PROGRESS ON THE WCPFC STOCK ASSESSMENTS AND SHARK RESEARCH PLAN (SUMMARY TABLE)

WCPFC Secretariat, SPC-OFP, ABNJ and ISC

This report updates the progress of the Shark Research Plan based on Table 1 and Table 2 in Attachment I of the SC12 Summary Report and WCPFC-SC14-2018/EB-WP-04. The document outlines previously agreed work and potential new work for 2020. The 2020 work programme will be reviewed by an Informal Small Group (ISG) at SC15, which will be tasked with reviewing the shark research plan; recommending any changes to project list; and providing associated indicative budgets for each project. It is recommended that the ISG take into account the report from Project 78 (WCPFC-SC14-2018/ EB-WP-02) in particular Annex 4 of that report.

For explanations of the intent of the work outlined in the Table 1, refer project specifications below. With respect to scheduling SC8 discussed the regularity of stock assessments from both biological and funding perspectives. SC8 considered that the stock assessments for the major tuna species should be conducted every three years, swordfish should be conducted every four years, and other billfish species should be conducted every five years. The ISG should consider whether to formalise the shark assessment schedule to be no more frequent than 5-yearly.

To assist the WCPFC Science Research Sub-Committee's deliberations, SC15 is invited to review these projects and the stock assessment schedule.

Table 1. Schedule of analyses under the WCPFC Shark Research Plan and proposed future tuna and billfish stock assessments. New proposed project outlines for 2020 are identified with # and the project details are provided in the subsequent tables for 2020 proposed work. For 2019, work submitted to SC15 with reports or project updates are indicated in red with the corresponding SC15 paper number for ease of reference. Projects listed in green were listed in 2018 but did not receive WCPFC funding for 2019 and were not undertaken.

Species	Stock	Last assessment	2019	2020	2021	2022	2023
TUNA and BILLFISH							
Bigeye tuna	WCPO	2018		X			X
	Pacific-wide	2015					
Skipjack tuna	WCPO	2016	Stock assessment (SC15-SA-WP-XX) SPC			X	
Yellowfin tuna	WCPO	2017		X			X
Albacore	South Pacific	2018			X		
Pacific bluefin	North Pacific	2016	??			X	
Striped marlin	Southwest Pacific	2012	Stock assessment (SC15-SA-WP-XX) SPC				
	Northwest Pacific	2012	Stock assessment (SC15-SA-WP- ??) ISC				
Swordfish	Southwest Pacific	2017			X		
	North Pacific	2018				X	
SHARKS							
Silky shark	WCPO	2013	Post release mortality update (SC15-EB-WP-XX) ABNJ/SPC		Assessment (SPC) Note: this was scheduled for 2020 but moved due to the heavy assessment load		
	Pacific-wide	2018		Stock discrimination? Note: Maybe better directed at another species? PSAT tagging underway in the Cook Islands and Niue	Stock discrimination?		X
Oceanic whitetip shark	WCPO	2012	Stock assessment (SC15-SA-WP-XX) SPC				
Blue shark	Southeast Pacific	-		Data preparation to support assessment #1 (if South Pacific wide is preferred this can be cancelled)	Assessment (if data supports) (WCPFC)		
	Southwest Pacific	2016		Assessment data preparation (SPC)	Assessment (if data supports)		

Species	Stock	Last assessment	2019	2020	2021	2022	2023
				#1 (if South Pacific wide is preferred this can be cancelled)			
	South Pacific-wide	-			Assessment (if data supports)		
	North Pacific	2017		Assessment (ISC)			
Mako shark (shortfin)	Southeast Pacific	-		Data preparation to support assessment #1	Assessment (if data supports) (WCPFC)		
	Southwest Pacific	-	Post release mortality update (SC15-EB-WP-XX) ABNJ/SPC		Assessment (if data supports) #2		
	Northwest Pacific	2018			Assessment		
	South Pacific wide	-		Assessment data preparation #1 (SPC)	Assessment (if data supports)		
Porbeagle	Pacific-wide (southern hemisphere)	2017				X	
Bigeye thresher	Pacific-wide	2017				X	
Hammerhead	WCPO	-				Biological research to determine species-specific age, growth and reproductive parameters? #3

Update catch history? Can be done as part of #4 SC13 #8 can be withdrawn if rolled into #4

Both projects above should be discussed in the light of proj 78 and pending the 2021-2025 SRP priorities | Stock discrimination?

Biological research to determine species-specific age, growth and reproductive parameters? #3 continued |
Whaleshark	WCPO	-		Stock discrimination? #5	Stock discrimination?		
	Pacific-wide	2018 Risk assessment					X
Manta and mobulids	WCPO	-					

Species	Stock	Last assessment	2019	2020	2021	2022	2023
General shark work	WCPO	NA	Identifying (LRPs) for elasmobranchs (project 57) (SC15-SA-MI-XX) (Additional funding for 2019 not approved by WCPFC 15 – revised report maybe submitted/presented??) SRP mid-term review (project 84 – not done as covered in Project 78 WCPFC-SC14-2018/ EB-WP-02) Testing the performance of alternative stock assessments approaches for oceanic whitetip shark. (project 92) (SC15-SA-WP-XX)	Develop a 2021-2025 shark research plan to be presented to SC16 in 2020 #A	Operational and management histories #4 Updated indicator analysis? (Pending outcome of proj 78 and SC14 deliberations decide on scope and species to be covered) Shark modelling Project #6 Operational planning for shark biological data improvement #7 Assess spawner recruit relationships? #8		
Review of shark CMM(s)	WCPFC key sharks	Not previously undertaken:	Potentially scheduled for 2023 if suggested review is retained in the CMM under development in 2019. However, some alternative suggestions in the text require review in 2021. This should be decided after any finalised shark CMM is agreed.				

2020 Proposed work

Sheet Number	A
Project title	Shark research plan - 2021-2025
Objectives	Develop a shark research plan for the WCPFC for 2021-2025 to be presented to SC16 in 2020
Rationale	The first Shark Research Plan (SRP) covered 2010-2014. At its Tenth Session the Scientific Committee (SC10) agreed in 2014 on a programme of shark work for the Scientific Service Provider (SSP). This work was to be carried out in 2015, and included that the SSP draft a new SRP for consideration by SC11 to cover work in 2016-2020. This project will evaluate progress against that plan and consider the WCPFCs shark information needs for 2021-2025. The review work will also evaluate the progress against and need for the original SRP components: 1) assessments undertaken; 2) coordination of research efforts to supplement biological and other assessment related information; and 3) improvement of data from commercial fisheries.
Assumptions	• SPC or another regional body has the personnel and budget available to undertake this work
Scope	While this document will focus on the WCPFC key shark species, other elasmobranchs should be considered as required.
Budget	0.5 FTE

Sheet Number	1 – <mark>Note this project was not funded in 2019 and has been moved to 2020</mark>
Project	Southeast Pacific data preparation to support blue and shortfin mako assessments
Objectives	Collaborate with the Chilean Instituto de Fomento Pesquero (IFOP) to prepare data inputs for use in future Pacific-wide assessments of blue and shortfin mako sharks. THE SRP ISG in 2018 noted that: as blue sharks are the most common species, if other sharks can be assessed blue sharks can probably be assessed too; SW Pacific data prep by SPC is required regardless of assessment region. Whole of Pacific assessment will require SE Pacific data are prepared (ABNJ funding).
Rationale	• Builds upon the momentum of collaboration established under the ABNJ porbeagle stock status assessment • Chile has expressed a strong interest in future joint analyses • Leverages ABNJ funds to incorporate Eastern Pacific data • Future blue and shortfin mako assessments will be more realistic and robust if EPO catches are considered • Will complement the North Pacific-wide assessments by ISC
Assumptions	• Chile maintains its interest in working on this topic • Future assessments of blue and shortfin mako sharks are planned • Either a study visit could be arranged to bring a Chilean scientist to SPC (or other location) or a consultant would visit Chile • ABNJ funds are available to support this data preparatory work
Scope	Utilizing data from Chile's industrial longline fleet (which has 85% observer coverage since 2006), as well as from its artisanal longline and driftnet fleets, all of which are targeting swordfish, the study would work toward a number of data products relevant to blue and shortfin mako sharks in the Southeast Pacific including: • developing indices of abundance • compiling biological data (e.g. length frequencies by sex) • gathering relevant parameters (e.g. size at maturity, reproductive periodicity) from regional published and unpublished studies • accessing or estimating catch and effort data from available sources • describing operational characteristics including hook depth, soak time, leader material, hook type, bait type, targeting strategies etc., as well as any changes in these over time, to assist with interpreting selectivity or catchability trends • producing a stand-alone report for submission to the WCPFC Scientific Committee and/or a scientific journal describing the findings of the study.
Budget	0.5 FTE

Sheet Number	5 – <mark>Note this project was not funded in 2019 and has been moved to 2020</mark>
Project title	Whale shark stock discrimination
Objectives	Develop an understanding of the stock structure of whale sharks in the Pacific Ocean.
Rationale	The stock structure of whale sharks in the Pacific Ocean is not well understood and developing an understanding of a population's stock structure and connectivity is essential for effective management of any species, as it identifies the appropriate spatial context for management actions. Whale shark population connectivity have been assessed through photographic identification, however, whale sharks are observed only rarely throughout their range except for the few locations where seasonal aggregations of whale sharks occur. Satellite tags have been used in a few studies with either limited deployments or in discreet areas such as the Red Sea. Genetic analysis has indicated that whale sharks represent three major populations in the Pacific, Caribbean, and Indian Oceans. Within each ocean there is little genetic differentiation between animals, indicating historical gene flow between populations and well mixed populations within each Ocean. Both the tagging and genetic analyses have been based on low numbers of samples and have not covered the Pacific Ocean particularly well.
Assumptions	• Enough work has been undertaken elsewhere to evaluate effective tagging, genetic or other methods. • The personnel and budget are available to undertake this work.
Scope	This work should have two phases. Phase 1: determine the best and most cost effective method to assess whale shark stock structure in the Pacific Ocean; and Phase 2: pending approval from SC14, undertake the biological sampling and analysis proposed under Phase 1. Phase 1 of this project should be a desktop analysis to outline effective methods and design ways to undertake the analyses, provide full costings for each and identify potential difficulties with each method. This work should include potential costings of each method and be presented to SC14 for consideration of Phase 2. Note: at SC12 a review of the data availability, data quality and data gaps for sharks was proposed, the results of that work presented in this EB-WP-07 should to be considered prior to considering this project.
Budget	0.3 FTE

Work proposed by SC14 but not progressed in 2018/19

Sheet Number	2 – <mark>Should only be undertaken after the data preparation work has been successfully completed (2021)</mark>
Project title	Southwest Pacific mako shark assessment
Objectives	Undertake a quantitative assessment of southwest Pacific Ocean mako sharks.
Rationale	This species is unproductive and susceptible to overfishing, but has never had a formal stock assessment undertaken to assess the impact of fishing. Furthermore, shortfin mako sharks are listed as vulnerable on the IUCN's Red List due to a decline in their abundance.
Assumptions	• Much of the existing fisheries and biological data are readily available. • Assessment personnel are available to undertake this work
Scope	Reviewing the previous shark assessment in the WCPO to assess and improve on methods to increase the understanding of data strengths and weaknesses, and update stock status. Update WCPO LL catch estimates and abundance indices using recent observer data. The analysis should consider what might be appropriate limit reference points for this species, but in the absence of any agreed reference points present the stock status in terms of F/F_{MSY} and $SB/SB_{F=0}$ ratios. Prepare a report containing the above results for SC14. If the data are too poor to undertake a full quantitative assessment then an indicator analysis may be appropriate. Decision on what approach should be taken should be based on an evaluation of the results of WCPFC Projects 57 and 92. Note: The ISC is undertaking an assessment of mako sharks in the north Pacific in 2018, and collaboration with these scientists to progress methods and data preparation procedures would be useful for both assessments.
Budget	1 FTE

Sheet Number	3– <mark>Note this project was not funded in 2019 and has been moved to 2022 and can be re-considered under the new SRP priorities</mark>
Project title	Hammerhead shark biology
Objectives	Review the findings and references from the WCPFC Pacific shark life-history expert panel workshop to identify which species, and for which regions the age and growth uncertainties are highest. Then undertake biological sampling and age and growth reproductive analyses to fill those gaps.
Rationale	Data on hammerhead sharks are extremely sparse; these species are both oceanic and coastal and data for these species are very patchy in time and space (Rice et al. 2015). As a result, an age-structured modelling approach is unlikely to result in a reliable estimate of stock status.
	Prior to any form of quantitative assessment, be it a per-recruit analysis or a fully integrated assessment, understanding of the fishes biology is essential. Furthermore, in the absence of an assessment, an understanding of the biology of a species can provide some insights into the productivity of a stock and its susceptibility to fishing pressure.
Assumptions	• Samples can be sourced within the timeframes required. • Sufficient samples from across the species distribution can be collected.
Scope	Phase 1: conduct a review of the findings from the WCPFC Pacific shark life-history expert panel workshop to identify which hammerhead shark species, and for which regions the age and growth uncertainties are highest. Then undertake an assessment of the likelihood of collecting samples for these species in sufficient quantities to undertake meaningful analyses.
	Phase 2: using the results of phase 1, undertake biological sampling and age and growth reproductive analysis to identify the productivity, longevity and reproductive capacity of these species.
	Note: 1) at SC12 a project to review the operational planning for shark biological data improvement was proposed but did not go ahead and is tabled again in project *Sheet 3* above, the results of that work may need to be considered prior to considering this project, which could be postponed for one year if project #3 is approved.
Budget	0.5 FTE (first year) 1 FTE (once all the samples have been collected)

Sheet Number	4 – <mark>Note this project was not funded in 2019 and has been moved to 2021 could be re-considered within the revised SRP</mark>
Project	Operational and management histories for WCPO longline fleets
Objectives	Compile timelines and brief descriptions for major longline fleets detailing the history of management measures and operational practices
Rationale	• This project addresses an SC11 (and prior) discussion about how to interpret changes in CPUE indices and the potential biases in constructing indices of stock abundance based on standardised CPUE from various fleets' data without knowing and adequately accounting for operational and management changes over time. • As indices of stock abundance are one of the key inputs to stock assessment models, adequately accounting for changes in operational practices that may influence CPUE is a high priority. • Australia has produced a simple fleet history that can serve as a template for other CCMs (WCPFC-SC12-2016/SA-IP-11). • These histories would serve as a resource not only for WCPFC analyses but for any analyses of Pacific shark data
Assumptions	• The information exists and can be located in a reasonable timeframe • CCMs are willing to assist with producing their own fleet histories • Funding is available to assist CCMs in producing their summaries (if they wish)
Scope	The fleet histories should, in the first instance, focus on longline fleets as it is these data that are often used as indices of stock abundance. Separate fleet histories for purse seine fleets could also be prepared as resources allow. The fleet histories should include details on management measures, fishing strategies, gears and sampling regimes over time. It is anticipated that each history would be up to 3 pages of text with key events described in sequence, with a few key figures and an excel spreadsheet version of the timeline. A coordinator should be appointed to compile and assist with the fleet histories. For those CCMs that are willing to produce their own fleet histories, the coordinator would just be involved in editing, formatting and ensuring consistency between different histories. For those CCMs that are willing to have a fleet history produced but cannot undertake it themselves, the coordinator could assist in writing up information or interviews facilitated by the CCM for approval by the CCM. At a minimum, the coordinator could research and pull together public domain information for each fleet. A collection of fleet histories would be presented by the coordinator to SC13, with the potential for CCMs to update or replace them over time.
Budget	0.3 FTE (scalable depending on national participation)

Sheet Number	6 – <mark>Note this project was not funded in 2019 and has been moved to 2021 could be re-considered within the revised SRP</mark>
Project title	Shark Modelling Project
Objectives	Modelling to account for the bias in the spatial distribution of observer data, total effort, size of the fishery, distribution of effort, catch and bycatch, and spatial stratification of the fishery in key stock assessment inputs.
Rationale	Inconsistencies in the distribution of the observed data and distribution of the fishery can impact estimates of CPUE and catch. This project will produce alternative catch and CPUE time series estimates that can be used as alternative states of nature in future stock assessments. It builds upon the findings of analyses performed under WCPFC SC project 78.
Assumptions	• The information exists and can be located in a reasonable timeframe • The regional observer data and logsheet data can be accessed by the analyst. • The observer data and logsheet data can be linked at the level of the set.
Scope	Shark stock assessments in the past have suffered from a lack of data leading to large amounts of uncertainty in the assessment outputs. The assessments have not only suffered from a lack of catch data, but where data exist changes in targeting through time have impacted the reliability of the CPUE as an index of abundance. This work will assess the effect of the spatial coverage of longline and purse seine observer effort in relation to the spatial coverage of the fishing effort, and the influence of match/mismatch of these two metrics on the estimation of catch and CPUE for each of the selected key shark species in these fisheries. To examine the potential interactions between shark species with different geographic distributions and interacting fisheries: • as a minimum for longline there should be one model run for silky, oceanic whitetip, hammerhead and thresher sharks that uses the best understanding of these species' distribution, the fleet effort distribution and potential observer coverage distributions; one for mako and blue shark in the northern hemisphere; and one for porbeagle in the south. The results will be compared between the known and the uniform distribution of sampling effort and then used to quantify the gaps. • This will then be repeated for FAL and OCS using the purse seine data. The outputs will then be run through SS3 models to assess whether the data are sufficient to allow the model to assess alternative levels of depletion, such as 5%, 40% and 75% depletion.
Budget	0.5 FTE

Sheet Number	7 – <mark>Note this project was not funded in 2019 and has been moved to 2021 could be re-considered within the revised SRP</mark>
Project	Operational planning for shark biological data improvement
Objectives	Collect, review and prioritize a list of biological data gaps for the WCPFC key shark species and propose a scalable and practical plan for filling them
Rationale	- The Pacific Shark Life History Expert Panel Workshop urged the t-RFMOs to be more proactive in setting a research agenda for life history and stock structure research - ISC and ICCAT have developed mechanisms for this type of work, but there is little shark biological work being done by the WCPFC - Various recommendations for further studies have been made by the Shark Research Plan, various stock assessments and the Expert Panel - The regional observer programme and SPC tissue bank provide opportunities for sample collection and access - It is difficult to begin filling data gaps without a focused, practical plan that can be proposed and costed - This project will develop such a plan, thereby spinning-off implementable projects that can proceed if funded
Assumptions	- There are cost-effective ways of gathering the necessary data and conducting the appropriate analyses - CCMs, or other national entities, will assist with sample collection and/or research coordination - SPC or another regional body is willing to act as the focal point for implementation of the future biological data improvement plan - At least some of the projects developed can be funded through WCPFC or other sources
Scope	Review the Shark Research Plan, shark stock assessments in the WCPO and elsewhere, the report of the Pacific Shark Life History Expert Panel Workshop and the review of shark data and modelling framework report (SC13) to develop a list of biological studies necessary to support conservation and management for WCPFC key shark species, potentially including: - Stock discrimination - Age and growth sampling - Inter-laboratory calibration of ageing methods - Validation/verification of ageing methods - Reproductive sampling - Length-length and length-weight relationships - Movement/migration Prioritize these studies based on the usefulness of the information, ease of sample access and cost, and develop practical plans (including a budget) such that priority studies can proceed as soon as funding is sourced. A minimum of three studies should be fully developed, organized and costed and tabled at SC14.

Budget	0.2 FTE

Sheet Number	8 – <mark>Note this project was not funded in 2019 and has been moved to 2021 could be re-considered within the revised SRP</mark>
Project title	Assess spawner recruit relationships
Objectives	Assess methods to determine the stock recruit relationships for WCPO key shark species and propose methods to be used for future stock assessments.
Rationale	Shark stock assessments in the WCPO have historically been particularly challenging and the results are often uncertain and considered works in progress. One major uncertainty is the ambiguity in the estimated stock recruitment relationship. This project will develop methods to assess the stock recruit relationships for elasmobranchs and propose methods and quanta (e.g. an appropriate range of steepness values) to be considered in future assessments.
Assumptions	• The data are available to undertake this work. • The personnel and budget are available to undertake this work.
Scope	The spawner recruitment relationship for elasmobranchs is particularly opaque and difficult to estimate in assessments. This opacity resulted in particular problems in some previous assessments, particularly for the blue shark assessment in the North Pacific model that used the low fecundity spawner recruitment relationship, where the resulting stock status conclusions were extremely sensitive to the shape of the curve. An assessment of the appropriate way to model elasmobranch stock recruitment relationships should be undertaken. Note the ISC SHARKWG has undertaken a meta-analysis to assess shark stock recruitment relationships in general and this will need to be taken into consideration when undertaking this work.
Budget	0.5 FTE