COMMISSION
FOURTEENTH REGULAR SESSION
Manila, Philippines
3 – 7 December 2017

SYNOPSIS OF SC13 SUMMARY REPORT

WCPFC14-2017-18 (Rev.02~~1~~)
~~17 November~~1 December 2017

Paper prepared by the Secretariat

1. The Summary Report of the 13th Regular Session of the Scientific Committee including its Executive Summary is posted on the SC13 website (https://www.wcpfc.int/meetings/sc13). The purpose of this synopsis paper is to provide a quick reference guide to the key findings and 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.

OPENING OF THE MEETING

2. The SC13 took place from 9 - 17 August 2017 at the National Auditorium, Marairenga, Rarotonga, Cook Islands. Ms Berry Muller (RMI) chaired the meeting, and six theme conveners assisted the process of the meeting.

Data and Statistics theme	V. Post (USA)
Stock Assessment theme	J. Brodziak (USA) and H. Nishida (Japan)
Management Issues theme	R. Campbell (Australia)
Ecosystem and Bycatch Mitigation theme	J. Annala (NZ) and A. Batibasaga (Fiji)

REVIEW OF FISHERIES

3. The provisional total WCP–CA tuna catch for 2016 was estimated at 2,717,850 mt, the second highest on record, which is 79% of the total Pacific Ocean catch of 3,406,269 mt, and 56% of the global tuna catch (the provisional estimate for 2016 is 4,795,867 mt).

Species	Catch (mt)	%
Skipjack	1,816,650	67
Yellowfin	650,491	24
Bigeye	152,806	6
Albacore	97,822 (N. Pacific: 29,221;	4

Gear	Catch (mt)	%
Purse seine	1,858,198	68
Pole-and-line	199,457	7
Longline	231,860	9
SP troll albacore	2,097	0.1
Remainder	269,100	16

	S. Pacific: 68,601)					

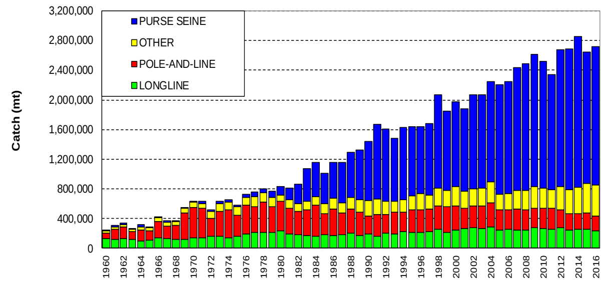


Figure 1. Catch (mt) of albacore, bigeye, skipjack and yellowfin in the WCP–CA, by purse seine, longline, pole-and-line and other gear types

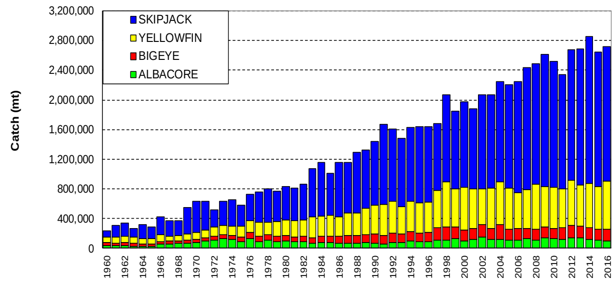


Figure 2. Catch (mt) of albacore, bigeye, skipjack and yellowfin in the WCP–CA

DATA AND STATISTICS

Data gaps of the Commission

4. SC13 recommended that the Scientific Services Provider conduct a gaps analysis and compile the requirements for enhancing conversion factor information required for future WCPFC work and present this information to SC14, including a proposal for how the gaps can be addressed.

5. SC13 recommended that the Scientific Service Provider review the importance and practicalities for including the provision of estimates of longline discards in number of individuals discarded/released in the "Scientific Data to be provided to the Commission", with a definition for discards/releases, and report to SC14.

6. SC13 acknowledged the necessary assistance that the SPC-facilitated "Regional Tuna Data Workshop (TDW)" provides in building technical capacity for SIDS, territories and developing states to produce annual catch estimates and Part 1 reports. SC13 recommended that the Commission continue to support SIDS, territories and developing states participation at future TDWs through the "Regional Capacity Building Workshops" fund.

7. SC13 recommended that the Scientific Services Provider proceed to enhance the set of WCPFC public domain data available on the WCPFC web site, with the assurance that the WCPFC rules for public domain data will be applied.

Species composition of purse seine catches (Project 60)

8. SC13 recommended that the future work proposed by the Scientific Service Provider under Project 60 (Improving purse seine species composition) continue over the coming year with a report to SC14 and agreed that this work should continue in the medium-term subject to annual review.

9. SC13 recommended that the Scientific Services Provider explore opportunities to undertake comprehensive comparisons of corrected grab sample based species compositions with accurate composition estimates from in-port sampling with other CCMs who hold the required data.

10. SC13 recommended that trials of electronic monitoring based approaches to species composition estimation be undertaken in a separate project.

11. SC13 recommended that the Scientific Services Provider include the original purse seine tuna species catch estimates provided by CCMs in the WCPFC Tuna Fishery Yearbook.

12. SC13 recommended that the Scientific Services Provider be tasked with designing and co-ordinating the systematic collection of representative samples of length measurements of bycatch species.

13. SC13 recommended that the Scientific Services Provider be tasked with a project to design and co-ordinate the systematic collection of length:length, length:weight and weight:weight data on all species to better inform bycatch estimation.

Estimates of purse seine fishery bycatch at a regional scale, 2003 – 2016

14. SC13 recommended that the Scientific Services Providers continue the work on purse seine bycatch estimates and extend this work to producing estimates of bycatch in the longline fisheries for presentation at SC14, acknowledging the issues related to the 5% observer coverage in these fisheries.

15. SC13 recommended that the Scientific Services Provider produce WCPFC-area estimates of longline bycatch on a regional fishery basis.

Additional FAD data fields to be provided by vessel operators

16. SC13 recommended that the operators of all vessels involved in FAD fishery, including support vessels, provide as a minimum the fields of information identified in Attachment C of the report of the 2nd meeting of the FAD management options intersessional Working Group (WCPFC-2016-FADMgmtOptionsIWG021_rev2).

17. SC13 further recommended that the WCPFC Secretariat, together with SPC and other interest parties prepare the set of data fields to be provided by vessel operators and coordinate with the IATTC staff to try to harmonize the minimum standards to be required across the Pacific Ocean. Special attention should be paid to avoid duplications of information by vessel operators and/or an increase of unnecessary paperwork.

18. SC13 recommended that the proposed fields to be collected by vessel operators be forwarded to TCC13 for review and WCPFC14 for adoption.

FAD marking and monitoring

19. SC13 recommended as a first step the Commission should consider introducing a buoy ID scheme which requires the registration of all buoys attached to FADs deployed. Field tests in conjunction with industry and observers should be undertaken to determine the optimal configuration of future developments of a fully marking system that also includes the FADs themselves.

Regional Observer Programme

20. SC13 recommended the following revisions to the ROP Minimum Standard Data Fields:

- Addition of a new section “FAD Information” that will include inventories of the FAD buoys on board at the start and end of each trip.
- Addition of a new field for FAD Identification.
- Deletion of FAD Data fields related to a) materials FAD is made from and b) estimated size of FAD.

21. SC13 noted that the revisions of the ROP minimum standards will require careful planning and implementation to ensure that the value of WCPFC data on FADs is maintained. In particular, there may need to be a period of overlap in reporting of FAD data where observers continue to report on FAD design and construction while the new reporting requirements for vessel operators are introduced.

22. SC13 recommended that the revisions to the ROP Minimum Standard Data Fields standards be forwarded to TCC13 for review and WCPFC14 for adoption.

23. SC13 recommended that the Scientific Services Provider, CCMs and the WCPFC Secretariat through the ROP provide guidance to improve observer training related to visual estimation of bycatch numbers and weight, and that the Scientific Services Provider and CCM observer programmes improve the observer debriefing process related to bycatch, including the Scientific Services Provider incorporating appropriate data quality flags within the ROP master database to facilitate use in analyses. This recommendation applies to both purse seine and longline fisheries.

24. SC13 recommended that the currently implemented procedure to convert from weight to numbers, and vice versa, should be reviewed by the Scientific Services Provider to ensure that resulting estimates are appropriate and report to SC14.

25. SC13 recommends that the Commission adopt a formal definition of SSIs, e.g. "species of special interest are those species for which the Commission has requested additional data collection under the ROP, either because they are protected under one or more WCPFC conservation and management measures, or for other reasons articulated by the Commission". SC13 notes that at present under this definition SSIs would comprise manta and mobulid (devil) rays on the basis of a Commission decision requiring a greater degree of observer data collection, and silky, oceanic whitetip and whale shark on the basis of no-retention conservation and management measures (CMMs 2011-04, 2012-04 and 2013-08). In responding to WCPFC13's specific request, SC13 confirms that as SSIs, manta and devil rays will have all required data collected under the Regional Observer Programme Minimum Standard Data Fields.

Electronic Reporting outcomes from WCPFC13

26. SC13 recommended that the WCPFC ERandEM Working Group convene prior to SC14 to continue work in this area, including consideration of how observer data obtained through E-Monitoring is to be dealt with in the WCPFC context.

27. SC13 recommended that the latest draft version of the WCPFC E-Reporting observer data standards be forwarded to WCPFC14 for adoption.

STOCK ASSESSMENT

28. Summary of stock status and management advice for WCPO key tunas, northern stocks, sharks and billfish are included in following reference papers and Attachments:

- WCPFC14-2017-12: summary for bigeye, yellowfin and skipjack tuna
- WCPFC14-2017-13: summary for South Pacific albacore
- WCPFC14-2017-14: summary for North Pacific albacore
- WCPFC14-2017-15: summary for Pacific bluefin tuna
- Attachment A: A brief summary matrix for all WCPO tunas, sharks and billfishes

- Attachment B: New *Provision of scientific information* for North Pacific blue shark, Pacific bigeye thresher shark, porbeagle shark and South Pacific sword fish

MANAGEMENT ISSUES THEME

29. SC13 recommendations related to the *Development of harvest strategy framework* are included in WCPFC14-2017-11 and recommendations related to Implementation of CMM 2016-01 are in WCPFC14-2017-12. Recommendations on *Management issues related to FADs* are listed below:

FAD tracking

30. SC13 reviewed preliminary data analyses from the PNA's FAD tracking programme, investigating research areas such as FAD densities in time and space, beaching events, dynamics around the WCPO FAD closure and some initial FAD life-history information (SC13-MI-WP-05). While acknowledging the confidentiality associated with FAD-tracking data, SC13 was supportive of these new data being made available to the Scientific Services Provider for analysis, and noting the scope for further analyses and the importance of complete FAD tracking data to support these analyses, encouraged additional data being made available by fishing companies to continue this research. SC13 also noted the importance of FAD marking and monitoring to better identify and follow individual FADs required to facilitate this research, and the on-going WCPFC considerations on FAD marking and monitoring. SC13 recommends that WCPFC14 note these preliminary analyses and identify mechanisms to help facilitate further analyses, if the Commission requires improved information for decision-making on this subject.

FAD management

31. SC13 reviewed the report of the Global FAD Science Symposium, March 20-23, 2017, in Santa Monica, California (What does well-managed FAD use look like within a tropical purse seine fishery? SC13-MI-WP-06). SC13 noted the 'best-practices' recommended in this paper under the three broad categories: (1) managing impacts on target species; (2) managing impacts on non-target species, coastal habitats, and the pelagic marine ecosystem; and, (3) the management framework, including monitoring, compliance and surveillance. SC13 also noted that impacts of FADs and FAD management cannot be considered entirely independently of harvest strategies, issues related to fishing capacity, ecosystem structure, or management of all other fishing gears in tropical tuna fisheries. SC13 also noted the report from the Joint T-RFMOs FAD Working Group (SC13-MI-IP-03). SC13 recommends that WCPFC14 take into consideration the examples of best practice made within these reports when developing a framework for the management of FADs within the WCPO.

ECOSYSTEM AND BYCATCH THEME

32. SC13 recommendations on sharks, seabirds and sea turtles are listed in WCPFC14-2017-16. Recommendations related to *FAD impacts* are listed below:

Case studies on FADs

33. Based on the results and recommendations of SC13-EB-WP-02, which reviewed the scientific information on drifting FAD designs that have a high risk of entangling sharks, turtles and other species, such as designs that use open net panels with (stretched) mesh sizes of 7cm or greater, SC13 requests that the Commission notes:

- That bycatch was more frequently observed on sets on drifting FADs, anchored FADs and logs than for sets on unassociated schools, and schools associated with whales and whale sharks. However, species-specific bycatch rates do not always follow this pattern; and
- The available scientific information on non-entangling dFAD designs.

FAD research plan

34. With SC13-EB-WP-05, consider potential research activities on and at-sea trials of designs for reducing small bigeye/yellowfin tuna catch rates and trials of non-entangling and biodegradable design options in the WCPO to fill key knowledge gaps provided in the report of SC13 ISG-2 on FAD data fields and FAD research plans.

35. SC13 adopted the report of ISG-2 on the FAD data fields and FAD Research Plan (SC13 Summary Report, Attachment E).

OTHER RESEARCH PROJECTS

Pacific Tuna Tagging Project

36. The Scientific Committee endorsed the PTTP work plan for 2017-2020, and supported:
   a) the PTTP as part of the ongoing work of the SC;
   b) efforts to identify sustainable financing of the PTTP, through a combination of WCPFC budget support to the extent possible and voluntary contributions from WCPFC members or other stakeholders; and
   c) an assessment of the cost-effectiveness of acquiring and running a dedicated tagging vessel.

WCPFC Tissue Bank (Project 35b)

37. The Scientific Committee confirmed that maintaining and enhancing the WCPFC Tuna Tissue Bank (P35b) remains an essential part of the WCPFC science system and supported its inclusion in the proposed budget for 2018.

38. The Scientific Committee agreed to include the WCPFC Tuna Tissue Bank (P35b) in its indicative budget for 2019-20.

39. The Scientific Committee agreed the development and implementation of a multi-level login to the web portal which would allow greater access to Tuna Tissue Bank data for those planning research.~~SC13 supported the recommendations.~~

FUTURE WORK PROGRAM AND BUDGET

40. SC13 adopted the proposed budget (Table 1) and forwarded it to the FAC at the December WCPFC meeting.

Table 1. Summary of SC work programme titles and budget for 2018, and indicative budget for 2019–2020, which requires funding from the Commission's core budget (USD).

Project title	TORs	Essential	Priority / Rank	2018	2019	2020
SPC Oceanic Fisheries Programme Budget		Yes		888,624	906,396	924,524

Project title	TORs	Essential	Priority / Rank	2018	2019	2020
SPC – Additional resourcing[1]		Yes		163,200	164,832	166,480
Project 35b. Maintenance and enhancement of the WCPFC Tissue Bank	Annexed	Yes	High	97,200	97,200	97,200
Project 42 Pacific Tuna Tagging Program	Annexed	Yes	High	500,000	650,000	690,000
Project 57. Identifying appropriate LRPs for elasmobranchs within the WCPFC	Annexed		High	25,000	0	0
Project 60: Improving purse seine species composition	Annexed		Medium / 1		40,000	40,000
Project 68. Estimation of seabird mortality across the WCPO Convention area	Annexed		High	22,500	17,500	
Project 81. Further work on bigeye tuna age and growth	Annexed	Yes	High/1	30,000		
Project 82. Yellowfin tuna age and growth	Annexed	?	High/2	100,000	85,000	
Project 83. Investigating the potential for a WCPFC tag vessel	Annexed	No	Medium	62,500		
Project 88. Acoustic FAD analyses	Annexed	No	Medium		120,000	72,000
Project 90. Better data on fish weights and lengths for scientific analyses	Annexed		High		40,000	20,000
Unobligated (Contingency) Budget				0	83,000	83,000
SC13 TOTAL BUDGET				**1,889,024**	**2,203,928**	**2,093,205**

ADMINISTRATIVE MATTERS

Election of Officers of the Scientific Committee

41. SC13 considered nominations for SC Chair, SC Vice-Chair, but no nominations were made. Members were asked to further consider potential nominations in the intersessional period.

Next meeting

42. SC13 confirmed that SC14 would be held in Busan, Korea, during 8 – 16 August 2018, and proposed that SC15 in 2019 be held in Samoa.

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

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

Brief summary of stock status and management advice for the WCPO tunas, sharks and billfishes

Species	Last assessment	Stock status	Management advice
Tropical Tunas			
Bigeye tuna (*Thunnus obesus*)	SC13 (2017)	○ Total catch in 2016: 152,806 mt - PS catch in 2016: 63,304 mt ○ Reference points: - Median $SB_{recent}/SB_{F=0}$ = 0.32 (SB_{recent} is the mean SB over 2012-2015) - Median SB_{latest} /$SB_{F=0}$ = 0.37 ○ It appears that the stock is not experiencing overfishing (77% probability) and it appears that the stock is not in an overfished condition (84% probability)	○ SC13 recommends: - that WCPFC14 could continue to consider measures to reduce F from fisheries that take juveniles, with the goal to increase bigeye fishery yields and reduce any further impacts on the spawning potential for this stock in the tropical regions. - as a precautionary approach that the F on bigeye tuna stock should not be increased from current level to maintain current or increased SB until the Commission can agree on an appropriate TRP.
Yellowfin tuna (*Thunnus albacares*)	SC13 (2017)	○ Total catch in 2016: 650,491 mt - PS catch in 2016: 394,756 mt ○ Reference points: - Median $SB_{recent}/SB_{F=0}$ = 0.33 (SB_{recent} is the mean SB over 2012-2015) - Median SB_{latest} /$SB_{F=0}$ = 0.37 ○ It appears that the stock is not experiencing overfishing 96% probability) and it appears that the stock is not in an overfished condition (92% probability).	○ SC13 reiterates its previous advice from SC10 that: - WCPFC could consider measures to reduce F from fisheries that take juveniles, with the goal to increase to maximum fishery yields and reduce any further impacts on the spawning potential for this stock in the tropical regions. - measures should be implemented to maintain current SB levels until the Commission can agree on an appropriate TRP.
Skipjack tuna (*Katsuwonus pelamis*)	SC12 (2016)	<u>SC13 (2017) indicator analysis</u>: ○ Total catch in 2016: 1,816,762 mt - PS skipjack catch in 2016: 1,408,110 mt ○ Based on 2016 fishery conditions: - Median F_{2018}/F_{MSY} = 0.37 - Median $SB_{2018}/SB_{F=0}$ = 0.47 <u>SC12 (2016) stock assessment</u>: ○ Two different views: - Majority: $SB_{2015}/SB_{F=0}$ = 0.58 for reference	<u>SC12 (2016) management advice:</u> ○ The current SB is around the adopted TRP ○ Maintain the SB near the TRP

		case model - Alternative: $SB_{2015}/SB_{F=0}$ = 0.43-0.71 reflecting the 5th and 95th percentiles of the structural uncertainty grid o The stock is not in an overfished state nor experiencing overfishing	
South Pacific albacore tuna (*Thunnus alalunga*)	SC11 (2015)	SC13 (2017) fishery information: o Total catch in 2016 (south of equator): 58,033 mt - LL catch in 2016: 55,635 mt - Troll catch in 2016: 2,372 mt o Based on 2015 fishery conditions: - $SB_{2033}/SB_{F=0}$ = 0.35 with P(SB_{2033}<LRP) = 0.07 - Overall vulnerable biomass (a CPUE proxy) in LL fisheries is estimated to decrease by 7% from 2013-2033. SC11 (2015) stock assessment: o Base case: $SB_{2013}/SB_{F=0}$ = 0.40 o The stock is not overfished and overfishing is not occurring	SC11-13 (2015-2017) management advice: o Longline F and catch be reduced to avoid further decline in the vulnerable biomass so that economically viable catch rates can be maintained, especially for longline catches of adult albacore - SC13 recommends that this advice be taken into consideration when the TRP for SP albacore is discussed at WCPFC14.
Northern Stocks			
North Pacific albacore (*Thunnus alalunga*)	SC13 (2017)	SC13 noted that the ISC provided the following conclusions on the stock status of North Pacific albacore: o The stock is likely not overfished relative to the LRP adopted by the WCPFC (SSB_{2015} = 2.47*20%$SSB_{current,F=0}$), and o No F-based reference points have been adopted to evaluate overfishing. Stock status was evaluated against seven potential reference points. Current fishing intensity ($F_{2012-2014}$ = 0.51) is below six of the seven reference points, except for F50%.	SC13 noted the following conservation information from the ISC: o If a constant fishing intensity ($F_{2012-2014}$) is applied to future projections, then median SSB is expected to undergo a moderate decline, with a < 0.01% probability of falling below the WCPFC's LRP by 2025. However, expected catches in this scenario will be below the recent average catch level for this stock. o If a constant average catch ($C_{2010-2014}$ = 82,432 mt) is applied to future projections, then the decline in median SSB will be greater than in the constant F intensity scenario and the probability that SSB falls below the LRP will be greater by 2025 (30%). Additionally, the estimated fishing intensity will double relative to the current level ($F_{2012-2014}$) by 2025 as SSB declines.

Pacific bluefin tuna (*Thunnus orientalis*)	SC12 (2016)	ISC's stock status conclusion: ○ The stock is in an overfished state and overfishing is occurring - SSB(2014) ≈ 17,000 mt - Provisional 2015 catch: 11,020 mt - $SB_{2014}/SB_{F=0}$ = 2.6% (initial rebuilding target = 7% of $SB_{F=0}$)	ISC's conservation advice: ○ The projection results indicate that a 10% reduction of smaller fish (<30kg) would have a larger effect on recovery than a 10% reduction of larger fish.
North Pacific swordfish (*Xiphias gladius*)	SC10 (2014)	ISC's stock status conclusion: ○ The WCNPO stock is healthy ($B_{2010-2012}>B_{MSY}$) and is above the level required to sustain recent harvest rates ($H_{2010-2012}$). ○ For the EPO stock, overfishing may be occurring in recent years.	ISC's conservation advice: ○ The WCNPO stock is not fully exploited. ○ Recent average yield is two times higher than the estimated MSY, and not likely sustainable in the long term.
Sharks			
Oceanic whitetip shark (*Carcharhinus longimanus*)	SC08 (2011)	○ $SB_{current}/SB_{MSY}$ = 0.153; $SB_{current}/SB_0$ = 0.065 ○ The stock is in an overfished state and overfishing is occurring	○ A management measure designed to reduce F has been agreed (CMM 2011-04). ○ Reference points for shark species, including oceanic whitetip sharks, are under consideration by the SC.
Silky shark (*Carcharhinus falciformis*)	SC09 (2012)	○ $F_{current}/F_{MSY}$ = 4.32; $SB_{current}/SB_{MSY}$ = 0.72 ○ The stock is in an overfished state and overfishing is occurring	○ The greatest impact on the stock is attributed to bycatch from the LL fishery in the tropical and subtropical areas, but there are also significant impacts from the associated PS fishery that catches predominantly juvenile sharks. ○ Management measure designed to reduce F has been agreed (CMM 2013-08). ○ Reference points for shark species, including silky sharks, are under consideration by the SC.
South Pacific blue shark (*Prionace glauca*)	SC12 (2016)	• The 2016 SP blue shark assessment is preliminary.	• No management advice has been provided.
North Pacific blue shark (*Prionace glauca*)	SC13 (2017)	○ SC13 noted that ISC provided the following conclusions on the stock status of North Pacific blue shark: - An estimate of SSB_{2015} (295,774 mt) was 69% higher than SSB_{MSY}. - The recent $F_{2012-2014}$) was estimated at approximately 38% of F_{MSY} . - The stock is considered not overfished and overfishing is not occurring	○ SC13 noted the following conservation information from ISC: - The 2015 SSB exceeds SSB_{MSY} and $F_{2012-2014}$ is below F_{MSY}. - Future projections under different F (status quo, F+20%, F-20%, F_{MSY}) show that median blue shark biomass in the North Pacific will likely remain above B_{MSY} in the foreseeable future.

North Pacific shortfin mako (*Isurus oxyrinchus*)	SC11 (2015)	• Insufficient data to conduct a stock assessment. • SC13 noted that there is no existing stock assessment for NP shortfin mako shark - The ISC conducted an indicator analysis in 2015 and a full assessment is planned in 2018.	• No management advice has been provided.

Pacific bigeye thresher shark (*Alopias superciliosus*)	SC13 (2017)	• SC13 reviewed a Pacific-wide sustainability risk assessment, and noted that:
		  o assuming a range of longline post-capture survival rates of 30-70%, median sustainability risk for the 2000-2014 period ranged between:
		    - 20% below to 60% above the MIST based on 0.5*r*,
		    - 50% below to 10% above the MIST based on 0.75*r*, and
		    - 60% to 20% below the MIST based on *r*.
		  o CPUE increased in the calibration area (the Hawaii-based fleet) in the last year of the assessment.
			• Noting the outcomes of the risk assessment in Paragraphs 427 – 430 of the SC13 Summary Report, SC13 recommends that WCPFC14 take the results of this assessment into consideration when framing a management measure for bigeye thresher sharks in the WCPO.

Porbeagle shark (*Lamna nasus*)		• Based on the outcomes of the stock status assessment, SC13 noted that fishing mortality on the Southern Hemisphere stock is very low, median F values ranged from 0.0008 to 0.0015 in the assessment area (Eastern Atlantic to Western Pacific Ocean) in the last decade (2005 to 2014).	• SC13 advises WCPFC14 that there is a very low risk that the Southern Hemisphere porbeagle shark is subject to overfishing anywhere within its range. • SC13 recommends that WCPFC14 request the Common Oceans (ABNJ) Tuna Project to explore options for data improvements through liaison with other regional fishery bodies.
Billfishes			

South Pacific swordfish (*Xiphias gladius*)	SC13 (2017)	• SC13 noted that:
		  - median ($SB_{recent}/SB_{F=0}$) = 0.35 (80% probability interval: 0.29 – 0.43) Median (SB_{recent}/SB_{MSY}) = 1.23
		  - Median (F_{recent}/F_{MSY}) = 0.86 (80% probability interval: 0.51 – 1.23)with Prob((F_{recent}/F_{MSY})>1) = 0.32.
		• It is highly likely that the stock is not in an
			• SC13 recommends that:
			  o the Commission consider developing appropriate management measures for the area north of 20°S to the equator, noting that:
			    - recent catches between the equator and 20°S continue to represent the largest component of the catch in Region 2, and,
			    - catches in that area contribute substantially to F and SB depletion levels

		overfished condition (0% probability of being overfished) and the stock is not experiencing overfishing (32% probability of overfishing).	in eastern Region 2 that are substantially higher than in the western region (Region 1). ○ current restrictions on catches south of 20°S also be maintained.
Southwest Pacific striped marlin (*Kajikia audax*)	SC08 (2011)	○ The stock may be overfished though overfishing is not occurring.	○ Reduce the overall catch through the expansion of the geographical scope of CMM 2006-04 in order to cover the distribution range of the stock.
North Pacific striped marlin (*Kajikia audax*)	SC11 (2015)	○ SSB_{2013} / SSB_{MSY} = 0.39; $F_{2010\text{-}2012}$ / F_{MSY} = 1.49 ○ $SSB_{current}/SSB_{current,F=0}$ = 0.12 ○ The stock is in an overfished state and overfishing is occurring.	○ Develop a rebuilding plan for NP striped marlin with subsequent revision of CMM 2010-01 in order to improve stock status.
Pacific blue marlin (*Makaira nigricans*)	SC12 (2016)	ISC's stock status conclusion: ○ The stock is not currently overfished and is not experiencing overfishing.	ISC's conservation advice: ○ Since the stock is nearly full exploited, F should be remained at or below current levels (2012-2014).

Attachment B[2]

4.3.4 North Pacific blue shark (*Prionace glauca*)

4.3.4.2 Provision of scientific information

375. ISC presented working paper **SC12-SA-WP-10** Stock Assessment and Future Projections of Blue Shark in the North Pacific Ocean through 2015.

376. ISC considered that the current assessment provides the best available scientific information on North Pacific Blue shark stock status.

a. Stock status and trends

377. SC13 noted that ISC provided the following conclusions on the stock status of North Pacific blue shark.

378. The assessment uses a fully integrated approach in Stock Synthesis with model inputs that have been greatly improved since the previous assessment. The main differences between the present assessment and the 2014 assessment are: 1) use of SS with a thorough examination of the size composition data and the relative weighting of CPUE and composition data; 2) improved life history information, such as growth and reproductive biology, and their contribution to productivity assumptions; 3) an improved understanding and parametrization of the low fecundity stock recruit relationship (LFSR); 4) catch, CPUE and size time series updated through 2015; 5) a suite of model diagnostics including implementation of an Age Structured Production Model implemented in SS. There remain some uncertainties in the time series based on the quality (observer vs. logbook) and timespans of catch and relative abundance indices, limited size composition data for several fisheries, the potential for additional catch not accounted for in the assessment, and regarding life history parameters.

379. Extensive model explorations showed that the reference run had the best model performance and showed fits most consistent with the data. The CPUE indices used in the reference case were considered most representative of the North Pacific blue shark stock due to their broader spatial temporal coverage in the core distribution of the stock and the statistical soundness of the standardizations. Alternate CPUE series for the latter part of the time series produced different stock trajectories depending upon the index used, but in each case, median SSB during the last three years exceeded SSBMSY. Using alternate assumptions on stock productivity (i.e., form of the stock recruitment relationship) also resulted in variation in the stock trajectories; assuming stock productivity lower than supported by current biological studies, resulted in lowered spawning stock biomass relative to MSY.

380. Results of the reference case model showed that the spawning stock biomass was near a time-series high in the late 1970s, fell to its lowest level between 1990 to 1995, subsequently increased gradually to reach the time-series high again in 2005, and has since shown small fluctuations with no apparent trend (Figure NPBSH- 1B) close to the time-series high. Recruitment has fluctuated around 37,000,000 age-0 sharks annually with no apparent trend (Figure NPBSH-1A). Stock status is reported in relation to MSY based reference points.

381. Based on these findings, the following information on the status of the North Pacific blue shark stock is provided:

[2] Attachment B is the excerpts from the SC13 Summary Report.

a) Female spawning biomass in 2015 (SSB_{2015}) was 69% higher than at MSY and estimated to be 295,774 mt (Table NPBSH-1; Figure NPBSH-1B).
b) The recent annual fishing mortality ($F_{2012-2014}$) was estimated to be well below F_{MSY} at approximately 38% of F_{MSY} (Table NPBSH-1; Figure NPBSH-1C).
c) The reference run produced terminal conditions that were predominately in the lower right quadrant of the Kobe plot (not overfished and overfishing not occurring) (Figure NPBSH-2).

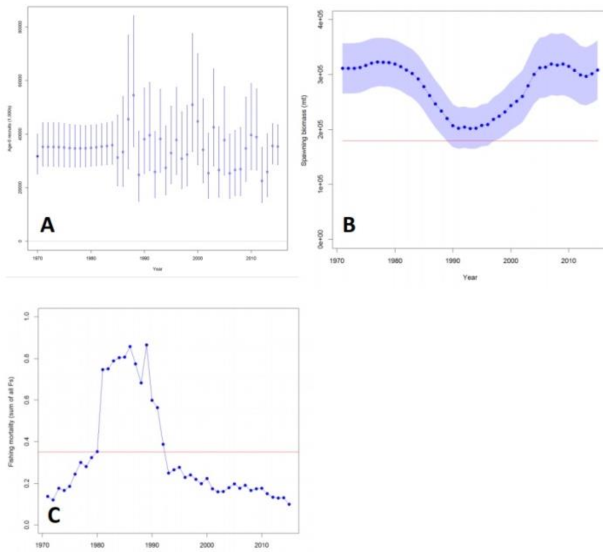


Figure NPBSH- 1. Results of the SS stock assessment reference case model: (A) estimated age-0 recruits (circles) and 95% confidence intervals (vertical bars); (B) estimated female spawning biomass and 95% confidence intervals (blue shaded area); (C) estimated fishing mortality (sum of F's across all fishing fleets). Red solid lines indicate the estimates of SB_{MSY} and F_{MSY} in (B) and (C), respectively.

Table NPBSH-1. Estimates of key management quantities for the North Pacific blue shark SS stock assessment reference case model and the range of values for 13 sensitivity runs.

Management Quantity	Reference Case Model	Range for Sensitivity Runs
SSB_{1971}	301,739 mt	174,381 - 980,878 mt
SSB_{2015}	295,774 mt	140,742 - 1,082,300 mt
SSB_{MSY}	175,401 mt	100,984 - 482,638 mt
F_{1971}	0.15	0.01 - 0.15
$F_{2012-2014}$	0.14	0.06 - 0.15
F_{MSY}	0.36	0.26 - 0.66
SSB_{2015}/SSB_{MSY}	1.69	1.39 - 2.59
$F_{2012-2014}/F_{MSY}$	0.38	0.15 - 0.50

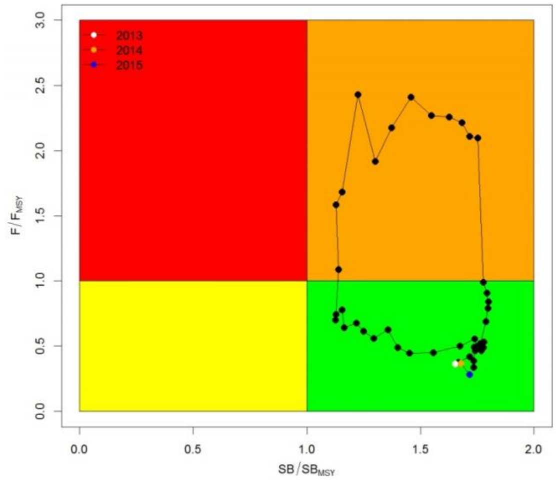


Figure NPBSH- 2. Kobe plot of the trends in estimates of relative fishing mortality and spawning biomass of North Pacific blue shark between 1971- 2015 for the reference case of the SS stock assessment model.

b. Management advice and implications

382. SC13 noted the following conservation information from ISC.

383. Target and limit reference points have not yet been established for pelagic sharks by the WCPFC and IATTC, the organizations responsible for management of pelagic sharks caught in international fisheries for tuna and tuna-like species in the Pacific Ocean.

384. The 2015 SSB exceeds SSB_{MSY} and $F_{2012-2014}$ is below F_{MSY}. Future projections under different fishing mortality (F) harvest policies (status quo, +20%, -20%, F_{MSY}) show that median BSH biomass in the North Pacific will likely remain above B_{MSY} in the foreseeable future (Table NPBSH-2; Figure NPBSH-3). Other potential reference points were not considered in these evaluations.

Table NPBSH-2. Projected trajectory of spawning biomass (in metric tons) for alternative harvest scenarios.

Year	Average F + 20%	F_{MSY}	Average F - 20%	Average F (2012-2014)
2015	308,286	308,286	308,286	308,286
2016	319,292	319,292	319,292	319,291
2017	328,679	324,591	330,693	329,683
2018	334,827	324,839	339,339	337,069
2019	337,305	323,009	344,621	340,929
2020	339,267	319,719	349,439	344,292
2021	340,833	316,419	353,720	347,185
2022	342,133	313,352	357,498	349,691
2023	343,229	310,601	360,796	351,859
2024	344,166	308,173	363,648	353,728

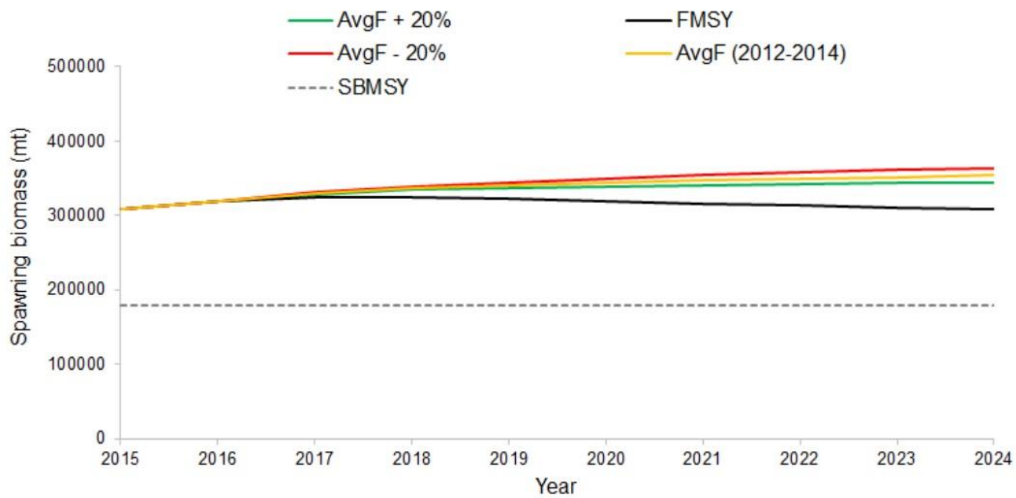


Figure NPBSH-3. Comparison of future projected blue shark spawning biomass under different F harvest policies (status quo, +20%, -20%, and F_{MSY}) using the SS reference case model. Status quo fishing mortality was based on the average from 2012-2014.

4.3.6 Pacific bigeye thresher shark (*Alopias superciliosus*)

4.3.6.2 Provision of scientific information

406. SC13 reviewed the report for Pacific-wide sustainability risk assessment of bigeye thresher shark (*Alopias superciliosus*) presented by S. Clarke, S. Hoyle and C. Edwards (SC13-SA-WP-11). The team assessed the fishing mortality status by comparing estimates of fishing mortality against three maximum impact sustainable threshold (MIST) reference points equivalent to *r*, 0.75*r* and 0.5*r*, where *r* refers to the estimated intrinsic growth rate of increase of the species.

a. Stock status and trends

407. SC13 noted that the results of the assessment indicate that assuming a range of longline post-capture survival rates of 30-70%, which likely reflects current fishing operations, median sustainability risk for the 2000-2014 period ranged between:

- 20% below to 60% above the MIST based on 0.5*r*,
- 50% below to 10% above the MIST based on 0.75*r*, and
- 60% to 20% below the MIST based on *r*.

408. SC13 also noted that CPUE increased in the calibration area (the Hawaii-based fleet) in the last year of the assessment. This may suggest an increase in biomass, but the reason for the CPUE increase is not understood.

b. Management advice and implications

409. SC13 noted that although the stock status of this species is currently unknown, the bigeye thresher assessment showed that, estimating for current fishing operations (with 30-70% post-capture mortality) across a range of scenarios, some of the median F estimates exceeded two of the three indicative reference points (0.5*r* and 0.75*r*) (Table BTH-1). Across all 30-70% post-capture scenarios, there is a >50% probability in most years that F > MIST based on 0.5*r* and a >20% probability in most years that F > MIST based on 0.75*r*. (Table BTH-2).

TABLE BTH-1. Sustainability risk (ratio of impact to MIST, at three levels of the MIST, with values >1 considered to be unsustainable) (median values and 95% quantile range) for bigeye thresher in the Pacific. Estimates are for the Core Area and the Assessment Area assuming the occurrence of post-capture survival (random occurrence between 30% and 70%) in impact estimation and three initial population status assumptions (low (0.3), medium (0.5), and high (0.7)). Results are contrasted for the fifteen-year period (2000-2014) and the recent period (2011-2014). F*crash* = *r*, F*lim* = 0.75*r*, and F*msm* = *r*/2.

MIST	Area	Assumed initial status	Impact / MIST (2000 - 2014)	Impact / MIST (2011 - 2014)
F_{crash}	Core area	Low (0.3)	0.815 (0.247 - 2.540)	0.902 (0.281 - 2.794)
		Medium (0.5)	0.563 (0.164 - 2.154)	0.619 (0.184 - 2.399)
		High (0.7)	0.438 (0.119 - 1.764)	0.483 (0.134 - 1.961)
	Assessment area	Low (0.3)	0.755 (0.230 - 2.426)	0.974 (0.302 - 3.051)
		Medium (0.5)	0.519 (0.148 - 1.890)	0.677 (0.193 - 2.428)
		High (0.7)	0.379 (0.110 - 1.620)	0.488 (0.142 - 2.065)
F_{lim}	Core area	Low (0.3)	1.086 (0.330 - 3.387)	1.203 (0.375 - 3.725)
		Medium (0.5)	0.750 (0.219 - 2.872)	0.826 (0.245 - 3.199)
		High (0.7)	0.585 (0.159 - 2.351)	0.644 (0.179 - 2.614)
	Assessment area	Low (0.3)	1.006 (0.306 - 3.234)	1.299 (0.402 - 4.068)
		Medium (0.5)	0.691 (0.198 - 2.520)	0.902 (0.257 - 3.238)
		High (0.7)	0.506 (0.147 - 2.160)	0.651 (0.189 - 2.753)
F_{msm}	Core area	Low (0.3)	1.629 (0.495 - 5.080)	1.805 (0.563 - 5.588)
		Medium (0.5)	1.125 (0.328 - 4.308)	1.238 (0.368 - 4.798)
		High (0.7)	0.877 (0.239 - 3.527)	0.966 (0.269 - 3.922)
	Assessment area	Low (0.3)	1.510 (0.459 - 4.852)	1.949 (0.603 - 6.101)
		Medium (0.5)	1.037 (0.297 - 3.780)	1.353 (0.386 - 4.857)
		High (0.7)	0.759 (0.220 - 3.240)	0.977 (0.284 - 4.130)

TABLE BTH-2. Sustainability risk probabilities (Pr(Impact > MIST), for 3 levels of MIST: F*crash*, F*lim*, and F*msm*) for bigeye thresher in the Pacific, 2000-2014, assuming 100% capture mortality (left) and the occurrence of post-capture survival (right) over the Core Area and the Assessment Area (combined values across three initial population status assumptions). F*crash* = *r*, F*lim* = 0.75*r*, and F*msm* = *r*/2.

	Absence of post-cap survival						Occurrence of post-capture survival					
	Core area			Assessment area			Core area			Assessment area		
Year	F_{crash}	F_{lim}	F_{msm}	F_{crash}	F_{lim}	F_{msm}	F_{crash}	F_{lim}	F_{msm}	F_{crash}	F_{lim}	F_{msm}
2000	0.295	0.489	0.756	0.188	0.358	0.645	0.163	0.294	0.51	0.108	0.215	0.405
2001	0.226	0.413	0.684	0.129	0.275	0.538	0.126	0.236	0.435	0.062	0.145	0.320
2002	0.372	0.573	0.818	0.216	0.388	0.673	0.218	0.345	0.558	0.117	0.217	0.429
2003	0.521	0.711	0.905	0.413	0.626	0.853	0.308	0.460	0.673	0.248	0.393	0.616
2004	0.359	0.555	0.803	0.228	0.413	0.689	0.197	0.334	0.556	0.124	0.235	0.442
2005	0.565	0.746	0.926	0.392	0.594	0.837	0.333	0.488	0.706	0.224	0.370	0.593
2006	0.405	0.592	0.834	0.224	0.399	0.668	0.229	0.372	0.597	0.114	0.225	0.437
2007	0.463	0.656	0.870	0.347	0.545	0.796	0.269	0.431	0.644	0.191	0.336	0.558
2008	0.375	0.583	0.822	0.323	0.530	0.779	0.211	0.353	0.572	0.175	0.313	0.537
2009	0.319	0.512	0.776	0.356	0.567	0.820	0.175	0.299	0.513	0.214	0.357	0.571
2010	0.338	0.547	0.799	0.285	0.484	0.740	0.193	0.335	0.549	0.158	0.289	0.499
2011	0.414	0.619	0.849	0.379	0.583	0.832	0.236	0.384	0.598	0.222	0.359	0.581
2012	0.586	0.775	0.936	0.674	0.829	0.965	0.369	0.520	0.727	0.434	0.587	0.790
2013	0.501	0.697	0.897	0.614	0.790	0.943	0.298	0.450	0.660	0.392	0.545	0.743
2014	0.411	0.603	0.836	0.353	0.562	0.806	0.233	0.365	0.584	0.204	0.350	0.560

410. SC13 noted that the modelled scenario of 30-70% post-capture survival reduced F estimates by approximately one third and reduced the risk that the MIST based on *r* will be exceeded by 50%

compared to the scenario assuming no post-catch survival. A "no-retention" measure was not modelled but would be expected to reduce F even further.

411. SC13 noted that the area of highest estimated fishing mortality overlapped with the region of higher relative abundance for the species, corresponding to a narrow band between approximately 10-15°N and 150°E-140°W. Fishing operations targeting bigeye tuna and operating during the April-June period had the highest mortality over the recent period (2011-2014).

412. SC13 noted that the Commission needs to further consider appropriate limit reference points and risk tolerances for exceeding LRPs for sharks.

413. SC13 recommends that WCPFC14 take the results of this assessment into consideration when framing a management measure for bigeye thresher sharks in the WCPO.

4.3.7 Porbeagle shark (*Lamna nasus*)

4.3.7.2 Provision of scientific information

422. SC13 reviewed the report for Southern Hemisphere porbeagle shark (*Lamna nasus*) stock status assessment presented by S. Clarke, S. Hoyle and C. Edwards (SC13-SA-WP-12). The Pacific-wide sustainability risk assessment of Southern Hemisphere porbeagle shark assessed status by comparing estimates of fishing mortality against three maximum impact sustainable threshold reference points equivalent to *r*, 0.75*r* and 0.5*r*, where r refers to the estimated intrinsic rate of increase of the species.

a. Stock status and trends

423. SC13 noted that although the stock status of the species is currently unknown the results of the assessment show that fishing mortality on the Southern Hemisphere stock is very low, and that it decreases eastward from the waters off South Africa to the waters off New Zealand. In the assessment area (Eastern Atlantic to Western Pacific Ocean) in the last decade (2005 to 2014), median F values ranged from 0.0008 to 0.0015 (mean 0.0010). This fishing mortality was less than 9% of the MIST based on *r* in all years assessed (1992-2014) and fell to half that level in more recent years (Figure POR-1), with at most a 3% probability of exceeding the MIST based on *r* in 2010-2014 (Figure POR-2). For the same scenarios, fishing mortality is less than 12% of the MIST based on 0.75*r* and less than 18% of the MIST based on 0.5*r*.

424. These scenarios are based on 100% capture mortality, and assuming that some porbeagles survive their encounter with the fishery would reduce the estimated risk levels even further.

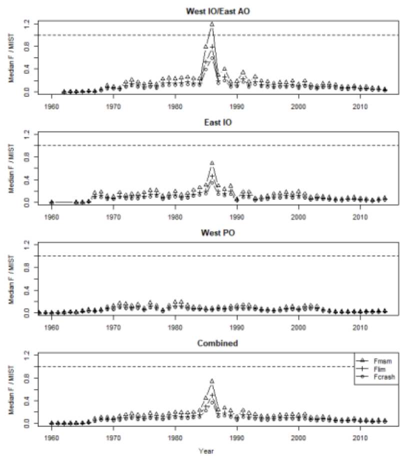


Figure POR-1. F-ratio plots showing the median values of F / MIST by year, for the three versions of the MIST (Fmsm, Flim, and Fcrash) for each of the three regions and for the three regions combined (the assessment area). Note that the F-ratio is almost always below 1, indicated by the horizontal dotted line.

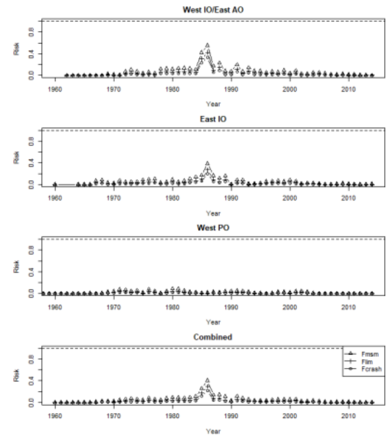


Figure POR-2. Risk plots showing the probability that F exceeds the MIST by year, for the three versions of the MIST (Fcrash, Flim, and Fcrash) for each of the three regions and for the three regions combined (the assessment area).

b. Management advice and implications

425. SC13 advises WCPFC14 that although the stock status of the species is currently unknown there is a very low risk that the Southern Hemisphere porbeagle shark is subject to overfishing anywhere within its range.

426. SC13 recommends that WCPFC14 request the Common Oceans (ABNJ) Tuna Project to explore options for data improvements through liaison with other regional fishery bodies managing fisheries catching Southern Hemisphere porbeagle shark.

4.4.1 South Pacific swordfish (*Xiphias gladius*)

4.4.1.2 Provision of scientific information

435. SC13 noted that the preliminary total south Pacific swordfish tuna catch by longliners in the WCPFC area south of the equator in 2016 (6,300 mt) was a 20% decrease over 2015 and a 25% decrease over 2011-15 (SC13-GN-WP-01).

436. Y. Takeuchi (SPC) presented SC13-SA-WP-13 *Stock Assessment of Swordfish (Xiphias gladius) in the southwest Pacific Ocean*. The stock assessment was based on a structural uncertainty grid comprised of 72 models, each of which was considered to be a plausible representation of South Pacific swordfish (SWO) stock dynamics. The four structural uncertainties represented in the grid were: the three stock-recruitment steepnesses, the two weightings of the size data, the three weightings of the diffusion rate and the four values of natural mortality. Each individual model consisted of a unique combination of settings from the uncertainty axes. As a result, the uncertainty grid was comprised of 72 related but different models, each of which made a distinct claim about the dynamics of SWO fishery system to best explain and predict stock status. The major uncertainty related to growth and maturity noted in the previous assessment has now been resolved due to the results of new research which were presented to and endorsed by SC12 (SC12-SA-WP-11).

437. SC13 endorsed the 2017 SWO stock assessment as the best and most up to date scientific information available for this species.

438. SC13 also endorsed the use of the SWO assessment model uncertainty grid to characterize stock status and management advice and implications.

439. SC13 reached consensus on the weighting of assessment models in the uncertainty grid for SWO. The consensus weighting considered all options within the four axes of uncertainty for steepness, size data, diffusion rate and natural mortality to be equally likely. The resulting uncertainty grid was used to characterize stock status, to summarize reference points as provided in the assessment document SC13-SA-WP-13, and to calculate the probability of breaching SB_{MSY} and the probability of F_{recent} being greater than F_{MSY}.

a. Stock status and trends

440. The median values of relative recent (2012-2015) spawning biomass (SB_{recent}/SB_{MSY}) and relative recent fishing mortality (F_{recent}/F_{MSY}) over the uncertainty grid were used to measure the central tendency of stock status. The values of the upper 90th and lower 10th percentiles of the empirical distributions of relative spawning biomass and relative fishing mortality from the uncertainty grid were used to characterize the probable range of stock status.

441. Description of the updated structural sensitivity grid used to characterize uncertainty in the assessment is provided in Table SWO-1. Time trends in estimated catch, recruitment, biomass, fishing mortality and depletion are shown in Figures SWO-1 – 5. Figures SWO-6 and SWO-7 show Majuro plot summarising the results for each of the models in the structural uncertainty grid retained for management advice. Kobe plots are shown in Figures SWO-8 and SWO-9. Figure SWO-10 provides estimated time-series (or "dynamic") Majuro and Kobe plots from the SW Pacific swordfish 'diagnostic case' model run. Figure SWO-11 shows Estimates of reduction in spawning potential due to fishing by region, and over all regions (lower left panel), attributed to various fishery groups (distant water 'north', 'central' and 'south', corresponding to the model regions, and a combined domestic fleet) for the diagnostic case model. Summary of reference points over all 72 individual models in the structural uncertainty grid are shown in Table SWO-2.

Table SWO-1: Description of the structural sensitivity grid used to characterize uncertainty in the assessment

Axis	Levels	Option
Steepness	3	0.65, 0.80, 0.95
Diffusion rate	3	0, 0.11, 0.25
Size frequency weighting	2	Sample size divided by 20,40
Natural mortality vectors	4	M1,M2,M3, M4

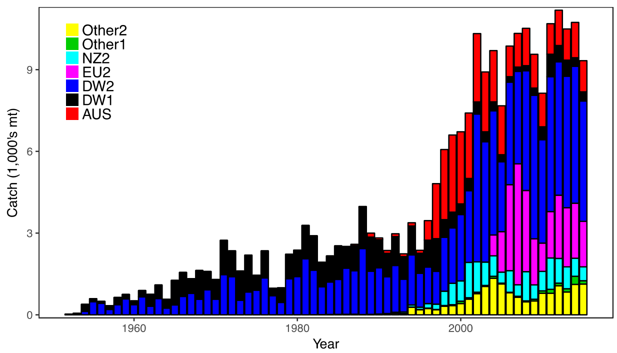


Figure SWO-1. Total swordfish catches in weight grouped by major longline-method fisheries in the model regions, 1952–2011. (DW1 - distant water fleet region 1; AUS – Australian region 1; Other1 - Other fisheries region 1; DW2 - distant water fleet region 2; NZ2 - New Zealand region 2; EU2 – EU (Spanish) region 2; Other2 - other fisheries region 2)

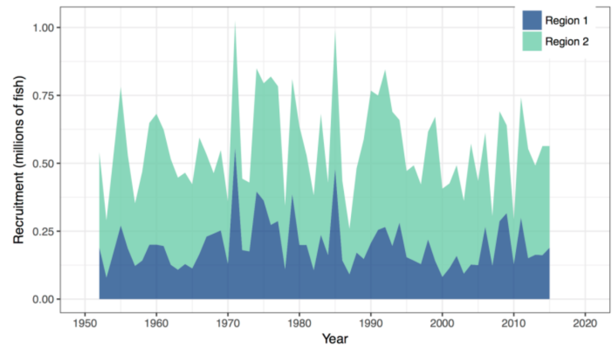


Figure SWO2. Estimated annual average recruitment by model region for the diagnostic case model, showing the relative sizes among regions.

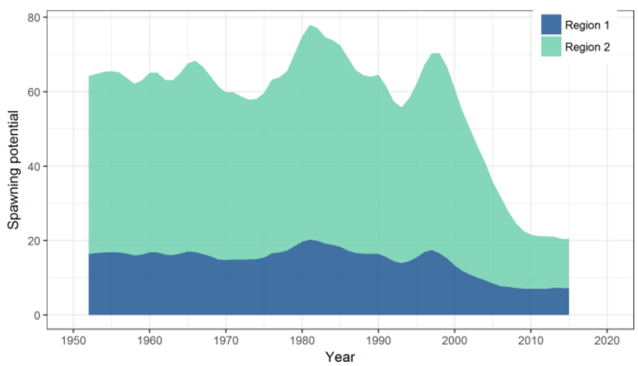


Figure SWO3. Estimated annual average spawning potential by model region for the diagnostic case model, showing the relative sizes among regions.

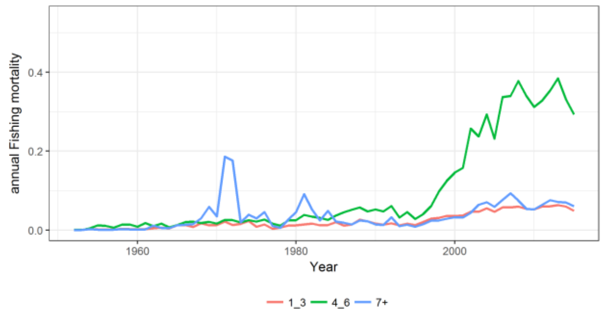


Figure SWO-4. Estimated annual average juvenile (age classes 1-3), maturing adult (4-6) and adult (7+) fishing mortality for the diagnostic case model.

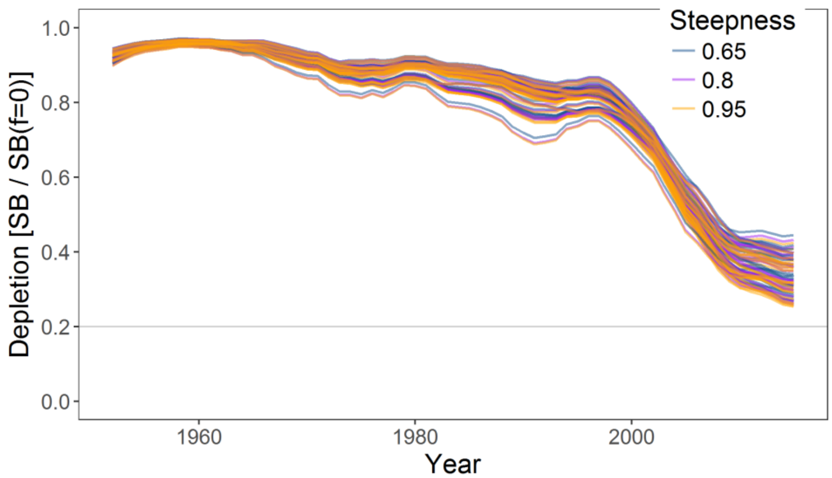
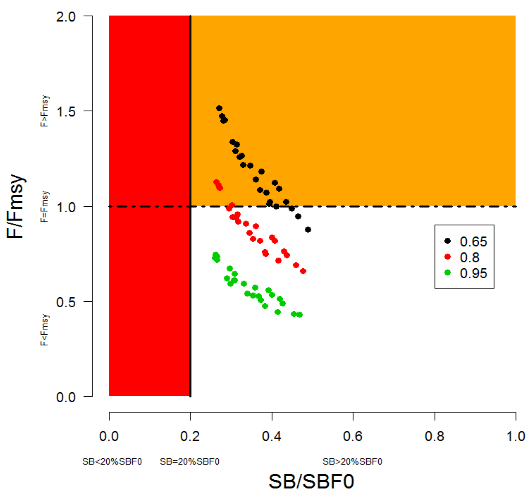


Figure SWO-5. Plot showing the trajectories of fishing depletion (of spawning potential) for the 72 model runs retained for the structural uncertainty grid used for management advice. The colours depict the models in the grid with three levels of steepness (0.65, 0.8 and 0.95).



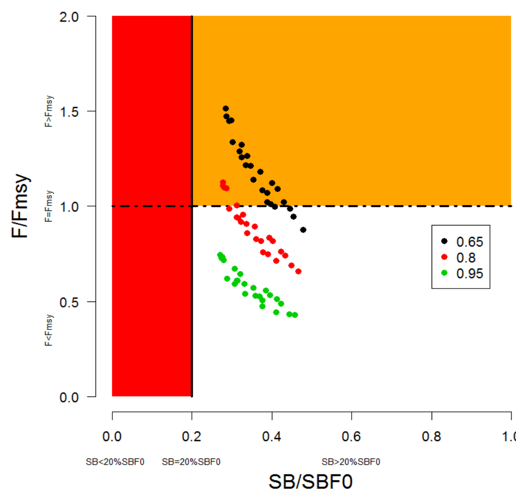


Figure SWO-6. Majuro plot summarising the results for each of the models in the structural uncertainty grid retained for management advice. The plots represent estimates of stock status in terms of spawning potential depletion and fishing mortality. The red zone represents spawning potential levels lower than the agreed limit reference point which is marked with the solid black line. The orange region is for fishing mortality greater than F_{MSY} (F_{MSY} is marked with the black dashed line). The points represent SB_{latest} /$SB_{F=0}$, and the colours depict the models in the grid with three levels of steepness (0.65, 0.8 and 0.95).

Figure SWO-7. Majuro plot summarising the results for each of the models in the structural uncertainty grid retained for management advice. The plots represent estimates of stock status in terms of spawning potential depletion and fishing mortality. The red zone represents spawning potential levels lower than the agreed limit reference point which is marked with the solid black line. The orange region is for fishing mortality greater than F_{MSY} (F_{MSY} is marked with the black dashed line). The points represent $SB_{recent}/SB_{F=0}$, and the colours depict the models in the grid with three levels of steepness (0.65, 0.8 and 0.95). Note, SB_{recent} is defined as the mean of SB over 2012-2015.

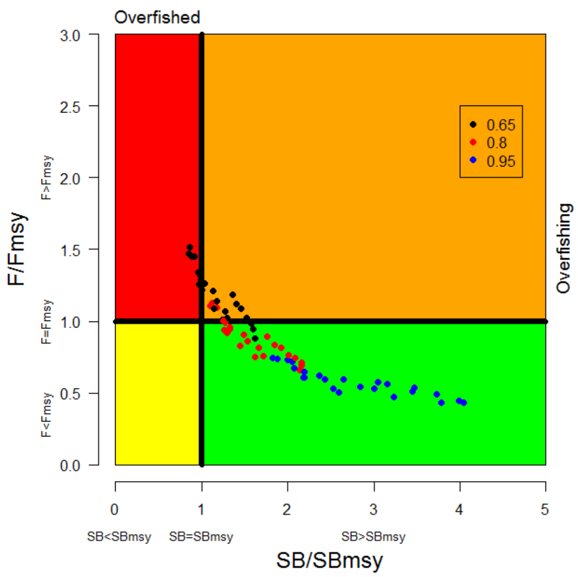


Figure SWO-8. Kobe plot summarising the results for each of the models in the structural uncertainty grid, where the x-axis represents SB_{latest} /SB_{MSY}. The colours depict the models in the grid with three levels of steepness (0.65, 0.8 and 0.95).

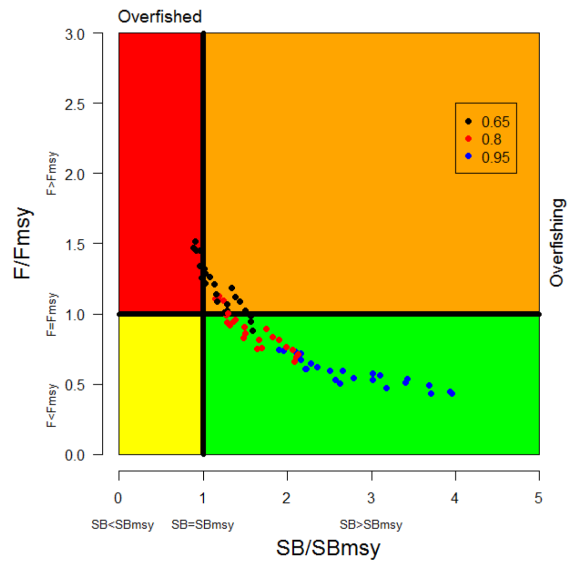


Figure SWO-9. Kobe plot summarising the results for each of the models in the structural uncertainty grid. The colours depict the models in the grid with three levels of steepness (0.65, 0.8 and 0.95). As in Figure SWO7, SB_{recent} was used instead of SB_{latest}.

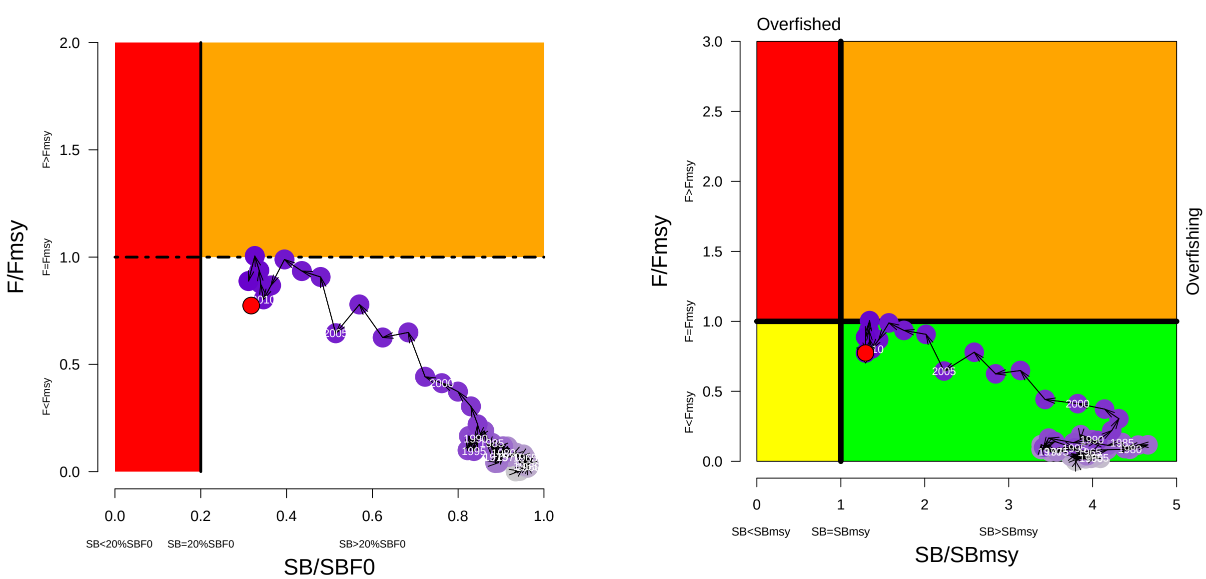


Figure SWO-10. Estimated time-series (or "dynamic") Majuro and Kobe plots from the SW Pacific swordfish 'diagnostic case' model run.

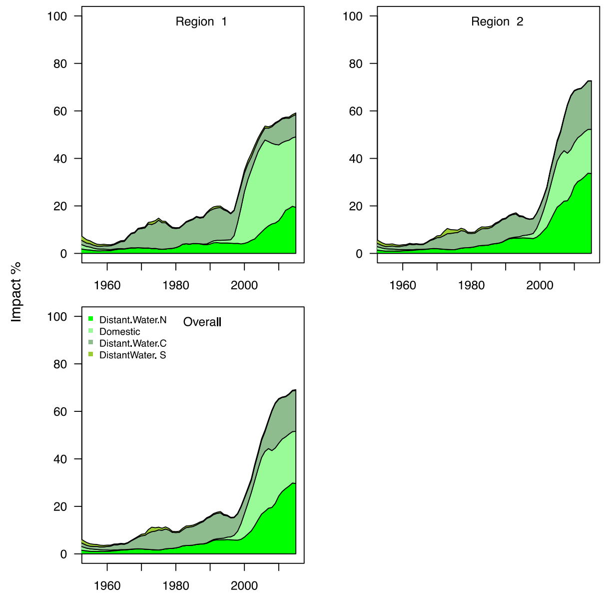


Figure SWO-11. Estimates of reduction in spawning potential due to fishing by region, and over all regions (lower left panel), attributed to various fishery groups (distant water 'north', 'central' and 'south', corresponding to the model regions, and a combined domestic fleet) for the diagnostic case model.

Table SWO-2. Summary of reference points over the 72 models in the structural uncertainty grid for management advice. Note that $SB_{recent}/SB_{F=0}$ is calculated where SB_{recent} is the mean SB over 2012-2015 instead of 2011-2014 (used in the stock assessment report), at the request of the Scientific Committee.

	Mean	**Median**	**Min**	**10%**	**90%**	**Max**
C_{latest}	9,884	9,884	9,318	9,343	10,157	10,287
MSY	8,172	7,913	5,905	6,396	10,150	11,360
$Y_{Frecent}$	7,628	7,775	4,998	6,062	8,948	9,684
f_{mult}	1.27	1.15	0.66	0.79	1.89	2.32
F_{MSY}	0.16	0.14	0.10	0.10	0.22	0.23
$F_{recent}/F_{\mathrm{MSY}}$	0.88	0.87	0.43	0.53	1.26	1.51
SB_{MSY}	17,314	17,740	7,278	8,943	26,661	30,460
SB_0	84,173	84,075	57,070	71,199	98,039	111,000
SB_{MSY}/SB_0	0.20	0.21	0.11	0.12	0.28	0.28
$SB_{F=0}$	78,619	78,301	61,996	64,342	92,120	100,691
$SB_{\mathrm{MSY}}/SB_{F=0}$	0.22	0.23	0.10	0.12	0.32	0.33
SB_{latest}/SB_0	0.33	0.32	0.24	0.25	0.44	0.46
$SB_{latest}/SB_{F=0}$	0.35	0.35	0.26	0.27	0.44	0.49
$SB_{latest}/SB_{\mathrm{MSY}}$	1.85	1.61	0.85	0.99	3.14	4.05
$SB_{recent}/SB_{F=0}$	0.36	0.35	0.27	0.29	0.43	0.48
$SB_{recent}/SB_{\mathrm{MSY}}$	1.86	1.58	0.88	1.02	3.10	3.96

442. SC13 noted that the central tendency of relative recent spawning biomass was median ($SB_{recent}/SB_{F=0}$) = 0.35 with a probable range of 0.29 to 0.43 (80% probability interval). The median estimate (0.35) is below that estimated from the 2014 assessment grid(($SB_{current}/SB_{F=0}$) = 0.49, see SC9-SA-WP-05), noting the differences in grid uncertainty axes used in that assessment, due to the inclusion of two representations of growth and maturity. SC13 also noted that in the previous assessment this central tendency was not considered for the provision of management advice given the uncertainties in

growth assumptions. The median estimate for SB_{recent}/SB_{MSY} is 1.23, which is below that estimated from the 2014 assessment grid (($SB_{current}/SB_{MSY}$) = 2.07, see SC9-SA-WP-05).

443. SC13 noted that the central tendency of relative recent fishing mortality was median (F_{recent}/F_{MSY}) = 0.86 with an 80% probability interval of 0.51 to 1.23. While this suggested that there was likely a buffer between recent fishing mortality and F_{MSY}, it also showed that there was some probability that recent fishing mortality was above F_{MSY}.

444. SC13 also noted that there was a roughly 32% probability (23 out of 72 models) that the recent fishing mortality was above F_{MSY} with Prob((F_{recent}/F_{MSY})>1) = 0.32. The median estimate (0.86) is above that estimated from the 2014 assessment grid ($F_{current}/F_{MSY}$ = 0.74, see SC9-SA-WP-05).

445. Fishing mortality rate increased notably from the mid-1990s in both model regions, on maturing swordfish aged 4-6 fish in particular.

446. Across all models in the uncertainty grid the spawning biomass declines steeply between the late 1990s and 2010 but since then the rate of decline has been less. Those declines are found in both model regions, but are higher in the eastern Region 2 (equator to 50°S, 165°E to 130°W).

447. SC13 noted that in comparison with the bigeye and yellowfin assessments, evidence for an increase in recent recruitment for southwest Pacific swordfish was not found in either the CPUE time series or estimates of recruitment. SC13 noted that the longline only nature of the fishery catching mainly larger, older swordfish, is not strongly informative with regards to recruitment dynamics.

b. Management advice and implications

448. Based on the uncertainty grid adopted by SC13, the south west Pacific swordfish spawning biomass is likely above the $20\%SB_{F=0}$, biomass LRP adopted for tunas and the SB_{MSY} level (noting that the Commission has yet to adopted an LRP for south Pacific swordfish) and it is highly likely that the stock is not in an overfished condition (0% probability). Recent F is likely below F_{MSY}, and it appears that the stock is not experiencing overfishing (32% probability of overfishing).

449. SC13 noted that there has been an increase in fishing mortality notably from the mid-1990s, and that the biomass relative to unfished levels is estimated to have declined rapidly during the period late-1990s to 2010 followed by a more gradual but continued decline after 2010, across the uncertainty grid. It was noted the fishing mortality was likely below F_{MSY}.

450. Consistent with its previous advice (from SC9), SC13 recommends that the Commission consider developing appropriate management measures for the area north of 20°S to the equator which is not covered by CMM 2009-03, noting that:

- recent catches between the equator and 20°S continue to represent the largest component of the catch in Region 2 (equator to 50°S, 165°E to 130°W) and represent half the total catches from the stock, and,
- catches in that area contribute substantially to fishing mortality and spawning biomass depletion levels in eastern Region 2 that are substantially higher than in the western region (Region 1).

451. Further, SC13 recommends that current restrictions on catches south of 20°S also be maintained.