COMMISSION
ELEVENTH REGULAR SESSION
Faleata Sports Complex, Apia, SAMOA
1 - 5 December 2014

EXECUTIVE SUMMARY (HIGHLIGHTED)

WCPFC11-2014-16b
29 November 2014

AGENDA ITEM 1 — OPENING OF THE MEETING

1.1 Welcome address

1. The Tenth Regular Session of the Scientific Committee (SC10) was held in Majuro, Republic of the Marshall Islands from 6–14 August 2014. Ludwig Kumoru chaired the meeting. The Hon. Michael Konelios, Minister of Resources and Development, Republic of the Marshall Islands, delivered opening remarks.

2. The theme conveners and their assigned themes are:

Data and Statistics theme	Ludwig Kumoru
Stock Assessment theme	Jon Brodziak (USA) and Miki Ogura (Japan)
Management Issues theme	Robert Campbell (Australia)
Ecosystem and Bycatch Mitigation theme	Aisake Batibasaga (Fiji) and John Annala (New Zealand)

AGENDA ITEM 2 — REVIEW OF FISHERIES

2.1 Overview of the western and central Pacific Ocean fisheries

3. The provisional total tuna catch for the Western and Central Pacific Fisheries Commission (WCPFC) Statistical Area in 2013 was estimated at 2,621,511 mt, the second highest ever and only 30,000 mt below the record catch in 2012 (2,652,322 mt). This catch represents 80% of the total Pacific Ocean catch of 3,213,733 mt, and 57% of the global tuna catch (the provisional estimate for 2013 is 4,511,238 mt, which was the second highest on record).

4. The 2013 WCPFC Statistical Area skipjack tuna catch (1,784,091 mt – 68% of the total catch) was the highest recorded, eclipsing the previous record of catch in 2009 (1,779,307 mt) by 5,000 mt. The WCPFC Statistical Area yellowfin tuna catch for 2013 (535,656 mt – 21%) was more than 75,000 mt less than the record catch of 2012 (612,797 mt) due to relatively poor catches in both the longline and purse-seine fisheries. The WCPFC Statistical Area bigeye tuna catch for 2013 (158,662 mt – 6%) was less than that in 2012, but relatively stable compared with the average over the past 10 years. The 2013 WCPFC

Statistical Area albacore catch (143,102 mt – 5%) was slightly higher than that in 2012 and the second highest on record (after 2002 at 147,793 mt). The WCPFC Statistical Area albacore catch includes catches of North and South Pacific albacore in the WCPFC Statistical Area, which comprised 81% of the total Pacific Ocean albacore catch of 177,568 mt in 2013. The South Pacific albacore catch in 2013 (84,698 mt) was the third highest on record.

5. The provisional 2013 purse-seine catch of 1,898,090 mt was the highest catch on record and more than 60,000 mt more than the previous record in 2012 (1,836,295 mt). The 2013 pole-and-line catch (221,022 mt) was the lowest annual catch since the late 1960s and is continuing the trend in declining catches for the past three decades. The provisional WCPFC Statistical Area longline catch (230,073 mt) for 2013 was the lowest catch since 1999. The 2013 South Pacific troll albacore catch (3,226 mt) was the highest during the last five years. The number of active purse-seine vessels in 2013 (excluding artisanal vessels in the Philippines, Indonesia and the Japanese coastal fisheries) was an all-time high (297 vessels) and total effort (in terms of fishing days estimated from logbook data and vessel monitoring system,data) was also the highest on record.

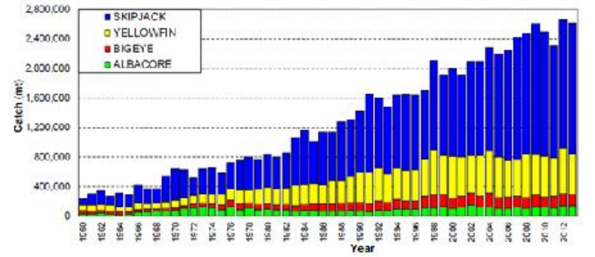

Figure 1: Catch (mt) of albacore, bigeye, skipjack and yellowfin tunas in the WCPFC Statistical Area.

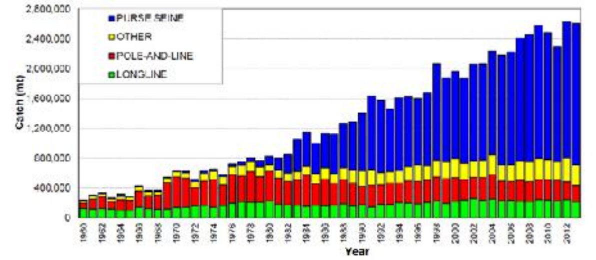

Figure 2: Catch (mt) of albacore, bigeye, skipjack and yellowfin tunas in the WCPFC Statistical Area, by longline, pole-and-line, purse-seine and other gear types.

AGENDA ITEM 3 — DATA AND STATISTICS THEME

3.1 Data gaps

6. SC10 recommended that:

a) the paper SC10-ST-WP-01 is forwarded to the Tenth Regular Session of the Technical and Compliance Committee (TCC10), highlighting the main data gap related to the non-provision of operational catch and effort data for 10 years by some Members, Cooperating Non-members and participating Territories (CCMs);

b) in regard to data issues related to the attribution of catch under charter arrangements, any revision to conservation and management measure (CMM) 2012-05 should include a reference to section 6 of "Scientific Data to be provided to the Commission";

c) TCC10 consider establishing a tier and scoring system to better reflect the magnitude and severity of the non-provision of scientific data;

d) the data gap of the Chinese Taipei purse-seine fleet — related to the estimation of species catches in their aggregate data (Data Gap Note 13) — be removed from Table 4 of SC10-ST-WP-01 and that Chinese Taipei provide a paper to SC11, describing the methodology used to estimate tuna species catches in their aggregate purse-seine data provided to WCPFC; and

e) as a response to the requirements stated in paragraph 46 of CMM 2013-01, the summary of "other" gear catches of the tropical tuna species in the paper SC9-ST-WP-01 (Table 1) be updated to reflect:

i) the exclusion of those fisheries that take less than 2,000 mt of bigeye, yellowfin and skipjack tunas, and

ii) the inclusion of any available information CCMs have provided on the estimates of fishing effort of these fisheries (refer to paragraphs 47 and 48 of CMM 2013-01).

7. SC10 recommended that:

a) the scientific services provider update the Plan for the Improvement of the Availability and Use of Purse-seine Catch Composition Data set out in SC8-WCPFC8-08 for consideration by SC11 and TCC11, noting the need for the Commission to adopt an integrated approach to improving purse-seine species composition data, including both scientific and compliance aspects. The update should take into account the outcomes of the work undertaken in Project 60, including the information in SC10-ST-WP-02;

b) the information in SC10-ST-IP-02 regarding purse-seine species composition sampling protocols, spill bin size, and expectations of crew usage be forwarded to industry by CCMs to assess implications and operational constraints of wider use of spill sampling and report the feedback to SC11 and TCC11.

c) as a carry-over from an SC9 recommendation, the scientific services provider provide to SC11 annual estimates of purse-seine catches based on: i) logbook-reported species composition, ii) observer grab samples (previous approach), and iii) observer grab samples corrected for selectivity bias from spill sampling. Catch series from any variants on these should also be included. This will allow SC to follow changes in purse-seine catch estimates from historical methods. The work should also include any guidance on the implications of future estimates if only grab sampling occurs (e.g. Can the selectivity bias correction be used into the future?).

3.2 Regional Observer Programme

8. SC10 recommended that:

a) the output from the informal small group on the longline observer coverage (Attachment E) be forwarded to TCC10 to progress this work; and

b) the Regional Observer Programme (ROP)-defined observer data, summarized in past and present SC papers that have not been provided to WCFPC, be provided to the WCPFC Secretariat as soon as possible. The observer data summarized in SC10-ST-IP-10 are an example of data that should be provided to the WCFPC Secretariat.

3.3 Electronic monitoring and electronic reporting

9. SC10 recommended that:

a) the outcomes from the WCPFC e-reporting and e-monitoring workshop (March 2014) are taken to TCC10, in particular, the urgent need for developing standards for formats and validation checks of the potential e-reporting and e-monitoring data to be submitted to WCPFC that ensure accordance with agreed WCPFC data standards and take into consideration existing standards; and

b) the e-reporting and e-monitoring trials continue to be supported and expanded, leading to large-scale implementation, where appropriate

AGENDA ITEM 4 — STOCK ASSESSMENT THEME

4.1 WCPO tunas

4.1.1 WCPO bigeye tuna

10. SPC presented SC10-SA-IP-01 (Summary of major changes in the 2014 tropical tuna assessments) and SC10-SA-WP-01 (Stock assessment of bigeye tuna in the WCPO). The updated assessment addresses many of the recommendations provided in SC8-SA-WP-01 (Independent review of the 2011 bigeye tuna stock assessment). Other key papers document: i) the methods used in producing the purse-seine size data (Abascal et al. 2014) and catch estimates (Lawson 2013); ii) longline size data (McKechnie 2014), longline catch per unit of effort (CPUE) data (McKechnie et al. 2014b), and tagging data (Berger et al. 2014); iii) revisions to the fisheries and spatial definitions (McKechnie et al. 2014a); and iv) the guidance of the Pre-Assessment Workshop (PAW) held in April 2014 (SPC 2014).

a. Stock status and trends

11. There have been significant improvements to the 2014 stock assessment resulting from the implementation of the 2012 bigeye tuna review recommendations. Improvements were made to regional and fisheries structures, CPUE, size, and tagging data inputs, and the MULTIFAN-CL modeling framework. This assessment is also the first since the adoption of an LRP based on the spawning biomass in the absence of fishing ($0.2SB_{F=0}$).

12. SC10 selected the reference case model as the base case to represent the stock status of bigeye tuna. To characterize uncertainty, SC10 chose three additional models based on alternative values of steepness and a shorter tag-mixing period. Details of the base case and other models are provided in Table BET1.

Table BET1: Description of the base case and key model chosen for the provision of management advice.

Name	Description
Base case	JP CPUE for Regions 1, 2, and 4, all flags for Regions 3, 7, 8, 5, and 6, and nominal for Region 9. Size data weighted as the weighted number of samples divided by 20, steepness fixed at 0.8, M fixed, tag mixing at 2 quarters, and the mean length of fish in the oldest age class (L2) fixed at 184 cm.
h_0.65	Steepness=0.65
h_0.95	Steepness=0.95
Mix_1qtr	Tag-mixing period=1 quarter

13. Time trends in estimated recruitment, biomass, fishing mortality and depletion are shown in Figures BET 1–4.

14. The estimated MSY of 108,520 mt is higher than previous assessments. This is for three key reasons: i) the improved assessment has higher average recruitment; ii) application of the lognormal bias correction to the spawner-recruitment relationship; and iii) increased catches used in the new assessment.

15. Fishing mortality has generally been increasing through time, and for the reference case $F_{current}$ (2008–2011 average) is estimated to be 1.57 times the fishing mortality that will support MSY. Across the four models (base case and three sensitivity models), $F_{current}/F_{MSY}$ ranged from 1.27 to 1.95. This indicates that overfishing is occurring in the WCPO bigeye tuna stock and that in order to reduce fishing mortality to F_{MSY} levels, the base case indicates that a 36% reduction in fishing mortality is required from 2008–2011 levels (Table BET2 and Fig. BET5). This is similar to the 32% reduction from 2006–2009 levels recommended from the 2011 assessment.

16. The latest (2012) estimates of spawning stock biomass are below both the level that will support MSY (SB_{latest}/SB_{MSY} = 0.77 for the base case and range from 0.62 to 0.96 across the four models) and the newly adopted LRP of $0.2SB_{F=0}$ ($SB_{latest}/SB_{F=0}$ = 0.16 for the base case and range from 0.14 to 0.18.

17. An analysis of historical patterns in the mix of fishing gear types indicates that MSY has been reduced to less than half its level prior to 1970 through the increased harvesting of juveniles (Fig. BET6).

Table BET2: Estimates of management quantities for selected stock assessment models (see Table BET1 for details). For the purpose of this assessment, "current" is the average over the period 2008–2011 and "latest" is 2012.

	Base case	**h=0.65**	**h=0.95**	**Mix_1qtr**
MSY (mt)	108,520	101,880	116,240	107,880
C_{latest}/MSY	1.45	1.55	1.36	1.45
$F_{current}/F_{MSY}$	1.57	1.95	1.27	1.73
B_0	2,286,000	2,497,000	2,166,000	2,183,000
$B_{current}$	742,967	744,596	741,549	640,645
SB_0	1,207,000	1,318,000	1,143,000	1,153,000
SB_{MSY}	345,400	429,900	275,200	328,700
$SB_{F=0}$	1,613,855	1,848,385	1,483,216	1,585,331
SB_{curr}	325,063	326,007	324,283	269,820
SB_{latest}	265,599	266,290	264,937	218,679
$SB_{curr}/SB_{F=0}$	0.20	0.18	0.22	0.17
$SB_{latest}/SB_{F=0}$	0.16	0.14	0.18	0.14
SB_{curr}/SB_{MSY}	0.94	0.76	1.18	0.82
SB_{latest}/SB_{MSY}	0.77	0.62	0.96	0.67

Table BET3: Comparison of selected WCPO bigeye tuna reference points from the 2010, 2011 and 2012 base case models.

Management quantity	**Base case 2010**	**Base case 2011**	**Base case 2014**
MSY(mt)	73,840	76,760	108,520
$F_{current}/F_{MSY}$	1.41	1.46	1.57
$SB_{latest}/SB_{F=0}$	0.16	0.21	0.16

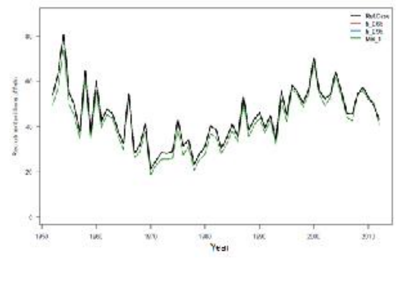

Figure BET1: Estimated annual

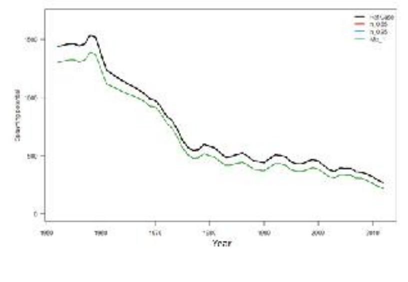

Figure BET2: Estimated annual average

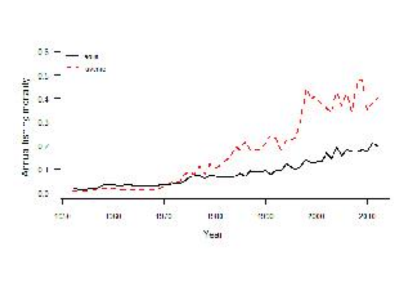

Figure BET3: Estimated annual average

recruitment (millions of fish) for the WCPO obtained from the base case model and three additional runs described in Table BET1. The model runs with alternative steepness values give the same recruitment estimates.	spawning potential for the WCPO obtained from the base case model and three additional runs described in Table BET1. The model runs with alternative steepness values give the same spawning potential trajectory estimates as the reference case.	juvenile and adult fishing mortality for the WCPO obtained from the base case model.

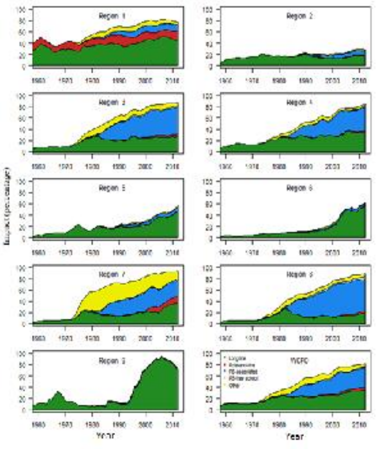	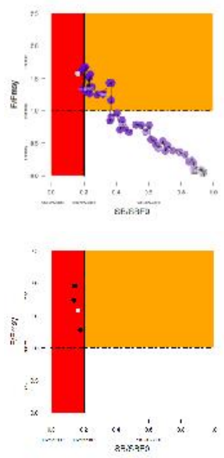	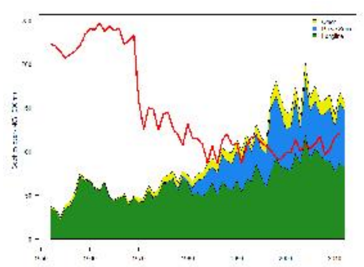
Figure BET4: Estimates of reduction in spawning potential due to fishing (fishery impact = 1-$SB_t/SB_{t,F=0}$) by region and for the WCPO attributed to various fishery groups for the base case model.	**Figure BET5:** Temporal trend for the base case model (top) and terminal condition for the base case and other sensitivity runs (bottom) in stock status relative to $SB_{F=0}$ (x-axis) and F_{MSY} (y-axis). The red zone represents spawning potential levels lower than the agreed LRP, which is marked with the solid black line (0.2$SB_{F=0}$). The orange region is for fishing mortality greater than F_{MSY} (F=F_{MSY}; marked with the black dashed line). The pink circle (top panel) is $SB_{2012}/SB_{F=0}$ (where $SB_{F=0}$ was the average over the period 2002–2011). The bottom panel includes the base case (white dot) and sensitivity analyses described in Table BET1.	**Figure BET6:** History of annual estimates of MSY compared with catches of three major fisheries for the base case model.

b. Management advice and implications

18. SC10 noted that the spawning biomass of WCPO bigeye tuna breached the biomass LRP in 2012 and that the stock was overfished. Rebuilding spawning biomass to be above the biomass LRP will require a reduction in fishing mortality.

19. SC10 recommended that fishing mortality on WCPO bigeye tuna be reduced. A 36% reduction in fishing mortality from the average levels for 2008–2011 would be expected to return the fishing mortality rate to F_{MSY}. This reduction of at least 36% should also allow the stock to rebuild above the LRP over a period of time. This recommended level of reduction in fishing mortality could also be stated as a minimum 33% reduction from the 2004 level of fishing mortality, or a minimum 26% reduction from the average 2001–2004 level of fishing mortality.

20. Future status quo projections (assuming 2012 conditions) depend on assumptions on future recruitment. When spawner-recruitment relationship conditions are assumed, spawning biomass continues to decline and the stock is very likely (94%) to remain below the LRP based on projections through 2032 ($SB_{2032}<0.2SB_{F=0}$). If recent (2002–2011) actual recruitments are assumed, spawning biomass increases and it is unlikely (13%) to remain below the LRP. Under both recruitment assumptions, it was virtually certain (100%) that the stock would remain subject to overfishing ($F>F_{MSY}$).

21. Overfishing and the increase in juvenile bigeye tuna catches have resulted in a considerable reduction in the potential yield of the WCPO bigeye tuna stock. The loss in yield per recruit due to excess harvesting of juvenile fish is substantial. SC10 concluded that MSY levels would increase if the mortality of juvenile bigeye tuna was reduced.

22. Fishing mortality varies spatially within the Convention Area, with high mortality in the tropical Pacific Ocean. WCPFC could consider a spatial management approach in reducing fishing mortality for bigeye tuna.

23. Considering the unavailability of operational longline data for the assessment from some key fleets, SC10 recommended that all operational data, including high seas data, should be available for future stock assessments. The current lack of operational data for some fleets, and in particular the lack of operational longline data on the high seas, has hampered the 2014 assessment in a number of ways (e.g. the construction of abundance indices), and consequently, has hindered SC from achieving "best practice" in the 2014 stock assessment.

24. SC10 noted that arrangements are being developed between CCMs and SPC to facilitate the availability of operational data for the Pacific-wide bigeye tuna stock assessment scheduled for 2015 (Attachment F).

25. SC10 recommended that the Commission consider the results of updated projections at WCPFC11, including an evaluation of the potential impacts of CMM 2013-01, to determine whether the CMM will achieve its objectives and allow the bigeye tuna stock to rebuild above the LRP.

4.1.2 WCPO yellowfin tuna

26. N. Davies (SPC) presented SC10-SA-WP-04 (Stock assessment of yellowfin tuna in the WCPO). The updated assessment addresses many of the recommendations provided in SC8-SA-WP-01 (Independent review of the 2011 bigeye tuna stock assessment), which apply equally to yellowfin tuna. Other key papers document: the methods used in producing the purse-seine size data (Abascal et al. 2014), longline size data (McKechnie 2014), longline CPUE data (McKechnie et al. 2014b), and tagging data (Berger et al. 2014); revisions to the fisheries and spatial definitions (McKechnie et al. 2014a); the guidance of the PAW held in April 2014 (SPC 2014).

a. Stock status and trends

27. There have been significant improvements to the 2014 stock assessment resulting from the implementation of the 2012 bigeye tuna review recommendations, which apply equally to yellowfin tuna. Improvements were made to regional and fisheries structures, catch estimates, CPUE, tagging data inputs, and the MULTIFAN-CL modeling framework. This assessment is also the first since the adoption of an LRP based on the spawning biomass in the absence of fishing ($0.2SB_{F=0}$).

28. SC10 selected the reference case model, which had an assumed steepness of 0.8 to represent the stock status of yellowfin tuna. To characterize uncertainty in the assessment, SC10 chose three additional

models based on alternate values of steepness and tagging-mixing period. More detail of the base case and other models are provided in Table YFT1.

Table YFT1: Description of the base case and key model chosen for the provision of management advice.

Name	Description
Base case	JP longline CPUE for Regions 1 and 2, all flags longline for Regions 3 to 7, and all flags longline nominal for Regions 8 and 9; with purse-seine CPUE for PH-ID in Region 7 and all flags in Region 8. Size data weighted as the number of samples divided by 20, steepness fixed at 0.8, M fixed, tag-mixing period of 2 quarters, and fixed natural mortality.
h_0.65	Steepness=0.65
h_0.95	Steepness=0.95
Mix_1qtr	Tag-mixing period=1 quarter

29. Time trends in estimated recruitment, biomass, fishing mortality and depletion are shown in Figures YFT 1–4.

30. High levels of fishing mortality on juveniles have been recorded in Region 7 (Fig. YFT6). Stock depletion levels are higher in the equatorial regions than elsewhere (refer to Fig. YFT4).

31. The estimated MSY of 586,400 mt is within the range of previous assessments, and model quantities are generally similar with these earlier assessments. This is due largely to the consistent information on declining relative abundance provided by the longline CPUE indices and the large amount of tagging data input to the model.

32. The dramatic decline in MSY in the 1970s follows the increased development of those fisheries that catch younger yellowfin tuna, principally the small-fish fisheries in the western equatorial region (Fig. YFT7).

33. Fishing mortality has generally been increasing through time, and for the reference case $F_{current}$ (2008–2011 average) is estimated to be 0.72 times the fishing mortality that will support MSY. Across the four models (base case and three sensitivity models) $F_{current}/F_{MSY}$ ranged from 0.58 to 0.90. This indicates that overfishing is not occurring in the WCPO yellowfin tuna stock, however latest catches are close to or exceed MSY by up to 13% (Table YFT2 and Fig. YFT5).

34. The latest (2012) estimates of spawning biomass are above both the level that will support *MSY* (SB_{latest}/SB_{MSY} = 1.24 for the base case and range from 1.05 to 1.51 across the four models) and the newly adopted LRP of $0.2SB_{F=0}$ ($SB_{latest}/SB_{F=0}$ = 0.38) for the base case model and range from 0.35 to 0.40.

Table YFT2: Estimates of management quantities for selected stock assessment models (see Table YFT1 for details). For the purpose of this assessment, "current" is the average over the period 2008–2011 and "latest" is 2012.

	Ref.Case	Mix_1	h_0.65	h_0.95
MSY(mt)	586400	526400	527200	642800
C_{latest}/MSY	1.02	1.12	1.13	0.93
$F_{current}/F_{MSY}$	0.72	0.87	0.9	0.58
B_0	4319000	3862000	4475000	4221000
$B_{current}$	1994655	1597536	1996179	1995224
SB_0	2467000	2202000	2557000	2411000
SB_{MSY}	728300	648000	859600	594500
$SB_{F=0}$	2368557	2206510	2556733	2255523
$SB_{current}$	998622	746743	999474	998914
SB_{latest}	899496	770210	899362	898389
$SB_{current}/SB_{F=0}$	0.42	0.34	0.39	0.44
$SB_{latest}/SB_{F=0}$	0.38	0.35	0.35	0.4
$SB_{current}/SB_{MSY}$	1.37	1.15	1.16	1.68
SB_{latest}/SB_{MSY}	1.24	1.19	1.05	1.51

Table YFT3: Comparison of selected WCPO yellowfin tuna reference points from the 2009, 2011 and 2014 base case models.

Management quantity	Ref.case-2009	Ref.case-2011	Ref.case-2014
MSY	636,800	538,800	586,400
$F_{current}/F_{MSY}$	0.58	0.77	0.72
$SB_{latest}/SB_{F=0}$	0.50	0.44	0.38

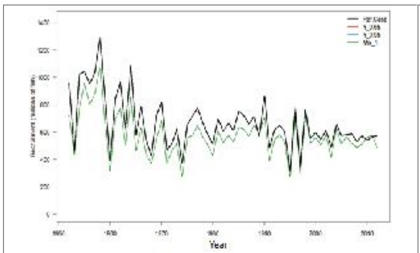

Figure YFT1: Estimated annual average recruitment for the WCPO obtained from the base case model and three additional runs described in Table YFT1. The model runs with alternative steepness values give the same recruitment estimates.

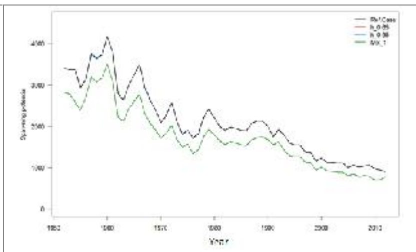

Figure YFT2: Estimated annual average spawning potential for the WCPO obtained from the base case model and three additional runs described in Table YFT1. The model runs with alternative steepness values give the same recruitment estimates.

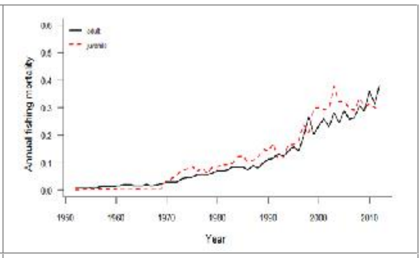

Figure YFT3: Estimated annual average juvenile and adult fishing mortality for the WCPO obtained from the base case model.

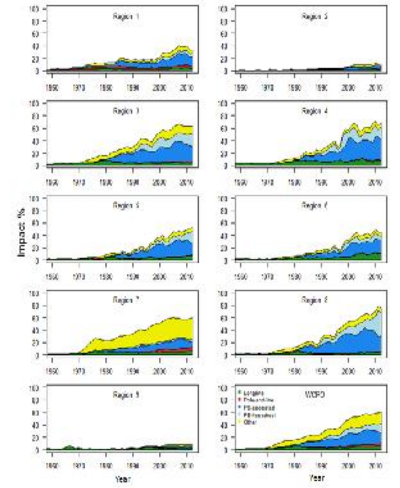

Figure YFT4: Estimates of reduction in spawning potential due to fishing (fishery impact = 1-$SB_t/SB_{t,F=0}$) by region and for the WCPO attributed to various fishery groups for the base case model.

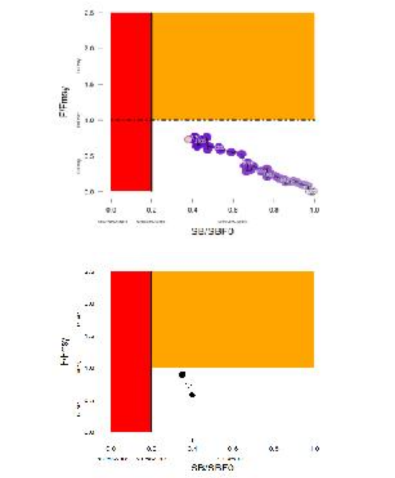

Figure YFT5: Temporal trend for the base case model (top) and terminal condition for the base case and other sensitivity runs (bottom) in stock status relative to $SBF=0$ (x-axis) and F_{MSY} (y-axis). The red zone represents spawning potential levels lower than the agreed LRP, which is marked with the solid black line (0.2$SB_{F=0}$). The orange region is for fishing mortality greater than F_{MSY} ($F=F_{MSY}$; marked with the black dashed line). The pink circle (top panel) is $SB_{2012}/SB_{F=0}$ (where $SB_{F=0}$ was the average over the period 2002–2011). The bottom panel includes the base case (white dot) and sensitivity analyses described Table YFT1.

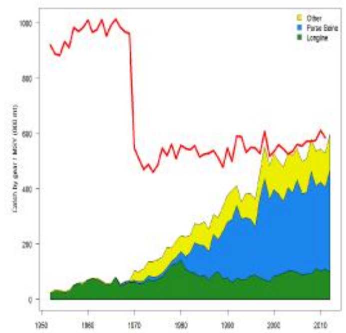

Figure YFT7: History of annual estimates of MSY compared with catches of three major fisheries for the base case model.

b. Management advice and implications

35. The WCPO yellowfin tuna spawning biomass is above the biomass-based LRP that WCPFC adopted, 0.2$SB_{F=0}$, and overall fishing mortality appears to be below F_{MSY}. It is highly likely that the stock is not experiencing overfishing and is not in an overfished state.

36. Latest (2012) catches (612,797 mt [SC10-GW-WP-01]) of WCPO yellowfin tuna marginally exceed MSY (586,400 mt).

37. Future status under status quo projections (assuming 2012 conditions) depends on assumptions on future recruitment. When spawner-recruitment relationship conditions are assumed, spawning biomass is predicted to increase and the stock is exceptionally unlikely (0%) to become overfished ($SB_{2032}<0.2SB_{F=0}$) or to fall below SB_{MSY}, or to become subject to overfishing ($F>F_{MSY}$). If recent (2002–2011) actual recruitments are assumed, spawning biomass will remain relatively constant, and the stock is exceptionally unlikely (0%) to become overfished or to become subject to overfishing, and it was very unlikely (2%) that the spawning biomass would fall below SB_{MSY}.

38. SC also noted that levels of fishing mortality and depletion differ between regions, and that fishery impact was highest in the tropical region (Regions 3, 4, 7 and 8 in the stock assessment model). WCPFC could consider measures to reduce fishing mortality 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.

39. WCPFC could consider a spatial management approach in reducing fishing mortality for yellowfin tuna.

40. SC recommended that the catch of WCPO yellowfin tuna should not be increased from 2012 levels, which exceeded MSY, and measures should be implemented to maintain current spawning biomass levels until the Commission can agree on an appropriate target reference point (TRP).

4.1.3 WCPO skipjack tuna

41. J. Rice presented SC10-SA-WP-05 (Stock assessment of skipjack tuna in the WCPO). The updated assessment addresses many of the recommendations provided in SC8-SA-WP-01 (Independent review of the 2011 bigeye tuna stock assessment) that pertain to skipjack tuna. Other key papers document: the methods used in producing the purse-seine size data (Abascal et al. 2014),and tagging data (Berger et al. 2014); revisions to the fisheries and spatial definitions (McKechnie et al. 2014); and the guidance of PAW held in April 2014 (SPC 2014).

a. Status and trends

42. There have been significant improvements to the 2014 stock assessment resulting from the implementation of the 2012 bigeye tuna review recommendations. Improvements were made to regional and fisheries structures, CPUE, size, and tagging data inputs, and the MULTIFAN-CL modeling framework. This assessment is also the first since the adoption of an LRP based on the spawning biomass in the absence of fishing ($0.2SB_{F=0}$).

43. SC10 selected the reference case model as the base case to represent the stock status of skipjack tuna. To characterize uncertainty, SC10 chose three additional models based on alternative values of steepness and a longer tag-mixing period. Details of the base case and other models are provided in Table SKJ1.

Table SKJ1: Description of the base case and key model chosen for the provision of management advice.

Name	Description
Base case	JPN PL CPUE for Regions 1,2,3, PH PS-Associated CPUE for Region 4, PNG PS-Associated CPUE for Region 5. Size data weighted as sample number/20, steepness fixed at 0.8, growth fixed, mixing period of 1 quarter, terminal 4 recruitments not estimated
h_0.65	Steepness=0.65
h_0.95	Steepness=0.95
Mix_2qtr	Tag-mixing period=2 quarters

44. Time trends in estimated recruitment, biomass, fishing mortality and depletion are shown in Figures SKJ 1–4.

45. The estimated MSY is 1,618,800 mt, which is slightly lower than recent catches.

46. Fishing mortality has generally been increasing through time, and for the base case $F_{current}$ (2008–2011 average) is estimated to be 0.61 times the fishing mortality that will support MSY. Across the base

case and three sensitivity models $F_{current}/F_{MSY}$ ranged from 0.45 to 0.82. This indicates that overfishing is not occurring for the WCPO skipjack tuna stock.

47. The latest (2011) estimates of spawning biomass are above both the level that will support MSY (SB_{latest}/SB_{MSY} = 1.74 for the base case and range from 1.45 to 2.10 across the four models) and the newly adopted LRP of $0.2SB_{F=0}$ ($SB_{latest}/SB_{F=0}$ = 0.48 for the base case and range from 0.46 to 0.5). These biomass estimates are within the range (0.4–0.6) of depletion levels currently under consideration for a possible TRP.

48. Future status under status quo projections (assuming 2012 conditions) was robust to assumptions on future recruitment. Under either assumption, spawning biomass remained relatively constant and it is exceptionally unlikely (0%) for the stock to become overfished ($SB_{2032}<0.2SB_{F=0}$) or for the spawning biomass to fall below SB_{MSY}, and it is exceptionally unlikely (0%) for the stock to become subject to overfishing ($F>F_{MSY}$).

49. Abundance indices of coastal fisheries in the Pacific coastal waters of Japan show a declining trend, and the level between 2006 and 2013 was half of the level between 1996 and 2005. The migration of the skipjack tuna stock to coastal areas around Japan, one of the edge areas of skipjack tuna distribution, has diminished since around 2006, possibly due to a range contraction of this species in the WCPO, although other reasons cannot be ruled out.

50. It is noted higher catch of skipjack tuna existed for recent years.

51. SC10 recommended that PAW consider the inclusion of fisheries data into the skipjack tuna assessment for the northern and southern margins of the Convention Area.

52. SC10 recommended that further research on range contraction of skipjack tuna be conducted in the framework of Project 67.

Table SKJ2: Estimates of management quantities for selected stock assessment models (see Table SKJ1 for details). For the purpose of this assessment, “current” is the average over the period 2008–2011 and “latest” is 2011.

	Base case	**h=0.65**	**h=0.95**	**Mix_2qtr**
MSY	1,618,800	1,426,800	1,806,800	,784,000
C_{latest}/MSY	1.02	1.16	0.92	0.93
$F_{current}/F_{MSY}$	0.61	0.82	0.45	0.52
B_0	6,587,000	6,913,000	6,404,000	7,419,000
$B_{current}$	3,615,213	3,613,290	3,612,585	4,374,786
SB_0	6,229,000	6,538,000	6,056,000	6,989,000
SB_{MSY}	1,753,000	2,111,000	1,453,000	1,999,000
$SB_{F=0}$	6,303,358	6,690,474	6,082,301	7,085,699
$SB_{current}$	3,260,579	3,258,721	3,258,170	3,971,998
SB_{latest}	3,052,995	3,050,692	3,049,508	3,548,468
$SB_{current}/SB_{F=0}$	0.52	0.49	0.54	0.56
$SB_{latest}/SB_{F=0}$	0.48	0.46	0.50	0.50
$SB_{current}/SB_{MSY}$	1.86	1.54	2.24	1.99
SB_{latest}/SB_{MSY}	1.74	1.45	2.10	1.78

Table SKJ3: Comparison of selected WCPO skipjack tuna reference points from the 2010, 2011 and 2014 base case models.

Management quantity	**Base Case 2010**	**Base Case 2011**	**Base Case 2014**
MSY	1,375,600	1,503,600	1,618,800
$F_{current}/F_{MSY}$	0.34	0.37	0.61
$SB_{latest}/SB_{F=0}$	0.48	0.55	0.48

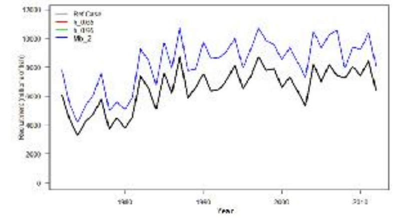

Figure SKJ1: Estimated annual recruitment (millions of fish) for the WCPO obtained from the base case model and three additional runs described in Table SKJ1. The model runs with alternative steepness values give the same recruitment estimates.

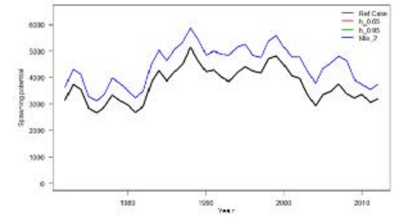

Figure SKJ2: Estimated annual average spawning potential for the WCPO obtained from the base case model and three additional runs described in Table SKJ1. The model runs with alternative steepness values give the same spawning potential estimates.

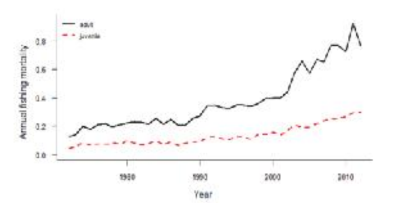

Figure SKJ3: Estimated annual average juvenile and adult fishing mortality for the WCPO obtained from the base case model.

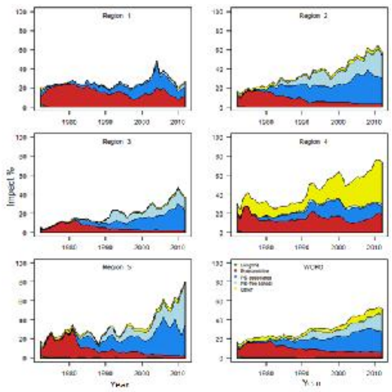

Figure SKJ4: Estimates of reduction in spawning potential due to fishing (fishery impact = $1\text{-}SB_t/SB_{t,F=0}$) by region and for the WCPO attributed to various fishery groups for the base case model. Note: Region 1 Japanese purse-seine fishery was grouped as an associated set fishery in this analysis.

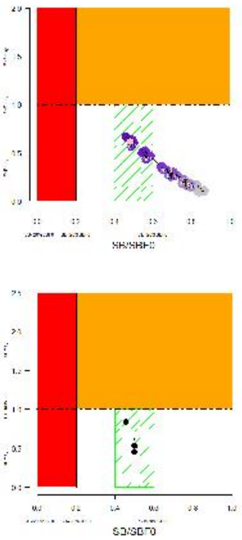

Figure SKJ5: Temporal trend for the base case model (top) and terminal condition for the base case and other sensitivity runs (bottom) in stock status relative to $SB_{F=0}$ (x-axis) and F_{MSY} (y-axis). The red zone represents spawning potential levels lower than the agreed LRP, which is marked with the solid black line ($0.2SB_{F=0}$). The orange region is for fishing mortality greater than F_{MSY} ($F=F_{MSY}$; marked with the black dashed line). The lightly shaded green rectangle covering $0.4–0.6SB_{F=0}$ are the candidate

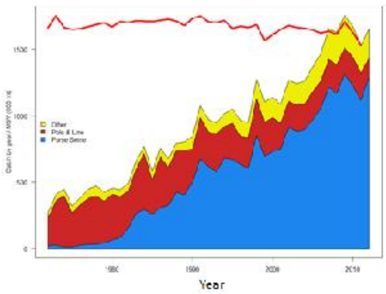

Figure SKJ6: History of annual estimates of MSY compared with catches of three major fisheries for the base case model.

	TRPs of 40%, 50% and 60% of unfished spawning stock biomass that WCPFC10 has asked for consideration of a TRP for skipjack tuna. The pink circle (top panel) is $SB_{2012}/SB_{F=0}$ (where $SB_{F=0}$ was the average over the period 2002–2011). The bottom panel includes the base case (white dot) and sensitivity analyses described Table SKJ1.	

b. Management advice and implications

53. Recent catches are slightly above the estimated MSY of 1,618,800 mt. The assessment continues to show that the stock is currently only moderately exploited ($F_{current}/F_{MSY} = 0.61$) and fishing mortality levels are sustainable. However, the continuing increase in fishing mortality and decline in stock size are recognized.

54. SC10 advised the WCPFC that there is concern that high catches in the equatorial region could result in range contractions of the stocks, thus reducing skipjack tuna availability to high latitude fisheries.

55. Fishing is having a significant impact on stock size, especially in the western equatorial region and can be expected to affect catch rates. The stock distribution is also influenced by changes in oceanographic conditions associated with El Niño and La Niña events, which impact on catch rates and stock size. Additional purse-seine effort will yield only modest gains in long-term skipjack tuna catches and may result in a corresponding increase in fishing mortality for bigeye and yellowfin tunas. The management of total effort in the WCPO should recognize this.

56. The spawning biomass is now around the mid-point of the range of candidate TRPs of 40%, 50% and 60% of unfished spawning stock biomass that WCPFC10 has asked SC10 to consider for skipjack tuna. SC10 recommends that the Commission take action to avoid further increases in fishing mortality and to keep the skipjack tuna stock around the current levels, with tighter purse-seine control rules and advocates for the adoption of TRPs and harvest control rules.

57. SC10 recommended that the Commission consider the results of updated projections at WCPFC11, including the evaluation of the potential impacts of CMM 2013-01 in order to determine whether the CMM will achieve its objectives, including impacts of the skipjack tuna fishery on bigeye and yellowfin tunas.

4.1.4 South Pacific albacore tuna

58. SPC presented SC10-SA-WP-07 (Trends in the South Pacific albacore longline and troll fisheries), a compendium of fishery indicators for South Pacific albacore tuna. Documented indicators included: total catch; catch by gear, longline effort and nominal longline CPUE trends, along with their spatial patterns; catch size composition; and trends in average fish weight.

a. Status and trends

59. SC10 noted that no stock assessment was conducted for South Pacific albacore tuna in 2014. Therefore, the stock status description and management recommendations from SC8 are still current.

60. However, recent trends for South Pacific albacore tuna are also important for describing the stock status.

a) The total South Pacific albacore catch in 2013 was 84,698 mt, which was the third highest on record, and was 3% lower than the catch in 2012, but 9% higher than the average over 2008–2012.
b) Total VMS effort information south of 10°S, which is considered to be more up to date than logsheet data, indicated that total effort had increased by 9% from 2012 to 2013. The rate of effort increase has been greater in the high seas area.
c) On the basis of stochastic stock projections using 18 assessment model runs there is a 30% chance that spawning biomass is exceeding the biological LRP. However, further analyses at SC10, based on a reduced range of 9 assessment model runs, indicated zero risk of falling below the LRP level, but decreases in median spawning biomass levels over 20 years to $65\%SB_{F=0}$ and $59\%SB_{F=0}$ for 2010 and 2012 conditions, respectively.

b. Management advice and implications

61. SC10 noted that no stock assessment has been undertaken since SC8.

62. SC10 noted the increasing catch and effort on South Pacific albacore south of the equator in both the WCPFC and IATTC convention areas which, under 2012 conditions, is projected to result in a 16% reduction on average (range of 6% to 30% reduction) in vulnerable biomass by 2030 (the biomass available to longline fleets, as a proxy for CPUE, thus particularly impacting on the vulnerable biomass available to small island developing states domestic fleets and their profitability.

63. SC10 recommends that longline fishing mortality and longline catches be reduced to avoid further decline in the vulnerable biomass and possibly exceeding the biomass LRP, and so that economically viable catch rates can be maintained.

4.2 Northern stocks

64. The chair of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) presented SC10-GN-IP-02, which outlined highlights of the 14th meeting of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean held in Taipei, Taiwan from 16 to 21 July 2014.

4.2.1 North Pacific albacore tuna

65. ISC presented working paper SC10-SA-WP-12 (Stock assessment of albacore tuna in the North Pacific Ocean in 2014).

a. Status and trends

66. SC10 noted that the ISC provided the following conclusions on the stock status of North Pacific albacore.

> Because the F for 2010–2012 relative to most candidate reference points, except F_{MED} and $F_{50\%}$, are below 1.0, NPALB is not experiencing overfishing (Table NP-ALB1). Although no biomass-based reference points have been developed for this stock, there is little evidence from this assessment that fishing has reduced SSB below reasonable candidate biomass-based reference points, so the ALBWG concludes that the stock is likely not in an overfished condition at present. The ISC concludes that the North Pacific albacore stock is healthy and that current productivity is sufficient to sustain recent exploitation, assuming average historical recruitment continues.

Table NP-ALB1: Potential reference points and estimated F-ratios using current F ($F_{2010–2012}$) and $F_{2002–2004}$ (reference years for North Pacific albacore CMMs adopted by IATTC and WCPFC) to assess current stock status, associated spawning biomass and equilibrium yield for North Pacific albacore when exploited at $F_{2010–2012}$. Median SSB and yield are shown for $F_{SSB–ATHL}$ as this simulation-based reference point is based on a non-equilibrium concept.

Reference Point	F2002-2004 /FRP	F2010-2012 /FRP	SSB (t)	Equilibrium Yield (t)
FSSB-ATHL	0.85	0.72	100,344	90,256
FMSY	0.76	0.52	49,680	105,571
F0.1	0.56	0.51	73,380	93,939
FMED	1.34	1.3	156,291	74,640
F10%	0.71	0.63	22,867	96,590
F20%	0.8	0.71	54,530	105,418
F30%	0.92	0.81	86,192	99,612
F40%	1.07	0.94	117,855	89,568
F50%	1.29	1.13	149,517	77,429

b. Management advice and implications

67. SC10 noted the following conservation advice from the ISC.

The current exploitation level ($F_{2010–2012}$) is estimated to be below that of $F_{2002–2004}$, which led to the implementation of conservation and management measures (CMMs) for the North Pacific albacore stock in the EPO (IATTC Resolution C-05-02 supplemented by Resolution C-13-03) and the WCNPO (WCPFC CMM 2005-03). Assuming average historical recruitment and fishing at a constant current F, median female SSB is expected to remain relatively stable between the 25th and median historical percentiles over both the short- and long-term, with a 13% probability that female SSB falls below the SSB-ATHL threshold during a 25-year projection period. In contrast, if a low recruitment scenario is assumed, then median female SSB declines under both harvest scenarios (constant $F_{2010–2012}$, constant $F_{2002–2004}$) and the probability that it falls below the SSB-ATHL threshold in the 25-year projection period increases to 65% as calculated by the ALBWG and noted above. The high recruitment scenario is more optimistic, with median future SSB increasing above the historical median SSB and the estimated probability of falling below the SSB-ATHL threshold is correspondingly low at 3%.

68. SC members continue to encourage the development of reference points for northern stocks, including the North Pacific albacore fishery, that are consistent with the reference points being developed for other WCPFC fisheries.

4.2.2 Pacific bluefin tuna

69. ISC presented SC10-SA-WP-11 (Stock assessment of bluefin tuna in the Pacific Ocean in 2014).

a. Status and trends

70. SC10 noted that ISC provided the following conclusions on the stock status of Pacific bluefin tuna in the Pacific Ocean in 2014.

Using the updated stock assessment, the 2012 SSB was 26,324 mt and slightly higher than that estimated for 2010 (25,476 mt).

Across sensitivity runs in the update stock assessment, estimates of recruitment were considered robust. The recruitment level in 2012 was estimated to be relatively low (the 8th lowest in 61 years), and the average recruitment level for the last five years may have been below the historical average level (Figure B1). Estimated age-specific fishing mortalities on the stock in the period 2009–2011 relative to 2002–2004 (the base period for WCPFC Conservation and Management Measure 2010-04) increased by 19%, 4%, 12%, 31%, 60%, 51% and 21% for ages 0-6, respectively, and decreased by 35% for age-7+ (Figure B2).

Although no target or LRPs have been established for the PBF stock under the auspices of WCPFC and IATTC, the current F average over 2009–2011 exceeds all target and limit biological reference points (BRPs) commonly used by fisheries managers except for F_{loss}, and the ratio of SSB in 2012 relative to unfished SSB (depletion ratio) is less than 6%. In summary, based on reference point ratios, overfishing is occurring and the stock is overfished (Table B1).

Table B1: Ratio of the estimated fishing mortalities $F_{2002–2004}$, $F_{2007–2009}$ and $F_{2009–2011}$ relative to computed F-based biological reference points for Pacific bluefin tuna (*Thunnus orientalis*), depletion ratio (ratio of SSB in 2012 relative to unfished SSB), and estimated SSB (mt) in year 2012. Values in the first eight columns above 1.0 indicate overfishing.

	F_{Max}	$F_{0.1}$	F_{Med}	F_{loss}	$F_{10\%}$	$F_{20\%}$	$F_{30\%}$	$F_{40\%}$
$F_{2002–2004}$	1.70	2.44	1.09	0.84	1.16	1.68	2.26	2.98
$F_{2007–2009}$	2.09	2.96	1.40	1.08	1.48	2.14	2.87	3.79
$F_{2009–2011}$	1.79	2.54	1.25	0.97	1.32	1.90	2.55	3.36

For illustrative purposes, two examples of Kobe plots (plot A based on SSB_{MED} and F_{MED}, plot B based on *SSB20%* and *SPR20%*, Figure B3) are presented. Because no reference points for PBF have yet been agreed to, these versions of the Kobe plot represent alternative interpretations of stock status in an effort to prompt further discussion.

Historically, the WPO coastal fisheries group has had the greatest impact on the PBF stock, but since about the early 1990s the WPO purse seine-fleet has increased its impact, and the effect of this fleet is currently greater than any of the other fishery groups. The impact of the EPO fishery was large before the mid-1980s, thereafter decreasing significantly. The WPO longline fleet has had a limited effect on the stock throughout the analysis period. The impact of a fishery on a stock depends on both the number and size of the fish caught by each fleet; i.e., catching a high number of smaller juvenile fish can have a greater impact on future spawning stock biomass than catching the same weight of larger mature fish (Figures B4 and B5).

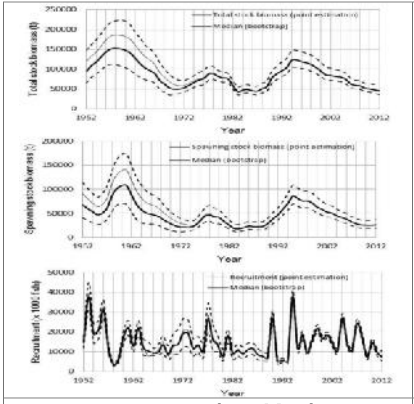

Figure B1: Pacific bluefin tuna (*Thunnus orientalis*) total stock biomass (upper panel), spawning stock biomass (middle panel) and recruitment (lower panel) of PBF from the base case run. Thick line indicates median, thin line indicates point estimate, and dashed lines indicate the 90% confidence interval

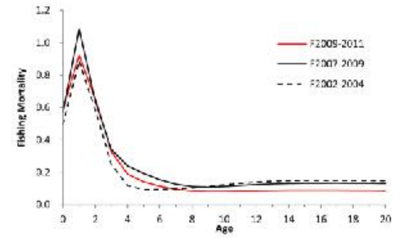

Figure B2: Geometric mean annual age-specific Pacific bluefin tuna (*Thunnus orientalis*) fishing mortalities for 2002–2004 (dashed line), 2007–2009 (solid line) and 2009–2011 (red line)

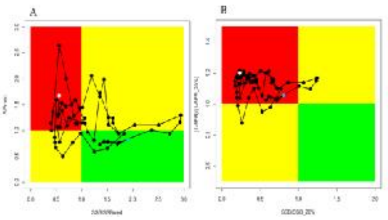

Figure B3: Alternative Kobe plots for Pacific bluefin tuna (*Thunnus orientalis*). A. SSB_{MED} and F_{MED}; B. *SSB20%* and *SPR20%*. Citation of these Kobe plots should include clarifying comments in the text. The blue and white points on the plot show the start (1952) and end (2012) year of the period modeled in the stock assessment, respectively.

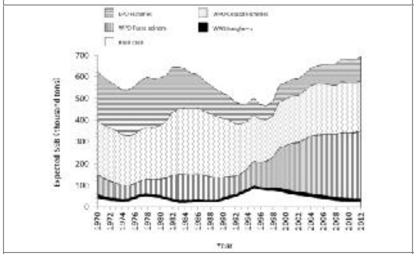

Figure B4: Trajectory of the spawning stock biomass of a simulated population of Pacific bluefin tuna (*Thunnus orientalis*) that was unexploited (topmost line) and that predicted by the base case (white area). The shaded areas between the two lines show the proportions of impact of each fishery.

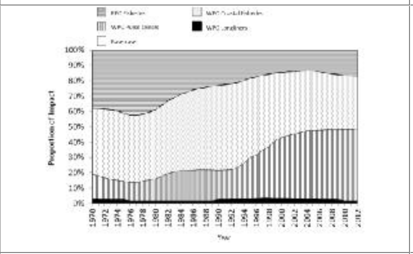

Figure B5: The proportion of the impact on the Pacific bluefin tuna (*Thunnus orientalis*) spawning stock biomass by each group of fisheries.

b. Management advice and implications

71. SC10 noted the following conservation advice from ISC:

The current (2012) PBF biomass level is near historically low levels and experiencing high exploitation rates above all biological reference points except for F_{loss}. Based on projection results, the recently adopted WCPFC CMM (2013-09) and IATTC resolution for 2014 (C-13-02), if continued into the future, are not expected to increase SSB if recent low recruitment continues.

In relation to the projections requested by NC9, only scenario 6[1], the strictest one, results in an increase in SSB even if the current low recruitment continues (see Figures). Given the result of

[1] For the WCPO, a 50% reduction of juvenile catches from the 2002–2004 average level and F no greater than $F_{2002–2004}$. For the EPO, a 50% reduction of catches from 5,500 t. From the scientific point of view, juvenile catches were

scenario 6, further substantial reductions in fishing mortality and juvenile catch over the whole range of juvenile ages should be considered to reduce the risk of SSB falling below its historically lowest level.

If the low recruitment of recent years continues the risk of SSB falling below its historically lowest level observed would increase. This risk can be reduced with implementation of more conservative management measures.

Based on the results of future projections requested at NC9, unless the historical average level (1952–2011) of recruitment is realized, an increase of SSB cannot be expected under the current WCPFC and IATTC conservation and management measures[2], even under full implementation (scenario 1)[3].

If the specifications of the harvest control rules used in the projections were modified to include a definition of juveniles that is more consistent with the maturity ogive[4] used in the stock assessment, projection results could be different; for example, rebuilding may be faster. While no projection with a consistent definition of juvenile in any harvest scenario was conducted, any proposed reductions in juvenile catch should consider all non-mature individuals.

Given the low level of SSB, uncertainty in future recruitment, and importance of recruitment in influencing stock biomass, monitoring of recruitment should be strengthened to allow the trend of recruitment to be understood in a timely manner.

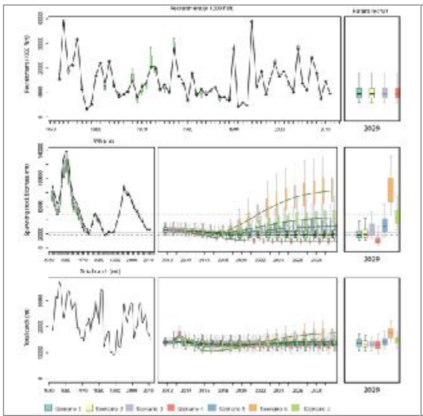

Figure B6-1: Comparison of future Pacific bluefin tuna (*Thunnus orientalis*)

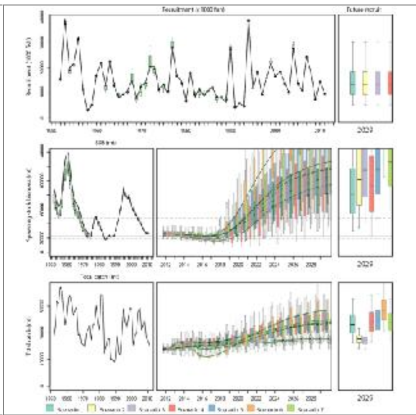

Figure B6-2: Comparison of future Pacific bluefin tuna (*Thunnus orientalis*)

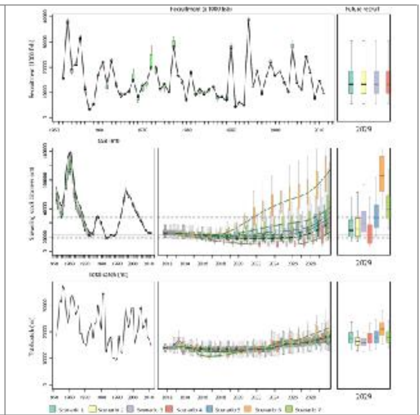

Figure B6-3: Comparison of future Pacific bluefin tuna (*Thunnus orientalis*)

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not completely represented in the reductions modeled under scenario 6 for some fisheries although these reductions comply with the definition applied by the NC9.

[2] WCPFC: Reduce all catches of juveniles (age-0 to 3 [less than 30 kg]) by at least 15% below the 2002–2004 annual average levels, and maintain the total fishing effort below the 2002–2004 annual average levels. IATTC: Catch limit of 5000 t with an additional 500 t for commercial fisheries for countries with catch history. (1. In the IATTC Convention Area, the commercial catches of bluefin tuna by all the CPCs during 2014 shall not exceed 5,000 metric tons. 2. Notwithstanding paragraph 1, any CPC with a historical record of eastern Pacific bluefin catches may take a commercial catch of up to 500 metric tons of eastern Pacific bluefin tuna annually. (C-13-02), see
https://www.iattc.org/PDFFiles2/Resolutions/C-13-02-Pacific-bluefin-tuna.pdf)

[3] Although these measures assume F be kept below $F_{2002–2004}$, $F_{2009–2011}$ was higher than $F_{2002–2004}$.

[4] 20% at age 3; 50% at age 4; 100% at age-5 and older.

SSB trajectories in seven harvest scenarios (see full text for scenario definitions of SC10-SA-WP-11) under low recruitment conditions. Error bars represent 90% confidence limits.	SSB trajectories in seven harvest scenarios (see full text for scenario definitions of SC10-SA-WP-11) under average recruitment conditions (resampling from recruitment in 1952–2011). Error bars represent 90% confidence limits.	SSB trajectories in seven harvest scenarios (see full text for scenario definitions of SA-WP-11) assuming 10 years (2014–2023) of low recruitment followed by average recruitment after 2024 (resampling from recruitment in 1952–2011). Error bars represent 90% confidence limits.

4.2.3 North Pacific swordfish

72. ISC presented SC10-SA-WP-13 (North Pacific swordfish [*Xipiaus gladius*] stock assessment in 2014). In the North Pacific, the swordfish (*Xiphias gladius*) population comprises of two stocks, separated by a diagonal boundary extending from Baja, California, to the equator. These are the western and central North Pacific Ocean stock (WCNPO), distributed in the western and central Pacific, and the eastern Pacific Ocean stock (EPO), distributed in the eastern Pacific (Fig. S1).

a. Stock status and trends

73. SC10 noted that ISC provided the following conclusions on the stock status of North Pacific swordfish.

> Exploitable biomass of WCNPO swordfish fluctuated at or above B_{MSY} throughout the assessment time horizon and has remained high in recent years and harvest rate fluctuated at or below H_{MSY}. Trends in exploitable biomass and harvest rate from the current assessment are very similar to those from the 2009 assessment. In recent years, catches and harvest rates of WCNPO swordfish have had a declining trend, with exploitable biomass fluctuating around 70,000 mt, since 2007. The Kobe plot showed that the WCNPO swordfish stock does not appear to have been overfished or to have experienced overfishing throughout most of the assessment time horizon of 1951–2012. For the current status, results indicated it was very unlikely that the WCNPO swordfish population biomass was below B_{MSY} in 2012 (Pr($B_{2012} < B_{MSY}$)=14%). Similarly, it was extremely unlikely that the swordfish population was being fished in excess of H_{MSY} in 2012 (Pr($H_{2012} > H_{MSY}$) < 1%). Retrospective analyses indicated that there was no retrospective pattern in the estimates of exploitable biomass and harvest rate.
>
> For the EPO stock, time series of estimates of exploitable biomass and harvest rate over the assessment time horizon differed from the previous assessment in recent years but have remained high in recent years (Table S2 and Figure S4). Exploitable biomass had a declining trend during 1969–1995 and has increased from 31,000 mt in 1995 to over 60,000 mt in 2010, generally remaining above B_{MSY}. Harvest rates were initially low, have had a long-term increasing trend, and likely exceeded H_{MSY} in 1998, 2002, 2003, and also the most recent year, 2012 (Figure S4). The Kobe plot showed that overfishing likely occurred in only a few years, but may be occurring in recent years (Figure S5). In 2012, there was a 55% probability that overfishing was occurring in 2012, but there was a less than 1% probability that the stock was overfished. Retrospective analyses indicated that there was a clear retrospective pattern of underestimating exploitable biomass and overestimating harvest rate.

Table S2: Reported annual values of catch (mt) and posterior mean values of exploitable biomass (B, mt), relative biomass (B/B_{MSY}), harvest rate (percent of exploitable biomass), relative harvest rate (H/H_{MSY}), and probability of annual harvest rate exceeding H_{MSY} for the EPO swordfish stock.

Year	2006	2007	2008	2009	2010	2011	2012	Mean[1]	Min[1]	Max[1]
Reported catch	3,235	3,701	4,262	7,473	9,631	9,586	9,910	3,561	1	9,910
Exploitable biomass	43,100	47,980	53,840	60,570	62,120	60,810	58,590	48,875	31,510	67,070
Relative biomass	1.38	1.54	1.73	1.95	2.00	1.95	1.87	1.58	1.02	2.16
Harvest rate	8%	9%	9%	14%	17%	18%	19%	8%	<1%	22%
Relative harvest rate	0.49	0.50	0.51	0.80	1.00	1.03	1.11	0.49	0.00	1.30
Pr($H > H_{MSY}$)	0.01	0.02	0.02	0.20	0.44	0.47	0.55	0.11	0.00	0.71

[1] During 1951–2012.

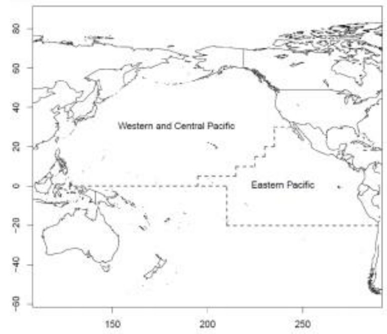

Figure S1: A two-stock structure for swordfish in the North Pacific Ocean, indicating separate stocks in the WCPO and the EPO.

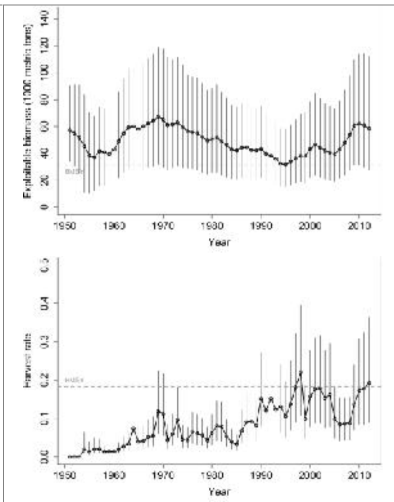

Figure S4: Trends in exploitable biomass (top) and harvest rate (bottom) of swordfish (*Xiphias gladius*) in the EPO stock area. Estimated mean values from the posterior distribution (black circles and solid line), 95% confidence interval bars (solid vertical lines), and estimated biological reference points (B_{MSY} and H_{MSY}, horizontal dashed lines) are presented

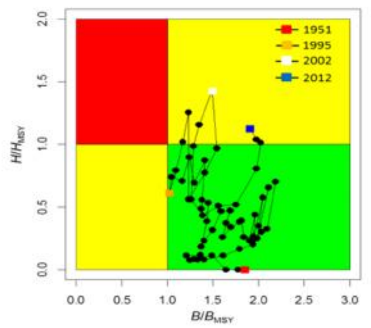

Figure S5: Kobe diagram showing the estimated trajectories of relative exploitable biomass (B/B_{MSY}) and relative harvest rate (H/H_{MSY}) for swordfish (*Xiphias gladius*) in the EPO stock area during 1951–2012.

b. Stock projections and risk analyses

74. SC10 noted that ISC provided the following conclusions on the stock projections and risk analysis of North Pacific swordfish.

> For the WCNPO stock, stochastic projections for eight harvest scenarios were conducted through 2016 (Figure S6). Results relative to MSY-based reference points indicated that exploitable biomass would likely remain above B_{MSY} through 2016 under the status quo catch or status quo

harvest rate scenarios (Figure S6). For the high harvest rate scenarios (i.e. maximum observed harvest rate, 150% of H_{MSY}, 125% of H_{MSY}), exploitable biomass was projected to decline below B_{MSY} by 2016 (Figure S6) with harvest rates exceeding H_{MSY}. In comparison, the stock would not be expected to experience any overfishing during 2014–2016 under the status quo catch and status quo harvest rate scenarios (Figure S6).

For the EPO stock, stochastic projections showed that exploitable biomass will likely have a decreasing trajectory during 2014–2016 under all eight of the harvest scenarios examined (Figure S7). Under the high harvest rate scenarios (status quo catch, maximum observed harvest rate, 150% of H_{MSY}), exploitable biomass was projected to decline to be roughly equal to B_{MSY} in 2016 (Figure S7) and maintain harvest rates above H_{MSY}. In comparison, under the status quo harvest rate scenario, exploitable biomass was projected to decline to only 40,000 mt by 2016, well above the B_{MSY} level. Overall, the projections showed that if recent high catch levels persist, exploitable biomass will very likely decrease and a moderate risk of overfishing will likely continue to occur. The risk analyses of harvesting a constant annual catch of WCNPO swordfish during 2014–2016 showed that there would be virtually no chance of the stock being overfished or experiencing overfishing in 2016 (Figure S8) if current annual catches of about 10,000 mt were maintained.

The risk analyses for harvesting a constant catch of EPO swordfish during 2014–2016 showed that the probabilities of overfishing and becoming overfished increased as projected catch increased in the future (Figure S8). Maintaining the current catch of EPO swordfish of approximately 9,700 mt would lead to a moderate risk of overfishing in 2016 but would lead to less than 1% probability of the stock being overfished in 2016.

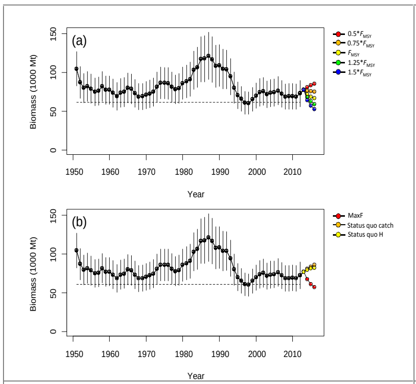

Figure S6: Stochastic projections of expected exploitable biomass (1000 metric tons) of swordfish (*Xiphias gladius*) in the WCPO stock area during 2013–2016 under alternative harvest rates. Upper panel shows projection results of applying a harvest rate set to be 50%, 75%, 100%, 125%, and 150% of the value of estimate of H_{MSY} (denoted as F_{MSY} in the Figure). Lower panel shows projection results of applying a status quo harvest rate based on the 2010–2012 average estimates, a status quo catch based on the 2010–2012 average catch, and the maximum observed harvest rate in the 1951–2012 time series.

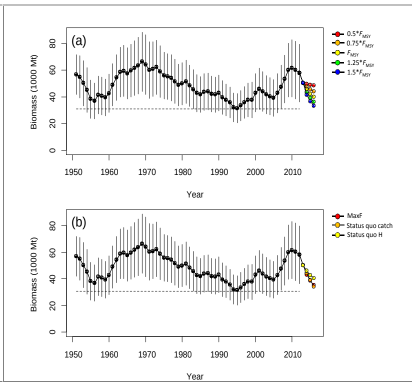

Figure S7: Stochastic projections of expected exploitable biomass (1000 metric tons) of swordfish (*Xiphias gladius*) in the EPO stock area during 2013–2016 under alternative harvest rates. Upper panel shows projection results of applying a harvest rate set to be 50%, 75%, 100%, 125%, and 150% of the value of estimate of H_{MSY} (denoted as F_{MSY} in the Figure). Lower panel shows projection results of applying a status quo harvest rate based on the 2010–2012 average estimates, a status quo catch based on the 2010–2012 average catch, and the maximum observed harvest rate in the 1951–2012 time series.

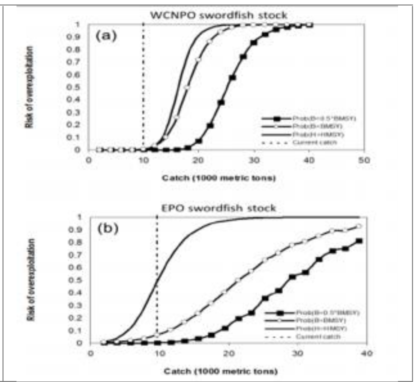

Figure S8: Probabilities of experiencing overfishing ($H > H_{MSY}$, solid line), of exploitable biomass falling below B_{MSY} ($B < 0.5*B_{MSY}$, open circles), and of being overfished relative to a reference level of $½B_{MSY}$ ($B < 0.5*B_{MSY}$, solid squares) in 2016 for swordfish in the WCPO stock area (a) and EPO stock area (b) based on applying a constant catch biomass (x-axis, thousand mt) in the stock projections.

c. Management advice and implications

75. SC10 noted the following conservation advice from ISC.

> Based on the assessment update, the WCNPO stock is not currently overfished and is not experiencing overfishing. The WCNPO stock is not fully exploited.
>
> For the EPO swordfish stock, overfishing may be occurring in recent years. The recent average yield of roughly 10,000 mt, or almost two times higher than the estimated MSY, is not likely to be sustainable in the long term. While biomass of the EPO stock appears to be nearly twice B_{MSY}, any increases in catch above recent levels should consider the uncertainty in stock structure and unreported catch

4.3 WCPO sharks

4.3.1 Oceanic whitetip shark

a. Status and trends

76. SC10 noted that no stock assessment was conducted for this species in 2014.

b. Management advice and implications

77. Because there was no stock assessment for this species, advice from SC8 should be maintained, pending a new assessment or other new information.

4.3.2 Silky shark

a. Status and trends

78. SC10 noted that no stock assessment was conducted for this species in 2014.

b. Management advice and implications

79. There was no stock assessment for this species, therefore advice from SC9 should be maintained, pending a new assessment or other new information.

4.3.3 South Pacific blue shark

a. Status and trends

80. SC10 noted that no stock assessment was conducted for this species in 2014.

b. Management advice and implications

81. There was no stock assessment for this species, therefore advice from SC9 should be maintained, pending a new assessment or other new information.

4.3.4 North Pacific blue shark

82. ISC and SPC conducted a stock assessment for North Pacific blue shark in 2014. The ISC Shark Working Group used two stock assessment approaches to examine the status of blue shark (*Prionace glauca*) in the North Pacific Ocean: a Bayesian surplus production (BSP) model; and an age-based statistical catch-at-length model. These efforts provide an updated assessment of North Pacific blue shark based on the 2013 Shark Working Group assessment.

a. Stock status and trends

83. SC10 chose reference case models from the BSP (JEJL_Ref), and the Stock Synthesis-based analyses to represent the stock status of North Pacific blue shark. Brief details of these two models are provided in Table NPBSH0.

Table NPBSH0: Brief description of the BSP and Stock Synthesis reference case models chosen for the provision of management advice.

Name	Description
BSP ref case	JE and JL indices were used. Priors: uniform log(K) (100, 20000 kT); lognormal r (0.34 ± 0.5 SD); lognormal B_{init}/K (0.8 ± 0.5); Fixed B_{MSY}/K = 0.47; Process error SD = 0.07; CVs for JE and JL indices (0.100 and 0.074 respectively).
SS ref case	JE and JL indices were used. Age and sex specific natural mortality (Peterson and Wroblewski (1984) method with data from Nakano (1994). Sample size weighting of 0.2, stock recruitment parameterization Beta=2, S_Frac=0.3. Sigma R= 0.3. Initial equilibrium catch= 40,000 mt.

84. Biomass trends from the reference case models are shown in Figures NPBSH 1 and 2.

85. Based on the trajectory of the reference case of the BSP model (BSP), the ratio of B_{2011}/B_{MSY} was estimated to be 1.65. Stock biomass of blue shark in 2011 (B_{2011}) was estimated to be 622,000 mt. Median annual fishing mortality in 2011 (F_{2011}) was approximately 32% of F_{MSY} (Table NPBSH1 and Fig. NPBSH3).

86. Based on the trajectory of the Stock Synthesis reference case model, female spawning stock biomass of blue shark in 2011 (SSB_{2011}) was estimated to be 449,930 mt the ratio of SSB_{2011}/SSB_{MSY} was estimated to be 1.621. The estimate of F_{2011} was approximately 34% of F_{MSY} (Table NPBSH2 and Fig. NPBSH3).

87. TRPs and LRPs have not yet been established for pelagic sharks in the Pacific. Relative to MSY, the reference case and the majority of models run with input parameter values considered most probable based on the biology of blue sharks support the conclusion that the North Pacific blue shark stock is likely not overfished ($B_{2011}>B_{MSY}$) and overfishing is likely not occurring ($F_{2011}<F_{MSY}$).

88. While the results of the sensitivity runs varied depending on the input assumptions (Figs. NPBSH 4 and 5), a few parameters were most influential on the results. These included the CPUE series selected as well as the shape parameters for the BSP models and the equilibrium initial catch and form of the LFSR relationship for the Stock Synthesis models.

89. SC10 noted that there are substantial uncertainties in a number of inputs to the assessments, such as the time series for estimated catch, the quality (observer versus logbook) and time spans of abundance

indices, the size composition data and many life history parameters such as growth and maturity schedules. These uncertainties are considered to be considerably greater than those for the main tuna target species. However, SC10 notes that this is the best available scientific information.

b. Management advice and implications

90. Future projections of the reference case models show that median BSH biomass in the North Pacific will remain above B_{MSY} under the catch harvest policies examined (status quo, +20%, -20%) (Figs. NPBSH 6 and 7). Similarly, future projections under different fishing mortality (*F*) harvest policies (*status quo*, +20%, -20%) show that median BSH biomass in the North Pacific will likely remain above B_{MSY} (Figs. NPBSH 6 and 7).

91. The North Pacific blue shark stock is likely not experiencing overfishing and likely not to be in an overfished condition. For a range of sensitivity runs (such as the lower range of productivity assumptions, which were considered less plausible) the probability of the stock being overfished or undergoing overfishing was increased. Based on the future projections, the stock is likely above the level required to sustain recent catches. However, SC10 noted that there is substantial uncertainty in the model results and the Commission should be cautious in interpreting the results.

92. SC10 noted that there is significant and substantial uncertainty associated with the level of current fishing mortality from the target fishery for blue shark and the ongoing sustainability of this stock. SC10, therefore, recommends that all targeted shark fisheries be required to submit management plans with robust catch limits to the Commission by WCPFC12.

93. Given the uncertainties regarding the estimated catch and choice of input parameters for the assessment, SC10 recommended that the catch and fishing effort on blue shark should be carefully monitored. Attaining the required 5% longline observer coverage, as well as continued research into the fisheries, biology and ecology of blue shark in the North Pacific are recommended to make improvements prior to the next assessment.

94. SC10 encourages WCPFC to adopt appropriate reference points.

Table NPBSH1: Reference case BSP model results (BSP ref case) for North Pacific blue shark. Mean, standard deviation, coefficient of variation, median and 90% confidence intervals of important biological parameters and reference points.

Variable	Mean	SD	CV	5th Percentile	Median	95th Percentile
r	0.41	0.14	0.33	0.20	0.41	0.65
K ('000 MT)	955	597	0.63	491	806	1884
MSY ('000 MT)	79	19	0.24	65	76	98
B_{msy} ('000 MT)	449	281	0.63	231	379	886
B_{1971} ('000 MT)	735	773	1.05	253	556	1657
B_{2011} ('000 MT)	744	542	0.73	373	622	1459
B_{2011}/B_{msy}	1.65	0.25	0.15	1.24	1.65	2.08
B_{2011}/B_{1971}	1.21	0.43	0.35	0.68	1.15	2.05
B_{2011}/K	0.78	0.12	0.15	0.62	0.82	1.04
F_{msy} (ratio)	0.20	0.07	0.33	0.10	0.20	0.33
F_{2011} (ratio)	0.07	0.02	0.37	0.03	0.07	0.11
F_{2011}/F_{msy}	0.33	0.07	0.23	0.22	0.32	0.45

Table NPBSH2: Reference case Stock Synthesis model results for North Pacific blue shark (SS ref case). Mean, standard deviation, coefficient of variation, and 90% confidence intervals of important biological parameters and reference points.

Variable	Mean	SD	CV	5th Percentile	95th Percentile
MSY (MT)	72,123	13,863	0.192	47,317	94,928
SSB_{MSY} (MT)	277,565	55,456	0.200	186,290	368,840
SSB_{1971} (MT)	430,336	121,860	0.283	229,876	630,796
SSB_{2011} (MT)	449,930	170,845	0.380	168,890	730,970
SSB_{2011}/SSB_{MSY}	1.621				
SSB_{2011}/SSB_{1971}	1.046				
F_{MSY} *(ratio)*	0.225	0.014	0.064	0.201	0.248
F_{2011} *(ratio)*	0.078	0.023	0.302	0.039	0.116
F_{2011}/F_{MSY}	0.345				

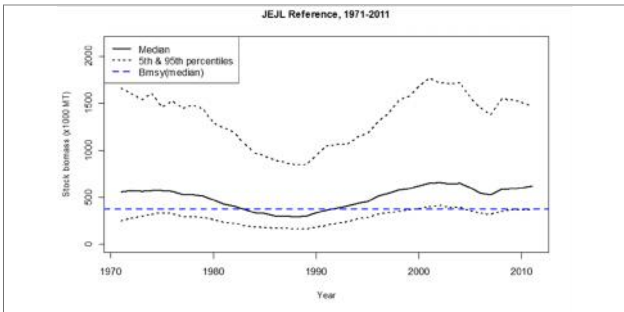

Figure NPBSH1: Median and 90% confidence intervals for the estimated historical stock dynamics of North Pacific blue shark from the BSP reference case run (BSP ref case).

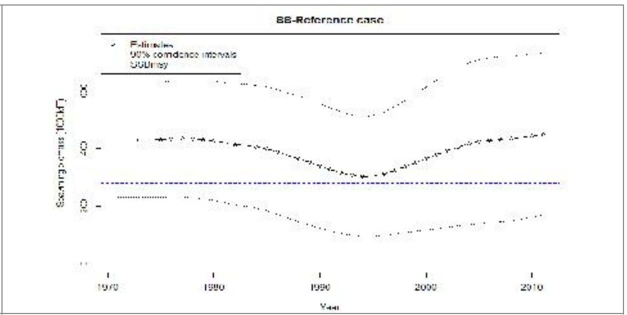

Figure NPBSH2: Estimated female spawning biomass and 90% confidence intervals of North Pacific blue shark from the Stock Synthesis reference case run (SS ref case).

(A) (B)

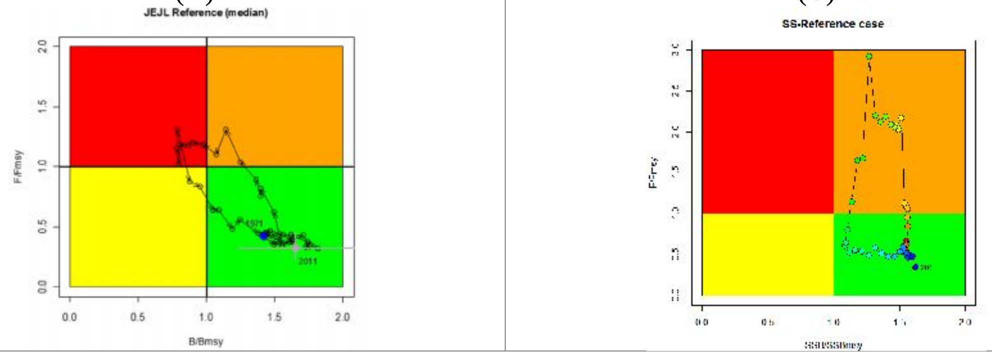

Figure NPBSH3: (A) Kobe plot showing median biomass and fishing mortality trajectories for the reference case Bayesian surplus production model for North Pacific blue shark. Solid blue circle indicates the median estimate in 1971 (initial year of the model). Solid gray circle and its horizontal and vertical bars indicate the median and 90% confidence limits in 2011. Open black circles and black arrows indicate the historical trajectory of stock status between 1971 and 2011. (B) Kobe plot showing estimated spawning biomass and fishing mortality trajectories for the reference case Stock Synthesis model for North Pacific blue shark. The circles indicate the historical trajectory from 1971 to 2011 colored from red (first year) to blue (terminal year).

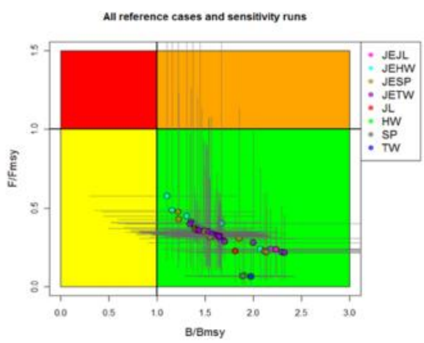

Figure NPBSH4: Kobe plot showing the 2011 median estimates of F/F_{MSY} and B/B_{MSY} for all the BSP model runs for North Pacific blue shark. The horizontal and vertical bars indicate the 90% confidence limits of the 2011 estimates.

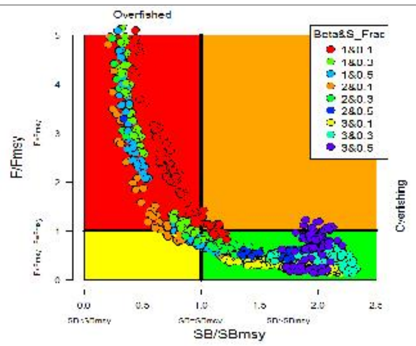

Figure NPBSH5: Kobe plot showing the range of terminal year reference points (F/F_{MSY} on the y axis and SB/SB_{MSY} on the x-axis) for the entire grid of Stock Synthesis runs. The total number of runs was 1,080, not all runs are shown on the plot due to extremely high (>5) F/F_{MSY} values. The points are color coded by the main axis of uncertainty, the parameterization of LSFR, using the combined Beta & S_Frac parameterization.

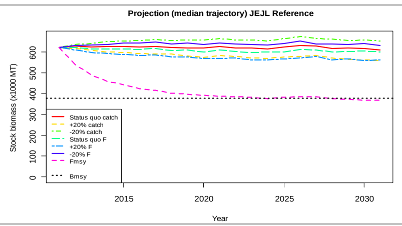

Figure NPBSH6: Comparison of future projected North Pacific blue shark stock biomass (medians) under different constant catch (status quo, +20%, -20%) and constant F harvest policies (status quo, +20%, -20%, and F_{MSY}) using the BSP reference case model. Status quo catch and fishing mortality was based on the average from 2006 to 2010.

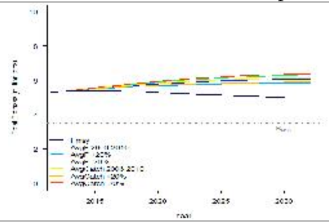

Figure NPBSH7: Comparison of future projected North Pacific blue shark stock biomass under different constant catch (status quo, +20%, -20%) and constant F harvest policies (status quo, +20%, -20%, and F_{MSY}) using the Stock Synthesis reference case model. Status quo catch and fishing mortality was based on the average from 2006 to 2010.

4.4 WCPO billfish

4.4.1 South Pacific swordfish

a. Status and trends

95. SC10 noted that no stock assessment was conducted for South Pacific swordfish in 2014. Therefore, the stock status description from SC9 is still current.

b. Management advice and implications

96. SC10 noted that no management advice had been provided since SC9. Therefore, the advice from SC9 should be maintained.

4.4.2 Southwest Pacific striped marlin

a. Status and trends

97. SC10 noted that no stock assessment was conducted for southwest Pacific striped marlin in 2014. Therefore, the stock status description from SC9 is still current.

b. Management advice and implications

98. SC10 noted that no management advice had been provided since SC9. Therefore, the advice from SC9 should be maintained.

4.4.3 North Pacific striped marlin

a. Status and trends

99. SC10 noted that no stock assessment was conducted for North Pacific striped marlin in 2014. Therefore, the stock status description from SC8 is still current.

b. Management advice and implications

100. SC10 noted that no management advice had been provided since SC8. Therefore, the advice from SC8 should be maintained.

4.4.4 Pacific blue marlin

a. Status and trends

101. SC10 noted that no stock assessment was conducted for Pacific blue marlin in 2014. Therefore, the stock status description from SC9 is still current.

b. Management advice and implications

102. SC10 noted that no management advice had been provided since SC9. Therefore, the advice from SC9 should be maintained, pending a new assessment or other new information.

AGENDA ITEM 5 — MANAGEMENT ISSUES THEME

5.1 Limit reference points for the WCPFC

103. Noting the adoption by WCPFC10 of the 10-year time-window (t_1-t_2) for estimating the average unfished biomass in the LRP $20\%SB_{(t1-t2),F=0}$, and the request to SC10 for further clarification of the implications of accepting various alternative levels of acceptable risk, which should be applied to breaching an LRP, SC10 considered the work described in working paper SC10-MI-WP-01 and recommended that:

a) the approach described in this paper be adopted for evaluating the implications of alternative levels of permissible risk of falling below an agreed biomass LRP;
b) the axes of uncertainties and associated weighting to be included in the structural grid of assessment runs be incorporated into these analyses be based on those shown in Attachment G; and
c) further analyses be undertaken for bigeye tuna, yellowfin tuna, skipjack tuna and South Pacific albacore, and the results presented to the Management Objectives Workshop 3 (if it takes place) and WCPFC11.

104. SC10 also noted that working paper SC10-MI-WP-01 had considered risk levels associated with breaching the LRP within the range 5–20%. Further noting that the identification of acceptable risk is a management issue, and that many CCMs have already expressed a firm preference for 5% risk to be used for skipjack tuna and South Pacific albacore stocks, SC10 recommended that WCPFC11 identify the level

of acceptable risk that should be applied to breaching an LRP for the key target species. SC10 notes that the UN Fish Stocks Agreement states that the risk of exceeding LRPs should be very low.

105. SC10 also considered working paper SC10-MI-WP-07, which reviewed options for identifying appropriate LRPs for elasmobranchs within the WCPFC and made the following recommendations:

a) That the Commission support the tiered, species-specific approach that is similar to that adopted for target species but noted that more work would be required to specify the values of the LRPs for key shark species, and to ensure consistency with article 10.1 (c) of the Convention;
b) That the Commission support the proposal to hold an expert working group to compile and review life history data for use in LRPs for sharks; and
c) That other work necessary to support the development of LRPs for sharks should be identified (not only for F-based LRPs but also for biomass-based LRPs as data are limited for most shark species) and included in the updated shark research plan. SC10 suggested that the Commission monitor the work of IATTC through the GEF-ABNJ Technical Coordinator – Sharks and Bycatch on the development of empirical LRPs (or indicators) for sharks. Liaising with other international organizations conducting shark assessments was encouraged to improve data and assessment methods. This work can assist and guide the identification of LRPs in WCPFC.

5.2 Target reference points and harvest control rules for the WCPFC

106. Noting the request from the Commission for the scientific services provider to provide the third meeting of the Management Objectives Workshop (MOW3) with further analyses required to inform the Commission's consideration and adoption of a TRPs and harvest control rules (HCR) at WCPFC 11, SC10 reviewed working paper SC10-MI-WP-09. SC10 also reviewed three working papers (SC10-MI-WP-02, SC10-MI-WP-03 and SC10-MI-WP-04) which had previously been presented to MOW2 together with a new analysis of the possibility of range contraction in the WCPO provided in working paper SC10-MI-WP-06. SC10 supported these analyses and recommends that WCPFC11 take the results of these papers into consideration when considering the adoption of any TRPs and HCRs for the key target species.

107. SC10 considered the draft CMM being proposed by Australia in working paper SC10-MI-WP-08. SC10 supported the initiative by Australia to have the Commission develop processes for adopting harvest strategies for key target species (to be clarified in the draft CMM). SC10 recommended that Australia continue to develop this CMM in consultation with other CCMs and that the updated CMM be presented to TCC10 and WCPFC11. To this end, SC recommended that MOW3 be organized before the next annual meeting.

5.3 Implementation of CMM 2013-01

108. Noting the request in para 29 of CMM 2013-01 for SC10 to provide advice to the Commission on the relative impact of FAD set measures, and any increases of yellowfin tuna purse-seine catch in unassociated schools, on fishing mortality for yellowfin tuna, SC10 reviewed working paper SC10-MI-WP-05. Based on the results of the analyses described in this paper SC10 advises WCPFC11 that the yellowfin tuna stock status in the WCPO is relatively insensitive to whether purse-seine effort comprises mainly associated sets or unassociated sets. SC10 also noted that slightly better stock status (higher spawning biomass indicators and lower fishing mortality), higher average catch and higher MSY occurred for purse-seine effort compositions favoring unassociated sets and recommended that the Commission take note of these conclusions. SC10 also recommended that the same impact analysis should be conducted for skipjack tuna.

109. Also noting the request in para 38 of CMM 2013-01, SC10 considered information paper SC10-MI-IP-06 on additional FAD management options prepared by the Commission Secretariat and SC10-ST-IP-09 on FAD design and activities. SC10 supported the establishment of a working group and recommended that TCC comment on the constituency of the working group. The working group should address the following three main issues:

i) FAD marking, and identification, and use of electronic signatures;
ii) FAD monitoring, tracking and control; and
iii) FAD management options including appropriate limits to FAD deployment based on scientific advice and the precautionary approach.

110. SC10 noted that that the provisional catch estimate of bigeye tuna taken by the WCPFC Statistical Area purse-seine fishery during 2013 was the highest on record and the number of associated sets made in the WCPO tropical purse-seine fishery during 2013, which while on a downward trend, still clearly exceeds the number of such sets undertaken in 2010 (Fig. A4 in working paper SC10-GN-WP-01). Also noting that previous CMMs have failed to reduce the fishing mortality of bigeye tuna to the level intended, SC10 reaffirms the recommendations made at previous SC meetings (para 351 of the SC8 Summary Report and para 409 from the SC9 Summary Report) supporting the need for additional or alternative targeted measures to reduce the fishing mortality on bigeye tuna, as seen as appropriate by the Commission.

AGENDA ITEM 6 — ECOSYSTEM AND BYCATCH MITIGATION THEME

6.1 Ecosystem effects of fishing

111. SC10 recommends that the Commission encourage an external review of the spatial ecosystem and population dynamics model (SEAPODYM) project to assist with guiding the Commission in evaluating potential applications and future directions.

6.2 Sharks

112. SC10 recommends that the Commission:

a) Consider the analysis of longline shark mitigation methods (e.g. hook type, leader material, non-deployment of shallow hooks, and a prohibition on shark lines) presented in EB-WP-01, as well as additional modeling of combinations of these measures and post-release mortality if available, in order to inform WCPFC11's further consideration of revising shark CMMs to incorporate shark mitigation requirements that reduce catch rates and at-vessel mortality.
b) Task TCC with identifying barriers to implementing the mitigation methods raised in SC10-EB-WP-05 (e.g. costs, operational issues and safety), along with any considerations raised by WCPFC11, and develop solutions, where appropriate
c) Note that SC will not be able to review the specification of the ratio of fin weight to shark weight as described in para 8 of CCM 2010-07 because of the lack of reliable data and of appropriate species- and fleet-specific methodology.
d) Request that for CCMs that applying fin-to-carcass weight ratios, these CCMs report to the Commission the details of the methods used to estimate the ratio of shark fin-to-carcass weight and CCMs should encourage its purse-seine and longline observers to collect data related to shark fin-to-carcass ratios. This information should be included in Part 2 of the Annual Reports to WCPFC.

113. SC10 recommends that WCPFC continue to support the Bycatch Mitigation Information System (BMIS) through the GEF-ABNJ project and seek external funding until GEF-ABNJ funds are available in late 2015/early 2016.

114. SC10 recommends the following priority order for funding research projects in 2015:

a) Monte Carlo simulation of mitigation options (see SC10-EB-WP-01 for details).
b) Expert panel work on the identification of appropriate life history parameters for use in developing shark LRPs.
c) Desktop examination of fin-to-carcass ratios (building on work underway by New Zealand).

115. SC10 recommends that:

a) Guidelines for the safe release of whale sharks (Attachment I) be considered by SC11.
b) A table summarizing the development of safe guidelines to maximize survival of sharks to be released from longline or purse-seine gear (Attachment J) should be reviewed by SC11 and forwarded to TCC for its consideration.

6.3 Seabirds

116. SC10 recommends that relevant members present:

a) the analysis of the different bycatch interaction rates between exempted small longline vessels (<24 m) and of larger non-exempt vessels north of 23°**N** in CMM 2012-07 at SC11; and
b) seabird bycatch interaction rates for longline vessels in the area between 25 and 30 South at SC11.

117. SC10 recommends that the Commission:

a) support the implementation of e-monitoring trials throughout the WCPFC in order to compare interaction rates between at-sea and dry observers, noting recommendations a and b under Agenda Item 3.3 "Electronic monitoring and electronic reporting";
b) encourages CCMs to collect robust seabird bycatch data, taking into account seasonal and spatial distribution and submit these to WCPFC.
c) take note that CMM 2012-07, which came into effect on 1 July 2014, includes requirements for annual reporting of interactions in Part 1 of Annual Reports and encourages CCMs to use the template in the CMM 2012-07 for completing details about their bycatch species and numbers;
d) supports the distribution and use of the Agreement for the Conservation of Albatrosses and Petrels (ACAP)/Japanese seabird identification guide, which will come out in late 2014;.
e) support the collection of DNA samples from seabirds taken as bycatch in the Southern Hemisphere to aid species identification. Protocols are in the ACAP/Japanese seabird identification guide.

6.4 Sea turtles

118. No papers were presented and there was no discussion on this agenda item.

6.5 Other species and issues

119. There were presentations on SC10-EB-WP-09 (Catch, Effort, and eCOsystem impacts of FAD-fishing, CECOFAD), SC10-EB-WP-08 (the International Sustainable Seafood Foundation's third bycatch mitigation research cruise in the WCPO), and SC10-EB-IP-05 (Issues for t-RFMOs in relation to the listing of shark and ray species by the Convention on the International Trade in Endangered Species). No recommendations were made under this agenda item.

AGENDA ITEM 7 — OTHER RESEARCH PROJECTS

7.1 West Pacific East Asia Project

120. The WCPFC Secretariat reported on the progress of the West Pacific East Asia Project and introduced a new Global Environment Facility-funded project (Sustainable Management of Highly Migratory Fish Stocks in the West Pacific and East Asian Seas), which includes Indonesia, Philippines and Vietnam as project partners.

7.2 Pacific Tuna Tagging Project

121. The 8th Pacific Tuna Tagging Project (PTTP) Steering Committee meeting was held on 7 August 2014. The meeting considered the work programme planned for 2014–2015, which is primarily focused on managing the tag recovery process and incorporating analysis of tagging data in various work programmes. PTTP data are now being used routinely in stock assessments, including the current tropical tuna stock assessments, which benefited greatly from the project.

AGENDA ITEM 8 — COOPERATION WITH OTHER ORGANISATIONS

122. SC10 reviewed the status of WCPFC's cooperation with other organizations.

AGENDA ITEM 9 — SPECIAL REQUIREMENTS OF DEVELOPING STATES AND PARTICIPATING TERRITORIES

123. The Secretariat briefly described the operations of the Japan Trust Fund (JTF) in 2014, which is the third year of the second phase of the JTF project. The Secretariat urged participants to be ready for the call for next year's funding, which would likely have a closing date of 31 December 2014.

AGENDA ITEM 10 — FUTURE WORK PROGRAM AND BUDGET

10.1 Review of the Scientific Committee work programme

124. The Secretariat reported on the progress of the 2013–2014 SC work programme since SC9.

10.2 Development of the 2015 work programme and budget, and projection of the 2016–2017 provisional work programme and indicative budget

125. SC10 adopted the work programme and budget as shown in Table 1.

Table 1: List of SC work programme titles and budget for 2015, and indicative budget for 2016–2017, which require funding from the Commission's core budget (in USD).

Research activity / Project with priority	2015	2016	2017
Project 14. West Pacific East Asia (WPEA) Project ➢ Scope: port sampling and capacity building of WPEA countries	25,000	25,000	25,000
Project 35. Refinement of bigeye tuna parameters ➢ Scope: 2015 is the last year of the project; sampling data and analysis of otoliths/gonads for assessment	125,000	50,000	
Project 42. Pacific-wide tagging project	10,000	10,000	10,000
Project 57. Limit reference points (LRPs): Expert panel work on the identification of appropriate life history parameters for use in developing shark LRPs	25,000		
Project 66. Target reference points			
Project 63. Harvest control rules			
Project 70. Additional resourcing SPC for the improvement of stock assessment along with 2011 bigeye tuna peer review recommendations	160,000		
Project 74. Pacific-wide bigeye tuna stock assessment (additional cost) • Travel and associated costs for two workshops (USD 52,600) • MULTIFAN-CL software development (USD 26,300) • Computer hardware (USD 13,100)	92,000		
New project – Monte Carlo simulation of mitigation options for longline shark bycatch ➢ See SC10-EB-WP-01 for details	25,000		
Project 67 – Review of impacts of recent high catches of skipjack tuna on fisheries on the margins of the WCPFC Convention Area	40,000		
Unobligated Budget	83,000	83,000	83,000
SPC Oceanic Fisheries Programme Budget (This includes USD 130,000 for shark research.)	871,200	1,031,200	1031,200
GRAND TOTAL	1,456,200	1,199,200	1,149,200

126. SC10 advised that Project 57 in Table 1 will be implemented by the WCPFC Secretariat and other projects will be conducted by the scientific services provider. SC10 and the scientific services provider agreed that the 2015 service agreement will include the following assessments and shark research programme activities:

a. Pacific-wide bigeye tuna stock assessment
b. South Pacific albacore stock assessment
c. Indicator analyses for key shark species
d. Development of a Shark Research Plan

e. Update of stock assessment for WCPO bigeye tuna, incorporating 2013 data in projection mode.

127. SC10 also ranked the projects listed in Table 2 that were considered for funding under the Unobligated Budget. If there is no other priority demand on these funds by WCPFC11, then calls for proposals will be advertised for the three highest ranked projects.

Table 2: List of candidate projects and priorities for consideration under the Unobligated Budget.

List of projects with high priority	Priority Level
1. Analysis of archival tag data held by SPC, in particular the relationship between fish movement and oceanography.	High
2. Regional Observer Programme data fields. Identification and description of operational characteristics of the major WCPO fleets and identification of important technical parameters for data collection (SC Project 19).	High
3. Further development of methods and analysis to account for changes in targeting practices on the catch of non-target species in particular shark species.	High
4. Electronic tagging of whale sharks released from purse-seine nets (to examine survival).	Low
5. Determination of North Pacific blue shark to be designated as a northern stock.	Low

AGENDA ITEM 11 — ADMINISTRATIVE MATTERS

11.1 Peer review of stock assessments

128. There were no comments on this agenda item.

11.2 Future operation of the Scientific Committee

129. SC10 considered that SC meeting should be supported by professional rapporteurs, freeing the conveners to concentrate on their primary roles of a) facilitating the theme session, and b) drafting their theme recommendations. A recommendation related to this issue may be drafted intersessionally for the Commission's consideration.

11.3 Election of officers of the Scientific Committee

130. No nominations were forthcoming for the positions of SC Chair and Vice Chair; the Chair announced that nominations may be submitted for selection during WCPFC11 in December 2014.

11.4 Next meeting

131. FSM kindly offered to host SC11 in Pohnpei, FSM. The meeting is provisionally scheduled for Wednesday, 5 August to Thursday 13 August 2015. Indonesia kindly offered to host SC12 in 2016.