COMMISSION
FIFTEENTH REGULAR SESSION
Honolulu, Hawaii, USA
10 – 14 December 2018

SYNOPSIS OF SC14 SUMMARY REPORT FOR AGENDA ITEM 9.1

WCPFC15-2018-23
22 November 2017

Paper prepared by the Secretariat

1. The Summary Report of the 14th Regular Session of the Scientific Committee including its Executive Summary is posted on the SC14 website (https://www.wcpfc.int/meetings/14th-regular-session-scientific-committee). The purpose of this paper is to provide a quick reference guide to the key recommendations of the Scientific Committee (SC) which are not covered by other reference documents. These recommendations will be covered under Agenda Item 9.1, and require the Commission's consideration and decision as needed.

2. The following matrix includes SC14 Agenda Items, related recommendations that will be covered under WCPFC15 Agenda Item 9.1, and anticipated actions from the Commission.

AGENDA ITEM 3 — DATA AND STATISTICS THEME

SC14 Agenda	Recommendations (Paragraph numbers from SC14 Summary Report)	Commission's Action requested
Data gaps	62. SC14 **recommended** that the Scientific Services Provider include a table listing the observer data collected by small island developing state (SIDS) observer providers in future versions of the ST Information Paper "Status of ROP Data Management"	Adopt
Species composition of purse-seine catches	68. SC14 recommended that the future work proposed by the Scientific Service Provider under Project 60 (Improving purse seine species composition) continue over the coming two years.	Adopt (Budget reflected in SC14 Budget Table for FAC12)
Bycatch estimates of longline and purse seine	83. SC14 **recommended** that the Scientific Services Provider continue the work on purse seine and longline bycatch estimates, and provide updates every 2-3 years. 84. SC14 encouraged CCMs to provide catch estimates of all species at the species level (in addition to the binding provision of estimates for the WCPFC key species) as part of	Adopt

	their annual data submission. 85. SC14 **recommended** that the bycatch estimates (from SC14-ST-WP-03) also include the estimates of uncertainty (e.g. CVs) in the next iteration of this work, and consider alternative better estimates where appropriate. 86. SC14 **recommended** that the Scientific Services Provider reconcile the names and codes of some species of sharks included in their databases. 87. SC14 **recommended** that the differences in coverage of longline observer data presented in some SC14 papers be investigated by Scientific Services Provider and reported to SC15.	
Better size data (length and weight) for scientific analyses (Project 90)	91. SC14 **recommends** that the Scientific Services Provider be tasked with a project to design and coordinate the systematic collection of data for conversion factors on relevant species to better inform catch estimation, and agrees its inclusion in the SC future work programme and budget under Project 90.	Adopt (Budget reflected in SC14 Budget Table for FAC12)
Electronic Reporting and Electronic Monitoring	108. SC14 **recommends** that FFA, PNA Office, the Scientific Services Provider and WCPFC Secretariat jointly work on a project to review the Commission's data needs and collection programmes (Project 93).	Adopt (No budget required)
Economic data	119. SC14 **recommended** that future reports on economic conditions in WCPO fisheries (SC14-ST-WP-04) be delivered in the SC general reports under Agenda item 2.1.	Endorse

AGENDA ITEM 4 — STOCK ASSESSMENT THEME

Agenda	Recommendations	Commission's Action requested
North Pacific swordfish (*Xiphias gladius*)	275-276. SC14 noted ISC's conclusions on the stock status of Western and Central North Pacific Swordfish in the Pacific Ocean in 2017 and its conservation advice. *Refer to Attachment 1 for the details.*	Take note
Silky shark (*Carcharhinus falciformis*)	302. SC14 concludes that on the basis of the best available science, and pending the availability of less uncertain stock status indicators, the stock is not overfished, but is subject to overfishing (Figure FAL-2). 303. SC14 **recommends**, given that the WCPO silky shark stock continues to be subject to overfishing, that CMM 2013-08 be maintained as a precautionary measure. *Refer to Attachment 2 for the details.*	Take note
North Pacific blue shark (*Prionace glauca*) –	319. Regarding the issue of the designation of North Pacific blue shark as a Northern Stock (WCPFC14 Report, Para 378), SC14 provides the following recommendations:	Provide clarify and quantify the meaning of

Recommendations on the designation of North Pacific blue shark as a Northern Stock	1. SC14 **recommends** that the Commission clarify and quantify what is meant by "*mostly north of 20 degrees N*". 2. In relation to paragraph 1, SC14 **recommends** that a check-list of benchmark scientific information for North Pacific blue shark be developed to support the Commission's deliberations in determining the designation of a northern stock. As such, the following draft checklist is forwarded for the Commission's consideration. *Refer to Attachment 3 for the Check-list.*	"*mostly north of 20 degrees N*" Review the *Check List* to support process of designation of northern stocks
North Pacific shortfin mako shark (*Isurus oxyrinchus*)	335-336. SC14 noted ISC's conclusions on the stock status of North Pacific Shortfin Mako Shark in the Pacific Ocean in 2017 and its conservation advice *Refer to Attachment 4 for the details.*	Take note
Whale shark (*Rhincodon typus*)	351. SC14 reviewed the report on the *Risk to the Indo-Pacific whale shark (Rhincodon typus) population from interactions with Pacific purse seine fisheries*. The analysis estimated the risk of overfishing the Indo-Pacific whale sharks by overlaying predicted spatial abundance of whale sharks with Pacific-wide fishing effort to estimate total fishing mortality relative to limit reference points. 357. SC14 considers there is a low probability that the Indo-Pacific whale shark is at risk from Pacific purse seine fisheries (median probability of less than 8% that current risk levels exceed life history-based notional reference points F_{Lim} and F_{crash}). 358. SC14 **recommends** that the WCPFC initiate concerted efforts to identify and promote best practice safe release methods for whale sharks. 359. SC14 **recommends** that research be undertaken to quantify post-release mortality rates under a variety of release scenarios. *Refer to Attachment 5 for the details.*	Request any instructions on identifying and promoting best practice safe release methods for whale sharks

AGENDA ITEM 5 — MANAGEMENT ISSUES THEME

Agenda	Recommendations	Commission's Action requested
Identifying appropriate limit reference points for elasmobranchs for the WCPFC	488. SC14 reviewed the progress report of the project "Identifying appropriate reference points for elasmobranchs within the WCPFC" (SC14-MI-WP-07) noting that this project had only recently commenced and that further work will be undertaken before the project is completed later this year. SC14 provided comments and feedback as requested on the initial work	Take note

	completed and the future work program. SC14 supported the general approaches being developed as a way of avoiding the weaknesses of conventional stock assessment on data poor species and the general hierarchical approach to LRP setting, also noting that the risk-based approach which is different from traditional stock assessment approach may take time to be understood. However, several CCMs expressed some concern that some of the suggested LRPs may be too conservative, noting that the WCPFC convention prescribes different level of treatment for target stocks and non-target species with respect to the setting of reference points. SC14 therefore **recommends** that WCPFC note that the objective of the WCPFC convention for the management of non-target species is to maintain or restore populations of such species above levels at which their reproduction may become seriously threatened, and **recommends** that this be explicitly considered in the ongoing work.	

AGENDA ITEM 7 — OTHER RESEARCH PROJECTS

Agenda	Recommendations	Commission's Action requested
Pacific Tuna Tagging Project	650. SC14 agreed that continuing the tagging work is essential because of its importance in providing critical information for the assessments of tropical tuna stocks. 651. SC14 acknowledged the voluntary contributions from the Republic of Korea, European Union, Papua New Guinea, Australia, New Zealand and ISSF. SC14 encouraged other CCMs and observer organisations to consider contributing to this important work. Further SC14 acknowledged the support of national fisheries administrations, observer programmes and the tuna fishing industry in assisting with the project, in particular in the recovery of recaptured tags. 652. SC14 **recommended** that the Commission support the PTTP work plan and associated budget for 2019 and the work plan and associated indicative budget for 2020-2021, noting that it includes consideration of the recent voluntary contribution from the Republic of Korea. 653. SC14 noted the advice of the Scientific Services Provider and the PTTP Steering Committee (SC14-RP-PTTP-01) that the availability and cost of suitable tuna fishing vessels to undertake tagging charters is subject to considerable uncertainty. SC14 **recommended** that should available budget be insufficient or if a suitable pole-and-line vessel makes it impossible to conduct WP5[1] in 2019 as scheduled in the work plan, the Executive Director may authorize an amendment to the schedule such that CP14[2] be conducted in 2019 and WP5 be conducted	Adopt (Authorise the ED to make amendments to the tagging schedule)

[1] Tagging research voyage WP5 is planned for 2019, to have a skipjack focus within the warm pool
[2] Tagging research voyage CP14 is planned to occur second half of 2020, to have a BET focus, and is likely to include a return to the central Pacific area

	in 2020. 654. SC14 also noted the advice of the Scientific Services Provider and the PTTP Steering Committee (SC14-RP-PTTP-01) that there is considerable uncertainty in the long-term sustainability of the tagging programme due to the escalating costs of vessel charter and limited availability of suitable vessels. SC14 therefore **recommended** that the Finance and Administration Committee and the Commission consider the proposed Project 83, in which it is proposed to assess the business case for the acquisition and operation of a dedicated research vessel for this purpose, with a view to realising cost-savings for the Commission over the long term. However one CCM did not consider that Project 83 was a scientific project and it should be possibly funded under another more appropriate budget line.	Adopt (Budget reflected in SC14 Budget Table for FAC12)
WCPFC Tissue Bank (Project 35b)	663. The Scientific Committee reconfirmed that maintaining and enhancing the WCPFC Tuna Tissue Bank (P35b) is an essential project and **recommended** the Commission support the work plan and associated budget for 2019, and the work plan and associated indicative budget for 2020-2021. • The Scientific Committee agreed to run the process of WCPFC Tuna Tissue Bank (P35b) reporting in a similar manner to the PTTP (P42) at SC15. • The Scientific Committee agreed that that the Secretariat and the Scientific Services Provider should work together to investigate any issues arising from the Nagoya Protocol for the Tuna Tissue Bank and provide advice on this matter to the Commission as appropriate.	Adopt

AGENDA ITEM 10 — FUTURE WORK PROGRAM AND BUDGET

Agenda	Recommendations	Commission's Action requested
SC work programme and budget for 2019-2021	677. SC14 adopted the proposed budget (Table B-1) and forwarded it to the WCPFC15 FAC meeting. 679. SC14 agreed that SPC will conduct stock assessments for skipjack tuna and South Pacific striped marlin in 2019 (Table SA-1). *Refer to Attachment 6 for the details related to SC work programme and budget.*	Adopt, subject to decision by FAC12

AGENDA ITEM 11 — ADMINISTRATIVE MATTERS

Agenda	Recommendations	Commission's Action requested
Election of SC	The SC Chair requested nominations for SC Vice-Chair and a stock assessment theme co-convener. No nominations were made. Members	Take note

Officers	were asked to further consider potential nominations in the intersessional period, with a view to naming a co-convener well before SC15.	
Next SC meeting	SC14 confirmed that SC15 would be held in Pohnpei, Federated States of Micronesia during 7-15 August 2019. Samoa offered to host for 2020.	Take note

Attachment 1

North Pacific swordfish (*Xiphias gladius*)

a. Stock status

275. SC14 noted that ISC provided the following conclusions on the stock status of Western and Central North Pacific Swordfish in the Pacific Ocean in 2017 presented in SC14-SA-WP-07 (Stock Assessment for Swordfish (*Xiphias gladius*) in the Western and Central North Pacific Ocean through 2016).

Estimates of total stock biomass show a relatively stable population, with a slight decline until the mid-1990s followed by a slight increase since 2000. Population biomass (age-1 and older) averaged roughly 97,919 t in 1974-1978, the first 5 years of the assessment time frame, and has declined by only 20% to 71,979 t in 2016 (Figure NPS-3). Female spawning stock biomass was estimated to be 29,403 t in 2016, or about 90% above SSB_{MSY} (Table NPS-1 and Table NPS-2). Fishing mortality on the stock (average F, ages 1 – 10) averaged roughly F = 0.08 yr^{-1} during 2013-2015, or about 45% below F_{MSY}. The estimated SPR (the predicted spawning output at the current F as a fraction of unfished spawning output) is currently SPR_{2016} = 45%. Annual recruitment averaged about 717,000 recruits during 2012-2016, and no long-term trend in recruitment was apparent. Overall, the time series of spawning stock biomass and recruitment estimates indicate a stable spawning stock biomass and suggest a fluctuating pattern without trend for recruitment (Figure NPS-3). The Kobe plot depicts the stock status relative to MSY-based reference points for the base case model (Figure NPS-4) and shows that spawning stock biomass declined to almost the MSY level in the mid-1990s, but SSB has remained above SSB_{MSY} throughout the time series (Figure NPS-3B).

For this 2018 benchmark assessment, note that biomass status is based on female spawning stock biomass, whereas for the 2014 update assessment, biomass status was based on exploitable biomass (effectively age-2+ biomass). It is also important to note that there are no currently agreed upon reference points for the WCNPO swordfish stock and that retrospective analyses show that the assessment model appears to underestimate spawning stock biomass in recent years.

Based on these findings, the following information on the status of the WCNPO SWO stock is provided:

1. **The WCNPO swordfish stock has produced annual yields of around 10,200 t per year since 2012, or about 2/3 of the MSY catch amount.**
2. **There is no evidence of excess fishing mortality above F_{MSY} ($F_{2013\text{-}2015}$ is 45% of F_{MSY}) or substantial depletion of spawning potential (SSB_{2016} is 87% above SSB_{MSY}).**
3. **Overall, the WCNPO swordfish stock is not likely overfished and is not likely experiencing overfishing relative to MSY-based or 20% of unfished spawning biomass-based reference points.**

b. Management advice and implications

276. SC14 noted the following conservation advice from ISC:

Stock projections were conducted using a two-gender projection model. The five stock projection scenarios were: (1) F status quo, (2) F_{MSY}, (3) F at $0.2*SSB_{F=0}$, (4) $F_{20\%}$, and (5) $F_{50\%}$ (Figure

NPS-5). These projection scenarios were applied to the base case model results to evaluate the impact of alternative levels of fishing intensity on future spawning biomass and yield for swordfish in the Western and Central North Pacific Ocean. The projected recruitment pattern was generated by stochastically sampling the estimated stock-recruitment model from the base case model. The projection calculations employed model estimates for the multi-fleet, multi- season, size- and age-selectivity, and structural complexity in the assessment model to produce consistent results.

Based on these findings, the following conservation information is provided:

1. **The results show that projected female spawning biomass is expected to remain above SSB_{MSY} under all of the harvest scenarios (Table NPS-3 and Figure NPS-5), with increases in spawning biomass expected under lower fishing mortality rates.**
2. **Similarly, projected catch is expected to increase under each of the five harvest scenarios, with greater increases expected under higher fishing mortality rates (Table NPS-3 and Figure NPS-5).**

Research needs

The lack of sex-specific size composition data and the simplified treatment of the spatial structure of swordfish population dynamics remained as two important sources of uncertainty for this benchmark assessment

Table NPS-1. Reported catch (mt) used in the stock assessment along with annual estimates of population biomass (age-1 and older, mt), female spawning biomass (mt), relative female spawning biomass (SSB/SSB_{MSY}), recruitment (thousands of age-0 fish), fishing mortality (average F, ages 1 to 10), relative fishing mortality (F/F_{MSY}), and spawning potential ratio of Western and Central North Pacific Ocean swordfish.

Year	2010	2011	2012	2013	2014	2015	2016	Mean[1]	Min[1]	Max[1]
Reported Catch	12,716	9,971	10,608	9,241	9,211	11,672	10,068	12,863	9,211	17,793
Population Biomass	66,417	66,087	68,117	67,885	69,560	71,951	71,979	67,487	51,856	97,919
Spawning Biomass	26,136	26,448	26,569	27,546	28,580	28,865	29,404	24,442	17,191	44,100
Relative Spawning Biomass	1.66	1.68	1.69	1.75	1.82	1.84	1.87	1.56	1.09	2.81
Recruitment (age 0)	789	565	671	710	683	742	781	761	401	1241
Fishing Mortality	0.10	0.08	0.09	0.07	0.07	0.09	0.07	0.12	0.07	0.18
Relative Fishing Mortality	0.57	0.46	0.51	0.44	0.40	0.51	0.44	0.72	0.40	1.05
Spawning Potential Ratio	38%	41%	39%	45%	47%	39%	45%	29%	17%	47%

[1] During 1975-2016

Table NPS-2. Estimates of biological reference points along with estimates of fishing mortality (F), spawning stock biomass (SSB), recent average yield (C), and SPR of WCNPO swordfish, derived from the base case model assessment model, where "MSY" indicates reference points based on maximum sustainable yield.

Reference Point	Estimate
F_{MSY}	0.17 yr^{-1}
$F_{0.2*SSB(F=0)}$	0.16 yr^{-1}
$F_{2013\text{-}2015}$	0.08 yr^{-1}
SSB_{MSY}	15,702 mt
SSB_{2016}	29,403 mt
$SSB_{F=0}$	97,286 mt

MSY	14,941 mt
$C_{2012\text{-}2016}$	10,160 mt
SPR_{MSY}	18%
SPR_{2016}	45%

Table NPS-3. Projected values of WCNPO swordfish spawning stock biomass (SSB, mt) and catch (mt) under five constant fishing mortality rate (F, yr^{-1}) scenarios during 2017-2026.

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Scenario 1: F = $F_{2013\text{-}2015}$										
SSB	32,118	33,207	34,599	35,476	36,270	37,082	37,951	38,967	40,083	41,087
Catch	8,851	9,135	9,407	9,599	9,794	10,022	10,275	10,595	11,053	11,142
Scenario 2: F = F_{MSY}										
SSB	28,267	23,963	21,443	19,458	18,303	17,618	17,293	17,197	17,253	17,263
Catch	20,885	18,323	16,509	15,294	14,666	14,353	14,308	14,520	14,650	14,348
Scenario 3: F = $F_{20\%SSB(F=0)}$										
SSB	28,425	24,384	21,800	19,735	18,530	17,874	17,496	17,586	17,818	17,779
Catch	20,691	18,122	16,454	15,261	14,653	14,361	14,319	14,554	14,665	14,384
Scenario 4: F = $F_{20\%}$										
SSB	29,007	25,431	23,527	21,763	20,736	20,131	19,893	19,883	19,981	20,066
Catch	18,680	16,933	15,657	14,726	14,242	14,033	14,050	14,292	14,496	14,253
Scenario 5: F = $F_{50\%}$										
SSB	32,559	34,334	36,290	37,666	38,836	39,984	41,148	42,490	44,049	45,625
Catch	7,556	7,973	8,343	8,605	8,847	9,101	9,366	9,692	10,087	10,223

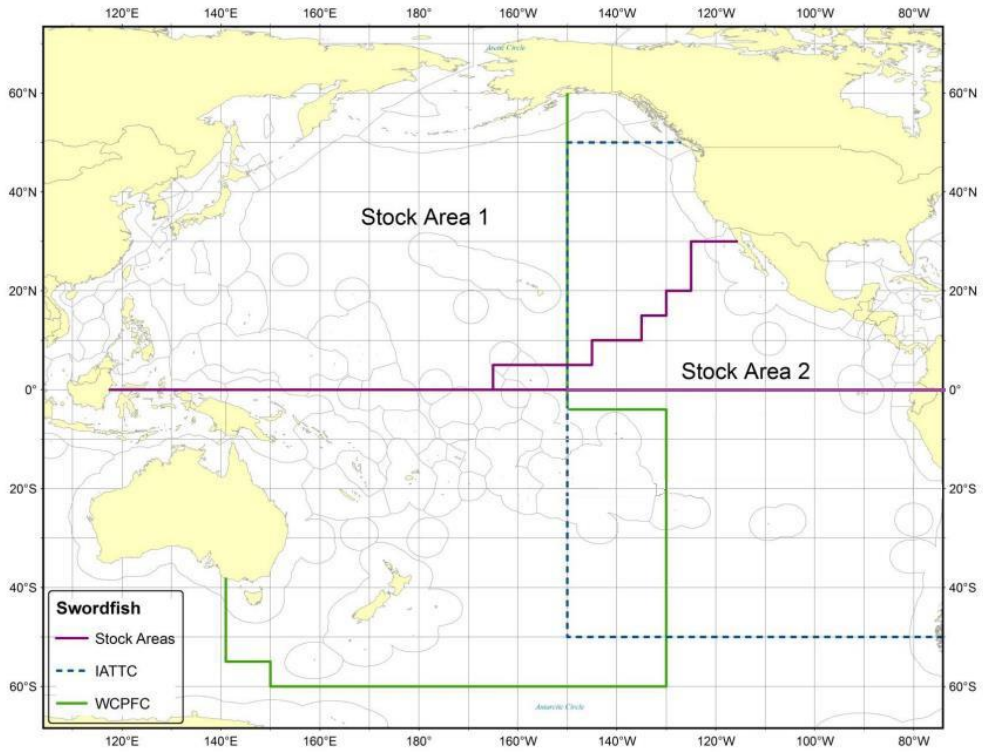

Figure NPS-1. Stock boundaries used for this assessment of North Pacific Ocean swordfish: purple lines indicate stock area divisions; stock area 1 was assessed as the WCNPO stock, stock area 2

contains the Eastern Pacific Ocean stock, the green line indicates Western Central Pacific Fisheries Commission convention area, blue dashed line indicates IATTC convention area.

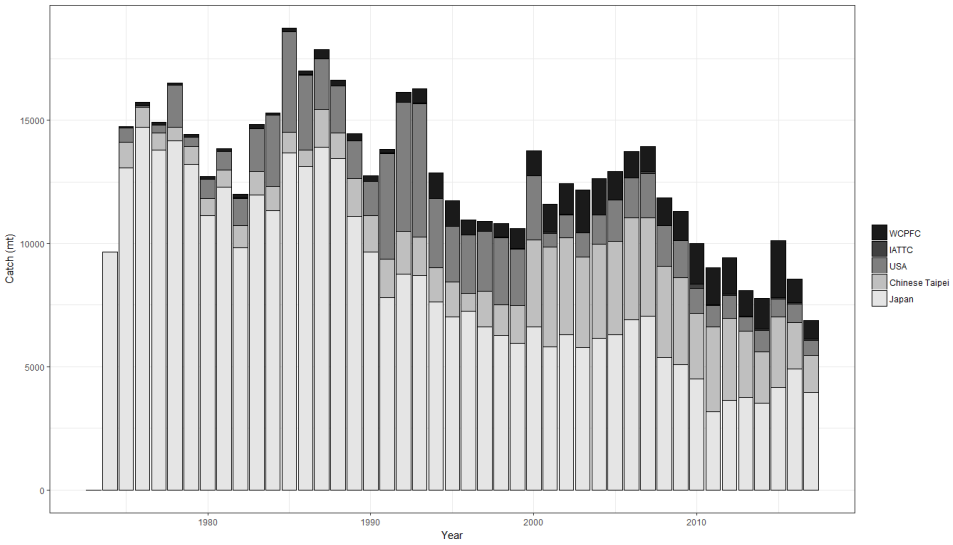

Figure NPS-2. Annual catch biomass (t) of WCNPO swordfish (*Xiphias gladius*) by country for Japan, Chinese Taipei, the U.S.A., and all other countries during 1975-2016.

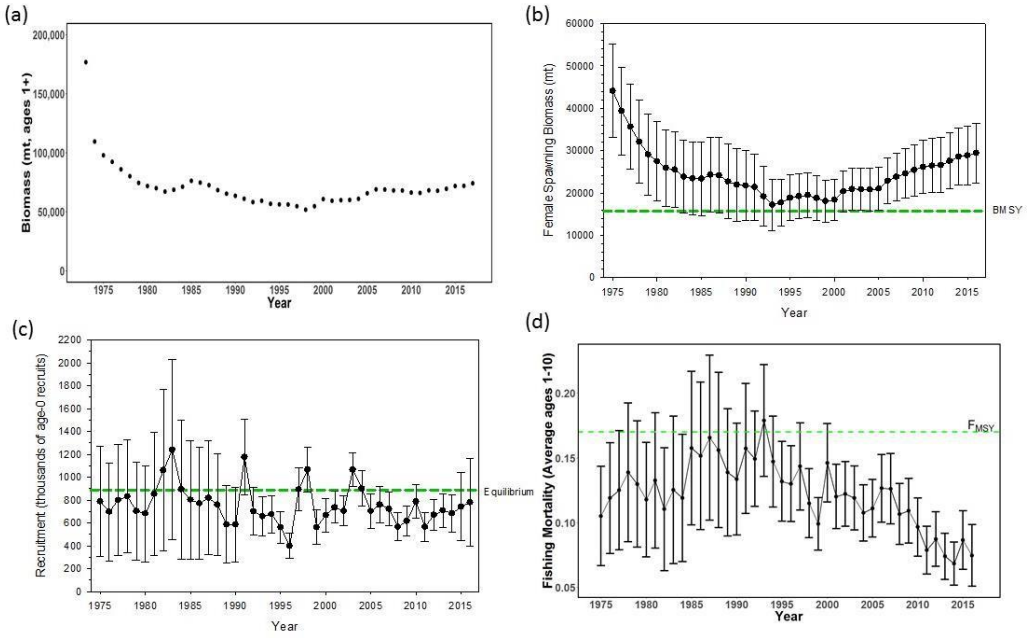

Figure NPS-3. Time series of estimates of (a) population biomass (age 1+) (first point in time series represents unfished biomass), (b) spawning biomass, (c) recruitment (age-0 fish), and (d) instantaneous fishing mortality (average for ages 1 to 10, yr^{-1}) for WCNPO swordfish (*Xiphias gladius*) derived from the 2018 stock assessment. The solid circles are the maximum likelihood estimates by year for each quantity and the error bars represent the uncertainty of the estimates (80% confidence intervals), green dashed lines indicate B_{MSY}, equilibrium recruitment, and F_{MSY} except for the population biomass time series.

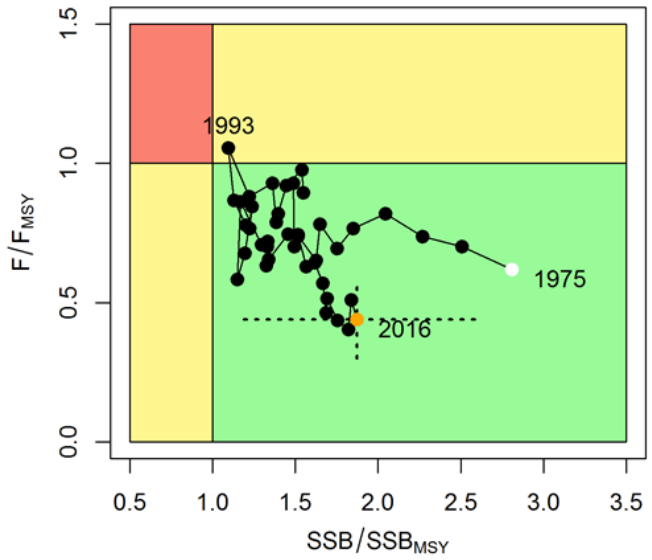

Figure NPS-4. Kobe plot of the time series of estimates of relative fishing mortality (average of ages 1-10) and relative spawning stock biomass of WCNPO swordfish (*Xiphias gladius*) during 1975-2016. The white circle denotes the first year (1975) and the yellow circle denotes the last year (2016) of the assessment time horizon. The dashed lines represent the 95% confidence intervals around the 2016 estimate.

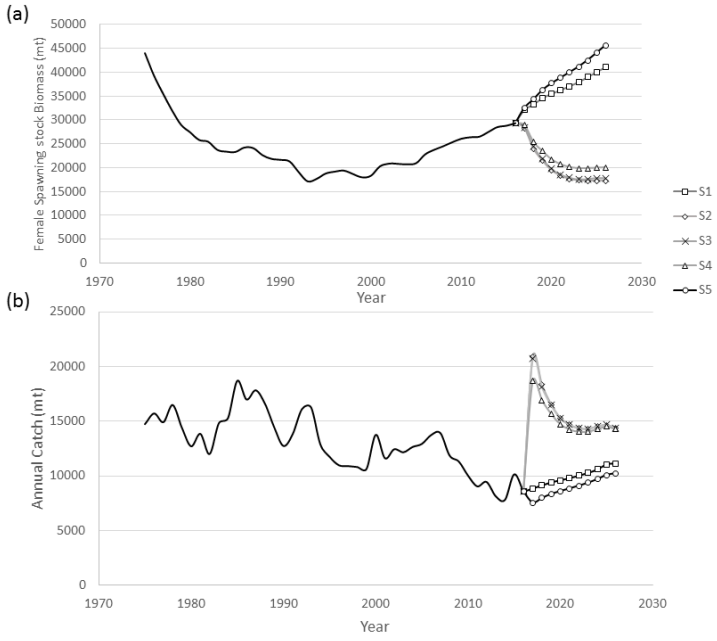

Figure NPS-5. Historical and projected trajectories of (a) spawning stock biomass and (b) total catch from the WCNPO swordfish base case model. Stock projection results are shown for S1 = the status quo or average fishing intensity during 2013-2015 ($F_{2013-2015}$= $F_{43\%}$); S2 = F_{MSY} ($F_{18\%}$); S3 = F to produce 20% of unfished spawning stock biomass or $F_{0.2}$*$SSB_{F=0}$ ($F_{22\%}$); S4 = the highest 3-year average F during 1975-2016 or High F ($F_{20\%}$); S5 = Low F ($F_{50\%}$).

Silky shark (*Carcharhinus falciformis*)

277. **The SC accepts the WCPO silky shark stock assessment as best available science for this stock.**

a. Stock status and trends

278. SC14 noted given the inherent uncertainty in the current assessment the current estimates of stock status should be considered indicative only. Although these estimates are not considered a reliable basis for management decision-making they represent progress since the 2013 assessment and the best available science concerning the status of silky sharks in the WCPO. Therefore, as part of its ongoing review of the established conservation and management measure for silky sharks (CMM 2013-08), the Commission may wish to consider these indicative results until such time as better estimates become available.

279. SC14 noted that indications from the 2018 WCPO model show that the stock declined steadily over the model period (1995-2016) (Figure FAL-1). The assessment model estimates spawning biomass in 2016 to have been at 47% of the unexploited level (SB_{2016}/SB_0 = 0.469). Current biomass is estimated to be above the MSY reference biomass level; however, there is considerable uncertainty associated with the estimate of stock status (SB_{2016}/SB_{MSY} = 1.178 95% CI 0.590-1.770) (Table FAL-1). On balance, the stock is not considered to be overfished, i.e. there is a 78% probability that SB_{2016} is greater than SB_{MSY} (Table FAL-1).

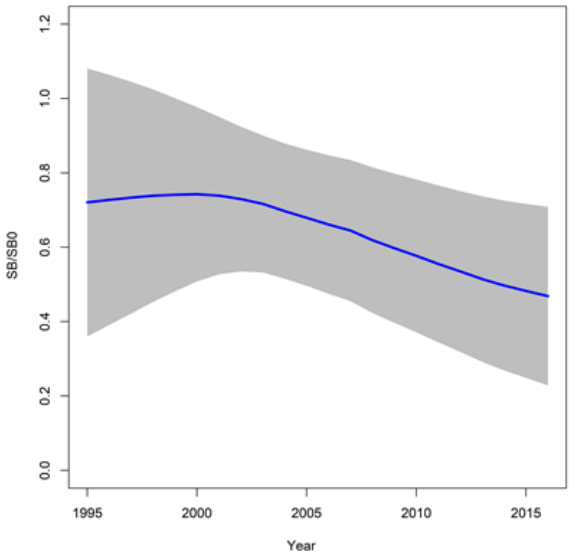

Figure FAL-1: Estimated spawning biomass relative to unexploited biomass (SB_0) for the WCPO assessment model (CPUEqdev).

Table FAL-1: Management quantities (and 95% confidence intervals) for the WCPO assessment model (*CPUEqdev*).

Management quantity	Value	Confidence interval (95%)
SB_0	11,865	6,412-17,318

SB_{1995}	8,552	2,590-14,513
SB_{MSY}	4,721	2,560-6,882
SB_{MSY}/SB_0	0.398	0.397-0.399
SB_{2016}	5,560	301-10,819
SB_{2016}/SB_0	0.469	0.229-0.729
SB_{2016}/SB_{MSY}	1.178	0.590-1.77
Pr($SB_{2016} > SB_{MSY}$)	0.78	
F_{2016}/F_{MSY}	1.607	0.316-2.810
Pr($F_{2016} > F_{MSY}$)	0.84	
F_{2016}	0.313	
MSY	12,162	6,711-17,615
Catch 2016 (mt)	22,503	

280. Fishing mortality is estimated to be above F_{MSY} (F_{2016}/F_{MSY} = 1.607, Pr($F_{2016} > F_{MSY}$) = 84%). The current level of catch is substantially higher than the MSY. If catches remain at the current level there is a high probability that the biomass will decline to below the SB_{MSY} level in the foreseeable future (~ 5 years).

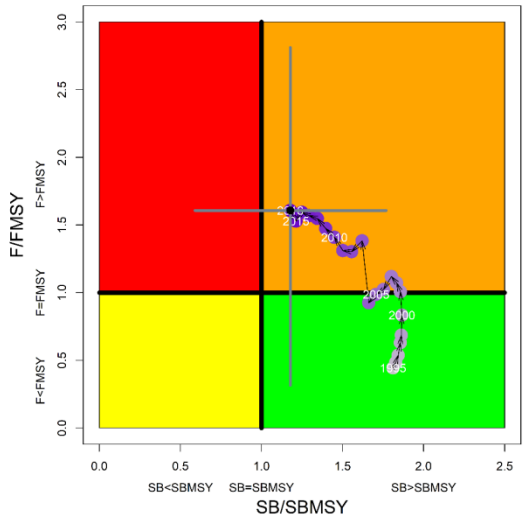

Figure FAL-2: Kobe plot for the WCPO assessment model (*CPUEqdev*).

b. Management advice and implications

281. SC14 concludes that on the basis of the best available science, and pending the availability of less uncertain stock status indicators, the stock is not overfished, but is subject to overfishing (Figure FAL-2).

282. SC14 recommends, given that the WCPO silky shark stock continues to be subject to overfishing, that CMM 2013-08 be maintained as a precautionary measure.

Attachment 3

Check list for the designation of North Pacific blue shark as a Northern Stock

No	Criteria	Response	Comments
1	What proportion of the total estimated stock biomass occurs on average north of 20°N?	Unknown	Current assessment model does not include population spatial structure. Nominal CPUE may be biased and could be overestimated in the north unless the effects of fishing time, depth and depth distribution of blue sharks are accounted for.
2	Does all of the breeding/spawning area(s) occur north of 20 °N?	No	Breeding area is mainly north of 20 °N but may overlap areas south of 20 °N
3	Does all of the nursery area(s) occur north of 20 °N	Yes	Mostly in the area 30-40 °N
4	Do any other important life history stages occur south of 20 °N?	Yes	Pregnant females are commonly found south of 20 °N
5	What proportion of the total annual estimated catch occurs north of 20 °N?	0.88 on average	Based on raised, aggregated (5x5 degree) longline data 2014-2017 submitted to WCPFC (Operational data would provide better resolution than aggregated data)
6	Is fishery catch-per-unit-effort demonstrably higher north of 20 °N for comparable fisheries?	(i) Similar CPUE observed north and south of 20 °N in Chinese Taipei LSTLL fishery and Hawaii deep-set LL fishery (ii) CPUE higher north of 20 °N in Japan shallow set research survey	CPUE comparisons may be biased by different depth distribution of blue shark north and south of 20 °N.
7	Is there sufficient information about fish movement between the areas north and south of 20 °N?	Yes	Conventional tagging data shows that the maximum range of movements suggests at least northern and southern sub-populations of blue shark, as demarked by the equator.

Attachment 4

North Pacific shortfin mako shark (*Isurus oxyrinchus*)

a. Stock status and trends

283. SC14 noted that ISC provided the following conclusions on the stock status of North Pacific Shortfin Mako Shark in the Pacific Ocean in 2017, as presented in SC14-SA-WP-11 (Stock Assessment of Shortfin Mako Shark in the North Pacific Ocean Through 2016).

Based on these findings, the following information on the status of the SFM stock is provided:

1. **Target and limit reference points have not been established for pelagic sharks in the Pacific Ocean. Stock status is reported in relation to MSY.**
2. **The results from the base case model show that, relative to MSY, the North Pacific shortfin mako stock is likely (>50%) not in an overfished condition and overfishing is likely (>50%) not occurring relative to MSY-based abundance and fishing intensity reference points (Table SFM-4; Figure SFM-9A).**

Stock status was also examined under six alternative states of nature that represented the most important sources of uncertainty in the assessment. Results of these models with alternative states of nature were consistent with the base case model and showed that, relative to MSY, the North Pacific shortfin mako shark stock is likely (>50%) not in an overfished condition and overfishing is likely (>50%) not occurring (Figure SFM-9B).

b. Management Advice and implications

284. SC14 noted the following conservation advice from ISC:

Stock projections of biomass and catch of North Pacific shortfin mako from 2017 to 2026 were performed assuming three alternative constant fishing mortality scenarios: 1) status quo, average of 2013-2015 ($F_{2013\text{-}2015}$); 2) $F_{2013\text{-}2015}$ + 20%; and 3) $F_{2013\text{-}2015}$ - 20% (Figure SFM-10).

Based on these future projections, the following conservation information is provided:

1. **If fishing mortality remains constant at F2013-15 or is decreased 20%, then the Stock Abundance is expected to increase gradually;**
2. **If fishing mortality is increased 20% relative to F2013-2015, then the Stock Abundance is expected to decrease in the final years of the projection.**
3. **It should be noted that, given the uncertainty in fishery data and key biological processes within the model, especially the stock recruitment relationship, the models' ability to project into the future is highly uncertain.**

Research Needs

There is uncertainty in the estimated historical catches of North Pacific shortfin mako shark. Substantial time and effort was spent on estimating historical catch and more work remains to be conducted. In particular, the SHARKWG identified two future improvements that are critical: 1) identify all fisheries that catch shortfin mako shark in the NPO, including fisheries that were not previously identified by the SHARKWG; and 2) methods to estimate shortfin mako shark catches should be improved, especially for the early period from 1975 to 1993.

Table SFM-4. Summary of reference points and management quantities for the shortfin mako shark (*Isurus oxyrinchus*) base case model. The percentages in brackets are the CV of the estimated quantity in the base case model.

Management Quantity	Symbol	Units	Base case
Spawning abundance (number of mature female sharks	SA_0	1000s of sharks	1465.8 (23%)
Maximum Sustainable Yield (MSY)	C_{MSY}	Metric tons (t)	3127.1 (22%)
Spawning Abundance at MSY	SA_{MSY}	1000s of sharks	633.7 (23%)
Fishing Intensity at MSY	$1\text{-}SPR_{MSY}$	NA	0.26
Current spawning abundance relative to MSY	SA_{2016}/SA_{MSY}	NA	1.36
Current spawning abundance relative to unfished level	SA_{2016}/SA_0	NA	0.58
Recent fishing Intensity relative to MSY	$(1\text{-}SPR_{2013\text{-}15})/(1\text{-}SPR_{MSY})$	MSY	0.62

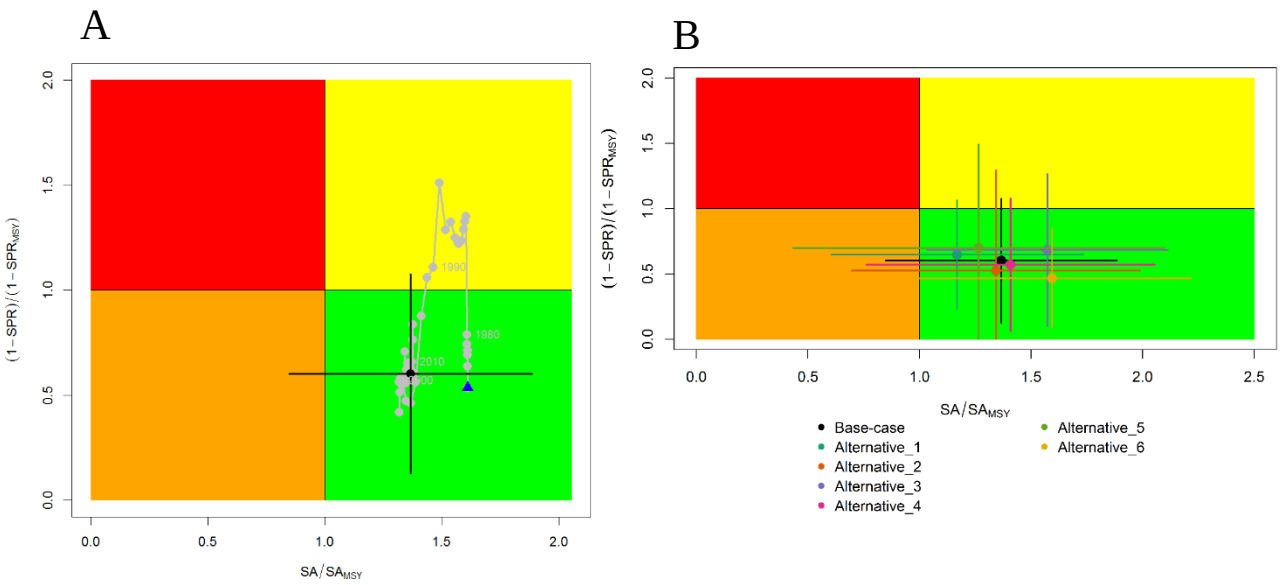

Figure SFM-9. Kobe plots of shortfin mako shark in the North Pacific Ocean showing. A) The time series of the ratio of SA to SA at MSY (SA_{MSY}) and fishing intensity to fishing intensity at MSY ($1\text{-}SPR_{MSY}$), and B) the same ratios for the terminal year (2016) for six alternative states of nature. SA is spawning abundance measured as the number of mature females. Fishing intensity is estimated as 1-SPR. Values for the start (1975) and end (2016) years in the time series (A) are indicated by the blue triangle and black circle, respectively. Gray numbers indicate selected years. Alternative states of nature in B) include: Alternative_1) higher catch, Alternative_2) lower catch; Alternative_3) higher uncertainty on Japan shallow-set CPUE index (1975-1993) (CV=0.3); Alternative_4) fit to Japan offshore distant water longline shallow-set fleet (JPN_SS_I; 1975-2016) and Hawaii longline shallow-set fleet (US_SS; 2005-2016), and no fit to initial equilibrium catch; Alternative_5) low steepness, h=0.26; and Alternative_6) high steepness, h=0.37. Solid lines indicate 95% confidence intervals.

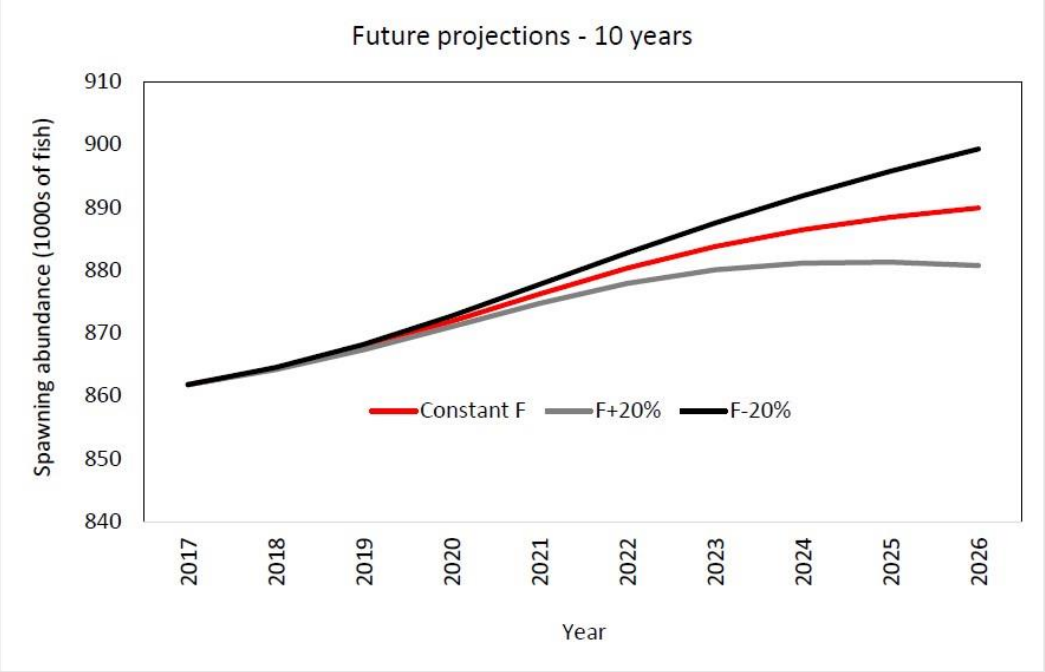

Figure SFM-10. Comparison of future projected North Pacific shortfin mako (*Isurus oxyrinchus*) spawning abundance under different F harvest policies (Constant F 2013-2015, +20%, -20%) using the base case model. Constant F was based on the average from 2013-2015.

Whale shark (*Rhincodon typus*)

a. Stock status and trends

285. A nominal trend of high interactions in 2006-2008, followed by lower rates thereafter was not altered by standardization (Figure RHN-1), and is consistent with trends found in the Eastern Pacific Ocean by Román et al. 2018. These decreasing annual trends in interactions do not appear to result from management measures as prohibitions on intentional setting of purse seines on whale sharks were adopted by the PNA in 2010, by the WCPFC in 2012 and by the IATTC in 2015. Furthermore, the trends may have been influenced by low WCPO purse seine observer coverage rates prior to 2010.

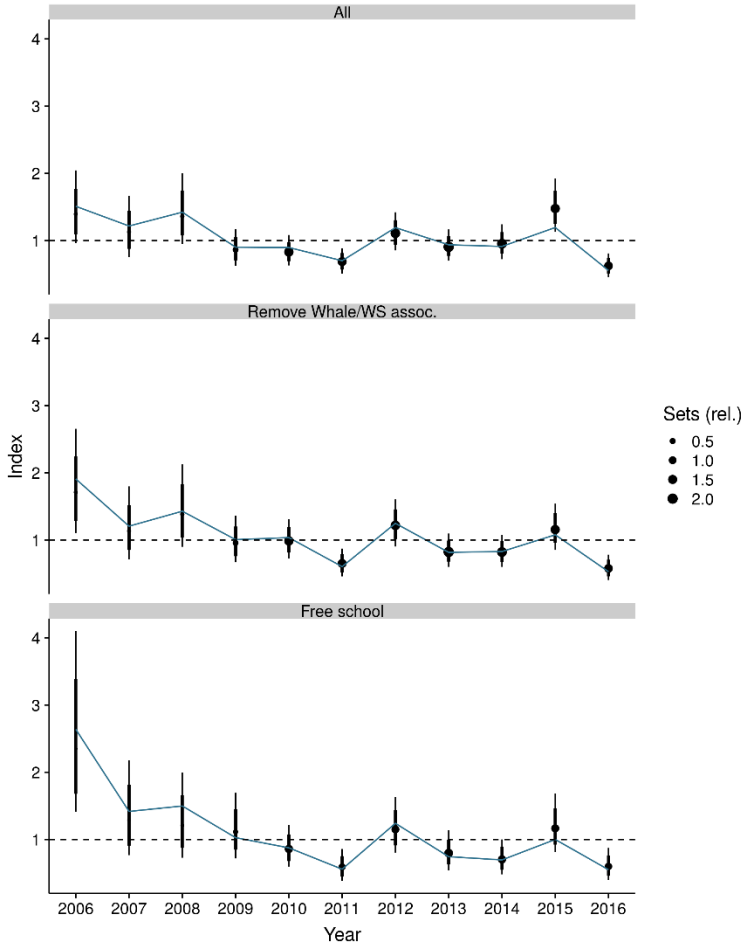

Figure RHN-1. Estimated temporal index of interactions based on a) the full observer dataset, b) the full dataset without whale- and whale shark associated sets, and c) free-school sets only. The rationale behind the different effort subsets is given in section 2.2.2 of SC14-SA-WP-12. The index is centred to have a geometric mean of one and is therefore unit-less.

286. SC14 noted that over a range of notional reference points, and in accordance with expert-elicited post-mortality rates of ~10%, median sustainability risk from Pacific Ocean fisheries alone for the 2006-2016 period ranged between (Figure RHN-2):

- **3-12% of the limit risk level based on $0.5r_{max}$ (F_{msm}),**
- **2-8% of the limit risk level based on $0.75r_{max}$ (F_{lim}), and**
- **2-6% of the limit risk level based on r_{max} (F_{crash}), where r_{max} is the maximum population growth rate.**

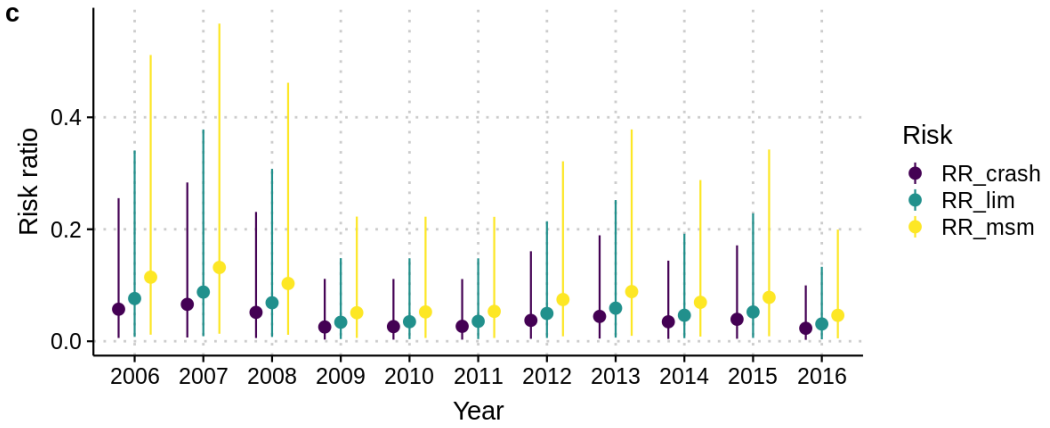

Figure RHN-2. Risk that mortality exceeds either of three limit reference points (RR_crash (F_{MSM}: $0.5r_{max}$), RR_lim (F_{Lim}: $0.75r_{max}$), RR_crash (F_{crash}: r_{max})).

287. SC14 noted the report's findings that understanding and reducing post-release mortality is recommended as one of most effective approaches to maintaining acceptable risk levels.

288. SC14 also noted the report's findings that the total risk to the Indo-Pacific whale shark population may be higher if there are differential impacts to more vulnerable population segments within the Pacific and/or higher fishing mortalities outside of the region (e.g. the Indian Ocean).

289. SC14 considered the use of precautionary risk assessment model inputs. It was noted that input parameters to the risk assessment were drawn from the best available data, but in some cases where the data were uninformative about the probability distributions of the parameters of interest the methodology put more weight on precautionary values.

b. Management advice and implications

290. SC14 considers there is a low probability that the Indo-Pacific whale shark is at risk from Pacific purse seine fisheries (median probability of less than 8% that current risk levels exceed life history-based notional reference points F_{Lim} and F_{crash}).

291. SC14 recommends that the WCPFC initiate concerted efforts to identify and promote best practice safe release methods for whale sharks.

292. SC14 recommends that research be undertaken to quantify post-release mortality rates under a variety of release scenarios.

Attachment 6

Table B-1. Summary of SC work programme titles and budget for 2019, and indicative budget for 2020–2021, which requires funding from the Commission's core budget (USD).

Project title	TORs	Essential	Priority rank	2019	2020	2021
SPC Oceanic Fisheries Programme Budget	MOU	Yes	High 1	906,396	924,524	943,015
SPC – Additional resourcing for harvest strategy evaluation, including stock assessments[3] (Rob Scott)	MOU	Yes	High 1	164,832	166,480	168,145
Project 35b. Maintenance and enhancement of the WCPFC Tissue Bank	Annexed	Yes	High 1	97,200	99,195	101,180
Project 42 Pacific Tuna Tagging Program (PTTP) Other: Approx. $170,000 from Korea	Annexed	Yes	High 1	645,000	645,000	730,000
Project 57. Limit Reference Points (LRPs) for elasmobranchs within the WCPFC	Annexed					
Project 60: Improving purse seine species composition ***** SPC will utilise funding from other sources in 2019	Annexed			*	40,000	40,000
Project 68. Estimation of seabird mortality across the WCPO Convention area	Annexed	No	High 2	17,500		
Project 81. Further work on bigeye tuna age and growth	Annexed					
Project 82. Yellowfin tuna age and growth	Annexed	Yes	High 1	85,000		
Project 83. Investigating the potential for a WCPFC tag vessel (Co-funded to be sought)	Annexed	No	High 2	95,000		
Project 88. Acoustic FAD analyses	Annexed				120,000	72,000
Project 90. Better data on fish weights and lengths for scientific analyses	Annexed	No	High 2	60,000	30,000	20,000
Project 91. Operational planning for shark biological data improvement *ABNJ-funded project ($30,000) – need to re-advertise						
Project 92. Testing the performance of alternative stock assessments approaches for oceanic whitetip shark.	Annexed	No	High 2	75,000		
Project 93. Review of the Commission's data needs and collection programs	Annexed					
Project 94. Workshop on yellowfin and bigeye tuna age and growth	Annexed	Yes	High 1	15,000		
Unobligated (Contingency) Budget Note: Any science-related projects requested by the Commission with no budget allocation					83,000	83,000
SC14 TOTAL BUDGET				**2,160,928**	**2,108,199**	**2,157,340**

[3] Revised terms of reference for this resourcing includes:

- further development of MULTIFAN-CL to support the Management Strategy Evaluation and the Harvest Strategy development process;
- further enhancement of MULTIFAN-CL and its use in stock assessment to implement SC recommendations;
- maintenance and further development of the MULTIFAN-CL website to facilitate access to software and support; and
- implementation of a formal framework for management of MULTIFAN-CL code updates, testing of new developments, and updating of the users' guide.

Table SA-1: Stock Assessment Schedule

Species	Region	Last assessment	2018	2019	2020	2021	2022	Notes
TUNA and BILLFISH								
Bigeye tuna	WCPO	2017	**SPC Update** (SC14-SA-WP-03)		**SPC**			3 year cycle
Skipjack tuna	WCPO	2016		**SPC**			**SPC**	3 year cycle
Yellowfin tuna	WCPO	2017			**SPC**			3 year cycle
Albacore	South Pacific	2015	**SPC** (SC14-SA-WP-05)			**SPC**		3 year cycle
Pacific bluefin	North Pacific	2016	**ISC** (SC14-SA-WP-06) ISC			**ISC**		To be confirmed by ISC
Striped marlin	Southwest Pacific	2012		**SPC** (deferred from 2018)				5 year cycle
	Northwest Pacific	2012		**ISC**				To be confirmed by ISC
Swordfish	Southwest Pacific	2017						5 year cycle
	North Pacific	2014	**ISC** (SC14-SA-WP-07)				**ISC**	To be confirmed by ISC