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REFERENCE DOCUMENT FOR BYCATCH MITIGATION CMM REVIEWS

WCPFC14-2017-16
15 November 2017

Paper prepared by the Secretariat

A. INTRODUCTION

1. The purpose of this paper is to provide a quick reference guide to the recommendations of the Scientific Committee (SC) and the Technical Compliance Committee (TCC) of relevance to the discussions in support of the review of bycatch mitigation CMMs. It highlights key recommendations drawn from the SC13 and TCC13 report.

B. SCIENTIFIC COMMITTEE RECOMMENDATIONS

2. The relevant recommendations of the Scientific Committee (SC13), with appropriate referencing, are listed below:

Sharks

Review of conservation and management measures for sharks (*SC13 Paragraphs 567-568*)

3. In relation to Paragraphs 4, 8, and 13 of CMM 2010-07 with reference to data provision, fin to carcass ratios, and the need for a revised or new CMM, SC13 notes that no new information was submitted to SC13 to review the ratio of fin weight to shark carcass weight. Since the adoption of this CMM, SC was unable to confirm the validity of using a 5% fin to carcass ratio and forwards this concern to TCC, noting that an evaluation of the 5% ratio is not currently possible due to insufficient or inconclusive information for all but one of the major fleets implementing these ratios (SC12, Paragraph 714).

4. SC13 recommends that:

a) TCC13 and WCPFC14 note that no new information was submitted to SC13 to review the ratio of fin weight to shark carcass weight.
b) TCC13 and WCPFC14 elaborate a mechanism for generating the data necessary to review the fins to carcass ratio if such a ratio is to be used as a tool for promoting the full utilization of sharks in the WCPFC.

Safe release guidelines (*SC13 Paragraphs 577 – 581*)

5. SC13 adopted the *Report of ISG-5 on the safe release guidelines for manta and mobulid rays* (*see* **Attachment 1**).

6. SC13 recommends TCC13 and WCPFC14 note that SC has not yet adopted *Guidelines for safe release for silky and oceanic whitetip sharks*.

Shark Research Plan (*SC13 Paragraphs 582 – 589*)

7. SC13 adopted the report of ISG-04 on the Shark Research Plan and future work plan (see **Attachment 2**).

Seabirds

8. SC13 noted from a number of CCM Part 1 Reports that high bycatch rates of seabirds, and in particular albatross, continue to be reported by some CCMs fishing in waters south of 30ºS. Therefore, SC13, taking note that SPC is about to initiate a project to assess seabird interactions with WCPFC fisheries and will report the results to SC14, recommends that TCC and the Commission review both observer coverage rates (used to estimate total seabird interactions) and the application of mitigation by fleets operating in this area, to inform what further action, if any, may be required by the Commission to address this issue.

Sea turtles

9. SC13 recommends that TCC and the Commission note the following findings of the Workshop when discussing sea turtle mitigation in the WCPF Convention Area:

a. The WCPFC does not hold sufficient information to quantify the severity of the threat posed by longline fisheries to sea turtle populations;
b. The effect of large circle hooks (size 16/0 or larger) in reducing interactions is generally greater than the effect of fish bait;
c. The effect of fish bait in reducing both interactions and mortality is generally similar to that of removal of the first hook position closest to each float;
d. The effect of large circle hooks (size 16/0 or larger) in reducing both interactions and mortality is generally similar to that of removal of the first two hook positions closest to each float;
e. While approximately 20% of the WCPO longline effort is in shallow sets, analysis suggests that <1% of WCPO longline effort is currently subject to mitigation;
f. Noting that the workshop separated shallow and deep sets at 10 hooks per basket, it found that–although interaction rates are higher in shallow-set longlines, introducing mitigation to deep-set longlines would deliver greater reductions in total interactions as compared to shallow-set longlines due to the four-times greater effort in deep-set longline fisheries;
g. Similarly, introducing mitigation to deep-set longlines would deliver greater reductions in at-vessel mortality as compared to shallow-set mitigation because sea turtles have a higher probability of asphyxiation in deep sets;
h. The effects of these and other combinations of mitigation measures are quantified and discussed in the final workshop report "Joint Analysis of Sea Turtle Mitigation Effectiveness" which can serve as a reference for the Commission's further consideration of CMM 2008-03.

i. It be determined if sufficient data exist to conduct further analyses to evaluate the impacts of various mitigation measures on fisheries operations in WCPO and on populations of sea turtle species.

C. TECHNICAL AND COMPLIANCE COMMITTEE RECOMMENDATIONS

10. The relevant recommendations of the Technical and Compliance Committee, with appropriate referencing, are listed below:

Sharks
(Review of CMM 2010-07, CMM 2011-04, CMM 2012-04, CMM 2013-08 & CMM 2014-05)

a. TCC13 notes for WCPFC14 the concerns raised by those Members conducting high seas boarding and inspections regarding the difficulty in determining compliance with CMM 2010-07 paragraph 6 and encourages further discussion to address this issue. (*TCC13 para 310*)
b. TCC13 recommended to WCPFC14 that the Commission note that despite a notable decrease in numbers since 2014, silky and oceanic white tip sharks were still retained onboard and finned in WCPFC fisheries. TCC13 also recommended to WCPFC14 that the Commission consider additional measures to ensure compliance with the relevant CMMs. (*TCC13 para 311*)
c. TCC13, taking note of SC13 advice that no new information was submitted for its consideration in view of reviewing the ratio of fins to carcass weight, recommended that WCPFC14 take note that TCC is still not able to fulfil its task in CMM 2010-07 paragraph 7. (*TCC13 para 312*)

Mantas and Mobulid Safe release guidelines

d. TCC13 recommended to WCPFC14 that the Commission adopt the safe release guidelines for manta and mobulids (as referenced in SC13 draft Summary Report, Attachment H, (*see* **Attachment 1**). (*TCC13 para 296*)

Seabirds

e. TCC13 recommends to WCPFC14 that the Commission tasks the Secretariat to consider what information could usefully be gathered around bycatch mitigation equipment and application, during transshipment processes and forward these to TCC14 for consideration to be incorporated into the transshipment process. (*TCC13 para 337*)

f. TCC13 recommends to WCPFC14 that the Commission considers incorporating data relevant to bycatch mitigation as part of any Port State Measures CMM that is adopted by the Commission. (*TCC13 para 338*)

Attachment 1
(SC13 Summary Report, Attachment H)

The Commission for the Conservation and Management of
Highly Migratory Fish Stocks in the Western and Central Pacific Ocean
Scientific Committee
Thirteenth Regular Session
Rarotonga, Cook Islands
9 - 17 August 2017

Report of the ISG-05
Best Handling Practices for the Safe Release of Mantas & Mobulids

The WCPFC13 designated six species of manta and mobulid rays as key shark species for assessment in December 2016 and called for the development of safe release guidelines for manta and mobulid rays during SC13 (WCPFC13 Summary Report, para. 550 (3)). SC13 recommends the following non-binding guidelines of best handling practices of manta and mobulid rays for both purse seine and longline fisheries:

Purse Seine

Do's:

- Release rays while they are still free-swimming whenever possible (e.g. back down procedure, submerging corks, cutting net).
- It is preferable that larger rays (>60 kg), that are too large to be lifted safely by hand are brailed out of the net and released using a purpose built large-mesh cargo net or canvas sling or similar device as recommended in document SC08-EB-IP-12 (Poisson *et al*. 2012, Good practices to reduce the mortality of sharks and rays caught incidentally by the tropical tuna purse seiners). [Note: It is preferable that release nets or devices are prepared prior to each set.]
- It is preferable that small (< 30 kg) and medium rays (30-60 kg) are handled by 2 or 3 people and carried by the sides of its wings or preferably using a purpose-built cradle/stretcher while ensuring the safety of the crew.
- When entangled in netting, carefully cut the net away from the animal and release to the sea as quickly as possible while ensuring the safety of the crew.

Don'ts:

- Do not leave a ray on deck until hauling is finished before returning it to the sea.
- Do not punch holes through the bodies of rays (e.g. to pass a cable or line through for lifting the ray).
- Do not gaff, drag, carry, lift or pull a ray by its "cephalic lobes" or tail or by inserting hooks or hands into the gill slits or the spiracles.

Longline

Do's:

- For small rays, gently bring on board and remove as much gear as possible by backing the hook out. If hooks are embedded, either cut the hook with bolt cutters or cut the line at the hook and gently return the animal to the sea.

- For medium to large rays (>30 kg), leave the animal in the water and use a dehooker to remove the hook or a long-handled line cutter to cut the gear as close to the hook as possible (ideally leaving < 0.5 meters of line attached to the animal).

Don'ts:

- Do not hit or slam a ray against any surface to remove the animal from the line.
- Do not attempt to dislodge a deeply hooked or ingested hook by pulling on the branch line or using a dehooker.
- Do not attempt to lift medium to large (>30 kg) rays aboard vessel.
- Do not cut the tail.
- Do not gaff, drag, carry, lift or pull a ray by its "cephalic lobes" or tail or by inserting hooks or hands into the gill slits or the spiracles.

SC13 adopted the following additional Recommendation:

1. Knowing that any fishing operation may catch rays, several tools can be prepared in advance (e.g. canvas or net slings or stretchers for carrying or lifting, large mesh net or grid to cover hatches/hoppers in purse seine fisheries, long handled cutters and de-hookers in longline fisheries).

Attachment 2
(SC13 Summary Report, Attachment I)

The Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean
Scientific Committee
Thirteenth Regular Session
Rarotonga, Cook Islands
9 - 17 August 2017

Report of the ISG-04 Shark Research Plan

Terms of Reference

- Review the Shark Research Plan progress
- Update as needed
    - Deletions or additions (considering sequencing)
    - Projects to put forward for WCPFC funding in 2018?
    - Consider budgets for Commission proposed projects.

Relevant papers

- SC13 EB-IP-09 'Progress on the WCPFC stock assessments and shark research plan (summary table)'
- SC13 EB-WP-07 'Progress Report for Project 78: Analysis of Observer and Logbook Data Pertaining to Key Shark Species in the Western and Central Pacific Ocean'
- SC13 RP-ABNJ-01 'Update on the Common Oceans (ABNJ) Tuna Project's Shark and Bycatch Components'

Shark research plan progress

In the 2016 review of the shark research plan, SC12 identified a range of work items for completion in 2017 two of which were identified for funding by the Commission. Progress is summarized below in Table 1 below with paper references in Table 3.

ISG-4 Table 1: Progress of SRP projects identified by SC12.

Project	Status
Review of shark data and modelling framework to support stock assessments. (WCPFC funding)	In progress
Identifying appropriate Limit Reference Points (LRPs) for elasmobranchs within the WCPFC (WCPFC funding)	Did not proceed
Update of silky shark status as a Pacific-wide assessment	In progress
Post-release mortality tagging study	In progress
Participation in ISC North Pacific blue shark stock assessment activities	Complete
Operational and management histories for WCPO longline fleets	Did not proceed
Operational planning for shark biological data improvement	Did not proceed
North Pacific blue shark assessment	Complete
Southern Hemisphere Porbeagle shark assessment	Complete
Pacific-wide Bigeye thresher shark assessment	Complete

Shark research plan Updates – Projects for 2018

ISG-4 considered the set of projects provided in SC13 EB-IP-09 with the addition of Project 57 (shark LRPs) that was again considered because it was not undertaken in 2017. Table 2 provides commentary on each of these projects with an indication of potential funding sources or whether the project should be deferred to allow for sequencing of other projects.

ISG-4 Table 2: Commentary by ISG-4 on potential projects for 2018.

No.	Proposed project	ISG-4 comment	Funding?
57	Project 57: Identifying appropriate Limit Reference Points (LRPs) for elasmobranchs within the WCPFC	Re-submit with updated budget figure.	WCPFC (SC13)
#5	Operational planning for shark biological data improvement	Required. Should precede any biological work e.g. hammerhead	ABNJ
#6	Shark Modelling Project (modelling developments to account for the bias in the spatial distribution of observer data…)	Possibly required. Should precede CPUE and assessment work	Pending SRP review
#11	Assess stock recruit relationships	Required before some assessments go ahead (excluding MIST). Note Pacific wide silky assessment will continue.	Pending SRP review
#7	SRP mid-term review	Required. Can help prioritise future work. Will take the results of PROJECT 78.	WCPFC (SC13)
#2	Southeast Pacific data preparation to support south Pacific blue and shortfin mako assessments	ABNJ could fund but depends on assessment schedule for SP mako (see #12)	ABNJ
#12	South Pacific mako and Blue shark assessments	Dependant on CPUE and catch history work above so should postpone. Note these are a priority and commercial species for some CCMs.	Defer 2019
#3	Participation in ISC North Pacific shortfin mako shark stock assessment activities.	Would need $ for SPC contributions. Work would need to commence prior to Commission approval.	WCPFC (SC13)
#8	Hammerhead shark catch histories	Required prior to assessments (if they are possible/necessary) but may be part of a larger catch histories methods work. Postpone pending results of PROJECT 78.	Defer
#9	Hammerhead shark biology	Postpone until the above biology gaps project #5 complete	Defer
#1	Pacific-wide analysis of whale shark-purse seine interactions – Potential assessment	ABNJ funding	ABNJ
#10	Whale shark stock discrimination	Tagging could go ahead using observers. Dependant on Project #5.	Pending SRP review
#4	Operational and management histories for WCPO longline fleets	Project relevant to sharks and tuna. NC work in progress.	ABNJ

ISG-4 Table 3: Schedule of analyses under the WCPFC Shark Research Plan and proposed future tuna and billfish stock assessments. New potential project outlines for 2018 are identified with # and the project details are provided in the subsequent tables for 2018 proposed work. For 2017, work submitted to SC13 with reports or project updates are indicated in red with the corresponding SC13 paper number for ease of reference.

Species	Stock	Last assessment	2017	2018	2019	2020	2021
Bigeye tuna	WCPO	2017	X (SC13-SA-WP-05)			X	
	Pacific-wide	-					
Skipjack tuna	WCPO	2016			X		
Yellowfin tuna	WCPO	2017	X (SC13-SA-WP-06)			X	
Albacore	South	2015		X			X

Species	Stock	Last assessment	2017	2018	2019	2020	2021
	Pacific						
Striped marlin	Southwest Pacific	2012		X			
	Northwest Pacific	2012		X?			
Swordfish	Southwest Pacific	2017	X (SC13-SA-WP-13)				
Silky shark	WCPO	2013					
	Pacific-wide	-	Assessment (ongoing) (SC13-SA-IP-12)	Assessment	Stock discrimination?	Stock discrimination?	
Oceanic whitetip shark	WCPO	2012			Assessment (if data supports) (WCPFC)		
Blue shark	Southeast Pacific	-		Data preparation to support assessment #2			
	Southwest Pacific	2016					
	South Pacific-wide				Assessment??		
	North Pacific	2014	Assessment (ISC) (SC13-SA-WP-10)				
Mako shark (shortfin)	Southeast Pacific	-		Data preparation to support assessment #2			
	South Pacific-wide	-			Assessment (if data supports) #12		
	NorthPacific	2015 (Indicator analysis)		Assessment (ISC) and #3			
Porbeagle	Pacific-wide (southern hemisphere)	-	Assessment (ABNJ) (SC13-SA-WP-12)				
Bigeye thresher	Pacific-wide	-	Assessment (SC13-SA-WP-11)				
Hammerhead	WCPO	-			? Update catch history #8 ? Biology #9 Stock discrimination? Biological research to determine species specific age, growth and reproductive parameters?	Stock discrimination? Biological research to determine species specific age, growth and reproductive parameters?	
	Pacific-wide	-					
Whaleshark	WCPO	-			? Stock		

Species	Stock	Last assessment	2017	2018	2019	2020	2021
					discrimination #10		
	Pacific-wide	-		Purse seine interactions # 1			
Manta and mobulids	WCPO		Best handling practices (SC-EB-IP-08) Mitigation (SC13-EB-IP-12) Develop manta and mobulid - observer training and identification guides (ongoing) (ABNJ+SPC)				
General shark work	WCPO	-	Review of shark data and modelling framework to support stock assessments (WCPFC) (SC13-EB-WP-07) Post-release mortality of silky and shortfin mako sharks in longline and purse seine fisheries (ABNJ + EU) (ongoing) (SC13-EB-IP-06) Operational planning for shark biological data improvement (unfunded) (TBD)	Fleet histories #4 SRP mid-term review?#7 Biological data improvement #5	Updated indicator analysis? ? Shark modelling Project #6 ? Assess stock recruit relationships? #11	Develop a 2021-2025 shark research plan to be presented to SC16 in 2020?	

Potential 2018 Projects (SRP)

Sheet Number	Project 57
Project	Identifying appropriate Limit Reference Points (LRPs) for elasmobranchs within the WCPFC
Background:	The Commission endorsed SC11's request of USD 25,000 for the continued development of limit reference points for elasmobranchs. The Commission tasked SC12 to develop a scope of work to progress this work within the budget allocated for 2016 (Paras 69-70, FAC9 Summary Report). SC12-ISG-2 also supported the project collaborating with the work presently being undertaken by ISC on the development of stock-recruitment relationships and their parameter estimates, such as stock-recruitment steepness for North Pacific blue shark.
Aim:	This project is to complete the work initiated by S. Clarke and S. Hoyle and presented to SC10 (as described in SC10-MI-07), and the subsequent work undertaken by the Pacific Shark Life History Expert Panel (as described in SC11-EB-13), to identify and quantify appropriate limit reference points for key shark species in the WCPO.
Scope of Work:	This project will facilitate a small workshop, or similar, of shark and stock assessment experts to undertake the following tasks: 1. For those elasmobranchs which have been evaluated using a stock assessment model, recalculate the risk-based limit reference points (as described in Table 5, SC10-MI-07) using the updated life history information produced by the Shark Life History Expert Panel. 2. For those elasmobranchs which have not been evaluated using a stock assessment model advise on alternative ways to estimate of current fishing mortality (F). Risk-based LRPs (as described in SC10-MI-07) should then be developed for all WCPFC key shark species. 3. Where the stock-recruitment relationship is highly uncertain, compare $F_{current}$ to SPR-based LRP such as $F_{60\%SPRunfished}$ and discuss any new insights into the recommended estimated LRPs so that the WCPFC Scientific Committee can decided on a case-by-case basis which LRP is most appropriate. 4. Review the use or otherwise of other potential LRPs based on, for example, SPR, reduction of recruitment or empirical measures (e.g. catch rate or length values designed to signal unacceptable population states). 5. Advise on any changes or updates to the recommended LRPs in SC10-MI-07 based on new developments, including any suggestions for further technical work before consideration of adoption of LRPs by fishery managers. 6. Review the work presently being undertaken by ISC on the development of stock-recruitment relationships and their parameter estimates, such as stock-recruitment steepness for North Pacific blue shark and assess the applicability of extending this work to other key shark species, especially South Pacific blue shark.
Output:	The project will produce a final report which shall be presented to and reviewed by SC14.
Secretariat Support:	The Principal Investigator for the project should liaise with the WCPFC Secretariat to help facilitate and coordinate arrangements for the workshop (e.g. arranging travel for the participants).
Budget	US$55k

Sheet Number	#1
Project	Pacific-wide analysis of whale shark-purse seine interactions
Objectives	Apply innovative methods to whale shark interaction rates with purse seine fisheries across the Pacific to provide further insights to conservation and management.
Rationale	• Both WCPFC and IATTC have adopted protective measures for this species (it is also listed on both CITES and CMS international conservation treaties) • With very high coverage rates in both western and eastern Pacific purse seine fisheries, these observer datasets may represent the best sources of information on this species anywhere in the world • A previous SPC analysis of whale shark data from the purse seine fishery suggested some ideas for developing an index of abundance • The whale shark is a WCPFC key shark species but thus far the lack of focused attention to methods development has resulted in mainly qualitative analysis of stock status • The proposed analysis would leverage ABNJ funds and potentially provide additional information for conservation and management
Assumptions	• Purse seine observer data are available for analysis under the WCPFC Regional Observer Programme from 2006 to the present (up to 90%, in recent years, of the total purse seine observer data)

	• Similar data may be made available by the IATTC under its recent provision of public domain shark data • Borrowing from methods used to derive seabird or marine mammal indices of abundance or minimum population estimates may provide a useful way forward for whale sharks • A suitable consultant can be identified to conduct the work
Scope	Working with purse seine observer data across the Pacific, the analysis should first review the existing data quantity and quality to determine what types of analyses can be supported. Ideally the analysis would seek to draw conclusions about whale shark stock status and/or whether interaction rates with the purse seine fishery are influencing that status. For example, it has been suggested that it may be possible to derive indices of abundance. If this proves infeasible, fallback goals may be pursued such as establishing a minimum population estimate for ongoing monitoring or a baseline interaction rate with an assessment of the sustainability associated with that level of interaction. The analysis should be phased so that the data review leads to a detailed exploration of potential methods, and then in combination with budgetary considerations, an analytical plan is agreed (i.e. budget may depend on what is technically feasible given the available data). A final report should be prepared and submitted to SC14 describing the results of the analysis and presenting recommendations for data improvement and/or future studies.
Budget	0.5-1.0 FTE

Sheet Number	#2
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.
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	#3
Project	Participation in ISC North Pacific shortfin mako shark stock assessment activities
Objectives	Contribute to and learn from ISC work toward revising the North Pacific shortfin mako shark stock assessment, thereby aiding methods development for other WCPO shark stocks.
Rationale	• The ISC will be working toward an assessment of the North Pacific shortfin mako in 2017-2018 with an aim to complete it by July 2018 • The ISC assessment would benefit from the contribution of additional shortfin mako observer data (catch rates and total removals) in the North Pacific

	• Participation in this collaborative stock assessment may lead to the development of new methods and/or new data insights for a future South Pacific shortfin mako assessment • Cooperation between the WCPFC and its Northern Committee could be strengthened
Assumptions	• If SPC were available to participate, it would contribute its shortfin mako data holdings • If the Secretariat or ABNJ participates, fewer data can be contributed due to data confidentiality rules • ISC is able and willing to incorporate these contributions to its work • ISC meetings avoid scheduling conflicts with other work
Scope	Available WCPO data would be compiled, formatted and analysed to produce data products that could be contributed to ISC Shark Working Group (SWG) meetings (no raw data would be contributed; this is similar to the contributions of ISC member countries). Data to be prepared would depend on needs identified by the ISC SWG but would be expected to include catch rate indices, catch estimates, effort statistics and/or biological data. It is assumed that participation in two ISC SWG meetings would be required (the FTE estimate is intended to account for both time and travel costs). These have tentatively been scheduled for November 2017 in Japan (data preparation meeting) and March-April 2018 in La Jolla (assessment meeting). Total time input including data handling and analysis, ISC SWG meetings and other tasks, and report review is estimated at ~2.5 months.
Budget	0.2 FTE, US$25,000

Sheet Number	#4
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 (SC12-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	#5
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	#6
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 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
Project title	SRP mid-term review
Objectives	Review the WCPFC Scientific Committee's 2016-2020 shark research plan, to evaluate progress against the plan and assess future needs for shark research relevant to management of the WCPO shark stocks.
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 future shark information needs of the WCPFC. This work will also evaluate the progress against and need for the original SRP components: • 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.
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 will be considered as required.
Budget	0.3 FTE , US$45,000

Sheet Number	#8
Project title	Hammerhead shark catch histories
Objectives	In order to account for the bias or lack of catch reporting, catch histories will need to be developed prior to any form of assessment. This work will attempt to develop methods for estimation of catch using recent observer data for hammerhead sharks in the WCPO. Using commercial logsheet data, the catch proportions (or other relevant quanta) will then be used to back-calculate catch of hammerhead sharks the WCPO fisheries.
Rationale	Lack of catch reporting form sharks has resulted in poor or absent catch histories for most species. This work will build on relevant findings of SC13-EB-WP-07 to estimate historic catch based on recent catch effort and fishery distribution data. These data can then be used as official catch history estimates for future assessment work.
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. • Outputs of SC13-EB-WP-07 indicate that an analysis is potentially feasible for hammerhead shark.
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. One of the most time consuming aspects of shark assessments is the development of reliable catch histories, and for future assessments this should be done prior to considering an assessment attempt. 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. Following an analysis of the level and appropriateness of species-specific hammerhead shark data in space, time and fishery, catch history estimates will be generated at appropriate species and species group levels. Note: 1) at SC12 a review of the data availability, data quality and data gaps for sharks was proposed, the results of that work may need to be considered prior to considering this work; 2) there may be substantial overlap with project 6 above and this work may benefit from being combined with that project.
Budget	0.5 FTE

Sheet Number	#9
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	#10
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

Sheet Number	#11
Project title	Assess stock 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 stock 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

Sheet Number	#12
Project title	South Pacific mako shark assessment
Objectives	Undertake a quantitative assessment of south 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 personal are available to undertaking 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. 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