CHAIR'S REPORT OF THE 1ST JOINT TUNA RFMO BY-CATCH WORKING GROUP MEETING

(*16-18 December 2019, Porto, Portugal*)

1. Opening and meeting arrangements

The meeting Chair, Dr. Paul de Bruyn the Science Manager at the IOTC, opened the meeting by welcoming all the participants to the Joint t-RFMO By-catch Working Group (the Group) meeting. He stated his hope that it would be a renewal of the process of coordination and cooperation between the t-RFMOs regarding by-catch issues. The Chair then thanked the ICCAT Secretariat for coordinating meeting preparations in cooperation with IATTC IOTC, WCPFC and CCSBT Secretariats. He then thanked all Keynote speakers for their availability and contribution to the meeting, as well as the European Union and FAO (via the Common Oceans ABNJ Tuna Project) for providing financial support for this initiative.

The Chair handed the floor to the ICCAT Executive Secretary (Mr. Camille Manel), who provided logistical information regarding the meeting. He further extended his welcome to the participants and thanked the EU and FAO/ABNJ for financial support. Mr. Manel then welcomed the Contracting Parties from the five tuna RFMOs present at the meeting. In total, 24 Contracting Parties were present, namely Algeria, Brazil, Canada, Costa Rica, Côte D'Ivoire, El Salvador, Equatorial Guinea, European Union, Gabon, Guatemala, Honduras, Japan, Mexico, Nicaragua, Nigeria, Panama, Peru, São Tomé e Príncipe, Senegal, Thailand, Tunisia, United States and Uruguay. Also in attendance were two International Organizations, FAO and the International Whaling Commission (IWC). Finally, 11 Non-governmental organizations and entities, namely Asociación de Atuneros del Ecuador (ATUNEC), Blue Resources Trust, Defenders of Wildlife, IPNLF (The International Pole & Line Foundation), ISSF (International Seafood Sustainability Foundation), PEW Charitable Trusts, SFP (Sustainable Fisheries Partnership), The Ocean Foundation, The Shark Trust, TRAFFIC and WWF (World Wildlife Fund) also attended. The List of Participants is in **Appendix 1**. The meeting's goals, framework and objectives are described in **Appendix 2**. The recommendations arising from the meeting would be directed at the tRFMOs.

Finally, Mrs. Isabel Teixeira from the Portuguese Marine Fisheries Directorate also welcomed the participants on behalf of the Minister who had been unable to attend. She expressed her hopes that the meeting would go well and that it would be fruitful for addressing issues at the tRMFOs.

2. Adoption of Agenda and assignment of rapporteur

The Agenda (j-BYC-01) and the Annotated Agenda (j-BYC-30) were adopted without changes (**Appendix 3**). The lists the documents (**Appendix 4)** made available to the meeting participants. Documents for the meeting are published at https://www.iccat.int/en/Meetings.asp

Dr. Nathan Taylor (By-catch Coordinator at the ICCAT Secretariat) was the meeting rapporteur.

3. Introductory keynotes

Seven keynotes presentations were provided. The presentations were followed by a period of discussion. What follows is a brief summary of the discussions. Section 10 captured recommendations arising from the presentations and discussions.

3.1 By-catch: A Challenge of Multiple Interests, Andrés Domingo

Dr. Domingo provided a broad perspective on by-catch noting that shark by-catch falls into the broader issue of by-catch in general. In this regard, he noted there are many facets to the by-catch issue including: as retained species, as discarded species, as components of the ecosystems, as problem species causing damage to/depredating gear, those specifies that benefit from consumption of bait and discards, iconic by-catch species that are attractive for conservation, and as a distraction from target fishing issues. Depending on who is involved, the by-catch problem can have many meanings so that it is difficult to arrive at a clear solution. The main question he set forward in his keynote address is how to determine if what is attempted for by-catch is effective for the species we want to protect and for those of less concern but that we should also protect? To address this question will require the collaboration of many organizations and the insight from many perspectives.

3.2 By-catch management at tuna RFMOs: Delayed action requires drastic change, Grantly Galland (BYC-27)

Grantly Galland, a policy officer at the Pew Foundation, provided his presentation on By-catch Mitigation at tRFMOs: Delayed Action Requires Drastic Change (**Appendix 6**). The thesis of his talk was that some by-catch species have been driven to low levels because the mandate of by-catch species is secondary to the management of tuna/swordfish and that some by-catch species have significant values despite being a secondary target. He reviewed his assessment of the status of shark and billfish populations managed by tRMFOs noting several stocks of concern and those of unknown status. He supplemented some of the stocks determined to be of unknown status by the tRMFOs with the analysis provided by the IUCN: noting that several are determined to be endangered and/or critically endangered. He further noted that data deficiencies could be filled with increased observer coverage, use of electronic monitoring, collection of data on interactions with sharks and billfishes. One of his recommendations was to design scientific research to specifically study potential policy solutions to by-catch problems. To support this claim, he reviewed some policies that have been attempted including rebuilding/recovery plans at ICCAT and retention bans. To date, retention bans have become a default management measure for sharks (e.g., oceanic whitetip, threshers, hammerheads, and silky sharks), as managers have delayed action until populations have been severely depleted.

A review of the status of sharks and billfishes – where available – was presented, along with cautionary tales from the Atlantic and Pacific Oceans, where delayed action has resulted in steep declines and the need for rapid action. These examples illustrate why action needs to be taken early to ensure that by-caught species are managed properly, and in the cases of extreme depletion, are given an opportunity to recover before disappearing entirely.

Discussion

Some participants noted that by-catch discussions like this one had been going on for many years. These discussions have also included some of the issues already referred to including how to define what by-catch is. With respect to the recommendations made by Mr. Galland, further discussions noted that ICCAT had taken a measure to more accurately estimate the dead discards of blue marlin and white marlin. Moreover, the recommendation made by Mr. Galland to increase observer coverage would not help improve the data coverage needed in order to resolve the catch of shark species in coastal areas. The discussion returned the matter of defining by-catch and it was noted from the floor that defining such terms is of paramount importance.

The matter of differences in IUCN methodologies vs. stock assessments was discussed. It was noted that that standards applied in using these two separate methodologies were different. Even though such differences exist, it was noted that the assessments from expert groups like IUCN/CITES could still form the basis for action. However, because different methods can also imply different objectives (for example, MSY vs. relative declines) it is difficult for managers to compare and interpret such information relative to the mandate of each RMFO. It was noted that considerable efforts were made on the part of Common Oceans ABNJ Tuna Project to do large ocean basin assessments of elasmobranchs. The IUCN estimates might better be replaced by these.

It was noted that in the WCPFC when retention bans were implemented, there was a large decrease in total elasmobranch catches. It was emphasized that it is important to continue to evaluate the efficacy of the management measures.

The effects of few and/or low-quality data were discussed. It was noted that few data or poor-quality data made it difficult to resolve stock status. But many developing countries were developing new data collection programs and alternative policy instruments such as effort control. New methods (electronic monitoring) could help improved data gaps as well. Given the importance of observer coverage, it should be considered of paramount importance.

3.3 Preliminary estimates of productivity, population dynamics parameters, and reference points for shark species of concern managed by tuna RFMOs, Enric Cortés (BYC-07)

Dr. Enric Cortés provided his summary of preliminary estimates of productivity, population dynamics parameters, and reference points for elasmobranch species of concern managed by tuna RFMOs (**Appendix 6**). The presentation consisted of his summary of vulnerability ranks for pelagic elasmobranchs from quantitative risk assessments or similar approaches in the Atlantic, Indian, and Pacific Oceans. Based on life-history information, his analysis determined the productivity values for pelagic elasmobranchs in Atlantic, Pacific and Indian Ocean by elasmobranch family. The analysis showed the analytically derived biomass-based and fishing mortality-based reference points including optimal depletion levels: the conclusion is significant because it means that these quantities can be determined using life history information alone (given certain caveats). The use of this optimal depletion level can be extended to consider the status of the stock relative this value using only an index of abundance. In addition, the method offers possibilities for estimating the current fishing mortality. Methods to do this include area-based methods, catch-based methods, length-based methods, and independent estimates derived from tagging data. Estimated reference points and current fishing mortality can be used to assess overfished and overfishing status for pelagic elasmobranchs using Ecological Risk Assessment (ERA). He summarized some of the potential problems with applying such methods but highlighted that the most important uncertainty to resolve is the basic life history including age, growth, and breeding frequency for elasmobranch species because without reliable life-history information these estimates would be unreliable.

It was noted that while it was possible to derive reference points using such methods it was important for the RMFOs to define targets; applying F_{MSY} as a target reference point might result in significant depletion for these stocks. Second it was asked if such methods might be applied in order to replace conventional stock assessment. In response to such questions, i) it was noted that the F_{CRASH} and F_{LIMIT} represent the maximum fishing mortality that a stock could tolerate and should be avoided with high probability and ii) it was noted that the methods that should be applied to each stock should be determined on a stock by stock basis. Whether applying conventional stock assessment or ERA, more - and better-quality data including life history information and trend information from CPUE will improve the assessments.

Regarding the need for life-history parameters, it was noted that the EU funded a study to determine the life-history information from elasmobranchs. It was noted that in the scientific committees, it was difficult to get agreements from the participants to use such methods. So, the main question was if a joint technical working group to obtain some common benchmarks between the RMFOs would be useful. The issues of how to address data gaps for stock assessment was common to all the t-RMFOs and there might be a benefit for having a common forum to address such data gaps.

It was noted that one problem that is particular to elasmobranchs is that data quality varied a lot across different species in coastal areas. Coastal species have very different life history from pelagic species. For these species, we have very little data for the most elementary quantities like catch and life-history information. Accordingly, it was important to get more information about coastal elasmobranchs and where possible to characterize the uncertainly in the life-history parameters. With respect to uncertainty, the speaker responded that life-history parameters variance could be determined – if data are available.

3.4 Fishery and non-fishery factors contributing to by-catch, Evgeny Romanov

Dr. Romanov began by defining by-catch. Relying on Hall 1996's definitions of by-catch, he reviewed the problems associated with defining by-catch. He defined the basic by-catch equation as:

By-catch=BPUE x Effort

Using this definition, he reviewed factors contributing to by-catch. He reviewed fisheries, biological, political/legislative, economic, and mental factors contributing to by-catch. He identified the need to reduce by-catch per unit effort for species with high at-haul and post-release mortalities (threshers and hammerheads, elasmobranch release from PS, the effect of gillnets, the management of by-catches in subsistent fisheries (gillnets) and compliance and enforcement are key issues to address for by-catch.

The discussion noted that while the presentation identified many facets to the problem, a key area of concern is to address these challenges: what might be the recommendations to resolve these challenges for example, how to address subsistence fisheries data and compliance needs? As part of resolving such challenges, it was noted that was an important concept to capture was the notion of prioritization in terms of objectives/outcomes.

3.5 Perspectives of the longline sector on shark and elasmobranch by-catch, Edelmiro Ulloa Alonso (BYC-31)

Mr. Ulloa Alonso provided a summary of the Spanish sector's longline fisheries perspective (**Appendix 6**). He noted the at the fleet confirms the incidence of elasmobranchs as by-catch species, but that they are an important by-catch species in the fleet. For the fleet, Endangered, Threatened and Protected (ETP) species are a problem because their capture decreases fishing-operation efficacy and the need to develop a Fisheries Improvement Plan (FIP) to address ETP species. This FIP required the following: evaluation of data gaps; revision of the contents of current information and means used; providing good quality base information for stocks assessments; improve performance to comply with annual obligation reporting of Task I and Task II data for catches and effort, size and catches of elasmobranchs. This work plan also included plans to review and report data of all ETP catches, data from electronic log books, and to achieve constant improvement in the application of the FAO's Guidelines to reduce sea turtle by-catch mortality in fishing operations by the fleet using a continual training approach.

The Group discussed the role of MSC certification in the management of elasmobranchs. Because of the limited number of sectors that could qualify for MSC certification, designing recommendations for all other sectors based on the MSC process might only be applicable to a limited portion of the fishing sector. Accordingly, a question that arose in the discussion was, in what all fishing sectors could be integrated into the process for making by-catch recommendations? By way of response, the speaker replied that to manage the stocks sustainably, the process would need representation from across all sectors.

It was discussed that there was great distrust in some sectors about measures for by-catch management. Given this distrust, it was queried as to what were the difficulties that need to be overcome to ensure implementation of mitigation measures? The speaker responded that some measures were perceived to be impractical (for example covering the eyes on 2m long elasmobranchs) or very complicated to apply in practice. One key method of moving forward with mitigations measures would be to develop and be creative in applying new methods. The discussion also noted the need for capacity development for parts of the fleet where the needs and justification for mitigation measures is explained to fishing crews. Capacity building needs to be applied to more than just skippers who may not be on decks during fishing operations but also to the crews who handle the captured fish in practice. In addition, some new measures/technology need to be developed with the participation of the fleet. Finally, the speaker noted that some measures such as time/area closures could be implemented easily for elasmobranchs.

It was noted that a lot of information and knowledge exists in the sector that has not made its way to the scientific committees. So, a key question was: what has impeded the provision of this information to the scientific committees? The speaker responded that he was not sure how this information could be made available to the scientific committee. The discussions ensued that one possibility was that members of fishing sectors be involved in the science committees and in research at sea. An idea to collect some of the proceeds from the catches in order to fund scientific research was heartily agreed to by the longline sectors. He also noted that existing collaborations with IEO in La Coruña are ongoing. The sector had not really wanted to be involved in the science meeting themselves because they do not want to appear as interfering in the process, but this was something that they might re-evaluate. It was noted that in some countries there was widespread collaboration. One major collaborative success was with the Galician longline sector which invited the Sharks Species Group to participate in some of the scientific work involving of their fishery. This incited strong participation of the Galician group in the Sharks Species Group to the benefit of all.

3.6 The role of fishing industry: Towards improving by-catch mitigation and management, Miguel Herrera and Alexandra Maufroy

This presentation outlined the existing context for the role of industry participation in data collection, research and adoption of regulations and mitigation measures, driving the implementation of mitigation measures, assistance in the evaluation of effectiveness and review of measures. The presenters articulated their personal view of the future pertaining to data collection and management. For data collection they argued for the need to adopt a list of by-catch species for which data collection is required, minimum standards for the collection of such data, and for a level playing field on observer coverage between the sectors. For management they argued that: precautionary approaches should apply in the adoption of measures; measures should not be adopted where there is a lack of appropriate enforcement/control mechanisms; and that consultation with the industry is required at all levels to avoid failed implementation of measures. They described the progress made by improving by-catch mitigation and management including: non-entangling drifting FADs (NEFADS), eliminating elasmobranch ghost fishing with NEFAD, limiting the use of FADs, harmonizing the control of FAD use, designing new Best Practices, providing high quality scientific data on elasmobranchs with 100% coverage, combining onboard and electronic observation. They recommended: harmonizing RFMO FAD management/definitions; to continue developing Best Practices; ensuring good quality data from EMS and onboard observers.

3.7 The role of science in ensuring appropriate fishery and biodiversity management of sharks, Shelley Clarke

Dr. Clarke noted that FAO ABNJ wish to express their happiness in supporting this by-catch meeting and noted that the Global Environmental Fund has invited FAO to submit another project proposal.

Dr. Clarke's presentation addressed four main questions: why do we need science? isn't science improving? why are science gaps a problem? and why is science not a silver bullet? To the first, she argued that systems are improving noting that B_{MIS} data show that the public domain data for elasmobranch catch reporting is improving but that (as others have noted) life-history information for elasmobranchs still has fundamental gaps. But she noted that the quality of technical data is not improving. What is missing is information about management efficacy because information about implementation and the impacts of mitigation measures is confidential and not reported. She argued that data quality remains problematic: she noted that ABNJ produced new identification guides to help but that observer coverage is low or unrepresentative, and elasmobranchs are biting off or being cut free with no identification. As to whether science is improving, she argued that it was a mixed picture: where the quantity of data is increasing, data quality is mixed: species ID is getting better, data representativeness remains the same, but data completeness is in decline. She asserted that science gaps create uncertain assessments or no assessments. The result is unknown, false negative, or false positives in stock assessment.

In addition, she argued that it remains the case that the efficacy of mitigation measures in practice has not been evaluated. Measures that have not been evaluated included: prohibition on finning, no-retention measures (oceanic whitetip, silky, whale shark, shortfin mako, threshers, hammerheads) and the ban on wire leader or shark lines. While there is an increasing number of studies on post-release mortality there is still very little notion of the handling mortality. Without reliable estimates of at-haulback mortality, there is no way to determine total by-catch mortality. She noted some small progress for example, that WCPFC had formerly banned wire leaders or shark lines but there was no requirement to report choice or whether it is applied by vessel or fleet. She noted new Conservation and Management Measures (CMMs) require the declaration of these choices. She noted that a lack of a clear understanding of elasmobranch status, and the implementation and effectiveness of mitigation, is not helpful to the debates about stock status. The major conclusions of her talk were: adoption of a management measures represent only the first step; there is a need to evaluate implementation & effectiveness; formulate management measures to improve, not diminish, data quality; pose questions that demand quantitative answers; focus not on what is adopted, rather what is achieved; consider uncertainty and work to reduce it over time; find alternative sources of data to complement t-RFMO data; and go beyond identifying data gaps to propose how to fill them.

The Group discussed that the paucity of data for many stocks made it difficult to resolve stock status but noted that there are remedies to this problem. Many developing countries were developing data collection solutions but also alternative policy instruments such as effort control. New data collection methods, i.e. electronic monitoring could help reduce data gaps as well. Given the importance of observer coverage, the expansion of such programs and the use of electronic monitoring should be considered of paramount importance for the science and management.

It was noted that there are more data available than might initially be apparent. There are data in the possession of CPCs that are not readily applied to address by-catch problems at the t-RMFOs. One remedy might be that there needs to be a forum to share this information. The speaker noted that ABNJ had provided a forum for this. Broadly the need to collect data from fisheries that are underrepresented in the data (artisanal, gillnet fisheries and some longline fleets) was very important.

There was much support for the need to evaluate implementation and effectiveness of management measures especially after they are implemented.

The following additional paper was also assigned to this session but not presented: *Dialogue Between Research and Fishing Industry Towards Improving Scientific Observations of Bycatch: The Case of The French And Italian Tropical Tuna Purse Seine Fleet in the Atlantic and Indian Oceans* (BYC-21). These keynote presentations and this paper are attached as **Appendix 6**.

4. Reports from tRMFOs

Dr. Simon Nichol provided a keynote presentation on Data, assessment and management measures for elasmobranchs at the WCPFC.

The WCPFC has introduced several management measures over the years. During that time, analytical approaches evolved from ERAs to full stock assessment. He noted that management measures are under continuous evaluation. WCPFC conducts several stock assessments per year. For minor elasmobranch species, assessments are done at longer intervals because the additional time will allow for more opportunity to detect what the response of the stock was to any management measures that have been applied.

Like all the RFMOs considerable uncertainties exists in the data. These include unreliable catch series, life-history information, and indices of abundance. A companion problem is that objectives are very poorly defined and as they tend to be generic, they can be interpreted in different ways by different countries. Evaluation of CMMs have demonstrated some efficacy with some improvement in data that have been submitted.

The presenter provided a summary of logbook and observer data collected by the WCPFC. It has well-defined data standards. The observer data collected is highly detailed on the condition of the fish released.

Finally, he touched on the By-catch Management Information System, BMIS. He noted that the effectiveness of management measure implementation comes from access to information. This information includes management measures at the WCPFC and measures applied at other tRMFOs. The system also provides a forum to provide as much information as possible in terms of technical reports, primary publications, etc. that would not otherwise be available to CPC scientists.

5. Qualitative and quantitative species population status determination methods for by-catch species

Dr. Shane Griffiths provided a keynote presentation (**Appendix 6**) based on *Easi-Fish - A flexible vulnerability assessment tool for quantifying the cumulative impacts of tuna Fisheries on data-poor bycatch species* [BYC-04].

EASI Fish is a quantitative prioritization tool that identifies species requiring immediate mitigation measures or those that require more data collection and research for future conventional stock assessment. It does not require catch data.

The Group discussed some of the finer technical details including how this method compared to other methods and how the underlying assumptions could be justified. There was not enough time to go into detail due to time constraints. They discussed that one key issue is to define an appropriate target harvest rate: these could be derived using other methods. One area that was also discussed was the potential to use the tool to address spatial stock assessment and management.

The keynote was followed by three additional presentations: Predicting hotspots of the main by-catch species of tuna purse seine fisheries in the Atlantic and Indian Oceans (BYC-22), Deriving abundance indices for pelagic elasmobranchs based on their associative behavior with floating objects (BYC-23) and Scope of close-kin mark-recapture for assessment of pelagic elasmobranchs (BYC-17). The following additional papers were also assigned to this session but not presented: *Observe: database and operational software for human observation, electronic monitoring, logbook and associated data of purse-seine and longline fisheries* (BYC-14), *Counting sharks incidentally captured by tropical tuna purse seine vessels- easier said than done!* (BYC-24) and *Inventory of sources of data in Guatemala on shark fisheries operating in the eastern Pacific Ocean* (BYC-28). These keynote presentations and papers are attached as **Appendix 6**.

5.1 Predicting hotspots of the main bycatch species of tuna purse seine fisheries in the Atlantic and Indian Oceans, Mannocci *et al.* (BYC-22)

Mariana Travassos Tolotti provided a presentation (**Appendix 6**) describing how data collected within French fisheries observer programs could be used to predict hotspots for the top five by-catch species as well as the spatio-temporal overlap with fishing effort at the basin scale in the Atlantic and Indian Oceans. The approach used General Additive Models (GAMs) to relate by-catch per floating object fishing set to habitat covariates. Estimated relationships were geographically extrapolated to derive predictions of multispecies by-catch hotspots at the basin scale then compared to the overlap of fishing effort in these areas. In the Atlantic, by-catch hotspots were predicted throughout subtropical waters with little overlap between species. In the Indian Ocean, major by-catch hotspots were predicted in northern waters for four species. The overlap of hotspots with the core fishing effort was substantial year-round in the Atlantic and in the second half of the year in the Indian Ocean. Potential for by-catch reduction is highest in the Indian Ocean where a seasonal fishing closure North of 8°N would protect four pelagic fishes, including vulnerable silky sharks. The extrapolations beyond the core fishing areas are particularly valuable for predicting by-catch risks associated with potential expansions of fishing effort.

5.2 Deriving Abundance Indices for pelagic sharks based on their associative behavior with floating objects, Diallo *et al.* (BYC-23)

Mariana Travassos Tolotti continued with another presentation (**Appendix 6**~~BYC-23~~) describing a new method to derive an abundance index for pelagic elasmobranchs associated with floating objects (FOBs). This method used a behavioral model for FOB-associated elasmobranchs for the probabilities of a elasmobranchs to associate with and leave a FOB, respectively. Silky shark (*Carcharhinus falciformis*) was chosen as a case study. The model was driven using EU-France and EU-Spain tropical tuna purse seine fishery observer data recorded in the Indian Ocean. The model's parameters were estimated by fitting the distribution of the number of elasmobranchs caught per FOB set. She contended that the methodology could be applied to other species associating with FOBs, generating population trends that could be incorporated into stock assessments.

5.3 Scope of close-kin mark-recapture for assessment of pelagic sharks, Bravington *et al.* (BYC-17)

Dr. Bravington provided a summary of the Close Kin Mark Recapture and discussed its applicability to shortfin mako shark (**Appendix 6**). CKMR has been successfully applied to two commercial fish species including one shark, as well as to several low-abundance endangered elasmobranchs. He described a preliminary design study for mako sharks in the North and South Atlantic Oceans, discussing sample sizes, data requirements, outputs relevant to management advice, logistic and administrative impediments, and the extent to which measures such as non-retention policies/regulations might or might not affect viability of CKMR.

The Group thought the Close-Kin Mark-Recapture for assessment was a promising task and inquired about potential costs. These were in the order of 25 dollars per sample. An additional question pertained to its applicability in practice, particularly why it had not replaced the existing stock assessment for southern bluefin tuna. In response to this question, Dr. Bravington explained that estimates were indeed used in CCSBTs management and that now the technique was more familiar, the presenter anticipated the technique would be applied again soon.

6. Post-release survival studies of pelagic sharks captured by pelagic longliners and purse seiners

Dr. Rui Coelho provided a keynote presentation (**Appendix 6**) based on a *Post-release survival studies of pelagic sharks captured by pelagic longliners and purse seiners: Updates from ongoing ICCAT, IOTC and WCPFC projects* (BYC-16).

BYC-16 was presented which was a compendium of studies on post-release survival studies (PRM) of pelagic elasmobranchs captured by pelagic longliners and purse seiners. The presentation concluded that: several elasmobranch PRM studies have been recently carried out and that further joint analyses to better understand PRM at a global level and in the various regions could be conducted, elasmobranch PRM is species specific and seems to vary at least with specimen size (ICCAT and WCPFC) and length/ratio of the trailing gear left on the elasmobranchs (WCPFC); condition can also be an important predictor (WCPFC), but possible issues/subjectivity for determining condition (ICCAT).

The Group noted that there were apparent patterns in size distribution according to spatial locations and fleet operations that occurred in those areas where those studies were carried out. The differences in fleet operations and location may contribute to apparent mortality differences between these different strata.

The keynote was followed by two additional presentations (**Appendix 6**).

Preliminary estimates of post-release survival of porbeagle sharks (Lamna nasus) following capture and handling techniques, Anderson *et al.* (BYC-07)

This study investigated the post-release survival of porbeagle sharks following capture and handling in rod-and-reel and pelagic longline fisheries in the northwest Atlantic. From 2015 to 2019, pop-off satellite archival tags were used to estimated post-release survival of porbeagle sharks. The study indicated nearly 100% poster release survival rates. But the observed depth-holding behavior may indicate porbeagle sharks exhibit a post-release recovery period following capture and handling.

Quantifying post-release mortality rates of sharks incidentally captured in Pacific tuna longline fisheries and identifying handling practices to improve survivorship, Hutchinson *et al.* (BYC-08)

This presentation provided information quantifying post-release mortality rates of elasmobranchs incidentally captured in Pacific tuna longline fisheries. The study showed that trailing gear and release condition were the most significant factors affecting survivorship. The data also indicated a post-release recovery period. Given the observed post-release recovery period occurred in surface waters where the most fishing effort occurs, this depth-holding behavior may make captured and release porbeagles more vulnerable to recapture in tuna fisheries in the northwest Atlantic.

One key recommendation arising from the presentation was to cut off all trailing gears. It was then discussed that this may be problematic, as removing trailing gear would increase handling time. While the speaker conceded that handling time was increased by removing trailing gear, the survival benefits of removing this gear far outweighed any negative effects.

7. Different means of mitigating the impacts of tuna fisheries: Best practices for handling, release, others

Dr. Melanie Hutchinson delivered a keynote presentation based on *Assessing the efficacy of best handling and discard practices for incidental elasmobranchs captured in a tropical tuna purse seine fishery* (BYC-09).

This presentation provided information on assessing the efficacy of best handling and discard practices for incidental elasmobranchs captured in a tropical tuna purse seine fishery. It highlighted the factors affecting post-release mortality. For longlines, the key recommendations for handling were the following: animals should be left in the water during gear removal; as much trailing gear should be removed as possible, leaving no more than 2.5 meters or less than one body length; and the fleet characteristics, gear configurations, and the species specific effects must be considered in terms of handling practices. For purse seine, most of the mortality occurs for FAL sharks which are entangled. For whale sharks, the best practices were to: cut nets or roll nets out from under whale shark. The recommendations were to avoid vertically lifting sharks by the tail; pulling sharks by a loop hooked around its gill or holes bored into a fin; gaffing the sharks; to leave any towing ropes attached; brail whale sharks larger than 2 meters; and brail whale sharks onto the deck. For Mobula, best practice recommendations are not as effective at reducing mortality as hoped and moving forward efforts should be focused around removing the animals from the net prior to sacking up. It also noted that seasonal aggregations are persistent and predictable. Future work should focus on identification of these and creating dynamic spatio-temporal avoidance measures.

The effect of hook material (stainless or galvanized) could be considered as a management measure. It was noted that while spatio-temperal closures need to be evaluated across multiple species, avoiding hot spots for some species might result in high by-catch of other species. Safe handling practices were also discussed. It was also noted that additional measure such as safe release techniques needed to be addressed as well.

The keynote was followed by the four additional presentations: *Assessing the efficacy of best handling and discard practices for incidental elasmobranchs captured in a tropical tuna purse seine fishery* (BYC-09), *Behavior of silky sharks and oceanic white tip sharks in relation to floating objects: Implications for shark conservation* (BYC-18), *Fishing on FADs without killing silky sharks: Where are we and what should we do?* (BYC-19), and *Mitigation actions on Spanish tropical tuna purse seiner fishery* (BYC-15). The following additional papers were also addressed: *The effect of light stick color in pelagic longline fisheries* (BYC-06), *Graphics for best handling practices for the safe release of sharks* (BYC-10), *Understanding the skipper effect in the blue shark by-catch from Mediterranean Sea* (BYC-11), *Shark by-catch trend of Spanish purse seiners industrial fisheries targeting tropical tuna around Africa: An overview* (BYC-12), *Forecasting oceanic whitetip shark potential global distribution in a context of climatic change* (BYC-13) and a *Glimpse into the status of elasmobranchs in Sri Lanka* (BYC-20). These keynote presentations and papers are attached as **Appendix 6**.

Mitigation actions on Spanish tropical tuna purse seiner fishery, Grande *et al.* (BYC-25)

This presentation provided a summary of a Code of Good Practices (CGP) developed and applied in the Spanish longline fishery (**Appendix 6**). The key conclusions and recommendations were as follows. The CGP has enable the assessment of the replacement of entangling FADs (open netting with mesh size >7cm) by non-entangling FADs; the sensitive species by-catch rate is low (<7t /1,000t), mainly composed by elasmobranchs that are mainly released by hand. The release time from detection has decreased, indicating the increasing commitment of the fleet. The fleet could adopt additional mitigation actions to further decrease the potential impact of drifting FADs and the mortality rate of sensitive species, for example: the purse seiner fleet should move to non-entangling FADs constructed entirely without any net and with biodegradable material. To reduce the amount of synthetic marine debris, the fleet should adopt new mitigation actions such as: (i) participating in FAD recovery programs, (ii) sharing buoy track data with scientific community to develop FAD drifting models to enhance the efficiency on FAD recovery and diminish FAD beaching or lost risk. In order to increase the survival of vulnerable species, alternative mitigation approaches should be explored (e.g. development of new releasing tools, avoidance of elasmobranch hot spots, avoid setting in small schools). Promote the training and capacity building: strengthen training of the crew involved in handling of sensitive species both in the upper and lower decks and on coastal states responsible of the observer programs. To implement research actions to further advance in improving by-catch species knowledge (e.g. post releasing survival) and developing, improving or evaluating mitigation actions.

Fishing on FADs without killing silky sharks: Where are we and what should we do? Dagorn *et al.* (BYC-19)

This presentation summarized some of the problems and solutions to reducing mortality of elasmobranchs on FADs (**Appendix 6**). It reported that it was possible to increase silky shark survival by 62% by shifting effort to free school sets, setting on FADs that only have >10t of tunas, removing fish from the seine, and releasing the elasmobranchs from the deck. The major challenge identified by the presentation was that there is currently no system to evaluate the number of elasmobranchs killed by the fishery and if mitigation practices are actually implemented. It was noted as well that the proposed mitigation solutions are unpopular with fishers for several reasons. Accordingly, there must be development of incentives, resolutions, enforcement

Behavior of silky sharks and oceanic white tip sharks in relation to floating objects: Implications for shark conservation, Dagorn *et al.* (BYC-18)

This presentation provided a summary of the behavior of silky sharks and oceanic white tip sharks in relation to floating objects and the implications for their conservation (**Appendix 6**). Among others, its principle conclusion was the need to improve observers data (electronic monitoring) and more frequent electronic tagging (fishery independent data). A similar set of recommendations could apply to oceanic whitetip sharks.

A meta-analysis for the effects of hook, bait and leader types on pelagic longlines: comparisons for target, bycatch and vulnerable species captures, Coelho *et al.* (BYC-15)

This presentation provided a meta-analysis for the effects of hook, bait and leader types on pelagic longlines including comparisons for target, by-catch and vulnerable species captures (**Appendix 6**). The preliminary work summarizes the work across many studies. The objective of the study was to characterize the relationships between retention rates and by-catch mortality and other variables such as hook type, bait, leader, target, retained catches and discards. The results presented here are preliminary.

Some future steps will include expanding information on fishery characteristics, e.g., deep vs shallow LL setting and doing meta-regression to evaluate the effect of additional covariates, including interactions.

The following additional papers were also assigned to this session but not presented: *Silky shark draft regional management strategy for SIOTI members* (BYC-26); *Reviews of by-catch species caught by the SIOTI fleet, codes of practice and other guidance for reducing by-catch mortality* (BYC-29). These keynote presentations and papers are attached as **Appendix 6**.

8. Closing keynotes

Two keynotes presentations were provided (**Appendix 6**):

Improving synergies between regional fishery bodies* and *CITES parties for the sustainable catch, trade and management of sharks, Fowler et al. (BYC-05), by Sarah Fowler.

The presenter provided a summary of plans for the German government to host a high level meeting to clarify the role of CITES in supporting legal, sustainable and traceable international trade, present a background review of the status of elasmobranch conservation, trade and management, and the role of RFBs in the management of CITES-listed species. This included a summary of what prohibitions are implied by the listing on Appendix 1, 2, or 3 and the CITES objectives. Guidance for shipping scientific samples was also providing noting that Appendix 2 listing should not prevent the shipping of scientific samples. Advice was also provided on the role of Non-Detrimental Findings (NDFs) and that regional fisheries bodies like the t-RMFOs might be well placed to aid with information needed to generate such findings. The presentation also provided some background on the international trade for elasmobranchs. It was noted that there are several synergies between CITES and t-RMFOs, notably: CITES trade data could contribute to RFMO stock assessments, as Parties submit their export and import records to the Secretariat; CITES rules, and guidance on traceability through the supply chain, reinforces compliance with RFMO CMMs; and RFMO stock assessments and advice can contribute to CITES NDFs. The presentation noted several future priorities for CITES parties and RMFOs.

The Group noted there is great potential for synergies between CITES and the tRMFOs to implement sustainability measures as opposed to prohibitions. The use of CITES trade data for stock assessment was discussed. The main question was if the CITES data was species, fleet and location specific. It was noted that parties do not have to reveal their non detrimental findings but that these do contain such information. The Group asked when the new guidelines for Introductions from the Sea would be finalized. The CITES Secretariat agreed to provide an information document at the meeting that was circulated.

Future priorities and areas for future collaboration across t-RMFOs for Science and Management by Dr. Fábio H. V. Hazin. Dr. Hazin provided a summary of what had been agreed to that had been agreed to regarding by-catch at Kobe I in 2007, Kobe II in 2009, recommendations from the Kobe II workshop on by-catch in 2010.

This presentation provided a summary of future priorities and areas for future collaboration across t-RMFOs for science and management. The presentation provided some of the historical context including what previous recommendations had been provided. These included: adopting standards for by-catch data collections, implementing and enhancing observer and port sampling program, standards for by-catch data collection and sharing. Many of the historical recommendations made long ago remain relevant today for example, the 2010 workshop identified the following future priorities and areas for future collaborations:

a) Improving assessment of by-catch within t-RFMOs (4 recommendations);
b) Improving ways to mitigate/reduce by-catch within t-RFMO (7 recommendations);
c) Improving cooperation and coordination across RFMOs (4 recommendations);
d) Capacity building for developing countries (1 recommendation).

Dr. Hazin stated that the future priorities for this KOBE group were identified in broad categories of data, management, and cooperation. His recommendations included:

- Harmonization and sharing data and protocols including BDEP, BMIS (ABNJ);
- Observer coverage including especially electronic systems, CBO, Port Sampling, outreach/Capacity-building efforts;
- Develop methods for processing/analysis of new data (AI, genetic- CKMR, etc.);
- Assess the effectiveness of the CMM adopted (+observer coverage);
- By-catch assessment methods (poor data, ERA, MIST, EASI Fish, etc.);
- Capacity-building (e.g. HCR/MSE);
- Resuscitate the Kobe Process/Joint t-RFMO By-catch Working Group!

The Group discussed how to reinvigorate the KOBE process. The Group pointed out that many CPCs were absent from the meeting and discussions were held on how to get their participation in the future. It was further noted that the first meeting started off with great enthusiasm and progress e.g. the standards for the review of each RMFOs is still being applied today. But the presenter then noted that the KOBE process began to have a more political flavor, with some accusing the KOBE process of trying to preside over all the RMFOs. On the correct footing, Kobe could restart the process. The ABNJ process has demonstrated these benefits in addition to other working groups like the Joint tRFMO Technical Working Group on MSE. While it was noted that there had been some successes in Kobe (and ABNJ), a revitalized process would require a deeper look at the progress that has been made. Notably that smaller, more targeted projects had demonstrated the highest degree of success.

9. Key areas for future action for the Joint t-RFMO By-catch Working Group

The participants generally agreed that the process conducted during the current Joint t-RFMO by-catch meeting was productive and it was recommended that the Group meet again under the KOBE process to continue the work conducted during the meeting and address the recommendations arising from it. While there was no resolution to the matter of how broad the Group's mandate was, it was agreed that technical work would continue in the future.

The Chair presented a list of recommended key areas for future action for the joint t-RFMO By-catch Working Group, which were discussed by the Group and are presented below. The recommendations were classified into three broad categories: those that pertained to management, those that pertained to scientific and technical matters, and those that pertained to data. While it was acknowledged that really any recommendation that involves the dedication of effort or funding is in effect a management recommendation, the categorization served to clarify who would be tasked to prioritize and address the recommendations. All research and data-related recommendations from the Group were deferred to be addressed by the Technical Working Group and are contained in **Appendix 5**.

10. Recommendations

During the meeting the rapporteur and several other participants took notes of potential recommendations that were explicitly mentioned in presentations or that arose during discussions and participants were asked to submit their recommendations to the Chair at the end of day 2. These recommendations were compiled and merged to remove duplication (where possible). As specified above, the complete list was categorized into three broad categories: management, research, and data collection. The Group discussed if the assignment of the recommendations into these categories was appropriate after some discussion changed the categorization of some items. The Group agreed on those classified as management recommendations and that they be included in the main body of this report. Research and data recommendations would be placed into Appendix 5 and deferred for prioritization and discussion by the Technical Working Group at its next meeting. The Group agreed to the following recommendations:

1. Re-invigorate the Kobe Joint T-RFMO By-catch Working Group and promote attendance at this Working Group from all regions;
2. Promote outreach/Capacity-building efforts to expand data collection and, sampling, as well as to increase participation in analytical/simulation work, and other activities;
3. Define a prioritized/hierarchical set of quantifiable management objectives as they pertain to by-catch species;
4. Consider adopting science-based management measures, including setting and respecting reference points for by-catch species;
5. Apply a concerted effort to determine the magnitude of elasmobranch (and other) by-catch in all fisheries;
6. Develop incentives, to reduce elasmobranch by-catch mortality;
7. Coordinate efforts to reduce uncertainty in relation to elasmobranch species identification
8. Develop, and share approaches across t-RFMOs to evaluate the implementation and effectiveness of by-catch CMMs
9. Ensure that the adoption of new management measures does not result in a decline in data quality and availability;
10. Taking into consideration the safety of the crew, adopt handling and safe release guidelines for elasmobranch building on the experience acquired at each RFMO or fishing sector level, for each of the fisheries as applicable, and promote their implementation and assess their effectiveness;
11. Promote a shift from single species approach towards a multi-species approach in the conservation and sustainable management of by-catch species;
12. Adopt the precautionary approach for all by-catch species;
13. Increase observer coverage and develop minimum standards for using human observers and other alternatives (including electronic monitoring or any other applicable techniques), that will provide sufficient data for robust estimates of total by-catch;
14. Improve communication and cooperation between CITES and tRMFOs to provide guidance and advice for the CITES listed species caught within the jurisdiction of each tRFMO;
15. Consider science-based time area closures to reduce interactions with by-catch, considering the potential trade-off between species;
16. Prioritize and mobilize adequate resources to assess and develop management measures including mitigation techniques for all fishing gears, including hooking mortality, at-haulback mortality, handling mortality, data collection and post-release survival rate for species incidentally caught in commercial and recreational fisheries based on current and future research;
17. Consider socio-economic effects in management advice;
18. Ensure implementation and compliance with mitigation measures.

11. Adoption of the report and closure

The Chair informed the participants that he would prepare a report of the meeting (Chair's report) which would be posted on the tuna.org webpage, sent to all t-RFMOs and to the Kobe Steering Committee.

The Chair thanked the ICCAT Secretariat for organizing the meeting, and the European Union and the FAO Common Oceans ABNJ Tuna Project for funding the meeting and providing financial assistance to participants from developing countries and invited experts attending the meeting, respectively. He also thanked the participants, particularly those providing documents and presentations, as well as the interpreters, who deeply contributed to the success of the meeting.

The ICCAT Executive Secretary also highlighted the high level of participation in the meeting and the spirit of cooperation of all participants. He also thanked the funders, participants, the staff of the all t-RFMOs Secretariats and the interpreters for their hard work which deeply contributed to a successful meeting.

The meeting was adjourned.

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Appendix 1

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Appendix 2

Joint t-RFMO By-catch Working Group Meeting Announcement and Terms of Reference

Meeting Goal

To promote discussions on the assessment and management of elasmobranchs (sharks and rays) from a global perspective within the Tuna Regional Fisheries Management Organizations (t-RFMOs).

Framework and objectives

The management of by-catch is an issue of common interest to t-RMFOs, including ICCAT. Through the KOBE process, t-RMFOs have met to discuss by-catch through joint technical working groups. The Joint t-RFMO Technical Working Group on By-catch was established in 2009 and had its first meeting in 2011 at the IATTC in La Jolla, California, U.S.A. The meeting was followed by others in 2014, 2015, in 2016. For sharks and rays, however, there has been no dedicated meeting. The Chair of the Kobe process Steering Committee (SC) has therefore recently decided that there should be a meeting of Joint tRFMOs By-catch Working Group on sharks and rays. We are pleased to inform you that the European Union and FAO's Areas Beyond National Jurisdiction Program (ABNJ) have offered to finance the meeting, and that the ICCAT Secretariat was invited to organize it.

The Working Group meeting will be Chaired by Dr. Paul de Bruyn, IOTC Science Manager.

Appendix 3

Agenda

1. Opening and meeting arrangements
2. Adoption of Agenda and assignment of rapporteurs
3. Why do t-RFMOs have an issue with bycatch?
4. Review of the Management and Conservation Measures for by-catch/elasmobranchs at each t-RMFO
5. Review of available catch data provided/held by each t-RFMO (e.g. catch by time and area; and size data)
6. Overview of current research projects on elasmobranches at each t-RFMO
7. Review of the available information on elasmobranch life history: data gaps and research needs
8. Relative magnitude of elasmobranch catches on target vs. bycatch fisheries
9. Impact of gear characteristics on elasmobranch catches (e.g. hook type, leader material and bait)
10. At haulback and post release mortality
11. Report drafting
12. Adoption of meeting report

Annotated Agenda

Session (time)	***Theme***	***Titles for presentations received or themes for discussion***
Monday, 16/12/2019 9:00-9:30	1. Opening and meeting arrangements 2. Adoption of Agenda and assignment of rapporteurs Session Chair: Paul DeBruyn	Welcome, meeting objectives and arrangements Adoption of the Agenda Assignment of rapporteurs
Monday, 16/12/2019 9:30-11:00 11:30-13:00 14:30-15:30 16:00-18:00	3. Introductory Keynote Talks Session Chair: Paul DeBruyn	**Keynotes:** i) By-catch: A Challenge of Multiple Objectives, Andrés Domingo ii) By-catch management at tuna RFMOs: Delayed action requires drastic change, Grantly Galland iii) Preliminary estimates of productivity, population dynamics parameters, and reference points for shark species of concern managed by tuna RFMOs, Enric Cortés iv) Fishery and non-fishery factors contributing to by-catch, Evgeny Romanov v) Perspectives of the longline sector on shark and elasmobranch by-catch, Edelmiro Ulloa Alonso and Francisco Portela Rosa vi) The role of fishing industry: towards improving by-catch mitigation and management, Miguel Herrera and Alexandra Maufroy vii) The role of science in ensuring appropriate fishery and biodiversity management of sharks, Shelley Clarke **Discussion** **Documents** (Bolded documents will be presented): **BYC-021, BYC-027**

Session (time)	***Theme***	***Titles for presentations received or themes for discussion***
Tuesday, 17/12/2019 9:00-9:30	4. Reports from tRMFOs Session Chair: Paul DeBruyn	**Presentations:** viii) Data, Assessment and Management Measures for Sharks at the WCPFCS Simon Nichol
Tuesday, 17/12/2019 9:30-10:30	5. Qualitative and quantitative species population status determination methods for bycatch species. Session Chair: Paul DeBruyn	**Keynote:** ix) Easi-Fish. A Flexible Vulnerability Assessment Tool for Quantifying the Cumulative Impacts of Tuna Fisheries on Data-Poor By-catch Species. Griffiths, S.P., Kesner-Reyes, K., Garilao, C.V., Duffy, L., and Roman, M., Nerea Lezama-Ochoa **Presentations:** x) Predicting hotspots of the main bycatch species of tuna purse seine fisheries in the Atlantic and Indian Oceans xi) Deriving Abundance Indices for pelagic sharks based on their associative behavior with floating objects xii) Scope of close-kin mark-recapture for assessment of pelagic sharks **Discussion** **Documents** (Bolded documents will be presented): **BYC-004**, BYC-014, BYC-017, **BYC-022**, **BYC-023**, BYC-024, **BYC-028**
Tuesday, 17/12/2019 11:00-13:00	6. Post-Release Survival Studies of Pelagic Sharks Captured by Pelagic Longliners And Purse Seiners Session Chair: Paul DeBruyn	**Keynote:** xiii) Post-Release Survival Studies of Pelagic Sharks Captured By Pelagic Longliners And Purse Seiners: Updates From Ongoing ICCAT, IOTC And WCPFC Projects. Coelho, R., Bach, P., Bigelow, K., Bonhommeau, S., Carlson, J., Clarke, S., Cortes, E., DeBruyn, P., Domingo, A. Finucci, B., Francis, M., Hazin, F., Hoyle, S., Hutchinson, M., Krug, I., Liu, K-M , Lyon, W., Macias, D., Martin, S., Mas, F., Miller, P., Murua, H. Musyl, M., Natanson, L, Norman, S., Peatman, T., Romanov, E.V., Rosa, D., Sabarros, P.S., Sanchez, C., Santos, C.C., Semba, Y., da Silva, C., Sippel, T., Travassos, P., Tsai, W-P. Urbina, J.O., and Zhu, J. **Presentations:** xiv) Preliminary Estimates Of Post-Release Survival Of Porbeagle Sharks (Lamna Nasus) Following Capture And Handling Techniques, Anderson, B.N., Natanson,L., Carlson, J., Coelho, R., Cortes, E. Domingo, A., Sulikowski, J.A. xv) Quantifying post-release mortality rates of sharks incidentally captured in Pacific tuna longline fisheries and identifying handling practices to improve survivorship. Hutchinson, M., Bigelow, K., Fuller, D., Schaefer, K.

		Discussion **Documents** (Bolded documents will be presented): **BYC-16**, **BYC-07**, **BYC-08**
Session (time)	***Theme***	***Titles for presentations received or themes for discussion***
Tuesday, 17/12/2019 14:30-16:00	7. Different means of mitigating the impacts of tuna fisheries: best practices for handling, release, others Session Chair: Paul DeBruyn	**Keynote:** xvi) Assessing the efficacy of best handling and discard practices for incidental elasmobranchs captured in a tropical tuna purse seine fishery. Hutchinson, M., Bauer, R., Borie, A., Salgado, A., Dagorn, L., Forget, F., Moreno, G. **Presentations:** xvii) Mitigation Actions on Spanish Tropical Tuna Purse Seiner Fishery. Grande M., Ruiz J., Jefferson M., Zudaire I., Goñi, N., Arregui, I., Ferarios, J.M., Ramos L., Báez J.C., Moreno G., Murua H., Santiago, J. xviii) Fishing on FADs without killing silky sharks: where are we and what should we do? Dagorn, L., Forget, F., Filmalter, J.D., Muir, J., Hutchinson, M., Itano, D., Sancristobal, I., Holland, K., Capello, M., Moreno, G., Murua, H., and Restrepo, V. xix) Behavior of silky sharks and oceanic white tip sharks in relation to floating objects: implications for shark conservation. Dagorn, L., Forget, F., Capello, M., Travassos-Tolotti, M., Filmalter, J.D., Muir, J., Hutchinson, M., Itano, D., Deneubourg, J-L., Holland, K., Restrepo, V. xx) A Meta-Analysis for the Effects of Hook, Bait and Leader Types on Pelagic Longlines: Comparisons for Target, Bycatch And Vulnerable Species Captures. Coelho, R., Santos, C.C., and Rosa, D. **Discussion** **Documents:** **BYC-09**, **BYC-25**, **BYC-19**, **BYC-15**, BYC-06, BYC-10, BYC-11, BYC-12, BYC-13, BYC-18, BYC-20, BYC-26, BYC-29
Tuesday, 17/12/2019 16:30-18:00	8. Closing Keynotes	**Keynotes:** xxi) Improving Synergies Between Regional Fishery Bodies and CITES Parties for The Sustainable Catch, Trade and Management of Sharks. Fowler, S., Bräutigam, A., Okes, N., Sant G. xxii) Keynote, Hazin, F. **Documents:** **BYC-05**
18:30 (side event)	International Whaling Commission	Cocktails for cetaceans needs and opportunities for reducing bycatch in tuna fisheries

Session (time)	***Theme***	***Titles for presentations received or themes for discussion***
Wednesday, 18/12/2019 11:00-13:00 14:30-15:30 16:00-18:00	Coffee 4. Report/Recommendation drafting Session Chair: Paul DeBruyn	

Appendix 4

List of Documents

Doc. Ref.	Title (ENG)	Titulo (SPA)	Titre (FRA)
BYC-01/2019	TENTATIVE AGENDA	ORDEN DEL DÍA PROVISIONAL	ORDRE DU JOUR PROVISOIRE
BYC-02/2019	INTERNET CONNECTION AND ACCESS TO DOCUMENTS (TBD)	CONEXIÓN A INTERNET Y ACCESO A DOCUMENTOS	CONNEXION À INTERNET ET ACCÈS AUX DOCUMENTS
BYC-03/2019	LIST OF PARTICIPANT'S SUMMARIES	LISTA DE RESUMENES	LISTE DES RÉSUMÉS
BYC-04/2019	EASI-FISH: A FLEXIBLE VULNERABILITY ASSESSMENT TOOL FOR QUANTIFYING THE CUMULATIVE IMPACTS OF TUNA FISHERIES ON DATA-POOR BYCATCH SPECIES	EASI-FISH : OUTIL D'ÉVALUATION FLEXIBLE DE LA VULNÉRABILITÉ POUR QUANTIFIER LES IMPACTS CUMULATIFS DES PÊCHERIES THONIÈRES SUR LES ESPÈCES DE PRISES ACCESSOIRES PAUVRES EN DONNÉES	EASI-FISH : OUTIL D'ÉVALUATION FLEXIBLE DE LA VULNÉRABILITÉ POUR QUANTIFIER LES IMPACTS CUMULATIFS DES PÊCHERIES THONIÈRES SUR LES ESPÈCES DE PRISES ACCESSOIRES PAUVRES EN DONNÉES
BYC-05/2019	IMPROVING SYNERGIES BETWEEN REGIONAL FISHERY BODIES AND CITES PARTIES FOR THE SUSTAINABLE CATCH, TRADE AND MANAGEMENT OF SHARKS	MEJORANDO LAS SINERGIAS ENTRE LAS ORGANIZACIONES REGIONALES DE PESCA Y LAS PARTES DE CITES PARA LA CAPTURA, COMERCIO Y ORDENACIÓN SOSTENIBLES DE LOS TIBURONES	AMÉLIORER LES SYNERGIES ENTRE LES ORGANISMES RÉGIONAUX DE PÊCHE ET LES PARTIES À LA CITES POUR LA CAPTURE, LE COMMERCE ET LA GESTION DURABLES DES REQUINS
BYC-06/2019	THE EFFECT OF LIGHTSTICK COLOR IN PELAGIC LONGLINE FISHERIES	EL EFECTO DEL COLOR DEL BASTÓN DE LUZ EN LAS PESQUERÍAS DE PALANGRE PELÁGICO	EFFET DE LA COULEUR DES BÂTONS LUMINEUX DANS LES PÊCHERIES PALANGRIÈRES PÉLAGIQUES
BYC-07/2019	PRELIMINARY ESTIMATES OF POST-RELEASE SURVIVAL OF PORBEAGLE SHARKS (LAMNA NASUS) FOLLOWING CAPTURE AND HANDLING TECHNIQUES	ESTIMACIONES PRELIMINARES DE LA SUPERVIVENCIA POSTERIOR A LA LIBERACIÓN DEL MARRAJO SARDINERO (LAMNA NASUS) TRAS LA CAPTURA Y TÉCNICAS MANIPULACIÓN	ESTIMATIONS PRÉLIMINAIRES DE LA SURVIE SUIVANT LA REMISE À L'EAU DU REQUIN-TAUPE COMMUN (LAMNA NASUS) SUITE À LA CAPTURE ET AUX TECHNIQUES DE MANIPULATION

BYC-08/2019	QUANTIFYING POST-RELEASE MORTALITY RATES OF SHARKS INCIDENTALLY CAPTURED IN PACIFIC TUNA LONGLINE FISHERIES AND IDENTIFYING HANDLING PRACTICES TO IMPROVE SURVIVORSHIP	CUANTIFICACIÓN DE LAS TASAS DE MORTALIDAD POSTERIOR A LA LIBERACIÓN DE LOS TIBURONES CAPTURADOS INCIDENTALMENTE EN LAS PESQUERÍAS DE PALANGRE DE TÚNIDOS DEL PACÍFICO E IDENTIFICACIÓN DE PRÁCTICAS DE MANIPULACIÓN PARA MEJORAR LA SUPERVIVENCIA	QUANTIFICATION DES TAUX DE MORTALITÉ SUIVANT LA REMISE À L'EAU DES REQUINS CAPTURÉS ACCIDENTELLEMENT DANS LES PÊCHERIES PALANGRIÈRES THONIÈRES DU PACIFIQUE ET IDENTIFICATION DES PRATIQUES DE MANIPULATION POUR AMÉLIORER LA SURVIE
BYC-09/2019	ASSESSING THE EFFICACY OF BEST HANDLING AND DISCARD PRACTICES FOR INCIDENTAL ELASMOBRANCHS CAPTURED IN A TROPICAL TUNA PURSE SEINE FISHERY.	EVALUACIÓN DE LA EFICACIA DE LAS MEJORES PRÁCTICAS DE MANIPULACIÓN Y DESCARTE PARA LOS ELASMOBRANQUIOS CAPTURADOS DE FORMA INCIDENTAL EN LA PESQUERÍA DE CERCO DE TÚNIDOS TROPICALES	ÉVALUATION DE L'EFFICACITÉ DES MEILLEURES PRATIQUES DE MANIPULATION ET DE REJET POUR LES ÉLASMOBRANCHES CAPTURÉS ACCIDENTELLEMENT DANS LA PÊCHERIE DE SENNEURS CIBLANT LES THONIDÉS TROPICAUX
BYC-10/2019	GRAPHICS FOR BEST HANDLING PRACTICES FOR THE SAFE RELEASE OF SHARKS	GRÁFICOS DE LAS MEJORES PRÁCTICAS DE MANIPULACIÓN PARA LA LIBERACIÓN SEGURA DE LOS TIBURONES	GRAPHIQUES CONCERNANT LES MEILLEURES PRATIQUES DE MANIPULATION POUR LA REMISE À L'EAU EN TOUTE SÉCURITÉ DES REQUINS
BYC-011/2019	UNDERSTANDING THE SKIPPER EFFECT IN THE BLUE SHARK BYCATCH FROM MEDITERRANEAN SEA,	COMPRENSIÓN DEL EFECTO DEL PATRÓN EN LA CAPTURA FORTUITA DE TINTORERA EN EL MAR MEDITERRÁNEO	COMPRENDRE L'EFFET DU CAPITAINE DANS LES PRISES ACCESSOIRES DE REQUINS PEAU BLEUE EN MÉDITERRANÉE
BYC-12/2019	SHARK BYCATCH TREND OF SPANISH PURSE SEINERS INDUSTRIAL FISHERIES TARGETING TROPICAL TUNA AROUND AFRICA: AN OVERVIEW	TENDENCIA DE LA CAPTURA FORTUITA DE TIBURONES POR PARTE DE LOS LAS PESQUERÍAS INDUSTRIALES DE CERQUEROS ESPAÑOLES DE TÚNIDOS TROPICALES EN TORNO A ÁFRICA: DESCRIPCION GENERAL	TENDANCE DES PRISES ACCESSOIRES DE REQUINS PAR LES PÊCHERIES INDUSTRIELLES DE SENNEURS ESPAGNOLS CIBLANT LES THONIDÉS TROPICAUX AUTOUR DE L'AFRIQUE : VUE D'ENSEMBLE
BYC-13/2019	FORECASTING OCEANIC WHITETIP SHARK POTENTIAL GLOBAL DISTRIBUTION IN A CONTEXT OF CLIMATIC CHANGE	PREDICCIÓN DE LA DISTRIBUCIÓN MUNDIAL POTENCIAL DEL TIBURÓN OCEÁNICO EN UN CONTEXTO DE CAMBIO CLIMÁTICO	PRÉVISION DE LA DISTRIBUTION MONDIALE POTENTIELLE DES REQUINS OCÉANIQUES DANS UN CONTEXTE DE CHANGEMENT CLIMATIQUE

BYC-14/2019	OBSERVE: DATABASE AND OPERATIONAL SOFTWARE FOR HUMAN OBSERVATION, ELECTRONIC MONITORING, LOGBOOK AND ASSOCIATED DATA OF PURSE-SEINE AND LONGLINE FISHERIES	OBSERVE: BASE DE DATOS Y SOFTWARE OPERATIVO PARA OBSERVACIÓN HUMANA, SEGUIMIENTO ELECTRÓNICO, CUADERNO DE PESCA Y DATOS ASOCIADOS DE LAS PESQUERÍAS DE CERCO Y PALANGRE	OBSERVE: BASE DE DATOS Y SOFTWARE OPERATIVO PARA OBSERVACIÓN HUMANA, SEGUIMIENTO ELECTRÓNICO, CUADERNO DE PESCA Y DATOS ASOCIADOS DE LAS PESQUERÍAS DE CERCO Y PALANGRE
BYC-15/2019	A META-ANALYSIS FOR THE EFFECTS OF HOOK, BAIT AND LEADER TYPES ON PELAGIC LONGLINES: COMPARISONS FOR TARGET, BYCATCH AND VULNERABLE SPECIES CAPTURES.	UN META-ANÁLISIS DE LOS EFECTOS DE LOS TIPOS DE ANZUELO, CEBO Y BAJO DE LÍNEA EN LOS PALANGRES PELÁGICOS: COMPARACIONES DE CAPTURAS DE ESPECIES OBJETIVO, FORTUITAS Y VULNERABLES	MÉTA-ANALYSE DES EFFETS DES TYPES D'HAMEÇONS, D'APPÂTS ET DE BAS DE LIGNE SUR LES PALANGRES PÉLAGIQUES : COMPARAISONS DE CAPTURES D'ESPÈCES CIBLES, DE PRISES ACCESSOIRES ET VULNÉRABLES
BYC-16/2019	POST-RELEASE SURVIVAL STUDIES OF PELAGIC SHARKS CAPTURED BY PELAGIC LONGLINERS AND PURSE SEINERS: UPDATES FROM ONGOING ICCAT, IOTC AND WCPFC PROJECTS	ESTUDIOS DE SUPERVIVENCIA POSTERIOR A LA LIBERACIÓN DE TIBURONES PELÁGICOS CAPTURADOS POR PALANGREROS PELÁGICOS Y CERQUEROS: ACTUALIZACIONES DE LOS PROYECTOS EN CURSO DE ICCAT, IOTC Y WCPFC	ÉTUDES DE SURVIE APRÈS LA REMISE À L'EAU DES REQUINS PÉLAGIQUES CAPTURÉS PAR LES PALANGRIERS PÉLAGIQUES ET LES SENNEURS : MISES À JOUR DES PROJETS EN COURS DE L'ICCAT, LA CTOI ET LA WCPFC
BYC-17/2019	SCOPE OF CLOSE-KIN MARK-RECAPTURE FOR ASSESSMENT OF PELAGIC SHARKS	ALCANCE DEL MÉTODO DE MARCADO Y RECUPERACIÓN DE PARENTESCO ESTRECHO PARA LA EVALUACIÓN DE TIBURONES PELÁGICOS	CHAMP DE LA MÉTHODE MARQUAGE-RÉCUPÉRATION DE MARQUES DE SPÉCIMENS ÉTROITEMENT APPARENTÉS AUX FINS DE L'ÉVALUATIN DE REQUINS PÉLAGIQUES
BYC-18/2019	BEHAVIOR OF SILKY SHARKS AND OCEANIC WHITE TIP SHARKS IN RELATION TO FLOATING OBJECTS: IMPLICATIONS FOR SHARK CONSERVATION	COMPORTAMIENTO DEL TIBURÓN JAQUETÓN Y DEL TIBURÓN OCEÁNICO EN RELACIÓN CON LOS OBJETOS FLOTANTES: IMPLICACIONES PARA LA CONSERVACIÓN DE LOS TIBURONES	COMPORTEMENT DES REQUINS SOYEUX ET DES REQUINS OCÉANIQUES PAR RAPPORT AUX OBJETS FLOTTANTS : IMPLICATIONS POUR LA CONSERVATION DES REQUINS
BYC-19/2019	FISHING ON FADS WITHOUT KILLING SILKY SHARKS: WHERE ARE WE AND WHAT SHOULD WE DO?	PESCA CON DCP SIN MATAR TIBURONES JAQUETONES: ¿DÓNDE ESTAMOS Y QUÉ DEBERÍAMOS HACER?	PÊCHER SOUS DCP SANS TUER LES REQUINS SOYEUX : OÙ EN SOMMES-NOUS ET QUE DEVRIONS-NOUS FAIRE ?

BYC-20/2019	A GLIMPSE INTO THE STATUS OF ELASMOBRANCHS IN SRI LANKA	UN VISTAZO A LA SITUACIÓN DE LOS ELASMOBRANQUIOS EN SRI LANKA	APERÇU DE L'ÉTAT DES ÉLASMOBRANCHES AU SRI LANKA
BYC-21/2019	DIALOGUE BETWEEN RESEARCH AND FISHING INDUSTRY TOWARDS IMPROVING SCIENTIFIC OBSERVATIONS OF BYCATCH: THE CASE OF THE FRENCH AND ITALIAN TROPICAL TUNA PURSE SEINE FLEET IN THE ATLANTIC AND INDIAN OCEANS	DIÁLOGO ENTRE LA INVESTIGACIÓN Y LA INDUSTRIA PESQUERA PARA MEJORAR LAS OBSERVACIONES CIENTÍFICAS DE LA CAPTURA FORTUITA: EL CASO DE LA FLOTA ATUNERA DE CERCO TROPICAL FRANCESA E ITALIANA EN LOS OCÉANOS ATLÁNTICO E ÍNDICO	DIALOGUE ENTRE LA RECHERCHE ET L'INDUSTRIE DE LA PÊCHE AUX FINS DE L'AMÉLIORATION DES OBSERVATIONS SCIENTIFIQUES DES PRISES ACCESSOIRES : LE CAS DE LA FLOTTILLE DE SENNEURS FRANÇAIS ET ITALIENS CIBLANT LES THONIDÉS TROPICAUX DANS LES OCÉANS ATLANTIQUE ET INDIEN
BYC-22/2019	PREDICTING HOTSPOTS OF THE MAIN BYCATCH SPECIES OF TUNA PURSE SEINE FISHERIES IN THE ATLANTIC AND INDIAN OCEANS	PREDICCIÓN DE LOS PUNTOS CALIENTES DE LAS PRINCIPALES ESPECIES DE CAPTURA FORTUITA DE LAS PESQUERÍAS DE ATÚN CON CERCO EN LOS OCÉANOS ATLÁNTICO E ÍNDICO	PRÉVISION DES ZONES SENSIBLES DES PRINCIPALES ESPÈCES DE PRISES ACCESSOIRES DES PÊCHERIES DE SENNEURS CIBLANT LES THONIDÉS DANS L'OCÉAN ATLANTIQUE ET DANS L'OCÉAN INDIEN
BYC-23/2019	DERIVING ABUNDANCE INDICES FOR PELAGIC SHARKS BASED ON THEIR ASSOCIATIVE BEHAVIOR WITH FLOATING OBJECTS	DERIVACIÓN DE LOS ÍNDICES DE ABUNDANCIA DE LOS TIBURONES PELÁGICOS BASADA EN SU COMPORTAMIENTO DE ASOCIACIÓN CON OBJETOS FLOTANTES	CALCULER LES INDICES D'ABONDANCE DES REQUINS PÉLAGIQUES À PARTIR DE LEUR COMPORTEMENT ASSOCIÉ AUX OBJETS FLOTTANTS
BYC-24/2019	COUNTING SHARKS INCIDENTALLY CAPTURED BY TROPICAL TUNA PURSE SEINE VESSELS	COMPTER LES REQUINS CAPTURÉS ACCIDENTELLEMENT PAR LES SENNEURS CIBLANT LES THONIDÉS TROPICAUX – PLUS FACILE À DIRE QU'À FAIRE !	RECUENTO DE TIBURONES CAPTURADOS INCIDENTALMENTE POR LOS BUQUES DE CERCO DE TÚNIDOS TROPICALES, ¡MÁS FÁCIL DECIRLO QUE HACERLO!
BYC-25/2019	MITIGATION ACTIONS ON SPANISH TROPICAL TUNA PURSE SEINER FISHERY	ACCIONES DE MITIGACIÓN EN LA PESQUERÍA ESPAÑOLA DE CERCO DIRIGIDA A LOS TÚNIDOS TROPICALES	MESURES D'ATTÉNUATION CONCERNANT LA PÊCHERIE DE SENNEURS ESPAGNOLS CIBLANT LES THONIDÉS TROPICAUX

BYC-26/2019	SILKY SHARK DRAFT REGIONAL MANAGEMENT STRATEGY FOR SIOTI MEMBERS	PROYECTO DE ESTRATEGIA DE ORDENACIÓN REGIONAL PARA EL TIBURÓN JAQUETÓN PARA LOS MIEMBROS DE SIOTI	PROJET DE STRATÉGIE DE GESTION RÉGIONALE DU REQUIN SOYEUX POUR LES MEMBRES DE SIOTI
BYC-27/2019	BYCATCH MANAGEMENT AT TUNA RFMOS: DELAYED ACTION REQUIRES DRASTIC CHANGE	ORDENACIÓN DE LA CAPTURA FORTUITA EN LAS OROP DE TÚNIDOS: LA DEMORA EN ACTUAR REQUIERE UN CAMBIO DRÁSTICO	GESTION DES PRISES ACCESSOIRES DANS LES ORGP THONIÈRES : UNE ACTION TARDIVE EXIGE UN CHANGEMENT RADICAL
BYC-28/2019	INVENTARY OF SOURCES OF DATA IN GUATEMALA ON SHARK FISHERIES OPERATING IN THE EASTERN PACIFIC OCEAN	INVENTARIO DE FUENTES DE DATOS DE GUATEMALA SOBRE LAS PESQUERÍAS DE TIBURONES QUE OPERAN EN EL OCÉANO PACÍFICO ORIENTAL	INVENTAIRE DE SOURCES DE DONNÉES DU GUATEMALA SUR LES PÊCHERIES DE REQUINS QUI OPÈRENT DANS L'OCÉAN PACIFIQUE ORIENTAL
BYC-29/2019	REVIEWS OF BYCATCH SPECIES CAUGHT BY THE SIOTI FLEET, CODES OF PRACTICE AND OTHER GUIDANCE FOR REDUCING BYCATCH MORTALITY. REPORT TO THE SUSTAINABLE INDIAN OCEAN TUNA INITIATIVE	EXAMEN DE LAS ESPECIES DE CAPTURA FORTUITA CAPTURADAS POR LA FLOTA SIOTI, CÓDIGOS DE PRÁCTICA Y OTRAS DIRECTRICES PARA REDUCIR LA MORTALIDAD POR CAPTURA FORTUITA - INFORME A LA INICIATIVA ATUNERA PARA UN OCÉANO ÍNDICO SOSTENIBLE	EXAMENS DES PRISES ACCESSOIRES D'ESPÈCES CAPTURÉES PAR LA FLOTTILLE DE SIOTI, DES CODES DE PRATIQUE ET D'AUTRES ORIENTATIONS VISANT À RÉDUIRE LA MORTALITÉ DUE AUX PRISES ACCESSOIRES. RAPPORT A L'INITIATIVE POUR LA GESTION DURABLE DES THONS DE L'OCÉAN INDIEN (SIOTI)
BYC-31/2020	PERSPECTIVES OF THE SPANISH LONGLINE SECTOR ON ELASMOBRANCH AND SHARKS BYCATCH	PERSPECTIVES DU SECTEUR PALANGRIER ESPAGNOL CONCERNANT LA PRISE ACCESSOIRE D'ÉLASMOBRANCHES ET DE REQUINS	PERSPECTIVAS DEL SECTOR PALANGRERO ESPAÑOL SOBRE LA CAPTURA FORTUITA DE ELASMOBRANQUIOS Y TIBURONES

Appendix 5

List of Recommendations for the Technical Working Group on By-catch for Elasmobranchs

Research Recommendations

1. Methods for processing/ analysis of new data (AI, genetic- CKMR, etc.).
2. Encourage further research into potential spatial and temporal management to avoid by-catch hotspots.
3. Compare methodologies used in risk evaluations and stock assessments (including poor data, ERA, MIST, EASI Fish, etc.) undertaken by SCs of various t-RFMOs and other assessments carried out by other bodies (e.g. IUCN, etc.) to improve the understanding and consistency of their respective outputs.
4. Developing appropriate reference points for elasmobranchs taking into account their specific biological features and the nature of the fisheries that contribute to their catches, to be proposed to various scientific bodies of t-RFMOs.
5. Develop and apply assessment methodologies to characterize the trade-offs between mitigation measures.
6. Include all sources of fishing mortality (including coastal fisheries) in stock-status determination for elasmobranch stock status determined in the tRMFO assessment and management process.
7. Promote harmonized ERA analysis across t-RFMOs and, where relevant, promote global assessments for by-catch stocks.
8. Test the management performance of alternative assessment methods using simulation methods like DLM tools.
9. Design scientific research to specifically study potential policy solutions to bycatch problems to resolve.
10. Prioritize and mobilize adequate resources for assessing to assess and develop management measures including mitigation techniques for all fishing gears, including hooking mortality, at haulback mortality, handling mortality, data collection and post-release survival rate for species incidentally caught in commercial and recreational fisheries based on current and future research.
11. Consider socio-economic effects in management advice.

Data Collection

1. Prioritize and mobilize adequate resources for research to improve knowledge on key biological and life history parameters of bycatch species
2. Improve the involvement of the fishing sector in the scientific work of tRFMOs, including by improving provision of data and facilitating the undertaking of scientific work onboard fishing vessels.
3. Ensure implementation and compliance with mitigation measures.
4. Improve life-history information for a suite of key elasmobranch species
5. Improved estimates of catch from coastal/domestic fisheries as well as recreational components
6. Find alternative sources of data to complement t-RFMO data
7. Identify key uncertainties and work to reduce them over time
8. Harmonize data collection and sharing standards and improve the quantity and quality of data collected across t-RFMOs for bycatch species, including through observer training and increased observer coverage and, when possible, electronic monitoring, in order to enable robust assessments of their conservation status and provide the basis for designing more effective CMMs.
9. Encourage the monitoring of catch composition of coastal fisheries, notably through dedicated capacity building activities, observer programs, including the use of electronic monitoring, and other programs (e.g. port sampling, on the field surveys, etc.) to improve data collection and evaluate the importance of bycatch in fisheries where information is lacking;
10. Promote the implementation of data mining programs devoted to the reconstruction of bycatch time series of catch and effort from historical data and any other information that can assist in the assessments of bycatch stocks.
11. Address the unintended decline in the availability of data collected (such as by-catch estimates, length measurements, species and sex identification, biological sampling etc.) that has been observed since the adoption of retention bans for several elasmobranch species.

Appendix 6

Extended abstracts of documents and presentations provided in the meeting

Easi-Fish - A flexible vulnerability assessment tool for quantifying the cumulative impacts of tuna Fisheries on data-poor by-catch species [BYC-04]

Griffiths, S.P. [1], *Kesner-Reyes, K.* [2], *Garilao, C.V.* [3], *Duffy, L.* [1], *and Roman, M.* [1], *Nerea Lezama-Ochoa*[1,4]

The principals of ecosystem-based fisheries management (EBFM) are being increasingly adopted by fisheries worldwide to demonstrate they are ecologically responsible. However, for tuna fisheries that interact with a diverse suite of data-poor by-catch species, demonstrating the sustainability of each impacted species is often not feasible using traditional stock assessment methods. Vulnerability assessments—widely known as Ecological Risk Assessment (ERA) - such as Productivity-Susceptibility Analysis (PSA), have been a popular alternative in data-limited fisheries for rapidly and cost-effectively identifying by-catch species that are potentially vulnerable to becoming unsustainable under existing levels of fishing effort. Unfortunately, PSA and similar attribute-based methods require detailed fishery susceptibility and biological information for a large number of parameters, but the resolution of these data are reduced to categorical scores to produce only a relative measure of vulnerability that is measured against an arbitrary reference point - having no biological or statistical foundation - that is generally not comparable between species groups (e.g. teleosts *vs*. sea turtles). Furthermore, these methods cannot quantify the cumulative impacts of multiple fisheries.

In order for fishery managers to ensure their fisheries are meeting the requirements of their conventions and international instruments, managers need a flexible method that can utilize available information in data-limited settings to rapidly provide a quantitative species-specific measure of vulnerability that can be assessed against scientifically meaningful reference points that can be easily interpreted by non-technical and technical audiences. Staff at the IATTC have met these needs by recently developing the Ecological Assessment of the Sustainable Impacts by Fisheries (EASI-Fish) approach. EASI-Fish uses less input parameters than PSA to first produce a proxy of fishing mortality (F) for each species for a particular year based on the 'volumetric overlap' of each fishery with the stock's distribution. The F value is then used in length-structured per-recruit models to assess the vulnerability status of each species using conventional biological reference points (e.g. F_{MAX}, $F_{0.1}$ and $SPR_{40\%}$).

This paper illustrates the utility of the method by assessing 24 species with varying data availability and life histories (epipelagic and mesopelagic teleosts, sharks, rays, sea turtles and cetaceans) that are impacted by the eastern Pacific Ocean (EPO) tuna longline and purse-seine fisheries. We show how the vulnerability status of each species can be represented in a "vulnerability phase plot", which allow fisheries managers to more confidently and transparently identify the most vulnerable species to apply immediate mitigation measures, subject to further detailed analyses, or collect further data to facilitate a formal stock assessment in the future.

We also demonstrate the ease of which 'what if' scenarios can be explored to assess the potential change in vulnerability status of a species after implementation of specific hypothetical conservation and management measures. We illustrate how EASI-Fish was used to explore a range of potential measures (e.g. spatial and temporal closures, improved handling practices to reduce post-release mortality, and a combination of various measures) that could potentially reduce the vulnerability of the IUCN-listed spinetail devil ray (*Mobula mobular*) caught in EPO tuna fisheries.

Overall, we see EASI-Fish as a promising tool to facilitate vulnerability assessments for by-catch species in data-poor settings, both to identify potentially vulnerable species, but also to explore the specific measures that may be implemented in isolation, or in unison, that may improve the long-term sustainability of vulnerable species populations impacted fisheries.

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Improving synergies between regional fishery bodies and CITES parties for the sustainable catch, trade and management of sharks (BYC-05)

Sarah Fowler[1], Amie Bräutigam, Nicola Okes and Glenn Sant
Review prepared for the *German* Federal Agency for Nature Conservation (Bundesamt für Naturschutz, *BfN*)

Fourteen species of pelagic sharks and 27 coastal and pelagic rays are listed in CITES Appendix II, which requires international trade to be legal, sustainable and traceable. Most of these species were historically targeted by fisheries, and many are still significant in fisheries and trade. FAO Members and CITES Parties have for many years, at their respective meetings, urged closer engagement and coordination between national environment and fisheries departments in order to improve the conservation and management of sharks. The important role of Regional Fishery Bodies (RFBs) has also been recognised.

This is the outline for a study. The study examines threats to CITES listed shark species[2], their conservation measures, as well as trade and management status, and the contributions of RFBs to improving the conservation and management status of CITES Appendix II shark species and implementing the listings. The aim of the study is to identify opportunities for further harmonizing the efforts of the RFBs and CITES Authorities to progress the sustainable and legal harvest of CITES Appendix II sharks, recognising that their common objectives are the recovery of depleted stocks, delivering sustainable fisheries and trade, and reducing the future need for strict protection measures.

Germany is planning to convene a high-level conference on these issues, and related actions identified in Resolution Conf. 12.6 (Rev. CoP18) on the Conservation and management of sharks. Outcomes of further work and studies on the topic will be reported through the CITES Animals and Standing Committees in 2020. Given these plans for a conference, Germany would appreciate comments on this study outline from both the CITES Parties and Regional Fishery Bodies, including through the Joint t-RFMO By-catch Working Group meeting in Portugal, December 2019. This discussion input will further form the background to convening that conference.

Conservation Status

The global conservation status of many major commercial shark and ray species is poor and still deteriorating, although there are some early signs of recovery for a few species. Poor conservation status is notable for the oceanic pelagic sharks that dominate the chondrichthyan fish taxa listed in the CITES Appendices, are the largest source of fins in international trade (70% are threatened), and are primarily taken in fisheries under the remit of the tuna Regional Fisheries Management Organisations (t-RFMOs). Their Red List status has recently been reassessed by IUCN, and several species are more seriously threatened than formerly understood. Oceanic whitetip shark, scalloped hammerhead and great hammerhead sharks are assessed as Critically Endangered; whale shark, pelagic thresher and smooth hammerhead shark as Endangered.

Threats

Fishing is the most widespread threat, affecting 89% of all sharks[2]. Some 43-46% of CITES-listed species are targeted by fisheries, *versus* only 11-14% of all chondrichthyans. By-catch in large-scale fisheries impacts over 80% of CITES species. Fewer than 50% of chondrichthyans, but over 60% of CITES-listed species, are a by-catch, or secondary non-target catch, of subsistence/small-scale fisheries. Strengthened fisheries management is urgently required to reduce excessive or unsustainable mortality in target and by-catch fisheries, both for unlisted species and for pelagic sharks and rays listed in the CITES Appendices.

Fisheries and Trade Status

Industrial and artisanal fleets supply markets in Asia for shark and ray fins. The meat of these sharks is often diverted along separate supply channels to meet demand in growing markets in Europe and South America. Total catches of sharks and rays reported to FAO peaked in 2000, before declining slowly. Most were taken from the Atlantic Ocean and adjacent seas (40%), followed by the Pacific (33%) and Indian

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[2] The term "sharks" refers to all species of sharks, skates, rays and chimaeras (cartilaginous fishes, Class Chondrichthyes).

Ocean (27%). The largest seven shark catchers[3] and the top 40 catchers are unchanged since 2000. However, the seven now report a greater proportion of global catches (rising from 48% to 59%). Although the number of catchers reporting more than 1% of the global catch has fallen from 26 to 24 over 10 years, these 24 now take 91% of the reported world catch, compared with 85% in earlier years. The above figures exclude some major fishing nations that may under-report their shark catches.

Shark and ray meat and fin trade volumes and value have declined over the past decade. The top 20 importers of shark meat account for 91% of global imports. Europe and South America are the largest retail markets and importers for shark and ray meat. The four largest importers of shark fin account for 90% of trade. Hong Kong Customs records report trade with an average of 83 nations annually.

The taxonomic resolution of catches reported to FAO has improved slightly over ten years: 62% of global reported chondrichthyan catches are now recorded within taxonomic groupings, including 19% as 'Sharks, rays, skates, etc., nei', and 38% at species level. Trade records are still mostly not species-specific, but genetic analyses have identified many shark, ray and chimaera species in trade. Four species (three listed in CITES Appendix II) contributed more than 50% of samples analysed, eight additional species contributed >1% each of the global total, and fins from CITES-listed species comprised over 20% of samples.

Management status

CITES Resolution Conf. 12.6 (Rev. CoP18) on the Conservation and Management of Sharks identifies the importance of maintaining close collaboration between FAO, RFMOs, RFBs, the Convention on the Conservation of Migratory Species and other relevant international organisations to improve coordination and synergies in the implementation of CITES provisions for CITES-listed shark species. It, *inter alia*, encourages Parties to work through the respective mechanisms of these instruments to improve coordination with activities under CITES.

Some 32 Regional Fishery Bodies (RFBs) have potential to support the implementation of CITES for chondrichthyans, including 14 RFMOs. Ten RFMOs have adopted one or more Conservation and Management Measures (CMM) for sharks and/or rays, including eight CMMs for CITES-listed species. Most prohibit their retention and mandate safe release of sharks caught accidentally; some prohibit intentional purse seine sets on whale sharks. Additional non-species-specific time/area closures and gear restrictions should reduce fishing mortality. However, there remains scope for improved data collection for and management of CITES-listed sharks taken in fisheries under the RFBs' remit. As noted in Res. Conf. 12.6 (Rev. CoP18), this could include making information available to assist Scientific Authorities in the making of Non-Detriment Findings (NDFs) for shared stocks under the remit of the RFBs; recommending and/or adopting precautionary catch limits for CITES-listed shark species; adopting traceability systems for their products to ensure their trade is legal; and adopting comprehensive management plans to reduce overfishing, or recovery plans for overfished CITES species, such as the Oceanic whitetip shark.

None of the t-RFMOs have so far developed Shark Plans under the framework of the FAO International Plan of Action for the Conservation and Management of Sharks (IPOA–Sharks). One RFMO has a Regional Shark Plan (RPOA): the bilateral Comisión Técnica Mixta del Frente Marítimo/Joint Technical Commission of the Maritime Front (CTMFM). The European Union Community Shark Plan (EU CPOA) operates at regional and global level (for all EU fisheries within and outside EU waters). All other RPOAs and/or guidance for Shark Plans were developed and adopted by advisory RFBs, RSCAPs, or other regional bodies. Several of the 18 UN Regional Seas Conventions and Action Plans (RSCAPs) are actively engaged in the conservation and management of sharks (particularly threatened species) or are developing programmes.

At national level: significant progress has been made since FAO's 2012 review of the implementation of the FAO IPOA–Sharks by the world's largest shark catchers. Additional large catchers have drafted and/or adopted National Shark Plans (NPOAs) or NPOA Guidance. Several have revised and updated their NPOAs, a few more than once. However, other important fishing countries have still not produced or published Shark Plans, including five of the new top 24 reporting shark catchers, and three countries with major fisheries capacity but low or no reported shark catch.

[3] The term "shark catchers" refers to countries, territories and other political entities reporting shark catch to FAO.

Important future challenges to improve the regional collaborative efforts by national CITES Authorities and Regional Fishery Bodies (RFBs) to strengthen CITES implementation for sharks and rays include: additional CMMs for sharks and rays; strengthening national legislation, enforcement (monitoring, control, surveillance), and international cooperation; and promoting the harmonization and exchange of data on sharks and rays.

The effect of lightstick color in pelagic longline fisheries (BYC-06)

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Improving the selectivity of the fishing gear is one of the most promising strategies to mitigate impacts produced by longline fisheries upon by-catch species. Light lures have recently become widespread in pelagic longline fisheries because they increase the catchability of target species such as swordfish (*Xiphias gladius*) and tunas. However, there is an overall lack of knowledge about their effect upon the incidence of by-catch species. Here, we used Bayesian generalized linear models through the Integrated Nested Laplace Approximation (INLA) approach to investigate how the catchability of target and by-catch species could be enhanced in a pelagic longline equipped with lightsticks of three different colors (green, white and blue). Two model-types, including different probability distributions, were considered: 1) negative binomial distribution with catch (number of fish) and fishing effort (number of hooks) as response and offset variables, respectively; and 2) binomial distribution with species' presence or absence as a binary variable. Two explanatory variables and terms were considered for each species and type of model. The lightstick color was considered as a parametric covariate (i.e. factor) and the interaction between lunar illumination (%, as a continuous variable) and lightstick color treatment were considered as a random walk trend (type 1, see details in R-INLA Package; http://www.r-inla.org/). Overall, green-colored lightsticks resulted in the highest catch rates and catch probabilities, by far, for all species analyzed, including both target and by-catch. In contrast, blue and white lightsticks had lower catch rates for all species, with similar performances, although the former resulted in slightly higher catches of marlin, swordfish and yellowfin tuna, whereas the latter had higher catches of albacore and bigeye tuna. The swordfish catch on green and white lightsticks increased conspicuously with increasing lunar luminosity, while it varied little on blue lightsticks. Istiophorid marlins caught on green and blue treatments showed opposite trends across the lunar illumination gradient, with catch rates increasing with increased luminosity on green lightsticks. The catches of albacore (*Thunnus alalunga*), yellowfin (*T. albacares*) and bigeye (*T. obesus*) tuna responded distinctly to lunar illumination on different lightstick color treatments. As for the blue shark, *Prionace glauca*, catch rates increased linearly with increasing luminosity on green lightsticks but they dropped suddenly at medium luminosity levels on blue and white treatments. In general, the amount of by-catch increased with increasing lunar illumination on green lightsticks but it tended to be greater at low luminosity levels on blue and white treatments. Identifying opposite patterns in the catch rate of target species and bycatch could be a promising strategy for enhancing longline selectivity and lessening the incidence of bycatch, but all the species caught seemed to be preferentially attracted by green lightsticks. Albeit lunar luminosity produced color- and species-specific effects on the performance of lightsticks, no differences between target species and by-catch were detected. Therefore, the utilization of different lightsticks as a strategy to reduce the by-catch while optimizing the catch rate of the target species did not seem feasible. Further research about the performance of light-emitting fishing devices is, however, necessary to address by-catch mitigation in pelagic longline fisheries while maintaining suitable catch levels of target species.

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Preliminary estimates of post-release survival of porbeagle sharks (*lamna nasus*) following capture and handling techniques (BYC-07)

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Understanding the fate of discarded by-catch is necessary for effective management and conservation of marine resources. For example, the northwest Atlantic population of porbeagle sharks (*Lamna nasus*) has experienced substantial declines in abundance since the early 1960s, and population trajectory models indicate human induced mortality must remain low for successful recovery to occur. However, this species remains highly susceptible to capture as by-catch in both commercial and recreational tuna fisheries (pelagic longline, rod-and-reel) in this region. Given the current management regulations for porbeagles in the northwest Atlantic (USA and Canada), retention of this species is limited and the vast majority of captured individuals are discarded. In order to gain a better understanding of the resiliency of this species to capture, handling, and release, the current study investigated the post-release survival of porbeagle sharks following capture and handling in rod-and-reel and pelagic longline fisheries in the Northwest Atlantic. From 2015 to 2019, pop-off satellite archival tags (PSATs) successfully transmitted from a total of 27 porbeagle sharks captured in the pelagic longline fishery with circle hooks (n=15; mean FL = 135.7 cm, range 85-200 cm) or with rod-and-reel gear (n=12; mean FL = 123.2 cm, range 88-209 cm). To encompass all possible handling techniques, individuals were either handled in the water to mimic fishery practices or brought onboard to be freed from gear. The PSATs were programed to release if the tag descended to >500-1400 m or if depth values remained constant for approximately 1-4 days, indicating mortality. Premature tag shedding occurred frequently but did not prevent the identification of short-term survivability from transmitted data; the average time at liberty for tags which shed early was 14.7 ± 6.0 days (range 6-24 days). The condition of tagged porbeagles ranged from healthy to injured and handling times ranged from approximately 1.5-13 minutes. Regardless of condition or handling time, all 12 sharks captured with rod-and-reel gear survived, indicating a post-release survival rate of 100% in this fishery. Of the 15 sharks captured in the pelagic longline fishery, 14 survived, indicating a post-release survival rate of 93.3% in this fishery. The single observed mortality occurred immediately (~1 hour) following release, as indicated by a rapid decent to 250 m followed by the cessation of vertical movement for 4 days. Additionally, several surviving individuals remained in surface waters (<30 m) for several hours to days following capture, after which porbeagles occupied a broad vertical depth range and made frequent dives to >200 m. The observed depth-holding behavior may indicate porbeagle sharks exhibit a post-release recovery period following capture and handling. Given the observed post-release recovery period occurred in surface waters where the majority of fishing effort occurs, this depth-holding behavior may make captured and release porbeagles more vulnerable to recapture in tuna fisheries in the Northwest Atlantic.

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Quantifying post-release mortality rates of sharks incidentally captured in pacific tuna longline fisheries and identifying handling practices to improve survivorship (BYC-08)

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Longline fisheries have the largest impact on pelagic shark populations due to the scale and magnitude of fishing effort around the globe. As some shark population assessments have shown declines due to overfishing, finding strategies that can reduce this impact are increasingly important. In many regions, sharks are typically discarded at sea due to low market value or conservation and management measures (CMMs) banning the retention of some species (e.g., *Carcharhinus falciformis* [IATTC; C-16-06 purse seine fishery only, WCPFC; CMM-2013-08], *C. longimanus* [IATTC; C-11-10, WCPFC; 2011-04]). Thus, understanding post-release fate and the identification of handling practices that can improve post-release survival are paramount to the development, implementation, and review of effective conservation management strategies.

In the eastern tropical Pacific Ocean, a study was conducted in domestic longline fishing fleets of Costa Rica and Ecuador. These fleets do not target sharks; however, they are commonly captured and retained during fishing operations. A handling method recommended by the fishers of these fleets to optimize post-release survival (PRS) was evaluated for silky sharks (*C. falciformis)*, using satellite linked pop-off archival tags (PATs), should regulations banning retention be implemented in the future. The PRS rate, estimated from Kaplan-Meier survival analyses, was 94.3% for 38 tagged silky sharks.

In the western and central Pacific Ocean, a separate study was conducted in the United States' Hawaii and American Samoa tuna longline fisheries to generate quantitative estimates of PRS rates for four key shark species; blue (*Prionace glauca*), bigeye thresher (*Alopias superciliosus*), oceanic whitetip (*Carcharhinus longimanus*), and silky sharks (*Carcharhinus falciformis*). This study also used PATs to elucidate post-release fate. Observers based in American Samoa tagged 31 silky (FAL) and 17 incidentally captured oceanic whitetip sharks (OCS). In Hawaii, observers tagged 44 blue (BSH), 28 bigeye thresher (BTH), and 17 OCS with survivorship PATs programmed for 30-day deployments. Hawaii based observers also tagged BSH (n = 12) with miniPATs programmed for 180 and 360 day deployment periods to assess the effects of trailing gear on long-term survival rates. The study found post-release survival rates were high; up to 30 days for BSH, BTH, FAL, and OCS if they are in good condition at release and if trailing gear is minimized. Survival rates were also higher for all species when released by cutting the line (96.2%) as opposed to removing the gear (83.3%). The results also indicated that the amount of trailing gear left on an animal has a negative effect on post- release survival potential for multiple species and is correlated with high delayed mortality rates of BSH. Because most sharks are released by cutting the line, making recommendations to remove as much trailing gear as possible will enhance post-release survival rates.

Although the WCPFC no-retention measures for FAL and OCS has the intended effect of reducing mortality, expanding the measures to include recommendations on reducing the amount of trailing gear left on animals to less than 2.5 m would likely further reduce mortality. Similarly, the no retention measure for OCS within the IATTC convention area would also be expected to see further reductions in mortality by recommending that fishers attempt to limit trailing gear from released sharks. Should no retention measures be implemented for FAL in the IATTC convention area, managers should consider adding clauses limiting the amount of trailing gear. These studies show that species, release condition, handling and release methods, trailing gear, and hooking location all influence fate post-release, and these data points should be recorded by fishery observers.

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Assessing the efficacy of best handling and discard practices for incidental elasmobranchs captured in a tropical tuna purse seine fishery (BYC-09)

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Mobulid rays (*Mobula spp*.) and whale sharks (*Rhincodon typus*) are sometimes incidentally captured in purse seine fisheries targeting tropical tuna. These species are particularly vulnerable to fishing related mortality impacts because of life history traits associated with slow growth and extremely low reproductive potential. Finding handling strategies that improve post-release survivorship for these species has been identified as a priority by several tuna regional fishery management organizations (RFMOs). Accordingly, several of these RFMOs have adopted recommendations for handling and discard practices to improve survival probabilities. Such guidelines are based on 'common sense' practices where post-release survival has not been validated or assessed for most species. This study presents post-release fate data from whale sharks (n =2) and *M. tarapacana* (n = 6) that were captured, tagged, and released using the recommended best handling and discard practices during a commercial tuna purse seine trip in the eastern Atlantic Ocean. The animals were tagged with satellite linked pop-off archival tags during July of 2018. The whale sharks were found to have survived the interaction while five of the six mobula died, between two and eleven days, post-release. These results indicate that reducing the impacts of commercial fishing on by-catch species is an iterative process, and the recommended handling and discard methods for mobula may need to be re-assessed. Another potential mitigation action would be to identify temporal-spatial hotspots to be avoided.

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Graphics for best handling practices for the safe release of sharks (BYC-10)

Ana Justel-Rubio[1], Yonat Swimmer[2] and Melanie Hutchinson[3]

Many pelagic shark populations that are captured incidentally in tuna fisheries have been found to be overfished. Several of these species are now subject to management measures that call for non-retention and for fishers to release them in a manner that minimizes harm. In some RFMOs, handling and discard practice guidelines have been adopted to help inform fishers of methods that improve survival potential post-release. In December 2018, at its 15th Regular Session of the Commission, the WCPFC adopted Best Practices Guidelines for the Safe Release of Sharks. This document presents a set of figures produced to illustrate the guidelines adopted by WCPFC15, as well as some small revisions to the text, which were endorsed by WCPFC SC15. The purpose of these graphics is to inform fishers visually on discard practices where language barriers may exist.

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Understanding the skipper effect in the blue shark by-catch from Mediterranean Sea (BYC-11)

David Macía [1], José Carlos Báez[2], Carla Martín-Toledano[3], José María Ortíz de Urbina[4], Salvador García-Barcelona[5] & Juan Antonio Camiñas[6]

It is widely accepted that there is a pattern effect to determine the bycatch of some species. In this context, blue shark bycatch in traditional Spanish longline home-base targeting swordfish fisheries (LLHB) from Mediterranean Sea are concentrated on certain vessels, fishing areas (for example Alboran Sea) and periods of the year. The main aim of this study is to analyze the technical, socioeconomic and environmental factors to determine what of them better explain the incidental capture of blue sharks in surface LLHB from Western Mediterranean Sea. For this study, we used scientific observer data provided for the IEO onboard observer program during the period 2008-2014. We perform different GLM models between by-catches CPUE, and different explanatory variables. Present results conclude that the main variables involved in the blue shark bycatch in surface LLHB from Western Mediterranean Sea are fundamentally technical and socioeconomic variables. Thus, in ports close to areas of concentration of blue sharks, a part of the surface LLHB fleet target blue shark, even though the economic profit is lower than in periods targeting swordfish, because the expenses in fuels, bait and insurance social of the crew (also there is a smaller number of crew) are smallest. Current results could help to us for advised in improving the management of this fishery.

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Shark by-catch trend of Spanish purse seiners industrial fisheries targeting tropical tuna around Africa: an overview (BYC-12)

José Carlos Báez [1], Pedro Pascua[2], María Lourdes Ramos[3] and Francisco Abascal[4]

The Spanish Institute of Oceanography (IEO) observers on board commercial purse seiner freezer vessels from Indian Ocean follows a scientific programme, implementing the EU Fishing Data Collection Programme (PNDB) (Parliament and Council Regulation (EU) No 2017/1004 of 17 May 2017). The data collection and processing methodology is common for the Atlantic and Indian oceans. The main aim of the scientific observer programme is obtaining direct information on catches and discards of target and by-catch species (e.g. catch and by-catch species, number of individuals, size, and other biological data). In the present study, we used data recorded by IEO from 2003 to 2018 from the above-mentioned programme.

Due to the piracy intensification problem the observer on board programme was disrupted between 2010 and 2014 both years inclusive. On the other hand, the observation effort is not the same per year, since it depends on multiple variables such as the availability of ships.

During the study period observed by-catches at least nine different sharks species including: Carcharhinidae, Lamnidae, Sphyrnidae and Rhincondontidae families. The most common species was *Carcharhinus falciformis* (observed during all years), and most scarce was *Carcharhinus obscurus*.

We analysed weight/total target weight ratio, and shark length per observed year.

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Forecasting oceanic whitetip shark potential global distribution in a context of climatic change (BYC-13)

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The oceanic whitetip shark (*Carcharhinus longimanus*) is an endangered marine shark species which can be adversely affected by the fishing activities of the industrial purse seine fleet targeting tropical tuna. The EU purse seiner is operating around all the tropical Ocean areas. We analyzed and modeled the spatial distribution and environmental preferences of oceanic whitetip shark based on presence and absence data from observer data.

We used a multi-algorithm analysis based on presence-absence dataset following best practices for species distribution modelling. Firstly, we selected a subset of suitable environmental variables explaining the distribution model using a generalized linear model that addressed multicollinearity, statistical errors, and information criteria. Secondly, we used the selected variables to build a model ensemble including 19 different algorithms for species distribution models. After eliminating models with insufficient performance, we assessed the potential distribution of oceanic whitetip shark using the mean of the predictions of the selected models. We also assessed variance between the predictions of different algorithms in order to identify areas identified by most of the models. Finally, we forecast Oceanic whitetip shark potential global distribution in a context of climatic change. We discuss the implications of these predictions for the conservation and management of this charismatic marine species.

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Observe: database and operational software for human observation, electronic monitoring, logbook and associated data of purse-seine and longline fisheries (BYC-14)

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ObServe in a nutshell. ObServe is an information system consisting of a database for data storage and multiple instances of an associated software for the acquisition and management of purse-seine (PS) and pelagic longline fisheries (LL) data. Those data would range from human observer collected at sea and electronic monitoring data to logbook-type data as well as transsshipments, local market and port sampling data. ObServe readily integrates the minimum standards requirements of tRFMOs (ICCAT and IOTC at least) for data collected on tropical PS and LL fisheries.

What is ObServe's history? ObServe's development and evolutions have been supervised by IRD, Ob7 (France). It was firstly designed for human onboard observer data from the French purse-seine fishery in 2010 based on historical data collection by European scientific observers since the 1990's. It was recently adapted (2019) to handle desk-based data from electronic monitoring installed on purse-seiners. It is expected to integrate PS logbook and associated data (FOBs, port sampling, etc.) in the next couple of years. Also, ObServe can deal with data collected from the LL fishery, whether they are human or electronic data since 2014. It will be ready to integrate LL logbook data in 2020. ObServe is in constant evolution as to adapt to new scientific programs and tRFMOs requirements.

What is ObServe technically? First of all, ObServe is only using open-source and cross-platform computer solutions. The three main components are: (1) a PostgreSQL database with PostGIS capabilities that is installed on a server and that communicates with (2) multiple instances of a Java-based client software (that would typically be installed on the observers', vessels' and data managers' computer) through (3) a web service component.

1. The PostgreSQL database is composed of several SQL database schemas, i.e., sets of tables and relations between tables grouped and organized by gear type (PS and LL). Reference data tables that are common to both gear types are mutualized in a common schema. SQL queries can be run to extract data from the database.

2. The Java-based software, which can run on any operating systems, presents a user-friendly interface with dedicated forms that are used to insert, review and manage data. These forms are based on the field sheets used by observers to collect data. The standalone software can be used offline (no connection to the central database) as it integrates a built-in instance of the database model that is identical to the central database model (under Java-based H2 database engine). The software integrates two-ways synchronization functions that are used to (i) download/update reference tables from the central database (or even from a file if offline) to the software standalone workspace, and (ii) upload data entered by the observer (and saved offline) into the central database.

3. The web service is a key component that improves the performance and reliability of all communications and data exchanges between the central database and instances of the software, as well as between databases belonging to different entities (for synchronizing reference data for instance).

Who is using ObServe? ObServe is used for PS fisheries by France (entities: IRD, OD, BigEye, TAAF), Spain (entities: AZTI, IEO, SeaEye), followed by Seychelles (entities: SFA), that have started with ObServe since 2010 for human observer data from the purse-seine fishery. Since 2019, ObServe can be used to store data collected through electronic monitoring systems. For LL data, France (entities: IRD, CAPRUN, PNMM, TAAF) uses ObServe since 2015 for scientific human observations (and crew-based observations), and Seychelles (entity: SFA) will be using ObServe starting next year (2020) for LL logbook data.

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Who has funded ObServe? IRD, Ob7 (France), that is developing and maintaining the information system, has mainly funded ObServe together with EU through the "Data Collection Framework". To a lesser extent, SFA (Seychelles), AZTI (Spain) and Orthongel (France) have provided funding at occasions for the development of specific features.

A meta-analysis for the effects of hook, bait and leader types on pelagic longlines: comparisons for target, bycatch and vulnerable species captures (BYC-15)

Rui Coelho[1,2,3], Catarina C. Santos[1,2], Daniela Rosa[1,2]

Marine fisheries have a major anthropogenic influence on marine systems worldwide, affecting marine populations and ecosystems. Within some of the key issues in marine fisheries, bycatch - the unintended capture of non-target organisms during the fishing operations - is a major issue. While some bycaught species are also commercial and usually retained, others, such as sea turtles, some sharks and rays, seabirds and marine mammals, are particularly vulnerable, forbidden to retain and/or have no commercial value, and therefore discarded if accidentally captured. For this latter component that comprises unwanted bycatch species, there is a particular interest and need to establish measures that minimize their bycatch and/or decrease their mortality rates.

Fishing gear modification measures are usually seen as good options with relatively easy implementation and low economic impact. For example, the use of circle hooks instead of J-hooks is one of the measures seen as beneficial in reducing bycatch especially for sea turtles, while it is supposed to maintain the catches of target species. However, different studies, sometimes with conflicting results, have generated discussion at scientific level and prevented wider implementation of this measure. Additionally, bait type and leader materials have also been reported to have an effect on the catches of some bycatch species, in the case of the leader material mostly due to bite-offs that some species can cause.

Given the multitude of studies available, there is a need to provide more comprehensive analysis and especially consider trade-offs between the effects of the various gear modification options and on how those affect the various components of the catch. As such, in this study we provide results from an ongoing meta-analysis for species-specific retention and at-haulback mortality rates when changing hook, bait and leader types, and including the various components of the catch, namely target, retained and unwanted bycatch species.

Information from studies and experiments that examined hook type (e.g., circle, tuna or J-hook), bait type (e.g., squid or fish) or leader material (e.g., monofilament or wire) effects on retention and at-haulback mortality in pelagic longline fisheries was compiled. Published literature, technical reports and unpublished data relevant to our search were identified based on electronic database searches. Only shallow setting longlines were considered at this point in the analysis. The relative risk (RR) of changing each of the factors were calculated, with a value of 1.0 representing no changes in the treatments compared to the control. A RR < 1.0 or RR >1.0 indicates, respectively, lower or higher values obtained with the treatment compared to the control. For this analysis, the control within each of the variables considered were J-hooks, squid bait and monofilament leader, while the treatments were considered when changing to circle hooks, fish bait and wire leader.

Following Reinhardt *et al*., 2017, the term reference was used to refer to a document and the term experiment to a unique dataset considered. Each experiment was considered unique if it differed with respect to attributes, such as the year of the study or season, location, gear, vessel size or fleet. Each unique experiment was assigned a unique identification number, noting that each unique reference could have more than one experiment. The current meta-data compilation contains a total 35 unique references totalling 52 experiments. For this specific work that currently refers only to shallow setting longlines, 24 references were available totalling 28 experiments. This information allowed analysing retention rates for 23 species with regards to hook type, 18 species with regards to bait type, and 13 species with regards to leader material. At-haulback mortality was analysed for 19 species considering hook type, 15 species considering bait type and 8 species with regards to leader material.

The main results of our study show the trade-offs between the various taxa that should be considered when changes are implemented in fishing gear specifications. For example, sea turtles retention rates are reduced when J-hooks are changed to circle hooks; however, for swordfish, the main target species of shallow pelagic longlines, there are also reductions in retention rates when using circle hooks instead of J-hooks. For other billfishes that are captured mostly as bycatch, there were also reductions, especially for blue marlin. In

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contrast, retention rates of tunas, especially bluefin tuna and albacore, are higher with circle hooks. With regards to elasmobranchs, the retention rates for some sharks, such as porbeagle, shortfin mako, tiger shark and crocodile shark are higher when using circle hooks, while the pelagic stingray shows lower retention rates with circle hooks.

Bait type did not seem to have a major influence on the retention rates of elasmobranchs and the majority of bony fishes, both target and bycatch. In general, elasmobranchs tended to have higher retention rates with fish bait but the effects were not significant. Tunas, on the other hand, tended to have higher retention rates when using squid bait, but the differences were only statistically significant for albacore. The only taxa where the differences were stronger and tended to be significant were the sea turtles, with lower retention rates when using fish bait instead of squid.

With regards to the use of wire leaders compared to monofilament, billfish and tuna species tended to have lower retention rates with wire leaders, but significant differences were only found for albacore, yellowfin tuna and blue marlin. On the other hand, for elasmobranch species there were mixed effects, with 3 species (blue shark, silky shark and shortfin mako) having higher retention rates with wire leaders, although this effect was only statistically significant for blue shark. At this point it was not possible to compare the retention rates of sea turtles by leader material, as not enough information is available.

Changing from J-style to circle hooks reduced at-haulback mortality rates of several elasmobranch species, such as the scalloped hammerhead, blue shark, shortfin mako, silky shark and oceanic whitetip. By the contrary, using circle hooks increased at-haulback mortality rate of bigeye thresher. Regarding bony fishes, there was a tendency for lower at-haulback mortality rates when circle hooks were used, including for all billfishes and some tunas. Bait type, on the other hand, had no significant effects on at-haulback mortality rates, except for blue shark. Likewise, there were no significant differences when changing leader types, even though it was noted that very few studies are currently available to test those effects.

It is important to note that the results presented are preliminary and part of an ongoing study. The main caveats are related to the analysis being restricted to retention rates, while the true catch rates are difficult to determine. It is known that bite-offs occur, especially when monofilament leaders are used; however it is difficult, if not impossible, to ascertain to which species each bite-off event should be attributed to. Also, at this stage, only at-haulback mortality is being analysed while, in the future, there is the need to complement this information with the effects of changing hooks, baits and leader material on post-release mortality.

Finally, for some species only few studies were currently available, especially when analysing bait and leader type effects. More experimental studies are needed, especially for the more occasionally captured species where sample sizes are low. Further work will expand on the fishery characteristics considered, for example to also include different hook types (e.g., tuna hooks) and different characteristics of the fishery (e.g., deep setting longlines).

This work provides further insights for consideration when establishing fishing gear modifications, especially with regards to hook, bait and leader material. There are clear trade-offs for the various options, and when considering the various components of the catch, namely target, desirable and unwanted bycatch species, and such trade-offs should be considered by managers when establishing such mitigation measures.

Reference

Reinhardt, J. F., Weaver, J., Latham, P.J., Dell'Apa, A., Serafy, J.E., Browder, J.A., Christman, M., Foster, D. G. and Blankinship, D. R. 2017. Catch rate and at-vessel mortality of circle hooks versus J-hooks in pelagic longline fisheries: A global meta-analysis. *Fish and Fisheries*, 19(3): 413–430.

Post-release survival studies of pelagic sharks captured by pelagic longliners and purse seiners: Updates from ongoing ICCAT, IOTC and WCPFC projects (BYC-16)

Fisheries are one of the main sources of mortality for shark populations. Particularly for oceanic pelagic species, longline and purse seine fisheries are major fishing gears that interact with those species. As such, understanding species interactions with these fisheries is a key issue for providing scientific advice for the development of management and conservation strategies.

Currently, ICCAT, IOTC and WCPFC have established Conservation and Management Measures (CMMs) banning the retention of some shark species. Therefore, accidently caught individuals of those species must be released. Specifically, ICCAT currently has no-retention measures for bigeye thresher - *Alopias superciliosus* (ICCAT Rec. 09-07), oceanic whitetip - *Carcharhinus longimanus* (ICCAT Rec. 10-07), hammerheads - *Sphyrna* spp. (ICCAT Rec. 10-08) and silky shark - *Carcharhinus falciformis* (ICCAT Rec. 11-08); IOTC has no-retention measures for thresher sharks - *Alopias* spp. (IOTC Res. 12/09), and oceanic whitetip (IOTC Res. 13/06), and prohibition for purse seiners setting on whale shark - *Rhincodon typus* (IOTC Res. 13/05); and WCPFC has no-retention measures for oceanic whitetip (WCPFC CMM 2011-04) and silky shark (WCPFC CMM 2013-08).

Given those CMMs, it is important to quantify the survivorship for released specimens by assessing both their at-vessel mortality and post-release survival. This allows assessing the effectiveness of those CMMs and also gathering data needed for stock assessments as all sources of mortality should be considered. Additionally, if other measures are established that can result in discarding practices, such as minimum landing sizes and/or quotas, which imply discarding once the quotas are reached, there is also the need to quantify the potential mortality of the discarded component of the catch.

ICCAT, IOTC and WCPFC have established research projects for studying the post-release survival of some shark species. In ICCAT, a dedicated shark research program (SRDCP - *Shark Research and Data Collection Program*) was created in 2014. Most tagging effort has been devoted to shortfin mako (*Isurus oxyrinchus*), even though other shark species are also targeted, including porbeagle, silky shark, oceanic whitetip and hammerheads. In IOTC, a project dedicated to bigeye thresher (IOTC BTH PRM Project) started in 2017, in conjunction with another EU-funded project (POREMO) focused on oceanic whitetip shark. In WCPFC, a research project (WCPFC-SC13-2017/EB-IP-06, WCPFC-SC15-2019/EB-WP-01) began in 2017 and tagged shortfin mako and silky sharks.

Two models of tags developed by Wildlife Computers are being used, namely i) survivorship PATs (sPATs) which are designed to evaluate short-term post release survival (up to 30-60 days) and (ii) miniPATs which are used mainly to evaluate potential delayed mortality beyond 30-60 days, as well as to obtain additional information used for other objectives of those research programs, related to movements, stock delimitations and habitat use. In all projects the condition of the tagged specimens is assessed qualitatively by the taggers (fishery observers and researchers during fisheries surveys), as well as inferred from other information related to the fishing characteristics (e.g., soaking time).

For ICCAT, sharks have been tagged in various regions, including the NW Atlantic, NE Atlantic, Equatorial region and SW Atlantic. Tagging operations so far have been carried out from Portuguese, Uruguayan, Brazilian, Spanish and US vessels, with additional tags distributed to France, Norway and South Africa. For shortfin mako, a total of 43 tags (14 sPATs and 29 miniPATs) have been deployed so far, with current data analysis based on 35 tags. From those, mortality events occurred in 8 specimens, meaning that the nominal post-release survival at this stage is 77.1%.

For IOTC, tagging operations have taken place from Portuguese, French, and Chinese Taipei longliners for bigeye thresher, and Portuguese, French and Spanish longliners and purse seiners for oceanic whitetip. Tags have also been distributed to China, Japan and South Africa. For bigeye thresher, a total of 54 tags were acquired (34 sPATs and 20 miniPATs) with 17 specimens tagged so far in 2018/2019. The current preliminary estimate is 37.5% nominal post release survival, noting however that such value is still based on a small dataset. For oceanic whitetip 35 tags were acquired (20 sPATs and 15 miniPATs) with 18 tags already deployed. Preliminary information is available from 12 specimens tagged from purse seiners, with an estimated nominal post-release survival of 91.7%, while for longliners data from only 3 tags are currently available and to this point no mortality events have been recorded.

For WCPFC, sharks were tagged in the western and central Pacific Ocean in the waters of New Zealand, Fiji, New Caledonia and the Marshall Islands. For shortfin mako sharks, 57 tags transmitted data and 7 died, giving a nominal post-release survival rate of 88%. For silky sharks, 53 tags transmitted data and 6 died, giving a nominal post-release survival rate of 89%. Those post-release survival rates have also been modeled using Kaplan-Meier survival curves, and both parametric and non-parametric models.

Besides providing nominal post-release survival estimates, all projects include plans and ongoing analyses to determine the effects of other variables on mortality rates, such as specimen sizes, temperature, location, fleet, soaking time, length of trailing gear, hook type, etc. In the case of WCPFC, modeling of survival rates has already been carried out, while similar analysis is planned for the ICCAT and IOTC projects. Even though those projects are independent and carried out in different oceans/tRFMOs, many of the tag specifications, tagging protocols and ongoing data analysis are similar.

To increase power and precision in the estimates, it would be worthwhile to consider in the future combining datasets from the three RFMOs in a joint data analysis to increase the sample size, which is typically low in such studies due to costs and logistical constraints. Larger sample sizes would strengthen the conclusions of those studies, allowing the Scientific Committees to provide more robust scientific advice for the consideration of those tRFMOs.

Scope of close-kin mark-recapture for assessment of pelagic sharks (BYC-17)

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Pelagic sharks are susceptible to overfishing, but their status is generally hard to assess using conventional fisheries data. It would be of great value to management if there was a more reliable data source for assessing current status and/or monitoring long-term effects of any management/mitigation measures. Close-Kin Mark-Recapture (CKMR) is a possibility; the data for CKMR (basically, tissue samples from dead animals) can be obtained directly from fishing operations, and yet the method is immune to the hidden biases associated with fishery-derived data like CPUE. CKMR can provide estimates of absolute adult abundance and natural mortality, even when - as is the case for many sharks - only juveniles are caught. Sample size requirements, although substantial, would be a small proportion of the catch for species of bycatch (or commercial) concern. CKMR has been successfully applied to two commercial fish species including one shark, as well as to several low-abundance endangered sharks. This paper briefly reviews the principles and some of the applications, and then focuses on a preliminary design study for mako sharks in the North and South Atlantic Oceans, discussing sample sizes, data requirements, outputs relevant to management advice, logistic and administrative impediments, and the extent to which measures such as non-retention policies might or might not affect viability of CKMR.

Behavior of silky sharks and oceanic white tip sharks in relation to floating objects: implications for shark conservation (BYC-18)

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Silky and oceanic white tip sharks are the two main species caught incidentally by tropical tuna purse seiners, usually when they are associated with floating objects. Knowing their behavior in relation to these objects is therefore a necessity in order to understand their accessibility and their vulnerability to tropical tuna purse seiners, and develop comprehensive conservation strategies.

In this presentation, we will review current knowledge to address the four following questions for each of the two species in the Indian and Atlantic oceans, using data from observers and electronic tagging:

- How many floating objects are occupied by sharks?
- How many sharks are usually found per floating object?
- How long do sharks stay associated to floating objects?
- Where do sharks go?

Implications of these results in terms of fisheries management regarding shark conservation are discussed.

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Fishing on FADs without killing silky sharks: where are we and what should we do? (BYC-19)

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Tropical tuna and silky sharks swim in the same waters, which explains why silky shark is frequently caught incidentally by tropical tuna purse seiners. Reducing catches of silky sharks by purse seiners is a key element towards the sustainability of the fishery. Ten years of research have allowed to test several options to reduce the fisheries-induced mortality of silky sharks: some did not show significant results while others proved to be effective and ended in advice for mitigation measures.

The research result with the main impact has been the discovery of ghost fishing due to sharks becoming entangled in nets hanging under Fish Aggregating Devices (FADs). Following this key finding, RFMOs have adopted measures for Non-Entangling FADs in order to eliminate this mortality.

Several methods have been found to partially reduce the mortality of sharks. Besides shifting a part of the effort to free-swimming school sets, three methods contribute to reduce the impacts of fishing on this vulnerable species: set only on FADs with more than 10 tons of tuna, fish individual sharks in the purse seine net and release them outside, release sharks from the deck following good handling practices. However, besides these results, implementing this set of solutions appears to be difficult.

After summarizing the main research progress in bycatch mitigation of silky sharks, the presentation examines why some solutions are not fully in place, and discusses what should be done in the next 10 years.

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A glimpse into the status of elasmobranchs in Sri Lanka (BYC-20)

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Sharks (superorder: Selachii) and mobulid rays (superorder: Batoidae) are incredibly diverse, with many species having circumglobal, pelagic distributions. In Sri Lanka, while some small scale targeted deep-sea shark fisheries exist, the majority of shark and ray (including mobulid) landings are from frequent bycatch in tuna and billfish gillnet and longline fisheries. These gears are deployed by both single and multi-day vessels operating within and beyond the EEZ, and the sharks and rays are retained for their highly valued fins and gill plates that are exported, and for domestic consumption of meat. From March 2017 to October 2019, a total of 602 days of survey across 21 gillnet and longline landing sites have recorded a total of 607 silky sharks (*Carcharhinus falciformis*); 249 blue sharks (*Prionace glauca*); 44 shortfin mako sharks (*Isurus oxyrinchus*); 27 longfin mako sharks (*Isurus paucus*); 50 scalloped hammerhead sharks (*Sphyrna lewini*); 26 smooth hammerhead sharks (*Sphyrna zygaena*); 5 oceanic white tip sharks (*Carcharhinus longimanus*), and a total of 1,167 mobulid rays comprising 5 species. Apart from blue sharks, all are CITES Appendix II listed, with oceanic white tip sharks receiving greater protection due to non-retention measures under IOTC. Strong bias toward immature and juvenile individuals are clearly observed in some species leading to concerns of overfishing. This is further compounded by the fact that multiple nations incidentally capture these species within the Indian Ocean and throughout their global range, in addition to pressures from IUU fisheries, ghost-nets, and species vulnerability to pollutants (plastics and agricultural runoff) and climate change. Coupled with updated IUCN Red List assessments highlighting that many of these species have the most conservative life histories of marine fish despite global ranges, it affirms that they make extremely poor candidates for retention in commercial fisheries. Given population declines, improved monitoring is required particularly for regional stocks, also to support the development of revised conditional non-detriment findings to continue enabling CITES trade. Additionally, management measures such as bycatch mitigation, non-retention measures until stock assessments are available, and identification of critical habitats (e.g. nursery grounds or areas of high density) for protection are strongly recommended. Such proactive measures to curb population declines and enable recovery should be prioritised over reactive measures once populations have already declined.

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Dialogue between research and fishing industry towards improving scientific observations of bycatch: the case of the French and Italian tropical tuna purse seine fleet in the Atlantic and Indian Oceans (BYC-21)

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Introduction

The presence of observers onboard tropical tuna purse seiners (PS) is required for multiple reasons: scientific data collection, compliance with tuna RFMO regulations, compliance with fishing agreement obligations, compliance with certification commitments (e.g. ISSF) or monitoring of the application of Best Practices. In order to meet these multiple requirements and to improve the scientific observation of bycatch, ORTHONGEL implemented in 2013 the Common Permanent Unique Observer (OCUP) pilot project (Goujon *et al.* 2017) with the aim of reaching an exhaustive coverage of its member fishing vessels. In 2014, as smaller vessels of the Indian Ocean could not carry observers due the lack of space onboard (piracy-protection teams are embarked since 2010), an electronic monitoring extension of the program was implemented (Electronic Eye Optimization "OOE" pilot project, Briand *et al*. 2017).

During the most recent years, the observer coverage rate has therefore rapidly increased in the Atlantic and Indian Oceans, leading to new challenges to ensure the quality of the large amount of collected data. The present document describes the methodology and the collaborative work between research and fishing industry to improve scientific observations of bycatch in the frame of the OCUP/OE program.

Towards an exhaustive observer coverage

In 2013, ORTHONGEL implemented the OCUP program to facilitate the boarding of scientific observers of coastal countries in collaboration with Oceanic Développement (OD), the French Institute for Research and Development (IRD) and 10 coastal countries of the Atlantic and Indian Oceans. Since 2013, onboard OCUP observers brought the complement of observer coverage to reach 100% of coverage of fishing sets in the Atlantic Ocean since 2015 and 46% in the Indian Ocean in 2018. In addition, the Electronic Monitoring System (EMS) was implemented in 2014 for purse seiners when embarking observers was not possible, covering for the remaining 54% of fishing sets in the Indian Ocean in 2018.

This increased coverage rate has contributed to a large increase in the amount of scientific data collected on bycatch and sensitive species. These data could contribute to a better assessment of stock status for species under t-RFMO mandate, provided that their quality is sufficient. However, with the increasing contribution of less-experienced observers boarding in the frame of fishing agreements and the increased volume of data collected, the amount of data corrections (e.g. errors in species identification) has increased significantly. Collaboration between partners of the OCUP program underlined the need for an improved individual follow-up of observers, which will be implemented in 2020 in a new phase of OCUP.

Towards an optimised Electronic Monitoring System

Following the implementation of the EMS onboard 2 purse seiners of the Atlantic Ocean and 8 purse seiners of the Indian Ocean in 2014 (OOE pilot project), the potentialities of the EMS were tested for the scientific of observation of discards. In 2017-2018, 'mixed' fishing trips, involving both electronic and onboard observers, were conducted in order to compare estimates of discards between the two types of observation. Good matches were obtained for tuna discards and bycatch species with high occurrence (Briand *et al*., 2017). However, for sharks and species kept on board for consumption (dolphinfish and wahoo), EMS systematically underestimated occurrence and discards volume compared to onboard observers, due to camera distance or dead angles.

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The results of the OOE pilot project indicated that EMS installed onboard French and Italian purse seiners has great potential for scientific observation, especially to evaluate discards, as EMS allows to exhaustively count individuals on the discard belt. In addition, EMS can be used as a tool to improve the protocol currently in use by onboard observers (Briand *et al*., 2018). Using all the potential of the EMS would however require solving existing issues of dead angles and camera distance, improving species identification, harmonizing EMS and onboard observation protocols, and improving the current collection and storage of EMS data.

Towards better "Best Practices" to reduce bycatch and sensitive species mortality

From 2010 to 2015, ORTHONGEL and scientists of IRD and Ifremer worked conjointly on solutions to mitigate the mortality of sensitive species, including sharks, rays and turtles. The results of this work provided important new information on bycatch species mortality (Filmalter *et al.*, 2013) and led to the implementation of (i) a Code of Best Practices for the manipulation of sensitive species (Poisson *et al*., 2014) and (ii) Lower Risk Entanglement FADs in 2012 in the Indian Ocean and 2013 in the Atlantic Ocean (ORTHONGEL 2011). Since 2016, the application of Best Practices by purse seine crews is monitored by OCUP and EMS observers in a dedicated form.

Preliminary analyses of the data indicated differences between vessels in the rate of compliance with Best Practices. These differences underline the need for a continuous training of crew on Best Practices and a careful monitoring of compliance by the fishing industry. Collaboration between scientists and the French and Italian PS fleet in the frame of the OCUP program should provide useful scientific advice to reach these objectives.

Conclusions and perspectives

During the last decade, considerable work has been done between scientists and fishing industry to improve scientific observations of discards of the French, Italian and associated PS fleet of the Atlantic and Indian Oceans. In recent years, an exhaustive coverage of their fishing activities was reached for the first time with the combination of onboard and electronic observers. Undergoing work will ensure the quality of the data collected by observers and compliance of crews with Best Practices.

References

K. Briand, A. Bonnieux, W. Le Dantec, S. Le Couls, P. Bach, A. Maufroy, A. Relot-Stirnemann, P. Sabarros, A.-L. Vernet, F. Jehenne, M. Goujon. 2017. Comparing electronic monitoring system with observer data for estimating non target species and discards on French tropical tuna purse seine vessels.

K. Briand, P. Sabarros, A. Maufroy, A. Relot-Stirnemann, S. Le Couls, M. Goujon, P. Bach. 2018. Improving the sampling protocol of electronic and human observations of the tropical tuna PS fishery discards.

J.D. Filmalter, M. Capello, J.L Deneubourg, P. Denfer Cowley and L. Dagorn, 2013. Looking behind the curtain: quantifying massive shark mortality in fish aggregating devices. Frontiers in Ecology and the Environment. 11:291-296.

M. Goujon, A. Maufroy, A. Relot-Stirnemann, E. Moëc, M.J. Amandè and P. Bach. 2017. Collecting data on board French and Italian tropical tuna purse seiners with common observers: results of ORTHONGEL's voluntary observer program OCUP (2013-2017).

ORTHONGEL 2011. Décision ORTHONGEL n°11 du 23 Novembre 2011 relative à l'utilisation de dispositifs de concentration de poisons.

F. Poisson, A.L. Vernet, B. Séret and L. Dagorn. 2014. Guide de bonnes pratiques pour réduire la mortalité des requins et des raies capturés accidentellement par les thoniers senneurs tropicaux.

Predicting hotspots of the main bycatch species of tuna purse seine fisheries in the Atlantic and Indian oceans (BYC-22)

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Five species dominate the composition of bycatch in tropical tuna purse seine fisheries: the dolphinfish, rainbow runner, silky shark, spotted oceanic triggerfish, and wahoo. Elucidating species-habitat relationships across species and oceans is crucial to design fisheries management strategies that efficiently reduce bycatch. We used data collected within French fisheries observer programs to predict hotspots for the top five bycatch species as well as the spatio-temporal overlap with fishing effort at the basin scale in the Atlantic and Indian oceans. For each species and ocean, we built a generalized additive model relating bycatch per floating object fishing set to habitat covariates. Estimated relationships were geographically extrapolated to derive predictions of multispecies bycatch hotspots at the basin scale. Bycatch hotspots were then overlapped with the multi-flag purse seine fishing effort available from RMFOs. Species-habitat relationships vary between oceans and species. In the Atlantic, bycatch hotspots were predicted throughout subtropical waters with little overlap between species. In the Indian Ocean, major bycatch hotspots were predicted in northern waters for four species. The overlap of hotspots with the core fishing effort was substantial year-round in the Atlantic and in the second half of the year in the Indian Ocean. Dissimilar habitat relationships highlighted the need to consider species and oceans specificities in the context of bycatch management in tuna purse seine fisheries. Potential for bycatch reduction is highest in the Indian Ocean where a seasonal fishing closure north of 8°N would protect four pelagic fishes, including vulnerable silky sharks. Finally, our extrapolations beyond the core fishing areas are particularly valuable for predicting bycatch risks associated with potential expansions of fishing effort.

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Deriving abundance indices for pelagic sharks based on their associative behavior with floating objects (BYC-23)

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We propose a new method to derive an abundance index for pelagic sharks that commonly associate with floating objects (FOBs). This method relies on a behavioural model describing the dynamics of sharks associated with FOBs in terms of the probabilities of a shark to associate with a FOB and to leave the FOB. These probabilities can depend on the FOB density and social behaviour. Due to its high frequency on FOB sets, the silky shark (*Carcharhinus falciformis*) was chosen as a case study. We used observer data from the French and Spanish tropical tuna purse seine fishery recorded in the Indian Ocean between 2005 and 2018 to feed the model. Since actual FOB densities were not available, a simple FOB-density index based on random encounters of floating objects recorded by the observers was calculated. The parameters estimates of the model were obtained by fitting the distribution of the number of sharks caught per FOB set. An abundance trend for silky sharks in the Indian Ocean relative to a reference year was then derived. This methodology has the potential to be applied to other species associating with FOBs, generating population trends that could be incorporated into stock assessments.

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Counting sharks incidentally captured by tropical tuna purse seine vessels- easier said than done! (BYC-24)

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Recording bycatch is important to evaluate the impact of fisheries on the ecosystem. In the tropical tuna purse seine fishery, tRFMOs coordinate scientific observer programs to monitor fishing activities and record bycatch. While considerable efforts have been made by tRFMOs to increase observer coverage and to promote the use of technology (i.e. Electronic Monitoring) to aid the acquisition of bycatch, the accuracy and uncertainty of these methods is poorly documented. The silky (*Carcharhinus falciformis*) and the oceanic whitetip (*Carcharinus logimanus*) are the primary elasmobranch bycatch in the global tuna purse seine fishery. We use shark count data acquired by scientists during the scientific cruises onboard purse seiners in the western central Pacific, Atlantic and Indian Oceans to assess accuracy of onboard observer and electronic monitoring systems. Generally, the results of this study shows that sharks counts at the set level were underestimated by both onboard observer and electronic monitoring systems.

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Mitigation actions on Spanish tropical tuna purse seiner fishery (BYC-25)

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About half of the tropical tuna caught worldwide annually is fished by purse seiners, mainly using fish aggregating devices (FADs). Even though this fishing technique increases sets success, these devices are also controversial due to their potential impacts on the marine ecosystem. In order to mitigate and reduce the effects of the purse seiner fishery on non-target species, the two Spanish tuna purse seiner associations (ANABAC and OPAGAC), collaborating with scientists, are performing specific actions for reducing bycatch mortality levels. This document summarizes the main actions conducted at global scale in Spanish tropical tuna purse seine fishery.

In 2012 the purse seiners associations established a Code of Good Practices (CGP) for the application of sustainable fishing practices. The aim of this agreement is to maximize survival of sensitive species incidentally caught (i.e., elasmobranchs, sea turtles and since 2019 cetaceans) and prevent passive ghost fishing by using non-entangling FADs. The CGP defines a set of good practices including: (i) the use of non-entangling FADs, (ii) best releasing practices for sensitive fauna, (iii) improving data collection on activities on FADs and other natural floating objects and FAD designs, (iv) 100% observer coverage in purse seiners and since 2017 gradually implemented in support vessels, (v) and continuous training of fishing crew and observers. In order to monitor and assess the level of compliance with this CGP, a system of verification was implemented in 2015, which is continuously evaluated. Results are shared with each company and are discussed in a Steering Committee (comprising members of the science industry) which evaluates improvement needs if required. Observations show that the fleet is mainly using non-entangling FADs in all oceans. Bycatch release time has been reduced since 2015, which is an indicator of the increased commitment of the crew and could contribute to higher post-release survival rates. Most releases of large bycatches in tuna purse seiners are still done manually, which potentially poses a risk to crew members. Some tools such as cargo nets or stretcher beds have been used with some success to release manta rays, but there is still room to refine deck release equipment to maximize their survival, facilitate rapid handling and ensure fishers' safety.

In parallel with the CGP, the HELEA project is devoted to developing fauna releasing devices to increase the survival, testing new tools to release sharks and manta rays. These tools are based on the feedback gathered during workshops with skippers. Metallic frame grids to release manta rays and manual tools like handles and specially designed fasteners for sharks have been designed and are being tested on board to measure their efficiency for manipulating these bycatches while minimizing injury to the animals and crew. Moreover, released animals are also tagged to assess post-releasing survival. In addition, the use of the hopper is being evaluated to test the efficiency on shark releases, which has been identified by some skipper as an appropriate device for enhancing releasing rate and survival.

Finally, in order to further improve FAD designs to reduce entanglement risk, mitigate contribution to marine litter and impacts on coastal ecosystems of the FAD fishery, actions are being focused on the development and testing of non-entangling biodegradable FADs. Public and private sector funded small- and large-scale initiatives are being conducted worldwide looking for non-entangling natural suitable materials for FAD construction.

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Silky shark draft regional management strategy for SIOTI members (BYC-26)

Poisson, F., Gilman, E., Seret, B., Bräutigam, A., and Fowler, S.[1]

The Sustainable Indian Ocean Tuna Initiative (SIOTI) is a large-scale Fisheries Improvement Project (FIP) comprising the major purse seine fleets and tuna processors operating in the Indian Ocean Tuna Commission (IOTC) Area of Competence. The FIP is supported by the Government of the Seychelles and WWF through a formal Memorandum of Understanding (October 2016) and an agreement between 17 industry partners (March 2017). The SIOTI FIP goal is to support improvement in the management of Indian Ocean tuna fisheries so that consumers can in the future be assured that the purse seine tuna they purchase has been harvested sustainably. The ultimate aim is to meet the highest standards of sustainable fishing, such as the Marine Stewardship Council (MSC) standard.

The SIOTI FIP considers three pelagic tuna species[2] targeted in the Indian Ocean by large-scale (>60 m) specialist tuna purse seine (TPS) vessels. These TPS net free-schooling tuna, or schools aggregating naturally around floating objects, including purpose-built fish aggregating devices (FADs). The majority of the SIOTI TPS fleet, operated by or on behalf of the SIOTI partners, are registered in the European Union (EU) by France, Italy, and Spain, while the remaining vessels are registered in the Seychelles and Mauritius. Additional TPS vessels registered to a range of countries (e.g., Iran, Philippines, Republic of Korea) fish in the IOTC area. The tuna stocks targeted by the SIOTI fleet are also targeted on the high seas and within EEZs using other gears (e.g., longlines, gillnets) that are deployed by an even larger number of vessels registered to a larger number of countries.

The TPS vessels that target and set on tuna also take a bycatch of marine mammals, marine turtles, and elasmobranchs[3]. Silky shark *Carcharhinus falciformis* is by far the most abundant recorded bycatch species, comprising over 90% of the total purse seine catch, or 95% of elasmobranchs. There is additionally a high level of hidden juvenile mortality through entanglement in FADs, and silky sharks are also a bycatch of longlines. Furthermore, silky sharks are caught in extensive artisanal and coastal gillnet and line fisheries around the Indian Ocean. Stock assessments and/or standardized catch rate indices show significant stock declines in many ocean regions, including the Indian Ocean. The Indian Ocean Tuna Commission is the only t-RFMO that has not adopted any species-specific management measures for silky shark. Other t-RFMOs have designated the silky shark as a prohibited/no-retention species in some or all of the fisheries under their remit.

The Sustainable Indian Ocean Tuna Initiative recently commissioned the following study, in preparation for the development of a regional silky shark management strategy:

i. The biology, population trends and stock status of silky shark in the Indian Ocean, drawing upon available capture and mortality data

ii. The strengths and weaknesses of current and emerging management measures for silky shark conservation at international, regional, national and SIOTI fleet-specific levels; and

iii. Appropriate gear-specific silky shark avoidance and mitigation measures (focused on purse seines).

The bycatch avoidance and mitigation measures identified for silky sharks include the following:

1. Improved reporting of catch and effort data by SIOTI fleets.
2. Finning prohibitions: to support proposals to the Commission for extending the current finning prohibition to mandate fins attached for frozen as well as for fresh catches.
3. Safe release and handling practices: to encourage the development of guidelines and protocols for the safe handling and release of sharks and rays caught by longlines and gillnets fisheries.

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[2] Skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*) and bigeye tuna (*Thunnus obesus*).
[3] "Elasmobranchs" (Subclass Elasmobranchii) incorporate sharks, skates, and rays but exclude the chimaeras (Subclass Holocephali), which together represent Class Chondrichthyes.

4. Promote the adoption of Non-Entangling and Biodegradable Fish Aggregating Devices (FADs) and FAD action plans.

5. Promote improved spatial and temporal management measures, such as closed areas.

6. Provide scientific data to improve future assessments of the status of silky shark stocks.

7. Promote a regional harvest strategy for silky sharks, which could inter alia inform CITES NDFs by IOTC Members.

8. Review, with reference to no-retention plans in other t-RFMOs, the benefits and disbenefits of non-retention measures for silky sharks in the IOTC Area.

9. Reduce the impacts of large-scale pelagic driftnets and coastal gillnets through improved reporting of illegal gears and through fleet and gear conversion programmes.

10. Prohibit the use of wire leaders and shark lines in longline fisheries.

11. Investigate the depth preferences and diurnal movements of silky sharks to determine whether setting gear deeper will reduce longline bycatch.

12. Reduce the use of chemical lightsticks to reduce bycatch and chemical and single-use plastic pollution

13. Cooperative management arrangements: encourage participation of SIOTI members in Kobe t-RFMO meetings, the Areas Beyond National Jurisdiction Program (ABNJ) Bycatch Data Exchange Protocol (BDEP) and other regional initiatives, including by non-tuna regional fishery bodies and regional seas programmes.

Suggestions are made for actions that could be taken by SIOTI Members in order to contribute to and/or improve the above measures.

By-catch management at tuna RFMOs: delayed action requires drastic change (BYC-27)

Grantly Galland,[1]KerriLynn Miller, Jennifer Sawada

Regional fisheries management organizations (RFMOs) have a responsibility to manage bycatch, or the catch of non-target species. Fisheries managed by the tuna RFMOs incidentally catch sharks, pelagic rays, billfishes, and other species, several of which have significant economic value. This combination of interactions with fishing gear and value to fishermen has led to the depletion of several shark and billfish populations across the global ocean, while the incidental nature of the interactions often delays management action, despite clear advice from scientists on the need for steps to curb population decline.

Vulnerable to overexploitation in fisheries, approximately 30 percent of shark and ray species are threatened with extinction according to the International Union for the Conservation of Nature. A recent global study shows the overlap of shark habitat and fishing effort, demonstrating that for pelagic sharks found in the high seas, there is limited spatial refuge.[2] Most billfish species caught in the fisheries managed by tuna RFMOs are either overfished, experiencing overfishing, or both. In some instances, fishing has resulted in depletion of shark and billfish populations by more than 90%. In many cases, the bycatch of juveniles, in particular, has contributed to declines and reduced the resiliency of some populations.

Governments have recognized that a number of sharks and pelagic rays caught within RFMOs are experiencing drastic population declines and in need of better management. This is evident in the listing of several species on the appendices of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Tuna RFMOs have the mandate to not only establish conservation and management measures for sharks and billfishes but to apply the precautionary approach. Precautionary management of bycatch should include: setting and enforcing science-based catch limits to maintain fishing for target and bycaught species at sustainable levels; implementing additional protections, where required, including time and area closures and no retention measures for vulnerable species; and developing bycatch mitigation measures, such as banning wire leaders or requiring appropriate circle hooks or weak hooks, to avoid catching bycatch altogether or to minimize mortality when bycatch is encountered. In addition, increased observer coverage both to improve data collection and compliance has been recommended within all RFMOs and should be addressed without delay.

To date, retention bans have become a default management measure for sharks (e.g., oceanic whitetip, threshers, hammerheads, and silky sharks), as managers have delayed action until populations have all but disappeared. Retention bans are opposed by the affected fishing operations but are necessary to prevent further decline, endangerment, and extirpation risk in extreme cases. Proactive, precautionary management of bycatch in fisheries managed by tuna RFMOs could prevent the need for such substantial actions.

A review of the status of sharks and billfishes – where available – is presented, along with cautionary tales from the Atlantic and Pacific oceans, where delayed action has resulted in steep declines and the need for rapid action. These examples illustrate why action needs to be taken early to ensure that bycaught species are managed properly, and in the cases of extreme depletion, are given an opportunity to recover before disappearing entirely.

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[2] Nuno Queiroz, *et al.*, "Global spatial risk assessment of sharks under the footprint of fisheries," Nature 572: 461-466 (2019). https://www.nature.com/articles/s41586-019-1444-4

Inventory of sources of data in Guatemala on shark fisheries operating in the eastern Pacific Ocean (BYC-28)

Carlos Francisco Marín Arriola[1], Carlos Alejandro Tejeda Velásquez[2], Salvador Siu[3]

The Directorate of Regulation of Fisheries and Aquaculture (DIPESCA) is the authority in Guatemala responsible for administering national aquatic resources, promoting their sustainable use, and monitoring administration of regulations and laws. The Guatemalan General Law on Fisheries and Aquaculture (Decree No. 80-2002) classifies fishing vessels by Gross Registered Tonnage (GRT), as follows: large-scale commercial (30.1-150 GRT); medium-scale commercial (2-30 GRT); small-scale commercial (1-1.99 GRT); artisanal (0.46-0.99 GRT). Guatemala currently has 31 medium and large-scale shrimp vessels, three large-scale tuna purse seiners, 18 medium-scale longliners, 5 small-scale gillnet/longline vessels, and 4,860 small-scale artisanal vessels operating in the EPO. According to OSPESCA (2010), Guatemalan fisheries employ a total of 18,600 fishers, almost half of whom operate in the Pacific. In the Guatemalan EEZ, sharks are caught mainly by *pangas* in the small-scale artisanal fisheries and by small-scale vessels targeting sharks, but as bycatch in artisanal gillnet fisheries (Ruano *et al*. 2007). About 30 shark species are caught in these fisheries, mainly species belonging to the orders Carcharhiniformes, Lamniformes and Rajiformes (Calderón-Solís 2014). Additionally, about 200 artisanal longliners target shark in the Guatemalan EEZ (PROBIOMA 2009). Sharks are also targeted by medium-scale industrial longliners. This fishery is fairly recent, having started in 2005, in contrast to the small-scale commercial fishery, which started in the early 1980s. The main ports for shark landings in Guatemala are, in order of importance, Puerto San José, Buena Vista, Champerico, Monterrico, and Sipacate. Landing by small-scale and artisanal vessels are concentrated in San José, and those by medium-scale vessels in Buena Vista.

Data collection

Data on shark landings in Guatemala originate mainly from port inspection records. Specifically, since 2001, DIPESCA inspectors collect data on landings, by species, and effort for the medium and small-scale longline fleets at the five main fishing ports. Prior to 2015, effort was recorded in fishing days, but currently it is recorded in number of hooks.

The landings inspection programme provides 100% coverage of medium-scale longliners. This is possible because fishery inspectors live in the communities near the ports where these vessels unload, and can therefore collect information at any time. Vessels arriving at night are not monitored until the next day, because the product must be certified. Each fishing port has an inspector. In the case of Buena Vista, where the medium-scale fleet is concentrated, the inspector has collected complete landings data, using OSPESCA forms, since 2014, classifying the catch by species, and, if appropriate, issuing a "no finning" certificate, which enables the product to be marketed. At the other ports, inspectors record landings data for small-scale and artisanal vessels - which account for a large portion of shark landings in Guatemala - and sometimes carry out fishery and/or biological sampling of landings of sharks and related species. However, both landings data and samples are collected opportunistically, so no consistent long-term data series are available. The port inspection data were stored in a Microsoft Access database until 2001. Subsequently they were stored in Microsoft Excel until 2014, when DIPESCA started to use the standard OSPESCA data collection form. The information stored in Excel was then transferred to an Access database developed by the IATTC and OSPESCA. Other than landing inspections, DIPESCA does not have any fishery and/or biological sampling programmes. However, a few data collection studies supported by external funding sources were conducted in Guatemala (e.g. FAO 2005-2006; OSPESCA 2009-2010; AECID 2006.) Also, DIPESCA holds datasets collected by students during thesis research projects.

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Research

In addition to DIPESCA's port inspection records, research studies provide valuable information on shark fisheries in Guatemala. One of the leading contributors to marine resource research in Guatemala is the University of San Carlos (USAC), particularly its Center for Marine and Aquaculture Studies (CEMA), which has provided the scientific basis for management and conservation of Guatemalan aquatic resources. As mentioned above, DIPESCA does not conduct any sampling programs; however, the data collected by CEMA students during their thesis work are provided to DIPESCA. Guatemala has produced more research than any other country in Central America. A total of 15 Guatemalan research studies dating from 1982 to 2014 were identified and obtained. These studies, conducted mainly by USAC and DIPESCA, address the following topics: reproduction (maturity), growth (length and weight), ecology (breeding areas), and others (chemical and pharmaceutical analyses, local trade analysis, and descriptions of fisheries). In addition, ten university theses were found, covering the following topics: description of the shark fisheries, distribution and abundance of coastal sharks, chemical analysis, and ecological studies. Three of these were published in scientific journals, while the others were either published in local journals or remain unpublished. Shark research in Guatemala has also been conducted by NGOs. A total of five reports produced by NGOs were found, addressing the following topics: description of the shark fisheries, catch analysis of sharks and rays in the artisanal fishery, ecological and taxonomic studies, and population structure in Guatemala.

Management

The General Fisheries and Aquaculture Law (Decree 28-2002) and its Government Decision (No. 223-2005) establishes the bases for managing shark fisheries in Guatemala; for instance, it prohibits fishing for sharks within 20 nautical miles of the coast and specifies the fishing gears that can be used. However, specific regulations, such as prohibitions on finning or closed seasons, are put into effect by implementing measures adopted by international or regional organizations and instruments such as IATTC, ICCAT, OSPESCA, and CITES; for example, finning of sharks is regulated through, among others, OSPESCA Resolution OSP-05-11.

References

Calderón-Solís, J.C. 2014. Caracterización de la captura de tiburones y rayas (Clase Chondrichthyes) en la costa este del Pacifico de Guatemala. CDC/RNUMM/CECON. Guatemala. 46 pp.

OSPESCA. 2010. Centroamérica en números- pesca artesanal y acuicultura. AECID-SICA-OSPESCA, San Salvador, El Salvador. 31 pp.

PROBIOMA. 2009. Análisis de vacíos y omisiones para el Pacífico de Guatemala: planificación para la conservación marina. Asociación de Profesionales en Biodiversidad y Medio Ambiente. Documento Técnico No. 3. 76 p.

Ruano, S.R. & Ixquiac, M.J. 2007. Comercialización eficiente de los productos de pesca artesanal. Clasificación de las principales especies capturadas con respecto a las temporalidades de pesca, cantidad y los precios de venta de primera mano en playa. Federación Nacional de Pescadores Artesanales de Guatemala (FENAPESCA), Guatemala. 50 pp.

Reviews of bycatch species caught by the SIOTI fleet, codes of practice and other guidance for reducing bycatch mortality. report to the sustainable Indian ocean tuna initiative (BYC-29)

Poisson, F., Gilman, E., Seret, B., and Fowler, S.[1]

The Sustainable Indian Ocean Tuna Initiative (SIOTI) is a large-scale Fisheries Improvement Project (FIP) comprising the major purse seine fleets and tuna processors operating in the Indian Ocean Tuna Commission (IOTC) Area of Competence. The FIP is supported by the Government of the Seychelles and WWF through a formal Memorandum of Understanding (October 2016) and an agreement between 17 industry partners (March 2017). The SIOTI FIP goal is to support improvement in the management of Indian Ocean tuna fisheries so that consumers can in the future be assured that the purse seine tuna they purchase has been harvested sustainably. The ultimate aim is to meet the highest standards of sustainable fishing, such as the Marine Stewardship Council (MSC) standard.

The SIOTI FIP considers three pelagic tuna species[2] targeted in the Indian Ocean by large-scale (>60 m) specialist tuna purse seine (TPS) vessels. These TPS net free-schooling tuna, or schools aggregating naturally around floating objects, including purpose-built fish aggregating devices (FADs). The TPS vessels that target and set on tuna also take a bycatch of marine mammals, marine turtles, and elasmobranchs[3]. The tuna stocks targeted by the SIOTI fleet are also targeted on the high seas and within EEZs using other gears (e.g., longlines, gillnets) that are deployed by an even larger number of vessels registered to a larger number of countries, and which take a greater bycatch than the SIOTI TPS fleet.

SIOTI commissioned the following reviews in preparation for developing a draft SIOTI-wide Code of Practice for reducing the mortality of vulnerable marine species during fishing operations:

a) A shark finning risk assessment;

b) A quantitative review of the main vulnerable marine vertebrate species taken as bycatch in SIOTI fleet purse seine tuna fisheries; and

c) A review of current Codes of Practice and other Guidance, within SIOTI members, RFMOs and main progressive NGOs, for reducing the mortality of vulnerable marine species during fishing operations. Particular emphasis was placed on sharks and rays, since these are the most abundant bycatch species.

The draft Code of Practice took into account the above reviews and best practices identified. It paid particular attention to existing methods and possible new experimental practices for reducing silky shark bycatch and improving silky shark survival after release.

The project report presents these reviews and initial recommendations for best practice in the SIOTI fleet and will be circulated for consultation with SIOTI Members.

Provisional citation

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[3] "Elasmobranchs" (Subclass Elasmobranchii) incorporate sharks, skates, and rays but exclude the chimaeras (Subclass Holocephali), which together represent Class Chondrichthyes.

Perspectives of the Spanish longline sector on elasmobranch and sharks by-catch (BYC-31)

Edelmiro Ulloa[1]

The surface longline fleets take several shark species as bycatch, and part of the fleet targets *Prionace glauca*. While interaction with other elasmobranchs is actually nil, this is not the case for pelagic sharks. Moreover, high ranking of several species in the ERA tables led the Spanish sector in 2009 to unilaterally call for the fisheries administration to adopt measures prohibiting their capture (*Alopias spp, Sphyrna spp*); these were implemented by Spain in January 2010. Some of these species, as well as others, i.e. various sharks (silky shark, oceanic whitetip shark, etc.) have been included in RFMOs' prohibitions on retention.

Bycatch of pelagic sharks whose retention is prohibited, as is the case for any ETP species, poses a problem for longliner activity, which has also suffered a decrease in at-sea operations. The MSC pre-evaluation exercises carried out by the Spanish longline fleet between 2014 and 2015 identified the need to improve principle 2. An MoU - which is open to other stakeholders - was signed by 95% of the EU fleet in the three oceans (comprising four Producer Organizations) and 80% of the EU supply chain of these species, in order to develop an FIP that will enable achievement of the compliance levels of the MSC standard.

Regarding the issues related to Principle 2 of the MSC criteria, the perspective of our organizations is to develop and strengthen actions to reduce interactions with ETPs (including pelagic sharks) down to the minimum required by the criteria of the MSC standard.

To achieve these objectives, since the start of the improvement process, the community longline fleet participating in the FIP has been working to improve:

i. Review of the pre-evaluation process to update it to the current standards of the 31 PI (Performance Indicators) in force.
ii. Progressive strengthening of the Onboard Observer Programmw, including introduction of Electronic Observation equipment.
iii. Review of data gaps related to ETPs species, and reinforcement of basic information to enhance the evaluations carried out by the Scientific Committees of the RFMOs, and to develop support activities for them and RFMO managers.
iv. Development of workshops and good practice guides to minimize interactions with all ETPs related to the fishery.

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