZ, SPL, SPK and FAL, as those are under certain ICCAT management recommendations. Additionally, LMA has also been added to the tagging objectives. To date, 92 ICCAT tags have been deployed on sharks, and there is the contribution from numerous other national projects and initiatives, so the group has on the order of 250 deployed tags on these shark species available (SMA=108; POR=51; FAL=46; OCS=17; BTH=15; SPZ=11; SPL=1; LMA=1). The SRDCP focused its studies on habitat use and distribution and post release mortality. Currently, the SRDCP carries out the following works: 1) Post-release mortality of SMA (led by Uruguay; with participation from Portugal, Spain, Brazil, USA, Canada); 2) Movements of POR in the North Atlantic (led by Norway; with participation from Ireland, Canada, Portugal, France); 3) Habitat use of silky shark in the NW and tropical Atlantic (led by USA; with participation from Portugal); 4) Hammerheads habitat use in the SW Atlantic (led by Uruguay, with participation from Brazil); 5) Hammerheads parturition areas in west Africa (led by Portugal, with participation from Mauritania); and 6) Oceanic whitetip habitat use and movements in the Equatorial region (led by Portugal).

With regards to the ongoing issues with the batteries of Wildlife Computer tags, the group was informed that Wildlife Computers is replacing more tags than what they initially said. The group acknowledged that that is good, but within the tagging costs, the actual tag cost is just a small fraction. Most of the cost is related with the observer time in the vessels, lost tagging opportunities, etc. It was also noted that the deployment of tags that failed while attached to animals was a considerable loss of data and resources. The possibility of holding a workshop that integrates all the ICCAT scientists who work with satellite tagging was discussed, to discuss issues inherent to tagging. The possibility of promoting an inverse process to the current one was raised and generating a document that defines the needs of the different groups in terms of transmitter requirements, what information is required, what benefits they should have for their placement, etc., for the purpose of informing companies how to design and manufacture transmitters based on those requirements.

The Group then discussed possibilities of acquiring tags from other manufacturers. Some ICCAT Species Groups are using tags from Lotek and/or Microwave Telemetry but the number of companies to choose from is limited. It was noted that these other manufacturers also have tag failures, and the way to work with and deploy these other tags is a little different. So before making changes the group will need to closely consider the pros and cons of the various tags. Additionally, the group was also informed that Lotek recently contacted the ICCAT secretariat, and they are interested in having tagging teams willing to deploy test tags for them.

The Group noted that most of the tagging in ICCAT has been opportunistic, and the tagging locations are fishery-dependent, so that will have some influence on the results. The Group will also need to discuss future possibilities for fishery-independent scientific cruises for deploying tags. Such cruises, if planned, could fit under the objectives of several Species Groups at ICCAT, as similar discussion on such needs has also been taking place with other Groups.

The Group was informed that a consortium composed of AZTI and IEO has recently received funding for developing habitat models for FAL in the tropical Atlantic and is also tagging Mobulid rays. The authors will present updates of those works in future Sharks SG meetings. The group discussed ways for existing ICCAT-related projects, to be integrated into the objectives of the SRDCP and to do so in a participatory manner and not just by communicating their activities.

The group briefly discussed the use of acoustic tags, and possible integration with the Ocean Tracking Network. It was noted that acoustic tagging has been more successful in coastal species, or species like the bluefin tuna that migrate across very specific areas such as the strait of Gibraltar, so are easier to cover with the acoustic receivers.

The Group then discussed that besides the ongoing satellite tagging, there is a need to continue efforts on conventional tagging. ICCAT has conventional tags available (plastic and steel darts) so the national teams that have opportunities to deploy them can contact the Secretariat to request using these tags. Maintaining such conventional tagging efforts on sharks is highly supported by the Group.

The Group also discussed that there is a need for a wider discussion on tagging studies in ICCAT, for setting objectives from the tagging programs and their relation with ICCAT objectives and requests from the Commission. It was noted that ICCAT has a Tagging Working Group that has been mostly inactive for several years, but there have been discussions within other Species Groups to re-activate that group. That will be a good forum to discuss those more general tagging issues that are common and cross over the various species groups.

Presentation SCRS/P/2023/081 provided a summary of the work developed on movements, habitat use and diving behavior of SMA in the Atlantic, which was the 1st priority set within the SRDPC tagging project. One of the conclusions of the study was that some shortfin makos considerably use the continental shelf edges and slope areas and move along those, sometimes for long distances. The group noted that the tagging effort in this work was opportunistic and fishery-dependent, and therefore the results are linked to the tagging locations, which in most cases were closer to those slope and continental shelf edge areas. The Group showed particular interest in a specimen that crossed from the Northern to the Southern hemisphere, specifically it was tagged at about 7 degrees North in the equatorial region and traveled to an area off Namibia at around 20 degrees South. That particular specimen was a female of 185 cm FL, and did that longer migration over a period of 117 days.

Some scientists noted that some additional tagging has been carried out after these initial efforts on SMA, so those tags can be included in a future updated collaborative work. A case of particular interest is South Africa, where tagged shortfin makos show the migrations between the Indian and Atlantic Oceans. The group delved into the possible connections between the western Indian and the Atlantic, since this connection was observed in different species and taxa.

Presentation SCRS/P/2023/129 provided the status of the work on horizontal and vertical movements of silky sharks in the western north Atlantic Ocean. The summary provided information not just for tags provided by ICCAT but a meta-analysis of tags from other contributors. Silky sharks generally remain in the upper portion of the water column (<200 m) but do make dives to 600 m. Some tagged sharks exhibited regional residency within in The Bahamas, the northern Gulf of Mexico, and off the east coast of Florida. However, two individuals made long-distance movements, with one individual traveling from south Florida to seamount areas off the coast of New England and another moving from southeastern Florida to the northern Gulf of Mexico and back over the course of one year. Other sharks moved between the USA, Cuba, and The Bahamas along the shelf edge of the Florida Straits.

During discussion, it was noted that there is enough data and information to move forward with a publication on these results and future silky shark tagging efforts should be directed towards other areas (e.g. eastern Atlantic). Unfortunately, no further discussion could occur due to technical difficulties.

3.4 Post-release mortality

A presentation was given on inferring recovery time, post-release mortality (PRM) and natural mortality (M) for shortfin mako and porbeagle sharks (SCRS/P/2023/085). The work used a break-point analysis on vertical dive depths to determine recovery times, applied survival mixture models to estimate PRM and M, and evaluated the influence of covariates on recovery time and mortality. The analysis supported tagging sharks in the water, was inconclusive on the influence of hook type, and suggested that smaller individuals experienced greater mortality and longer recovery following capture and handling. Estimates for PRM were similar to other studies and the estimate of natural mortality was consistent with expectations based on life history.

The group requested clarification on how mortality events and recovery times were identified from the tagging data, given the potential deep diving behaviour of the species. There was discussion on why delayed mortality might occur, and how time on the line could influence results. There was a suggestion to explore the speed of descent to better determine mortality from deep diving, and to use hook timers and time-depth recorders to better understand the effects of capture.

A presentation (SCRS/P/2023/092) was given on estimating post-release mortality for shortfin mako using the ICCAT tagging data. The study had good geographical coverage for tag deployments, and inferred mortality events using a method consistent with SCRS/P/2023/085. PRM estimates for releases in different condition were the same, highlighting that visual determination of shark condition may not be meaningful for shortfin mako. Larger animals exhibited lower PRM, and the overall rate from all tagging events was 22.7%.

The group noted that these two papers were used in a response to the Commission on shortfin mako. There was discussion on how condition was characterized and why PRM might be higher when hooks were removed. The group discussed how differences in PRM relative to covariates could arise from interactions between the covariates (e.g. large sharks are tagged in the water and thus handled less). There was agreement that the modeling to determine PRM and M should be updated with recent tag information for the 2024 stock assessment for shortfin mako.

3.5 Reproduction studies

Submission SCRS/P/2023/091 showed activities related to pelagic shark breeding studies that have been carried out since 2017 and have included 1) a hands-on training workshop in Narragansett, USA (2017); 2) a workshop in Olhão, Portugal (2020); and 3) continued work on shortfin and porbeagle shark breeding in the Atlantic.

A two-day, hands-on training session on determination of reproductive maturity of porbeagle sharks was held at the Narragansett Rhode Island, NOAA Fisheries NEFSC Laboratory in 2017. During this training, scientists from the participating laboratories (NOAA SEFSC and NEFSC) worked together to collect reproductive organ samples to aid in determining reproductive habits and maturity for the species. The training was aimed at establishing standardized dissecting and sampling practices among researchers for more consistent collection of life history data. Sampling took place at several shark tournaments between New York and Maine, USA.

SRDCP reproduction activities in 2020 included a workshop held at IPMA, in Olhão, Portugal, on reproductive and other life history aspects of the porbeagle and other pelagic sharks in the Atlantic Ocean. The following items were discussed at the workshop: updates on the reproductive cycle of porbeagle shark; maturity of the porbeagle in the South Atlantic; overview of shortfin mako reproduction in the North Atlantic; estimation of maturity for shortfin mako in the North Pacific and implications for stock assessment; reproductive biology of the blue shark in the North Pacific Ocean; and recommendations such as increased use of hormone analysis to determine maturity and pregnancy and combining data for size at maturity and reproductive cycle estimation of porbeagle. Related to this, a peer-reviewed article on shortfin mako reproduction in the North Atlantic by several members of the group was published, with the main findings based on 731 specimens in the North Atlantic (NOAA-USA, DFO-Canada, IPMA-Portugal) including length- and mass-based maturity ogives and median sizes/weights at maturity for males and females; investigation of spatio-temporal variation in the distribution of life history stages; and identification of an important birthing and nursery area in the Gulf of Mexico and another possibly in the Northeastern Atlantic off the Iberian Peninsula.

Current activities related to reproduction of pelagic sharks include a reproductive hormone analysis for North Atlantic shortfin mako using muscle tissue samples to help establish a relationship between muscle hormone concentrations and sexual maturity and/or reproductive status in this population (based on previous work on white shark and porbeagle).

3.6 Improvement of information available for stock assessment

Presentation SCRS/P/2023/090 showed how the activities of the Shark Research and Data Collection Program served to improve ICCAT stock assessments.

Since its inception in 2013, results of the SRDCP have been consistently used to parameterize SCRS shark stock assessments, specifically biological information was used in: 1) the 2015 BSH North and South stock assessments; 2) the 2017 SMA North and South stock assessments; 3) the 2020 POR North and South stock assessments stock assessments; 4) the 2022 POR Northeast Atlantic ICES-ICCAT stock assessment; and 5) the 2023 BSH North and South stock assessments.

As mentioned in Section 2 of this report, the blue shark life history information table presented, that was produced during the 2014 Sharks Species Group meeting, was used as inputs or to calculate derived quantities in the 2015 stock assessments of blue sharks.

Briefly, life history data on age, growth, lifespan, and reproduction are used as fixed inputs in length-based, age-structured models such as Stock Synthesis. Additionally, estimates of r_{\max} (intrinsic rate of population growth), steepness (h), natural mortality (M), and generation time (T) are typically obtained based on this basic life history information. These estimates are then used to parameterize priors for r_{\max} in Bayesian production models and establish the time horizon for projections of future stock status (T) and as fixed values for h and M at age in Stock Synthesis.

Information on distribution and population structure was also considered for the Stock Synthesis stock assessment of the North Atlantic stock of blue shark.

The same type of information was used in the 2017 stock assessments of shortfin mako and, additionally, the position of the inflection point (B_{MSY}/B_0), which is used to compute the shape parameter of production curves (m), was used to parameterize priors for this parameter in Bayesian production models (JABBA). Importantly, the results of the SRDCP project on age and growth for the North Atlantic stock were used in the stock assessment of that stock and stock identification and separation into a North and South stock was based in part on the population genetics study to estimate stock structure. The estimates of generation time (T) previously used in the 2017 stock assessment were also used to establish the time horizon for projections of future stock status in Stock Synthesis in the 2019 shortfin mako stock assessment meeting.

The same type of information used for the shortfin mako assessments was also used in the 2020 stock assessments of porbeagle and, additionally, the maximum lifetime reproductive rate (α) and spawning potential ratio at maximum excess recruitment (SPR_{MER}) were also computed based on the life history information provided. These estimates were then used to 1) estimate overfishing status by comparing a proxy value of F obtained with the SAFE (Sustainability Assessment for Fishing Effects) approach to a value of F_{MSY} obtained based on a relationship between the F_{MSY}/M ratio and productivity based on α ; and 2) in the ICM (Incidental Catch Model) method, by accounting for uncertainty in porbeagle life history by simulating values of productivity (expressed as α) and then using those values to estimate overfished status.

Similarly, in the joint 2022 ICES-ICCAT Northeast Atlantic stock assessment, the estimates of r_{\max} and B_{MSY}/B_0 obtained for the Northwest Atlantic stock were used to parameterize priors for r_{\max} and the shape parameter (m) in Bayesian production models (SPiCT by ICES; JABBA by ICCAT).

Some potential new activities of the SRDCP that can improve future stock assessments were also discussed. First, estimation of natural mortality (M) was highlighted as a very important outcome of satellite-tagging studies to go beyond estimation of post-release mortality. Second, incorporation of results of Close-Kin Mark Recapture (CKMR) studies, such as for the South Atlantic shortfin mako stock, into future stock assessments can provide estimates of M and absolute abundance independent of the stock assessment.

Discussion on CKMR ensued, with the group highlighting the importance of following up with the CKMR for shortfin mako as an attempt to have absolute abundance estimates independent from those obtained in stock assessments and natural mortality estimates obtained independently from the commonly used life-history theory estimators for better tuning future stock assessments. It was explained that some of the samples for CKMR were

already collected, and that there were some attempts to raise the budget to continue the work, but all have failed up to now. The group commented on the importance of making a proposal with a feasibility analysis with a clear definition of the scope, budget, team, and responsibilities.

The group also raised some concerns about several limitations with this type of analysis, including high cost, and difficulties with getting samples in the necessary conditions. Difficulties in establishing a plan for continuing data collection and analysis include the number of samples to be collected. Despite some having been collected from Brazil and South Africa, the group raised concerns about the temporal validity of the results due to time constraints.

4 Difficulties faced and possible ways to overcome them.

The group discussed the main difficulties related to the current activities in the SRDCP program. It also briefly discussed some difficulties that are likely to be expected with new activities that were discussed for possible inclusion in the future. The discussions on these main research items are provided below:

Difficulties related with sampling CITES listed shark species

Currently almost all the shark species that are included in the ICCAT convention are listed in CITES, with the two exceptions being the crocodile shark and the pelagic stingray. This is a unique situation within the various ICCAT Species Groups, and it poses a very strong limitation to many of the past and ongoing SRDCP objectives. It is important for the SCRS and the ICCAT Commission to be fully informed about the severe limitations that the group currently has with regards to taking biological samples of those species. This has a strong impact on the advice that the Sharks-SG can provide to the SCRS and the Commission.

To summarize the situation, the Group highlighted that within ICCAT rules, those species are permitted to be sampled, as the ICCAT Commission has adopted Rec 10-13 that allows CPCs that are participating in SCRS-adopted projects can take samples from no-retention shark species, under certain conditions (i.e, that they are taken by an onboard observer, that the specimen is dead at haulback, that the samples are collected in the framework of an SCRS adopted project, and that the teams present updates on such sampling to the Sharks-SG). This means that under the ICCAT current regulations, the SRDCP can continue to take samples and doing all the shark related research.

The issue regarding the limitation with the biological sampling is related with the CITES regulations, as there is a need for an “introductions from the sea” permit for specimens captured in international waters, and then permits for “export/import” for exchanges of samples between laboratories in different countries. There are procedures to request such CITES permits, but those are handled by each country’s national authorities and in general involve very long and time-consuming administrative processes. This means that many of the CPCs that are participating in the SRDCP cannot continue to collect new samples, since those shark species have been progressively listed in CITES. In some cases, even older samples that were collected before the CITES listings cannot be sent internationally to other institutes in other countries. This has implications for all the SRDCP- related tasks that involve exchange of biological material, including the age and growth, population genetics and reproduction studies.

For some countries, a letter from the ICCAT Secretariat mentioning that the Institutes from those countries are doing research within the ICCAT/SRDCP might help dealing with the national authorities. The Secretariat noted that a general letter mentioning that a laboratory from a CPC is participating in the SRDCP and taking samples from those species can be issued, and requested the national scientists that need such letters to contact the Secretariat.

The group was reminded that a few years ago the Sharks SG, with the support of the SCRS and the Chair of PA4, sent a letter to the CITES Secretariat explaining the difficulties and suggesting a possible new approach to facilitate the biological research process. The approach that was proposed by ICCAT, was for CITES to issue permits for biological sampling directly to ICCAT, and then ICCAT would manage those with the various laboratories and CPCs that are participating in ICCAT biological projects. That could be achieved by a MoU or some other mechanism. The Group agreed that a new effort should be made for contacting the CITES Secretariat to assess the feasibility of such suggestion. This needs to be done at a higher ICCAT level, and therefore the Group will make a Recommendation within the Sharks-SG to be forwarded to the SCRS and the Commission.

Difficulties with tagging

The first priority regarding tagging within the SRDCP was for shortfin mako, in support of the stock assessment. That tagging process was relatively fast and successful, as shortfin makos are captured relatively frequently and usually in good condition to be tagged.

In more recent years, the focus of the SRDCP tagging has been on the rarer species that are under ICCAT management rules, namely the several species that are no-retention (i.e., OCS, FAL, BTH and Hammerheads) or encouraged to be released (POR). Those are species that are captured much more occasionally, and in some cases have high at-vessel and/or post-release mortality. So even though there have been considerable tagging efforts from the various tagging teams for several years, the number of tags that can be realistically deployed per year in those rarer species is much more limited. It is noted that some of those species in some regions have had some success to date, but in order to be able to get results from those species at wider Atlantic-wide level, the entire process will take longer. The Group agreed that it is important to continue efforts on tagging those species, acknowledging that deployment of the tags takes longer as there are many fewer opportunities to do so.

As such, the group agreed to continue the tagging efforts in FAL, OCS, LMA, BTH, POR and Hammerheads. Additionally, the Group also agreed to continue the tagging effort on SMA and add BSH to the list, for particular situations where data is still missing (see section 5c for details).

Limitation on sampling and tagging large shortfin mako, especially large females

Even though the first priority of the SRDCP was focused on SMA, and several studies have been completed, the Group noted that there are still difficulties in sampling or tagging large SMA, especially large females. The vast majority of the oceanic longlines capture juvenile SMA specimens, and it is not clear why large animals, especially females, are very rarely found in those commercial fisheries. Some possibilities that were put forward by the Group are that those large females may be found in other regions where there is less fishing pressure, or that due to their very large size most of those large SMA bite-off the longline gear and therefore are not captured or recorded. The Group noted that in some particular cases, like in the NW Atlantic recreational fishery or in South African protective nets, sometimes those very large animals are found. The group agreed that additional effort should be made to sample and tag those animals, and more details are provided in section 5c of this report.

Epigenetics

Epigenetics was briefly discussed by the Group as a possibility for future work on ageing the specimens from sample tissues. It was noted that the ages first need to be calibrated for each particular species, meaning that there is first the need for age estimations and for those ages to be validated. The Group agreed that such method seems promising, but that should first be tested on shorter-lived sharks, as estimating ages and validation in longer-lived sharks is more complex.

5 Future steps.

5.1 Amendment of the ICCAT agreement and the shark species

The Secretariat clarified which are the shark species (elasmobranchs that are oceanic, pelagic, and highly migratory) currently under the ICCAT mandate (Rec. 19-01). The table below contains the list of the ICCAT oceanic, pelagic, and highly migratory elasmobranchs:

<i>Order</i>	<i>Family</i>	<i>Species</i>	<i>ENG Common name</i>
Orectolobiformes	Rhincodontidae	<i>Rhincodon typus</i>	Whale shark
Lamniformes	Pseudocarchariidae	<i>Pseudocarcharias kamoharai</i>	Crocodile shark
	Lamnidae	<i>Carcharodon carcharias</i>	Great white shark
		<i>Isurus oxyrinchus</i>	Shortfin mako
		<i>Isurus paucus</i>	Longfin mako
		<i>Lamna nasus</i>	Porbeagle
Cetorhinidae	<i>Cetorhinus maximus</i>	Basking shark	
Alopiidae	<i>Alopias superciliosus</i>	Bigeye thresher	
	<i>Alopias vulpinus</i>	Thresher	
Carcharhiniformes	Carcharhinidae	<i>Carcharhinus falciformis</i>	Silky shark
		<i>Carcharhinus galapagensis</i>	Galapagos shark
		<i>Carcharhinus longimanus</i>	Oceanic whitetip shark
		<i>Prionace glauca</i>	Blue shark
	Sphyrnidae	<i>Sphyrna lewini</i>	Scalloped hammerhead
<i>Sphyrna mokarran</i>		Great hammerhead	
<i>Sphyrna zygaena</i>		Smooth hammerhead	
Myliobatiformes	Dasyatidae	<i>Pteroplatytrygon violacea</i>	Pelagic stingray
	Mobulidae	<i>Manta alfredi</i>	Giant manta
		<i>Manta birostris</i>	
		<i>Mobula hypostoma</i>	Lesser devil ray
		<i>Mobula japonica</i>	Devil fish
		<i>Mobula mobular</i>	
<i>Mobula tarapacana</i>			
<i>Mobula thurstoni</i>			

With the list of species in mind, participants discussed a way forward to gather information currently available on these species, aiming to identify the knowledge and data gaps for these species. The Chair requested comments to a draft template table (file: SHK_Species_data_gaps_v1.xls)

5.2 Advances in pelagic sharks available information outside the SRDCP

A presentation was given on a phylogenetically-adjusted hierarchical meta-analysis of at-vessel mortality (AVM) rates (SCRS/P/2023/084). The key contribution of this analysis was that it accounted for non-independence of data by incorporating phylogenetic relationships into the random effects. AVM estimates for several shark species of interest to ICCAT were presented, separated into values for the Atlantic and Pacific. There would be the potential to use these AVM estimates for assessments of data-poor species in the Atlantic.

The group noted that this approach may provide parameters for input into stock assessment, particularly for data-limited species. There were concerns raised over sample sizes contributing to the estimates for individual species that should be evaluated further. Clarification was sought on the reason for ocean-specific differences in AVM, where it was noted that these were likely due to differences in general fishing practices (e.g. fleet and gear characteristics) among oceans.

A presentation was given to inform discussion on the possibility of spatiotemporal management procedures (STMP), with an example developed for blue shark (SCRS/P/2023/086). The presentation outlined steps that would be required for implementation and gave results for the potential amount of area (separated into shallow and deep habitats) that could be targeted for protection. Global seasonal habitat predictions are publicly available in Google Maps. The example raises several discussion points about: (1) the appropriate type of SDM (Species distribution model), (2) the need to work in a multi-species framework, (3) equitability if STMP were to be implemented, and (4) areas limiting progress (e.g. information on the spatial distribution of fishing effort).

The group raised concerns about potential effectiveness of SDM, particularly related to the accuracy of habitat predictions for target and non-target species, as well as the need to consider factors like fishing effort displacement, not just effort distribution. Other concerns related to the ways these studies can be used by the general society or other organizations. The validity of continuing research on STMP was discussed. In general, there would be a strong need for robust models with validation from multiple species before further progress can be made at ICCAT. Any work towards spatiotemporal management should be incremental, and it would likely be better to develop for national fleets (at a smaller spatial scale) rather than at the spatial scale of ICCAT. The group also briefly discussed logistical challenges associated with enforcing such large-scale spatial closures and how this could ultimately affect their feasibility as a management strategy.

5.3 Activities to be continued

The Group agreed that it is important that all the current tasks under the SRDCP are to be continued, namely age and growth, genetics, tagging and reproduction. Within each task, the species that will be focused on each year will be specified in the workplan. Below we provide the details of the discussions of the Group on those activities.

Age and growth

Under this task, the first priority was for SMA in the North Atlantic and that work was completed for the last ICCAT stock assessment. Additional samples of large individuals will be incorporated if made available in the future. The current focus is on the South Atlantic SMA and that activity will continue, with expectations to provide results for the scheduled 2024 SMA stock assessment. Age and growth for other species will be undertaken as new activities under this research program. A first step will be to determine the samples that are currently available at each laboratory for each species, and then establish priorities for the ageing work on those other species (see section 5d of this report regarding future activities).

Tagging

The current studies on distribution and habitat use of the various species are to be continued. Some new tagging efforts will be added specifically to SMA and BSH, as well as in particular regions, and those are detailed in section 5d of this report.

From the species that are currently being tagged, the Group noted that the FAL in the NW Atlantic now has a good coverage, so future efforts on that species should be for the eastern Atlantic. The OCS and hammerheads are also being prioritized, with some success tagging OCS in the equatorial region, and hammerheads in the SW Atlantic and tropical eastern Atlantic. Overall, the Group agreed to continue the tagging efforts in FAL, OCS, LMA, BTH, POR and Hammerheads. If additional teams have the possibility to deploy tags in those species, they are requested to contact the SRDCP Tagging coordinators and Sharks-SG Chair to coordinate such efforts.

The post-release mortality study on SMA should also be continued, incorporating the new tags that have been released since the last update. Additional works that have used tagging information, such as the estimations on natural mortality and recovery times from the satellite tagging have been completed for SMA and POR, and should be explored for other species.

Reproduction

Most of the work related with reproduction under the SRDCP has been for SMA in the North Atlantic, with the production of updated maturity ogives and hypothesis on nursery areas. More recently, work related with hormone analysis has started for SMA in the North Atlantic, and that work is to be continued.

Genetics

The genetics work has been focused on SMA using next-generation sequencing technique to evaluate population structure in the Atlantic. Recent efforts have increased the area covered by sampling and this work will support decisions on stock structure for the 2024 SMA assessment. Ongoing work is focused on applying similar methods to POR, incorporating new sampling from the South Atlantic. The CITES listing has made it difficult to share samples among different CPCs represented by the group.

5.4 New activities to be included

The following activities were agreed to be included in future efforts of the SRDCP. The sections below summarize the discussions and agreements on those points.

Age and Growth

Analyses will start on SMA in the South Atlantic, incorporating new samples from Brazil. Future activities are to start ageing other pelagic shark species that have not yet been the focus of the SRDCP, potentially focused on tropical species like silky or oceanic whitetip sharks. As a first step, the ageing coordinator of the SRDCP has requested national scientists to fill out an online table with sample numbers and associated meta-data for ICCAT shark species, so that planning for ageing on other species can start in 2024. The link to that table is provided in Section 3a of this report, and it is also copied here for convenience:

Tagging

The SRDCP initially prioritized SMA, and more recently, other pelagic species (i.e., OCS, FAL, BTH, LMA, POR and Hammerheads). As noted above in section 5c, tagging of those rarer species is to be continued. Because deployments are opportunistic, it is expected tagging rarer species will take place over numerous years.

With regards to new activities, the group agreed to keep tagging SMA, and add BSH for the first time to the current tagging list of species in the SRDCP program. For those two species, the tagging will be focused on selected priority areas and/or sizes, to address gaps on those more common and abundant species, as detailed below.

With regards to SMA, the areas that are of particular interest for future tagging are the SW and SE Atlantic, as well as in more oceanic areas that have not yet been fully covered in the past. One conclusion of the previous study was the important use of SMA specimens along the continental shelf edges and slopes, but that was in part dependent on the tagging locations. As such, prioritizing SMA tag deployments in the South Atlantic, as well as in more oceanic waters, is required to gain a better understanding of habitats throughout the Atlantic. In particular, the equatorial region is used as the stock management boundary, and understanding mixing in this area is prioritized.

Also, for SMA, another priority will be to tag large adult females, noting that to date this has not been possible. The vast majority of the SMA females captured in pelagic longlines are juveniles, below the estimated sizes at first maturity. The group noted that in some particular areas, such as in the NW Atlantic recreational fisheries and in the SE Atlantic protective nets, some very large females are captured, and those should be prioritized for tagging. It is a current caveat in terms of knowledge to understand where those very large SMA females are distributed, and this is the main component of the population that determines reproductive output. It was further noted that this specific activity fits well under the Commission requests in Recs 21-09 and 22-11.

The group also discussed and agreed to add BSH to the tagging effort. The priorities will also be tagging large females to help elucidate on the distribution of the large and possibly pregnant females. Additionally, the group also prioritized tagging BSH in the NE Atlantic, with the objective of determining possible links to the Mediterranean BSH. Within this line, the tagging coordinators and Sharks SG Chair will contact possible future partners in the Mediterranean that might be able to deploy tags on BSH in that region, particularly through the initiatives being developed by the Sub-Committee on Ecosystems and By-Catch.

Finally, the area around South Africa along the ICCAT/IOTC boundary was highlighted for future tagging efforts, both for SMA and BSH. There are questions related to stock structure and connectivity between those two oceans and management regions. The Sharks SG coordinator and SRDCP tagging coordinators will liaise with South African scientists, and others from other fleets operating in that region, to determine tagging opportunities.

The Group also discussed and supported that conventional tagging in sharks should be specifically added to the SRDCP, preferably with the use of steel-dart tags. To date this specific activity has not been included in the SRDCP, but a new budget line will be added. As this activity is mainly opportunistic and involves studies that require many years to develop and provide results (i.e., as they depend on returning tags from recaptured specimens), all the species in the ICCAT list of shark species are of interest. It was noted that from a logistics point of view, the group needs to invest not only in the tagging efforts, but also consider the costs associated with awareness actions, advertisement for encouraging the return of the tags if the specimens are recaptured, and rewards. The tagging coordinators will liaise with national scientists that have opportunities to deploy such conventional tags from their fleets.

Use of Hook Timers and Temperature-Depth Recorders (TDRs)

The Group noted Rec 21-09 and 22-11 that specifically request the SCRS and the Sharks-SG to develop research that involves mini-data loggers, which are assumed to refer to hook-timers and TDRs. It was noted that the information that such devices can collect is very important, as they can determine, for example, the amount of time specimens spend in the longlines which can be associated with hooking, post-release mortality and/or recovery times. They also provide information on the vertical depth of operation of the various longline métiers, that can then be compared with vertical habitat use of various species, determined from the satellite tagging, to evaluate risk of capture.

The group agreed to discuss the costs associated with acquiring and deploying such devices, and to add a research line in the SRDCP. It was also noted that part of this research is linked to the SCRS Sub-group on technical gear changes, under the Ecosystems and Bycatch Subcommittee, and that members of the Sharks-SG are participating actively in that Sub-group.

Hormone analyses

Some work has been recently published on using hormone analyses to differentiate maturity stages of POR (Anderson *et al.* 2023). This method will be applied to SMA and presented to the group in 2024 at the SMA stock assessment.

Potential future objectives

The group discussed several different types of research projects that could be developed within the SRDCP. None of these were specifically added to the current work plan but may be considered for future work.

The potential to use Close-Kin-Mark-Recapture to estimate absolute abundance remains of interest to the SRDCP. There was discussion on the feasibility study previously provided for SMA and recognition that sampling requirements were very high. A more detailed discussion on this is presented in section 4 (difficulties) of this report.

Epigenetics, a new aging method based on nuclear DNA sequencing was briefly discussed by the group. While the method holds promise, the largest current limitation relates to validation, specifically how the rate of genetic deterioration relates to age. A more detailed discussion on this is also presented in section 4 (difficulties) of this report.

The potential to use intra-uterine birth tags to determine pupping locations was mentioned, but the group considered the potential for spontaneous abortion to be high. Again, validation of the technique is the main limitation, even if pregnant females could be captured.

There was a suggestion that the SRDCP may need to undertake research on methods for reconstructing catch series. That was done by the Sharks-SG for the past BSH and SMA stock assessments. There are now many new shark species under the purview of ICCAT. Depending on future requests by the Commission, there may be a need to undertake data reclamation or revise historical data submissions, to develop total removals series for non-landed species.

6 Towards Phase 2 of the SRDCP: Draft proposal

The group discussed the mechanisms that should be carried out to elaborate a detailed proposal (phase 2) of the activities for the next years of the SRDCP. In this sense, it was understood that a table should be generated, in a similar way to that developed in phase 1, which allows visualizing the state of progress on the knowledge of the species by the group and the knowledge needs for their evaluation and management.

Due to the limited time during the meeting, the table was outlined (**Table 7**) and it was proposed that it would be completed by the group in the coming months so that, at the next meeting of the group, it could be complemented with the same work plans and research priorities of the group already developed in sections 5 c. and d.

References

- Anderson, B.N.; Kaloczi, J.; Holden, C.; Einig, A.; Donaldson, L.; Malone, H.; Passerotti M.S.; Natanson, L.J.; Bowlby H.D. & Sulikowski, J.A. 2023. Using reproductive hormones extracted from archived muscle tissue to assess maturity and reproductive status in porbeagles *Lamna nasus*. *Front. Mar. Sci.* Volume 10 – 2023 <https://doi.org/10.3389/fmars.2023.1176767>
- Anonymous. 2020. Report of the ICCAT Workshop on reproductive and other life history aspects of the Porbeagle and other pelagic sharks in the Atlantic Ocean. SCRS/2020/042.
- Bowlby, H.D.; Benoît, H.P.; Joyce, W.; Sulikowski, J.; Coelho, R.; Domingo, A.; Cortés, E.; Hazin, F.; Macias, D.; Biais, G.; Santos, C. & Anderson, B. 2021. Beyond Post-release Mortality: Inferences on Recovery Periods and Natural Mortality From Electronic Tagging Data for Discarded Lamnid Sharks. *Front. Mar. Sci.* 8:619190. doi: 10.3389/fmars.2021.619190
- Coelho, R.; Mejuto, J.; Domingo, A.; Cortés, E.; Liu, K.-W.; Yokawa, K.; Carvalho, F.; Arocha, F.; da Silva, C.; García-Cortés, B.; Ramos-Cartelle, A.M.; Lino, P.G.; Forselledo, R.; Ohshimo, S.; Hazin, F. & Santos, M.N. 2015. Distribution patterns of the blue shark, *Prionace glauca*, in the Atlantic Ocean from fishery observer programs of the major fishing fleets. SCRS/2015/039.
- Coelho, R.; Carlson, J.; Natanson, L.; Rosa, D.; Mas, F.; Mathers, A.; Domingo A. & Santos, M.N. 2017. Shark Research and Data Collection Program: progress on the age and growth on the shortfin mako in the Atlantic Ocean. *Collect. Vol. Sci. Pap. ICCAT*, 73(8): 2842-2850.
- Coelho, R.; Domingo, A.; Carlson, J.; Cortés, E.; Rosa, D.; Miller, P. & Santos, M.N. 2017. Shark Research and Data Collection Program: progress on the satellite tagging of shortfin mako for post-release survival and habitat use studies. *Collect. Vol. Sci. Pap. ICCAT*, 73(8): 2851-2859.
- Coelho, R.; Domingo, A.; Courtney, D.; Cortés, E.; Arocha, F.; Liu, K-M.; Yokawa, K.; Yasuko, S.; Hazin, F.; Rosa, D. & Lino, P.G. 2017. A revision of the shortfin mako shark catch-at-size in the Atlantic using observer data. *Collect. Vol. Sci. Pap. ICCAT*, 74(4): 1562-1578.
- Coelho, R.; Domingo, A.; Carlson, J.; Natanson, L.; Cortés, E. & Miller, P. 2017. Satellite tagging of shortfin mako for habitat use and post-release survival: progress report for SRDCP. *Collect. Vol. Sci. Pap. ICCAT*, 74(4): 1601-1612.
- Coelho, R.; Mejuto, J.; Domingo, A.; Yokawa, K.; Liu, K.M.; Cortés, E.; Romanov, E.V.; Da Silva, C.; Hazin, F.H.V.; Arocha, F.; Mwilima, A.M.; Bach, P.; Ortiz de Zárate, V.; Roche, W.; Lino, P.G.; García-Cortés, B.; Ramos-Cartelle, A.M.; Forselledo, R.; Mas, F.; Ohshimo, S.; Courtney, D.; Sabarros, P.S.; Perez, B.; Wogerbauer, C.; Tsai, W.P.; Carvalho, F. & Santos, M.N. 2018. Distribution patterns and population structure of the blue shark (*Prionace glauca*) in the Atlantic and Indian Oceans. *Fish and Fisheries*. 19:90–106 DOI: 10.1111/faf.12238
- Coelho, R.; Domingo, A.; Courtney, D.; Cortés, E.; Arocha, F.; Liu, K-M.; Yokawa, K.; Semba, Y.; Hazin, F.; Bowlby, H.; Abid, N.; Rosa, D. & Lino, P.G. 2018. An updated revision of shortfin mako size distributions in the Atlantic. *Collect. Vol. Sci. Pap. ICCAT* 75:476–492.
- Cortés, E.; Arocha, F.; Beerkircher, L.; Carvalho, F.; Domingo, A.; Heupel, M.; Holtzhausen, H.; Santos, M. N.; Ribera, M. & Simpfendorfer, C. 2010. Ecological risk assessment of pelagic sharks caught in Atlantic pelagic longline fisheries. *Aquatic Living Resources* 23: 25-34.
- Cortés, E.; Domingo, A.; Miller, P.; Forselledo, R.; Mas, F.; Arocha, F.; Campana, S.; Coelho, R.; Da Silva, C.; Hazin, F.H.V.; Holtzhausen, H.; Keene, K.; Lucena, F.; Ramirez, K.; Santos, M.N.; Semba-Murakami, Y. & Yokawa, K. 2015. Expanded ecological risk assessment of pelagic sharks caught in Atlantic pelagic longline fisheries. *Collective Volume of Scientific Papers ICCAT* 71(6): 2637-2688.
- Cortés, E.; Coelho, R. & Domingo, A. 2018. Thoughts for developing a potential indicator for non-retained sharks in support of an ecosystem report card. *Collect. Vol. Sci. Pap. ICCAT*, 75(2): 329-331.

- Cortés, E.; Bowlby, H.; Carlson, J.; Coelho, R.; Domingo, A.; Forselledo, R.; Jagger, C.; Mas, F.; Parker, D.; Santos, C.; Semba, Y.; Taylor, N. & Zhang, X. 2020. preliminary sustainability assessment for fishing effects (SAFE) of pelagic longline fisheries on porbeagle sharks and identification of f-based biological reference points. Collect. Vol. Sci. Pap. ICCAT, 77(6): 148-168.
- Domingo, A.; Cortés, E.; Forselledo, R.; Jiménez, S.; Mas, F. & Miller, P. 2016. Results of the double tagging study conducted in sharks. Collect. Vol. Sci. Pap. ICCAT, 72(5): 1105-1112.
- Domingo, A.; Coelho, R.; Cortés, E.; García-Cortes, B.; Mas, F.; Mejuto, J.; Miller, P.; Ramos-Cartelle, A.; Santos, M.N. & Yokawa, K. 2016. Is the tiger shark *Galeocerdo cuvier* a coastal species? Expanding its distribution range in the Atlantic Ocean using at-sea observer data. Journal of Fish Biology, Vol. 88, Issue 3: 1223 – 1228.
- Domingo, A.; Santos, C.C.; Carlson, J.; Natanson, L.; Cortés, E.; Mas, F.; Miller, P.; Hazin, F.H.V.; Travassos, P. & Coelho, R. 2018. Post-release mortality of shortfin mako in the Atlantic using satellite telemetry: preliminary results. SCRS/2018/105.
- Fernandez-Carvalho, J.; Coelho, R.; Mejuto, J.; Cortés, E.; Domingo, A.; Yokawa, K.; Liu, K.M.; García-Cortés, B.; Forselledo, R.; Ohshimo, S.; Ramos-Cartelle, A.M.; Tsai, W.P. & Santos, M.N. 2015. Pan-Atlantic distribution patterns and reproductive biology of the bigeye thresher shark, *Alopias superciliosus*. Reviews in Fish Biology and Fisheries 25(3): 551-568.
- Miller, P.; Santos, C.C.; Carlson, J.; Natanson, L.; Cortes, E.; Mas, F.; Hazin, F.; Travassos, P.; Macias, D.; Ortiz de Urbina, J.; Coelho, R. & Domingo A. 2020. Updates on post-release mortality of shortfin mako in the Atlantic using satellite telemetry. Collect. Vol. Sci. Pap. ICCAT 76(10): 298 – 315.
- Natanson, L.J.; Winton, M.; Bowlby, H.; Joyce, W.; Deacy, B.; Coelho, R. & Rosa, D. 2020. Updated reproductive parameters for the shortfin mako (*Isurus oxyrinchus*) in the North Atlantic Ocean with inferences of distribution by sex and reproductive stage. Fish. Bull. 118:21–36.
- Nohara, K.; Coelho, R.; Santos, M.N.; Cortés, E.; Domingo, A.; Ortiz de Urbina, J.; Semba, Y. & Yokawa, K. 2017. Progress report of genetic stock structure of shortfin mako (*Isurus oxyrinchus*) in the Atlantic Ocean. SCRS/2017/214.
- Rosa, D.; Mas, F.; Mathers, A.; Natanson, L.; Domingo, A.; Carlson, J. & Coelho, R. 2017. Progress on the Atlantic-wide study on the age and growth of shortfin mako shark: progress report for SRDCP. SCRS/2017/051.
- Rosa, D.; Mas, F.; Mathers, A.; Natanson, L.J.; Domingo, A.; Carlson, J. & Coelho, R. 2018. Age and Growth of Shortfin Mako in the South Atlantic. Collect. Vol. Sci. Pap. ICCAT 75: 457-475.
- Santos, C.C.; Domingo, A.; Carlson, J.; Natanson, L.; Cortés, E.; Miller, P. & Coelho, R. 2018. Habitat use and migrations of shortfin mako in the Atlantic using satellite telemetry. Collect. Vol. Sci. Pap. ICCAT 75: 445-456.
- Santos, C.C.; Domingo, A.; Carlson, J.; Natanson, L.; Travassos, P.; Macias, D.; Cortés, E.; Miller, P.; Hazin, F.; Mas, F.; Ortiz de Urbina, J. & Coelho, R. 2020. Updates on the habitat use and migrations of shortfin mako in the Atlantic using satellite telemetry. Collect. Vol. Sci. Pap. ICCAT 76(10): 235 – 246.
- Santos, C.C.; Forselledo, R.; Mas, F.; Cortés, E.; Carlson, J.; Bowlby, H.; Semba, Y.; Kerwath, S.; da Silva, C.; Parker, D.; Jagger, C.; Rosa, D.; Domingo, A. & Coelho, R. 2020. Size distribution of porbeagle shark in the north and south Atlantic using data from observer programs. SCRS/2020/097.
- Santos, C.C.; Domingo, A.; Carlson, J.; Natanson, L.J.; Travassos, P.; Macías, D.; Cortés, E.; Miller, P.; Hazin, F.; Mas, F.; Ortiz de Urbina J.; Lino, P.G. & Coelho, R. 2021. Movements, Habitat Use, and Diving Behavior of Shortfin Mako in the Atlantic Ocean. Front. Mar. Sci. 8:686343. doi: 10.3389/fmars.2021.686343
- Semba, Y. 2021. Mitogenomics and nuclear-genome-wide single-nucleotide polymorphism genotyping can resolve the complex reality of the genetic population structure of shortfin mako (*Isurus oxyrinchus*) in the Atlantic Ocean. SCRS/2021/163.

- Semba, Y.; Takeshima, H.; Nanba, R.; Ooka, S.; Ando, D.; Hayakawa, A.; Kokubun, S.; Noda, S.; Takano, Y.; Yanada, R.; Coelho, R.; Santos, M.N.; Cortés, E.; Domingo, A.; Ortiz de Urbina, J.; Sakuma, K.; Nohara, K. & Tahara, D. 2022. Preliminary results of the genetic population structure of the Atlantic shortfin mako (*Isurus oxyrinchus*) using mitogenomics and nuclear-genome-wide single-nucleotide polymorphism genotyping based on additional samples comprehensively collected from in and around the Atlantic Ocean. SCRS/2022/085.
- Semba, Y.; Tahara, D. & Takeshima, H. 2022. Workplan for the investigation of the genetic population structure of porbeagle (*Lamna nasus*) in the Atlantic Ocean. SCRS/2022/086.
- Taguchi, M.; Coelho, R.; Santos, M.N.; Domingo, A.; Mendonça, F.F.; Hazin, F.; Yasuko, S.; Sato, K. & Yokawa, K. 2016. Genetic stock structure of the Atlantic shortfin mako (*Isurus oxyrinchus*). SCRS/2016/076.
- Takeshima, H.; Nanba, R.; Ooka, S.; Ando, D.; Hayakawa, A.; Kokubun, S.; Noda, S.; Takano, Y.; Yanada, R.; Coelho, R.; Santos, M.N.; Cortés, E.; Domingo, A.; Ortiz de Urbina, J.; Sakuma, K.; Nohara, K.; Tahara, D. & Semba, Y. 2022. Final report on the genetic population structure on shortfin mako shark in the Atlantic Ocean. SCRS/2022/170.

Table 1. Traffic light approach to categorize the level of information (expressed as number of studies) available by topic in four geographical areas (North, South, and Equatorial Atlantic and Mediterranean) for 16 species of 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			
	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
Species																
BSH	Green	Green	Red	Green	Green	Yellow	Yellow	Yellow	Green	Yellow	Yellow	Red	Yellow	Yellow	Red	Yellow
SMA	Green	Green	Red	Green	Green	Yellow	Yellow	Yellow	Green	Yellow	Yellow	Red	Yellow	Yellow	Red	Yellow
LMA	Yellow	Red	Red	Yellow	Yellow	Red	Red	Red	Yellow	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	Green	Yellow	Red	Yellow	Yellow	Red	Red	Red	Green	Red	Red	Red	Red	Red	Red	Red
SPL	Green	Yellow	Red	Yellow	Green	Yellow	Yellow	Yellow	Green	Red	Red	Red	Red	Red	Red	Red
ALV	Green	Yellow	Red	Yellow	Yellow	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
BTH	Green	Yellow	Red	Green	Yellow	Yellow	Red	Red	Yellow	Red	Red	Red	Red	Red	Red	Red
FAL	Green	Green	Red	Yellow	Red	Red	Red	Red	Yellow	Yellow	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	Red	Green	Red	Red	Red	Red	Yellow	Yellow	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	White	White	White	White
PLS	Yellow	Red	Red	Red	Green	Red	Red	Red	Red	Red	Red	Red	Yellow	Red	Red	Red

Table 2. Species were classified in terms of “data poorness” (proportion of red cells in the above table, i.e. with no information) and “data richness” (proportion of green cells in the above table; 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	ranked	green
LMA	0.88	BSH	0.31
SPK	0.81	SMA	0.25
DUS	0.81	CCP	0.25
TIG	0.81	SPL	0.19
PLS	0.81	OCS	0.19
POR	0.75	FAL	0.17
SPZ	0.75	POR	0.13
ALV	0.69	BTH	0.13
OCS	0.69	DUS	0.13
CCP	0.69	ALV	0.06
CCS	0.67	TIG	0.06
FAL	0.58	PLS	0.06
BTH	0.56	LMA	0.00
SMA	0.50	SPZ	0.00
SPL	0.50	SPK	0.00
BSH	0.19	CCS	0.00

Table 3. SRDCP detailed tables summarizing the availability of life history parameters in 11 areas of the Atlantic and Mediterranean for the 16 ERA species.

	RESUMEN (numero de especies)										
	Med.	Atlant.	SWA	SCA	SEA	NWA	NCA	NEA	WEcA	CEcA	EEcA
Reproduccion											
$L_{mat}(\sigma)$	1		4			10		4	3	2	2
$T_{mat}(\sigma)$			3			9			2	1	
$L_{mat}(\varrho)$	1		3			13		3	3	2	2
$T_{mat}(\varrho)$			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. Particion	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		
$L_{inf}(\sigma)$			3			9					1
k(σ)			3			9					1
$T_o / L_o(\sigma)$			3			9					1
$T_{max}(\sigma)$			3			11		1	2		1
Longev(σ)			3			5					
$L_{inf}(\varrho)$			3			9					1
k(ϱ)			3			9					1
$T_o / L_o(\varrho)$			3			9					1
$T_{max}(\varrho)$			3			11		1	2		1
Longev(ϱ)			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

Table 4. Blue shark life history parameters in three regions (AN=North Atlantic, AS=South Atlantic, MED=Mediterranean).

	<i>Prionace glauca</i> (BSH)		
	MED	AN	AS
Reproduction			
$L_{mat} (\sigma)$		230-249 TL	
$L_{50} (\sigma)$	203 TL	239 TL	201-225 TL
$T_{mat} (\sigma)$		5	
$T_{50} (\sigma)$	4.9		6.5-7
$L_{mat} (\varphi)$		221 TL	
$L_{50} (\varphi)$	215 TL		194-228 TL
$T_{mat} (\varphi)$		5	
$T_{50} (\varphi)$	5.5	6	6-7
Cycle		1	1
GP (months)		9-12	9-12
L_0		55 TL	56 TL
Mean LS		39	34
Min LS		1	1
Max LS		96	94
Age & Growth			
$L_{inf} (\varphi)$	401 TL	371 TL	293-335 TL
$k (\varphi)$	0.13	0.13	0.11-0.183
$T_0 / L_0 (\varphi)$	-0.62	-1.77	-2.19
$T_{max} (\varphi)$	12*	15	12-16
$L_{inf} (\sigma)$	401 TL	338 TL	295-311 TL
$k (\sigma)$	0.13	0.18	0.14-0.149
$T_0 / L_0 (\sigma)$	-0.62	-1.35	-1.3
$T_{max} (\sigma)$		16	13-14
Tagging & movement			
Conventional		yes	yes
Archival		yes	yes
Acoustic		yes	
Conversion Factors			
Length-length [cm]	$TL=1.176FL+4.1$	$FL=0.8313TL+1.3908$	$TL=1.201FL+1.613$
Length-weight (b) [cm,kg]	$LT=74.6Wd^{0.307}$	$W=3.18E-06TL^3.1313$	
Length-weight (φ) [cm,kg]		$W=1.30E-06TL^3.2$	$W=1.1E-06FL^3.35$
Length-weight (σ) [cm,kg]		$W=3.90E-07TL^3.41$	$W=2.2E-06FL^3.189$

Table 5. Summary of the timeline of biological and other activities by topic and species conducted under the SRDCP since 2015 (with the addition of the two ERAs that were conducted in 2008 and 2012 as a precursor to work of the plan).

SPECIES	SMA						POR			FAL	OCS	SPL	LMA
	Age and growth	Population genetics	Movement and habitat use	Post-release mortality	Reproduction	Close Kin Mark Recapture	Reproduction	Movement and habitat use	Population genetics	Movement and habitat use	Movement and habitat use	Movement and habitat use	Movement and habitat use
2008	1st ERA on 12 species (precursor to the SRDCP)												
2009													
2010													
2011													
2012	2nd ERA on 20 stocks (precursor to the SRDCP)												
2013													
2014													
2015	■	■	■	■	■								
2016	■	■	■	■	■		■	■					
2017	■	■	■	■	■		■	■					
2018	■	■	■	■	■		■	■	■	■	■		
2019	■	■	■	■	■		■	■	■	■	■	■	
2020	■	■	■	■	■		■	■	■	■	■	■	
2021	■	■	■	■	■		■	■	■	■	■	■	
2022	■	■	■	■	■		■	■	■	■	■	■	

Table 6. SCRS papers and peer-reviewed articles that have been produced as a result of SRDCP activities.

SPECIES		SMA							POR				BSH		BTH		TIG
Year	ERA/ECOSYSTEMS	Size distribution	Movement and habitat use	Post-release mortality	Age and growth	Population genetics	Reproduction	Tagging	Size distribution	Post-release mortality	Reproduction	Population genetics	Distribution and population structure	Tagging	Distribution	Reproduction	Distribution
2008																	
2009																	
2010	ALR																
2011																	
2012	167																
2013																	
2014													021				
2015								064					039	064	RFBF	RFBF	
2016			056		055	076											JFB
2017		048	050	050	051 & 111	214							FaF				
2018	076	096	094	105	095												
2019			090	096		173											
2020	099					132	FB		097		042						
2021			FMS_2	FMS_1		163				FMS_1							
2022						085 & 170						086 & 171					

- ALR: Aquatic and Living Resources
- FB: Fishery Bulletin
- FaF: Fish and Fisheries
- RFBF: Reviews in Fish Biology and Fisheries
- JFB: Journal of Fish Biology
- FMS: Frontiers in Marine Science

Table 7. Outlined table proposed to be completed by the group in order to visualize the state of progress on the knowledge of the species and the knowledge needs for their evaluation and management.

Species	Population		Biology		Population					
	Stock	Managements units	Reproduction	Age and growth	Growth rate	Generation time	Steepness	Mortality		
								Natural	Post-release	At-vessel
<i>Rhincodon typus</i>										
<i>Pseudocarcharias kamoharai</i>										
<i>Carcharodon carcharias</i>										
<i>Isurus oxyrinchus</i>										
<i>Isurus paucus</i>										
<i>Lamna nasus</i>										
<i>Cetorhinus maximus</i>										
<i>Alopias superciliosus</i>										
<i>Alopias vulpinus</i>										
<i>Carcharhinus falciformis</i>										
<i>Carcharhinus galapagensis</i>										
<i>Carcharhinus longimanus</i>										
<i>Prionace glauca</i>										
<i>Sphyrna lewini</i>										
<i>Sphyrna mokarran</i>										
<i>Sphyrna zygaena</i>										
<i>Pteroplatytrygon violacea</i>										
<i>Manta alfredi</i>										
<i>Manta birostris</i>										
<i>Mobula hypostoma</i>										
<i>Mobula japonica</i>										
<i>Mobula mobular</i>										
<i>Mobula tarapacana</i>										
<i>Mobula thurstoni</i>										

Species	Biology/Ecosystem			Abundance indices	Length composition	Catches		
	Distribution		Diet			Historical	Current	Non-ICCAT fisheries
	Horizontal	Vertical						
<i>Rhincodon typus</i>								
<i>Pseudocarcharias kamoharai</i>								
<i>Carcharodon carcharias</i>								
<i>Isurus oxyrinchus</i>								
<i>Isurus paucus</i>								
<i>Lamna nasus</i>								
<i>Cetorhinus maximus</i>								
<i>Alopias superciliosus</i>								
<i>Alopias vulpinus</i>								
<i>Carcharhinus falciformis</i>								
<i>Carcharhinus galapagensis</i>								
<i>Carcharhinus longimanus</i>								
<i>Prionace glauca</i>								
<i>Sphyrna lewini</i>								
<i>Sphyrna mokarran</i>								
<i>Sphyrna zygaena</i>								
<i>Pteroplatytrygon violacea</i>								
<i>Manta alfredi</i>								
<i>Manta birostris</i>								
<i>Mobula hypostoma</i>								
<i>Mobula japonica</i>								
<i>Mobula mobular</i>								
<i>Mobula tarapacana</i>								
<i>Mobula thurstoni</i>								

Agenda

1. Opening, adoption of agenda and meeting arrangements.
2. History and overview of the SRDCP.
3. Main results obtained and ongoing activities.
 - 3.1 Age and growth.
 - 3.2 Genetics.
 - 3.3 Movements and habitat use.
 - 3.4 Post-release mortality.
 - 3.5 Reproduction studies.
 - 3.6 Improvement of information available for stock assessment.
4. Difficulties faced and possible ways to overcome those.
5. Future steps.
 - 5.1 Amendment of the ICCAT agreement and the shark species.
 - 5.2 Advances in pelagic sharks' available information outside the SRDCP.
 - 5.3 Activities to be continued.
 - 5.4 New activities to be included.
6. Towards Phase 2 of the SRDCP: Draft proposal.

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