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A progress report on the Shark Research Plan

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Abstract

This paper outlines progress against the Shark Research Plan (SRP) since the last meeting of the WCPFC Scientific Committee in August 2011. There have been several areas of progress under the SRP since SC7 including: 1) the adoption by the Commission of criteria for the determination of key shark species; 2) the adoption by the Commission of a CMM for oceanic whitetip sharks; 3) full stock assessments for silky and oceanic whitetip sharks; 4) preparatory work on stock assessments for blue and mako sharks in collaboration with the ISC (for the northern populations) and CSIRO and other Australasian researchers (for the southern populations); and 5) an analysis of whale shark against the recently adopted criteria for key shark species. A brief summary of the highlights under each area is provided, but interested readers are referred to the full SC8 documents.

This paper also notes that the strong progress made on the implementation of the SRP has required considerable resources outside of that presently supported by the WCPFC. In order to continue this progress, it will be necessary for the SC and Commission to consider the level of resourcing provided to support the SRP and the relative priorities of the currently scheduled activities to new and emerging issues relating to sharks in the WCPO.

The following recommendations are made in this paper for the consideration of SC:

- That the SC carefully consider the relative priority of the stock assessments proposed within the SRP for 2012/2013 (blue and mako sharks) and 2013/2014 (thresher sharks) with other potentially important activities (the top three would be considered the most important) consistent with the SRP such as:
    - Providing an analysis of potential mitigation techniques for reducing impacts with oceanic whitetip and silky sharks in longline fisheries based on existing observer data;
    - Conducting a standardized CPUE analysis for whale sharks using observer data from the tropical purse seine fishery with a stock assessment to follow if deemed feasible;
    - Advice on candidate target and limit reference points for shark species taken predominantly as bycatch;
    - Indicator analyses for the remaining five key shark species (porbeagle shark and the four hammerhead species);
    - Contributing to a stock assessment for porbeagle shark with CCSBT (if this proceeds)
    - Updating and enhancing the shark tagging database STAGIS;
    - Updating the stock assessments for silky and oceanic whitetip sharks;
    - Biological studies to reduce uncertainty in important life history parameters of key shark species;
    - Electronic tagging studies to estimate post-release mortality for key shark species; and
    - Undertaking a review of the SRP for the development of a revised plan;
- That the SC consider the utility of producing and distributing a shark identification handbook[2];

[2] http://www.spc.int/coastfish/index.php?option=com_content&Itemid=30&id=354

- That the SC recommend CCMs that encourage longline vessels to use logsheets that allow the accurate reporting of the key shark species. For example, an expanded longline logsheet that includes the key shark species is available in English, Japanese, Mandarin, Korean, and Spanish[3]; and
- That WCPFC members make all available observer and research / training data that has not previously been provided to SPC or WCPFC to support the SRP assessment work and/or provide cost-effective means for collaborative research efforts.

1. Introduction

In response to regional and global concerns about the status of shark populations, a Shark Research Plan (SRP) developed by the Secretariat of the Pacific Community-Oceanic Fisheries Programme (SCP-OFP) was approved by the Commission in December 2010 (WCPFC 2010). The SRP has three main inter-related components (Clarke and Harley, 2010):

- Phase 1: **assessments** to be undertaken with existing and available data;
- Phase 2: coordination of **research** efforts to supplement biological and other assessment-related information; and
- Phase 3: improvement of **data** from commercial fisheries.

Progress to date on the SRP has been very good. In 2011 five papers were submitted to seventh regular session of the WCPFC Scientific Committee (SC) including the review of SRP progress to date (Clarke 2011a) and several papers describing indicators of stock status for several key shark species (Clark et al. 2011a, 2011b). This work lead to the adoption of a Conservation and Management Measure for oceanic whitetip sharks (CMM2011-04[4]) which bans the retaining on board, transshipping, storing and landing of oceanic whitetip sharks and requires all oceanic whitetip sharks to be released in a manner that results in as little harm to the shark as possible.

For 2012, seven papers relating to the SRP have been submitted to SC8 for its consideration primarily relating to the detailed stock assessments for oceanic whitetip and silky sharks. The SRP has led to enhanced collaboration on shark research and stock assessment and Annex 1 and 2 contain publications that relate to the SRP and travel in the implementation of the SRP.

This paper summarizes the progress made since SC7 in August 2011 specifically, with respect to the three phases identified in the SRP and makes several recommendations for the consideration of the SC.

2. The key shark species

There has been some confusion regarding the initial determination of the key shark species and how this links to the SRP. The current list of the WCPFC key shark species includes 13 species (Table 1) of which eight are included within the proposed activities of the SRP.

[3] http://www.spc.int/oceanfish/en/publications/doc_details/986-ll-logsheet-expanded
[4] http://www.wcpfc.int/doc/CMM-2011-04/Conservation-and-Management-Measure-Oceanic-Whitetip-Sharks

Table 1 Summary of the thirteen key shark species of WCPFC and their status with respect to stock assessment analysis under the shark research plan.

Common name	Scientific name	Assessment	Comments
Blue shark	*Prionace glauca*	2012/2013	SPC to conduct assessment for southern hemisphere. ISC has indicated it will undertake an assessment for the North Pacific.
Longfin mako	*Isurus paucus*	2012/2013	Data deficient. To be combined with shortfin mako
Oceanic whitetip shark	*Carcharhinus longimanus*	2011/2012	SPC assessment for SC8
Shortfin mako	*Isurus oxyrinchus*	2012/2013	SPC to conduct assessment for southern hemisphere. ISC has indicated it will undertake an assessment for the North Pacific.
Silky shark	*Carcharhinus falciformis*	2011/2012	SPC assessment for SC8
Common thresher	*Alopias vulpinus*	2013/2014	It is not clear if sufficient species specific data will be available for a full assessment
Pelagic thresher	*Alopias pelagicus*	2013/2014	It is not clear if sufficient species specific data will be available for a full assessment
Bigeye thresher	*Alopias superciliosus*	2013/2014	It is not clear if sufficient species specific data will be available for a full assessment
Porbeagle shark	*Lamna nasus*		No resources currently assigned under the SRP
Great hammerhead	*Sphyrna mokarran*		No resources currently assigned under the SRP
Smooth hammerhead	*Sphyrna zygaena*		No resources currently assigned under the SRP
Winghead shark	*Eusphyra blochii*		No resources currently assigned under the SRP
Scalloped hammerhead	*Sphyrna lewini*		No resources currently assigned under the SRP

To assist with the further consideration of key shark species, and prioritization of activities for those species already within the list of key shark species, it is necessary to have objective criteria that can be used to assess a candidate shark species. A shared understanding of the immediate priority species can allow the allocation of currently available resources and can assist researchers in securing future funding. For these reasons the decision at WCPFC 8 to adopt the criteria for the designation of key shark species was an important step in the SRP. The proposal by Clark (2011b; 2012c) and adopted at WCPFC 8 has four[5] key criteria which are used to determine a) whether a species should become a WCPFC 'key shark species', b) whether new data collection procedures are required, and c) the priority of this species for further scientific analysis compared to other key shark species:

1. Is the species found in the WCPF Convention Area?
2. Is the species impacted by fishing?
3. Is the species of particular ecological concern?
4. Are data adequate to support detailed assessment?

This criteria has been applied to whale shark (*Rhincodon typus*) in Rice and Harley (2012a) with a key recommendation that whale shark be designated as a key shark species.

3. Phase 1: Assessments

In 2010/11 the focus of the SRP was the preliminary assessment of the fishery impacts on the key shark species based on the analysis of fisheries indicators (Clarke et al. 2011a, 2011b). In 2011/12

[5] SC7 recommended removal of a fifth criteria from the original proposal which related to the international status of a species.

the focus shifted to full stock assessments and oceanic whitetip and silky sharks were the first conducted under the SRP.

These two stock assessments were undertaken using the stock assessment software Stock Synthesis (as opposed to the software MULTIFAN-CL more commonly used for western and central Pacific stock assessments) to allow closer collaboration with IATTC and to benefit from some 'shark-specific' developments that were being made with that software (Taylor et al. in press).

For oceanic whitetip sharks, the full assessment confirmed the indicator analysis conclusions that the stock was undergoing a significant decline (Rice and Harley, 2012b) and all the important data sources seemed to agree on this. The stock assessment was able to confirm that overfishing is occurring and that the stock is currently in an overfished state. Further work may be required to evaluate whether the recently adopted CMM (which enters in to force in January 2013) will be sufficient to arrest the decline.

For silky shark, the assessment (Rice and Harley 2012c) also came up with a pessimistic estimate of stock status. There was some conflict between some of the major model inputs, but overall the stock assessment results suggest that it is very likely that silky shark is also experiencing overfishing and is currently in an overfished state.

One important matter for the Commission to address will be the determination of appropriate reference points for these species for which most of the fishery impact comes through bycatch rather than targeted fishing.

The results for oceanic whitetip in particular lead us to identify an important immediate area for analysis. We see value in using existing observer data to identify a) which factors increase the number of interactions between fishing gear and sharks (e.g., bait types); b) which factors influence the extent of the interaction (e.g. hook and leader types); c) the likelihood of survival of those sharks that come to the side of the boat (e.g. impact of non-retention policies).

For 2012/2013 the focus will shift to blue and mako sharks. These are more temperate in their distribution than the oceanic whitetip and silky sharks, and therefore separate stock assessments are proposed for the northern and southern hemispheres. Although no shark species have been designated by the WCPFC as "Northern Stocks", the International Scientific Committee (ISC) has indicated that it will undertake stock assessments for blue and shortfin mako sharks in the North Pacific. SPCs contribution to these stock assessments will either through the ISC (SPC is a member) or through independent analysis as appropriate. SPC will undertake assessments for the southern hemisphere. Initial preparatory work for these assessments is underway and we are expecting to be able to construct integrated stock assessments for these two populations using either Stock Synthesis or MULTIFAN-CL. The initial focus will be on using observer and reliable logsheet data to estimate CPUE and catches.

4. Phase 2: Coordination of research

4.1 Shark TAGging Information System (STAGIS)

One important development for the coordination of research was the Shark TAGging Information System (STAGIS) launched on the SPC web site[6] on 5 July 2011 (Clark et al. 2012c). The primary focus

[6] It can be accessed at: http://www.spc.int/ofp/shark/index.php.

of the STAGIS is to house meta-data on shark tagging studies (i.e. data about data). The database was designed and populated in order to be hosted on the SPC-OFP website for free public access. In addition to supporting stock assessments of the key shark species, STAGIS can assist in highlighting issues for further research, facilitating research collaboration, and identifying critical habitats.

It is recommended that specific funding be allocated to continue work on STAGIS. Subject to available funding support, STAGIS content will be updated or enhanced (see Clarke et al. (2011c) for details of potential enhancements). Any researchers who have published any shark tagging work during 2011/2012 are encouraged to provide these details to the Joel Rice (joelr@spc.int).

4.2 ISSF bycatch work

The ISSF has an active area of research focusing on purse seine bycatch and a research cruise has recently been completed in the WCPO. This work has involved some tagging and biological studies of sharks taken as bycatch and ISSF representatives will provide an update of this work to SC8. SPC has been involved in these activities, but our primary focus has been on sampling protocols rather than specific work on sharks.

4.3 Collaboration with other agencies

An important part of the SRP is collaboration with other agencies to maximize the efficiency of the resources available for shark science and stock assessment. Three main collaborations have occurred during 2011/12 with the ISC, the IATTC, and CSIRO in Australia.

As a member of the ISC, SPC tries to attend the meetings of their Shark Working Group when funds and resources allow. So far we have been only able to attend one meeting (La Jolla, Nov 2011), but we remain involved in electronic discussions and through the provision of data.

The shark CMM (CMM2010-07) mentions specifically the need to collaborate with the IATTC and we continue to communicate with them on a range of shark-related matters. In November 2011 and March 2012 we were able to visit the IATTC lab in La Jolla and work together on approaches for the assessment of silky shark. One plan from that work had been the development of a Pacific-wide silky shark stock assessment, but unfortunately the discovery of some important data gaps has delayed the IATTC's silky shark assessment. We will continue to look for opportunities to work with them on matters of common interest for both WCPFC and IATTC.

Australia and New Zealand both have research programs directed at the temperate water shark species such as mako and blue sharks. In February 2012 we met with researchers from Australasia at a workshop hosted by CSIRO to discuss data availability and the potential for a stock assessment for mako shark in the southern hemisphere. We will continue this dialogue to ensure that all available biological and fishery data, as well as expertise is utilized in the conducting of the 2012/13 mako shark assessment.

We encourage those agencies that would like to work on shark science and stock assessment in the WCPO to contact us[7] to discuss the scope for collaborative work. Details of collaborative visits to date under the SRP are provided in Annex 2.

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5. Phase 3: Improvement of data

5.1 Provision and access of shark data

Clarke et al. (2011c) provided a comprehensive summary of shark data holdings by SPC and WCPFC and data submissions to WCPFC with respect to the new requirements to submit shark catches. We will not be updating this information this year, instead we will highlight any major new shark data that is now available to WCPFC and highlight any major data gaps that remain.

Major advances in shark data collection in the past 12 months have included the submission of the Spanish longline data at an operational level which includes species-specific shark catches. These data will be important for the southern hemisphere blue and mako stock assessments planned in 2012/13. Also there have been improvements in the data submitted by some DWFNs such as China and Korea. Finally, many PICTs are now implementing the expanded longline logsheet form which allows for the collection of catch and discard information for the original key shark species.

Unfortunately there still remain some significant data gaps, in particular there are data that exist but are not available for SPC analyses under the SRP. There remains some important observer data which has not been submitted to SPC or WCPFC since the establishment of the WCPFC and there are also some extremely valuable research and training vessel data sets which would provide useful information. WCPFC members are encouraged to make these data sets available to SPC or WCPFC – if necessary, specific arrangements could be accommodated, but the costs of these will need careful consideration.

The requirement to increase longline observer coverage to 5% by 1 June 2012 throughout most of the WCPF Convention area is now in effect and the improved data on sharks and other bycatch that come from these programs will be extremely valuable for future analyses.

5.2 Shark identification guides

With increasing requirements for the recording of shark catches on logsheets[8], the ability to correctly identify sharks to the species level is even more important. This was emphasized within the newly agree CMM for oceanic whitetip sharks where Small Island Developing States requested support in shark identification:

> *"4. The Commission shall consider the special needs of Small Island Developing States and Territories, including supplying species identification guides for their fleets and develop guidelines and training for the safe release of sharks."*

In 2005, SPC produced a pocket shark identification guide[9] that includes all the current key shark species with the exception of the porbeagle shark. It also includes several other shark species, both oceanic and more coastal, that are likely to be encountered in WCPFC fisheries. This guide includes the shark names in English, French, Japanese, and Chinese. Currently SPC holds around 1600 of these guides[10]. The SC and WCPFC should consider if/how it would like to utilize this existing resource.

5.3 Expanded longline logsheets

[8] http://www.wcpfc.int/doc/data-01/scientific-data-be-provided-commission-revised-wcpfc4-wcpfc6
[9] http://www.spc.int/DigitalLibrary/Doc/FAME/Manuals/Anon_05_ID_Sharks.pdf
[10] The cost to produce these guides is NZD11, 241 for 2000 copies (delivered to Noumea).

In conjunction with the Data Collection Committee Report (a joint SPC/FFA initiative) various data collection forms have been developed and are used throughout the regions fisheries. These forms are developed to be consistent with the WCPFC guidelines for the provision of data. One important form recently developed is the expanded logsheet form which allows the collection of data for all key shark species (note that the hammerheads and thresher sharks are included but not separated to species). These forms are being increasingly used by coastal states in the region and have been translated into English, Japanese, Korean, Spanish, and Mandarin. These are freely available through the SPC website[11]. Please contact us if versions in other languages are required.

The SC and WCPFC should strongly encourage CCMs to use data collection forms consistent with the data provision rules, and note that an expanded logsheet currently exists to assist with shark catch reporting.

6. Future directions for the Shark Research Plan

The Shark Research plan was adopted by the WCPFC in December 2010 with the three key work areas of 1) stock assessment; 2) research coordination; and 3) improving shark data. Up until SC7 the shark work undertaken through the SRP has been primarily focused on areas 2 and 3, and with fishery indicator development. Now the SRP has entered the full stock assessment phase for the key shark species.

This year, when conducting assessments for two shark species (that have not previously been assessed), we have found that the resources allocated to this work through the WCPFC (one full time equivalent position) where insufficient to undertake the assessments and progress the other work areas within the SRP. These problems are expected to get worse in 2012/13 with four stock assessments being undertaken (two led by SPC and two through the ISC) and the addition of five new species to the WCPFC key shark species list.

Therefore there is a need to carefully consider both the level of resources allocated to the SRP by the WCPFC and to carefully prioritize the specific work to be undertaken each year. Table 1 provides the proposed timings for assessments currently planned under the SRP, but there are many other potentially important activities that are consistent with the SRP, for example:

- Providing an analysis of potential mitigation techniques for reducing impacts with oceanic whitetip and silky sharks in longline fisheries based on existing observer data;
- Conducting a standardized CPUE analysis for whale sharks using observer data from the tropical purse seine fishery with a stock assessment to follow if deemed feasible;
- Advice on candidate target and limit reference points for shark species taken predominantly as bycatch;
- Indicator analyses for the remaining five key shark species (porbeagle shark and the four hammerhead species);
- Contributing to a stock assessment for porbeagle shark with CCSBT (if this proceeds)
- Updating and enhancing the shark tagging database STAGIS;
- Updating the stock assessments for silky and oceanic whitetip sharks;
- Biological studies to reduce uncertainty in important life history parameters of key shark species;
- Electronic tagging studies to estimate post-release mortality for key shark species; and
- Undertaking a review of the SRP for the development of a revised plan;

[11] http://www.spc.int/oceanfish/en/data-collection/241-data-collection-forms

Most of these represent 'desktop' activities, but some include field elements. It is likely that the top three represent the highest priorities for additional work.

Therefore we believe that the future of the SRP will require both a) a medium term plan, b) the resources to implement the plan, and c) the flexibility to address emerging shark issues of importance to the Commission. We propose that the SC consider funding mechanisms to better support the SRP.

7. Acknowledgments

This document benefited by previous and recent work by Shelley Clarke and Peter Williams.

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Annex 1: Scientific papers and reports produced under, and in support of, the Shark Research Plan (chronological order with most recent first).

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Annex 2:Collaborative research meetings undertaken through the Shark Research Plan

Meeting	Funding	Comments
Joint SPC/NRIFSF workshop on sharks, Shimizu, (March 2011)	SPC/WCPFC	Collaborative analyses of Japanese commercial logsheets records of shark catches and the research and training vessel database.
Joint workshop on Hawaiian observer data for oceanic whitetip and silky sharks, Noumea, New Caledonia (Apr 2011)	NMFS	William Walsh of the NMFS PIFSC visited Noumea to work on analyses of these data that are currently not available to SPC or WCPFC.
Joint SPC/IATTC workshop on assessment of silky sharks, La Jolla, USA (Dec 2011)	SPC/WCPFC	Collaborative work on stock assessment approaches using Stock Synthesis to assess silky sharks stocks in the Pacific Ocean.
ISC shark working group, La Jolla, USA (Nov 2011)	SPC/WCPFC	These meetings focused on the blue and mako assessments for the North pacific Ocean.
Australasian mako shark workshop, Hobart, AUS (Feb 2012)	CSIRO	Scoping workshop to determine data availability and gaps and the potential timeline for a stock assessment for mako sharks in the South Pacific Ocean.
Management of marine megafauna affected by fisheries bycatch, La Jolla, USA (Mar 2012)	NMFS	Meeting brought together experts from across RFMOs and other fields (e.g. sea turtles, sea birds, and marine mammals) to discuss ways to assess these species groups.