



**Commission for the Conservation and Management of  
Highly Migratory Fish Stocks in the Western and Central Pacific Ocean**

**Scientific Committee  
Sixth Regular Session**

**Nuku'alofa, Tonga  
10–19 August 2010**

**SUMMARY REPORT**

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**USP Library Cataloguing-in-Publication Data**

**INSERT**

Publisher	Western and Central Pacific Fisheries Commission PO Box 2356 Kolonias, Pohnpei 96941 Federated States of Micronesia
Typesetting	Times New Roman PS 10/11
Production	Western and Central Pacific Fisheries Commission, Pohnpei, Federated States of Micronesia

**ACKNOWLEDGEMENTS**

The financial support provided by the Government of Tonga, and the logistical and administrative support provided by the staff of the Tonga Fisheries Department, are gratefully acknowledged. The Secretariat of the Pacific Community's Oceanic Fisheries Programme provided much of the technical material for the session. Mark Smaalders served as chief rapporteur for the meeting. Their efforts are acknowledged with appreciation.

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**SUMMARY REPORT**

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**AGENDA ITEM 1 — OPENING OF MEETING**

**1.1 Welcome address**

1. S. Matoto, Head of Fisheries, Kingdom of Tonga, welcomed delegates to the meeting of the Sixth Regular Session of the Scientific Committee (SC6), which took place in Nuku'alofa, Tonga from 10–19 August 2010. The list of participants is appended as Attachment A.

2. The Chair of the Scientific Committee, N. Miyabe (Japan), gave the keynote remarks (Attachment B).

3. Acting Prime Minister Viliami Ta'u Tangi (also Minister of Health, Kingdom of Tonga) gave the opening address (Attachment C).

4. On behalf of all participants, A. Mobiha (Papua New Guinea) thanked the Deputy Prime Minister and the Head of Fisheries for their welcome.

5. The following countries attended the session as WCPFC Members, Cooperating Non-Members, and Participating Territories (CCMs): Australia, China, Cook Islands, European Union, Federated States of Micronesia, Fiji, French Polynesia, Indonesia, Japan, Korea, Marshall Islands, Nauru, New Caledonia, New Zealand, Niue, Palau, Papua New Guinea, Philippines, Samoa, Solomon Islands, Chinese Taipei, Tokelau, Tonga, Tuvalu, United States of America Vanuatu and Vietnam. The following CCMs were unable to attend: American Samoa, Belize, Canada, Commonwealth of the Northern Mariana Islands, Ecuador, El Salvador, France, Guam, Kiribati, Mexico, Senegal, and Wallis and Futuna.

6. The Agreement for the Conservation of Albatross and Petrels (ACAP), Inter-American Tropical Tuna Commission (IATTC), Pacific Islands Forum Fisheries Agency (FFA), Secretariat of the Pacific Community (SPC), Pew Charitable Trust, Birdlife International, Greenpeace, the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC), and the International Sustainable Seafood Foundation (ISSF) attended as Observers.

7. Matters considered by the SC6 and its Theme Groups — Fish Biology (BI), Ecosystem and Bycatch Mitigation (EB), Fishing Technology (FT), Management Issues (MI), Methods (ME), Data and Statistics (ST), and Stock Status (SA) — included:

- i. a review of the fisheries in the western and central Pacific Ocean (WCPO) and the eastern Pacific Ocean (EPO);
- ii. a review of the status of stocks of bigeye tuna and skipjack tuna in the WCPO;

- iii. a summary of the most recent information and assessments for tuna and billfish stocks in the North Pacific;
- iv. by-catch mitigation issues associated with seabirds, sea turtles, sharks, and recommendations from Kobe II workshops;
- v. requests from WCPFC6;
- vi. issues associated with the data available to the Commission and initiatives to address data gaps,
- vii. the status of the West Pacific East Asia Oceanic Fisheries Management (WPEA OFM) Project, the Japan Trust Fund (JTF) and the Pacific Tuna Tagging Project (PTTP);
- viii. relations with other organizations; and
- ix. administrative matters associated with the functioning and structure of the SC meetings, streamlining the operations of the SC, and reviewing the Commission's Strategic Research Plan.

## **1.2 Adoption of agenda**

- 8. The provisional agenda was adopted (Attachment D).

## **1.3 Meeting arrangements**

- 9. The Secretariat outlined the meeting schedule and administrative arrangements.
- 10. The meeting observed a minute's silence in honor of three colleagues (M. Manning, U. Faanunu and B. Thoulag) who passed away over the previous year.
- 11. In accordance with a decision by the Commission and intercessional discussions with CCMs, the SC Chair announced a revised SC meeting structure, in which all six Specialist Working Group meetings are absorbed into the plenary meeting (Theme agendas appended as Attachment E).
- 12. The SC selected R. Campbell as the Theme Convenor for the new Management Issues Theme (Agenda item 7.2) for the SC6 meeting.
- 13. The selection of new SC officers, including the new Chair and Theme Conveners, is addressed under Agenda Item 13.
- 14. During SC6, two steering committee meetings were held by the following:
  - i. West Pacific East Asia Project; and
  - ii. Pacific Tuna Tagging Project.
- 15. Informal small groups (ISGs) were convened to address matters related to:
  - i. SC work programme and budget;
  - ii. recommendations from joint tuna RFMO (Kobe II) workshops;
  - iii. Strategic Research Plan, and
  - iv. Japan Trust Fund (JTF).

## **1.4 Reporting arrangements**

- 16. The SC agreed to adopt a Summary Report on the last day of the meeting, with the SC's recommendations to the Commission approved during the course of the meeting (following each theme discussion) whenever possible. An Executive Summary, which would serve as the basis for the report, advice and recommendations of the SC to the Commission, would be prepared by the Secretariat following the meeting.

17. A list of abbreviations and acronyms used in this report, and a list of documents for SC6 are included as Attachment F and Attachment G, respectively.

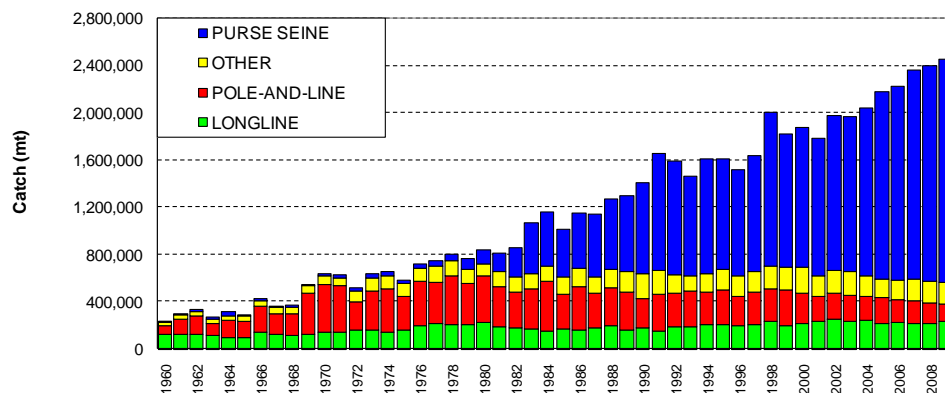
### 1.5 Intercessional activities of the Scientific Committee

18. The Science Manager presented a brief report on the SC’s intercessional activities for the last 12 months (WCPFC-SC6-2010/GN-IP-01) highlighting (i) renewal of the MOU with the Commission’s Science Service Provider, Secretariat of the Pacific Community – Oceanic Fisheries Programme (SPC), which provides data management and stock assessment services; (ii) publication of the SC5 Summary Report; (iii) cooperation with other organizations; (iv) the Western Pacific East Asia Oceanic Fisheries Management Project; (v) the Japan Trust Fund Project; and (vi) other work programme activities.

## AGENDA ITEM 2 — REVIEW OF FISHERIES

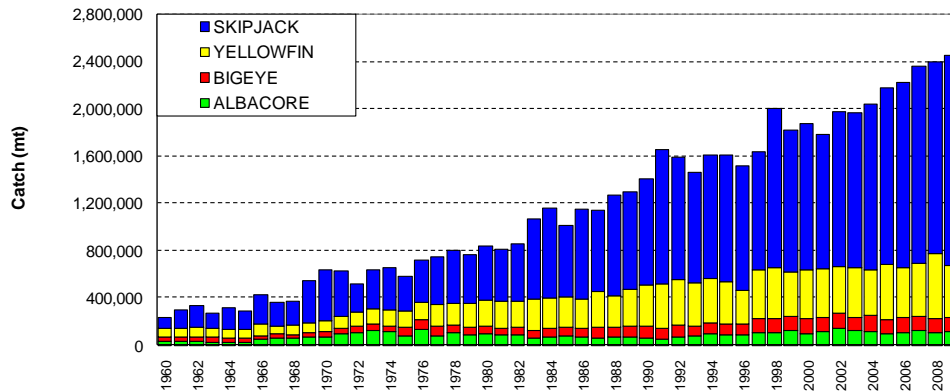
### 2.1 Overview of Western and Central Pacific Ocean (WCPO) Fisheries\*

19. P. Williams (SPC) and P. Terawasi (FFA) co-presented an “Overview of tuna fisheries in the Western and Central Pacific Ocean, including economic conditions — 2009” (WCPFC-SC6-2010/GN-WP-01). The provisional total WCP–Convention Area (CA) tuna catch for 2009 was estimated at 2,467,903 mt, the highest annual catch recorded and 70,000 mt higher than the previous record in 2008 (2,398,664 mt). During 2009, the purse seine fishery accounted for an estimated 1,894,500 mt (77% of the total catch, and another record for this fishery), with pole-and-line taking an estimated 165,814 mt (7%), the longline fishery an estimated 223,792 mt (9%), and the remainder (7%) taken by troll gear and a variety of artisanal gears, mostly in eastern Indonesia and the Philippines. The WCP–CA tuna catch (2,467,903 mt) for 2009 represented 81% of the total Pacific Ocean catch of 3,042,092 mt, and 58% of the global tuna catch (the provisional estimate for 2009 is 4,222,289 mt).



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

20. The 2009 WCP–CA catch of skipjack (1,789,979 mt – 73% of the total catch) was clearly the highest recorded and nearly 120,000 mt more than the previous record catch of 2007 (1,672,996 mt). The WCP–CA yellowfin catch for 2009 (433,788 mt – 18%) was 115,000 mt (21%) lower than the record catch taken in 2008 (547,985 mt). The WCP–CA bigeye catch for 2009 (118,657 mt – 5%) was the lowest since 2003, mainly due to a drop in 2009 provisional estimates for the longline fishery. The 2009 WCP–CA albacore catch (125,479 mt - 5%) was the second highest on record, with very good catches from the longline fishery.



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

21. The provisional 2009 purse-seine catch of 1,894,500 mt was the sixth consecutive record catch for this fishery and 70,000 mt higher than the previous record in 2008. The 2009 purse-seine skipjack catch (1,585,307 mt – 84% of the total catch) was clearly higher than both the 2008 catch (by 190,000 mt) and the record catch in 2007 (by 140,000 mt). The purse-seine skipjack catch has now increased by nearly 700,000 mt (or 79%) since 2001 (890,605 mt), at an average of about 88,000 mt per year. The 2009 purse-seine catch of yellowfin tuna (264,787 mt – 14%) was a significant reduction (124,000 mt) on the record catch taken in 2008 (386,293 mt) but still the fourth highest on record. The provisional catch estimate for bigeye tuna for 2009 (43,580 mt) was the second highest on record (only 900 mt (2%) less than the 2008 record catch).

22. The 2009 pole-and-line catch (165,814 mt) was the lowest annual catch for this fishery since the mid-1960s. The Japanese distant-water and offshore (104,232 mt in 2009) fleets, and the Indonesian fleets (60,415 mt in 2007), account for most of the WCP–CA pole-and-line catch. The catches by the Japanese distant-water and offshore fleets in recent years have been the lowest for several decades and this is no doubt related to the continued reduction in vessel numbers (in 2009 reduced to only 96 vessels, the lowest on record). The Solomon Islands fleet ceased operating in 2009, with no apparent plan to resume activities in the short term.

23. The provisional WCP–CA longline catch (223,792 mt) for 2009 was slightly below the average annual catch for the period 2000–2009 and around 10% (23,000 mt) lower than the highest on record attained in 2002 (256,582 mt). The WCP-CA albacore longline catch (87,080 mt – 39%) for 2009 was only 2,000 mt lower than the highest catch on record (89,883 mt in 2002). The provisional bigeye catch (65,606 mt – 29%) for 2009 was the lowest since 1996, but may be revised upwards when revised estimates are provided. The yellowfin catch for 2009 (69,158 mt – 31%) was similar to the average catch level for this species over the period 2000-2009.

24. The 2009 troll albacore catch (2,027 mt) was the lowest since 1986, and was apparently due to poor catches experienced in the New Zealand domestic fishery. The New Zealand troll fleet (165 vessels catching 1,790 mt in 2009) and the United States troll fleet (4 vessels catching 237 mt in 2009) typically account for most of the albacore troll catch, with minor contributions coming from the Canadian, the Cook Islands and French Polynesian fleets in previous years.

## Economic overview of WCPO tuna fisheries

### *Value of Purse Seine Catch*

25. Skipjack prices in 2009 averaged around 30% lower than 2008 prices; prices in Bangkok averaged USD 1,099 (compared with USD 1,543 in 2008, and USD 1,280 in 2007) and in Yaizu USD 1,325 (compared with USD 1,777 in 2008 and USD 1,287 in 2007).

26. The overall decline in skipjack price in 2009 was driven by the reversal in the trends of some of the important factors that previously had driven up fish prices, including trends in global food and oil prices as well as skipjack supplies. Estimated purse seine skipjack catch in the WCPO was almost 15% higher than in 2008.

27. The price trends for purse-seine caught yellowfin were also down in 2009, with Bangkok prices at around USD 1,387, or 30% lower than in 2008 (22% lower than in 2007); Yaizu prices (in US dollars) were USD 2,279, or about 11% lower than 2009, and 18% higher than in 2007.

28. At Yaizu market, purse-seine caught yellowfin prices, in USD terms, averaged USD 2,208/mt in the first half of 2009 and USD 2,345/mt in the latter half. The Yaizu average price during the first half of 2010 averaged USD 2,662/mt, a notable improvement over the previous twelve months.

29. The estimated delivered value of the purse seine tuna catch in the WCPFC area for 2009 is USD 2,300 million, a drop from last year's record level of USD 3,178 million. This represents a decline of USD 878 million or 28% on the estimated delivered value of the catch in 2008. This decrease was driven by a USD 515 million (21%) decrease in delivered value of the skipjack catch, which is estimated to be worth USD 1,897 million in 2009, resulting from a 31% decrease in the composite price that more than offset the rise of 15% in the catch. The value of the purse seine yellowfin catch declined even more sharply, by almost 41%, to around USD 404 million, as a result of a 24% decrease in the composite price and a 31% decrease in catch.

#### ***Value of pole and line catch***

30. During 2009 the Yaizu price of pole and line caught skipjack in waters off Japan averaged JPY 215/kg (USD 2,297/mt), a decrease of 11% from 2008. By contrast, the Yaizu price of pole and line caught skipjack in waters south of Japan increased, averaging JPY 253/kg (USD 2,704/mt) during 2009, a rise of only 1% in JPY terms.

31. The estimated delivered value of the skipjack catch in the WCPFC pole and line fishery for 2009 is USD 228 million. This represents a 26% decrease on the estimated value of the catch in 2007, resulting from a 7% decrease in prices and a 20% decrease in catch.

#### ***Value of longline catch***

32. Longline sashimi product prices broadly remained stagnant with some declining in 2009 as consumption focused on lower-end products owing to adverse economic conditions, both in Japan and US markets.

33. Yellowfin longline prices (ex-vessel) landed at Yaizu dropped by 3% to JPY 616/kg and average frozen yellowfin prices (ex-vessel) at selected Japanese ports also dropped 3% to JPY 634/kg. Japanese import prices for fresh yellowfin sourced from Oceania declined 9% to JPY 846/kg. Bigeye frozen bigeye prices (ex-vessel) at selected major Japanese ports rose 4% in 2009 to JPY 895/kg. Average prices for fresh bigeye from Oceania declined 5% to JPY 978/kg (USD 10.45/kg).

34. The price for frozen white meat canning product at Bangkok (10kg and up) averaged USD 2,653/mt in 2009, up 7% from 2008 and 25% from 2007. Prices throughout the year steadied at between



just above USD 2,500/mt and just under USD 2,800/mt. Thai imports of frozen albacore in 2009 rose 20% to 39,546 mt that more reversed the decline of 7% in 2008. Prices improved by 7% to USD 2,621/mt (2.62/kg) from USD 2,448/mt (USD 2.45/kg).

35. The estimated delivered value of the longline tuna catch in the WCPFC area for 2009 is USD 1,301 million. This represents an increase of USD 48 million on the estimated value of the catch in 2008. The value of the albacore catch increased by USD 42 million (22%) while the value of the bigeye catch decreased by USD 23 million (4%) and the value of the yellowfin catch increased by USD 29 million (6%). The albacore catch was estimated to be worth USD 232 million in 2009 with the 22% increase being driven by a 6% increase in the composite price and a 15% per cent increase in catch. The bigeye catch was estimated to be worth USD 583 million in 2009 with the 4% decline accounted for by a 10% drop in catch, and that more than offset the impact of the 7% increase in the composite price. The estimated delivered value of the yellowfin catch was USD 486 million, accounted for solely by the 6% increase in catch as the composite price marginally decreased (by less than 1%).

**Table 1: Catch and values by gear**

<b>Table 1. Catch and values by gear</b>						
Gear	Mt Millions			US\$ Billions		
	2008	2009	% Change	2008	2009	% Change
Longline	0.21	0.22	4%	1.25	1.30	4%
Purse seine	1.85	1.93	4%	3.26	2.35	-28%
Pole and line	0.18	0.17	-7%	0.39	0.34	-12%
Troll	0.01	0.01	-13%	0.02	0.02	-31%
Other gears	0.14	0.14	-5%	0.26	0.18	-32%
GRAND TOTAL	2.40	2.47	3%	5.18	4.19	-19%

**Table 2: Catch and value by species**

<b>Table 2. Catch and values by species</b>						
	Mt Millions			US\$ Billions		
	2008	2009	% Change	2008	2009	% Change
ALB	0.10	0.13	22%	0.26	0.33	30%
BET	0.13	0.12	-6%	0.70	0.65	-7%
SKJ	1.62	1.79	10%	2.84	2.19	-23%
YFT	0.55	0.43	-21%	1.39	1.02	-27%
GRAND TOTAL	2.40	2.47	3%	5.18	4.19	-19%

## Discussion

36. The question was posed whether it was possible to include billfish species in the WCPO fisheries overview prepared for future SC meetings. It was noted that WCPFC-SC6-2010/GN-WP-01 provides very good background and context for discussions throughout the SC meetings and that expanding its scope would be useful. It was also noted, however, that caution would be required in determining which additional species should be included to ensure that the main theme of the paper (key target species) is not overshadowed. SPC and FFA indicated that targeted billfish species (e.g. swordfish) could be incorporated in the Tuna Fisheries Overview paper, while other species were better addressed under the Ecosystem and Bycatch Mitigation theme; it was also observed that preparation of a full stock assessment for billfish would require much more comprehensive information than is now available.

37. In addition, concern was raised regarding the increase in purse seine effort and effort on drifting FADs reported in the paper; it was noted that this is an issue for discussion later in the agenda.

38. Clarification was provided that the term “eco-friendly” is used by some sectors in regards to the pole and line fishery due to the low levels of bycatch and discard.

**Recommendation:**

39. The SC agreed to include key billfish species in its overview of WCPO fisheries, beginning with SC7.

**2.2 Overview of Eastern Pacific Ocean (EPO) fisheries**

40. K. Schaefer (IATTC Secretariat) presented a summary of the fishery and assessments of major stocks of tuna exploited in the eastern Pacific Ocean (EPO) in the 2009 review of EPO Fisheries (WCPFC-SC6-2010/GN-WP-02). The fishing capacity of the purse-seine fleet fishing in the EPO has increased over the last 10 years, but stabilized in mid-2006. The reported nominal longline effort has fluctuated between about 300 and 100 million hooks set annually between 1980 and 2008. Total tuna catches increased starting in 1995, peaked in 2003, and then declined to levels of about 10 years previously.

41. Yellowfin tuna catches have remained fairly stable since the mid-1980s, except for a peak in 2001 through 2003 followed by a substantial decline in 2006 through 2008. The 2008 catch on dolphin-associated schools increased significantly, similar to levels in 2006 and 2007, and there were reduced catches on unassociated schools. The current stock assessment method being used for yellowfin is STOCK SYNTHESIS. Since 2001 recruitment has been relatively low, though not quite as low as it was during 1977 through 1985. The spawning biomass ratio (SBR) for 2008 is above the level corresponding to the MSY. The spawning stock size is above the maximum sustainable yield (MSY) level and fishing mortality rates are close to those corresponding to the MSY level. The current status of the stock is considerably more pessimistic if a stock recruitment relationship is assumed.

42. The status of the skipjack stock has been evaluated using eight different data and model based indicators. The purse-seine catch has been significantly increasing since 1994, and in 2008 was above the upper reference level. Except for a large peak in 1999, the catch per days fished (CPDF) on floating objects has generally fluctuated around an average level since 1992. The biomass and recruitment have been increasing over the past 10 years, and exploitation rate has been increasing over the past 20 years. The main concern with the skipjack stock is the constantly increasing exploitation rate.

43. There have been substantial historical changes in the bigeye fishery in the EPO. Beginning in 1994 purse-seine catches increased substantially from the targeting of tunas associated with drifting FADs in the equatorial EPO. During the past 14 years longline catches have been significantly below catches in the previous 20-year period. The current stock assessment method being used for bigeye is STOCK SYNTHESIS. Recruitment estimates have been above average from 2001 to 2008, except for 2007. Recent estimates indicate that the bigeye stock is overexploited and that overfishing is taking place. The recent SBR levels are below those corresponding to the MSY and this result is consistent across various modeling scenarios.

44. A tuna conservation resolution was adopted by the IATTC in July 2009, for the three-year period – (2009–2011). This includes an EPO-wide closure for purse-seine (>182 mt) fishing of 59 d in 2009, 62 d in 2010, and 73 d in 2011, along with a 30 d closure of a core offshore FAD fishing area. For longline vessels (>24 m) the resolution includes fixed bigeye catch limits for China, Japan, Korea, and Chinese Taipei, and other CPCs are not to exceed 500 t or their respective catches in 2001, whichever is greater.

### **2.3 Annual Reports (Part 1) from Members, COOPERATING NON-MEMBERS, AND Participating Territories (CCMs)**

45. CCMs presented their Annual Reports (Part 1) for 2009.

#### ***Australia***

46. Australian commercial fisheries for highly migratory species in the Western and Central Pacific Fisheries Commission (WCPFC) Convention Area are managed as part of the Eastern Tuna and Billfish Fishery (ETBF) (mainly a longline fishery with a small minor line component) and Eastern Skipjack Fishery (purse seine fishery). The majority of fishing occurs in the longline sector of the ETBF and as such, is the focus of the annual report.

47. Total catches reported in logbooks for the ETBF decreased from 5,768 mt in 2008 (5,742 mt longline, 26 mt minor line) to 5,403 mt in 2009 (5,271 mt longline, 132 mt minor line). This is a decline from a peak of 8,229 mt in 2002. Longline fishing effort in the fishery has fallen from a peak of 12.40 million hooks in 2003 to 8.82 million hooks in 2009; however, it is an increase from 2008 fishing effort levels (8.06 million hooks). The decrease in fishing effort from 2003 levels is mainly a result of the strength of the Australian dollar, increased operating costs and the surrender of permits under the structural adjustment component of the recent Australian Government Securing Our Fishing Future package. Fifty-five vessels reported longlining in the WCPFC Convention Area during 2009. Longline logbook catches of albacore tuna increased from 1,083 mt in 2008 to 1342 mt in 2009. Longline catches of bigeye tuna decreased from 900 mt in 2008 to 619 mt in 2009. Longline catches of yellowfin tuna also decreased from 1,478 mt in 2008 to 1,201 mt in 2009. Longline catches of swordfish decreased from 1,241 mt in 2008 to 1,111 mt in 2009. Longline catches of striped marlin decreased from 374 mt in 2008 to 325 mt in 2009.

48. There were 11 active minor line vessels during 2009. The number of vessels reporting using minor line has steadily decreased from a peak of 52 vessels in 2001. This is partly due to the surrender of 49 percent of permits under the structural adjustment component of the recent Australian Government Securing Our Fishing Future package. Annual minor line effort decreased from 310 lines in 2008 to 164 lines in 2009. In the 2008–2009 fishing season, there were no active vessels in the Eastern Skipjack Fishery.

49. The Australian Fisheries Management Authority (AFMA) observer program has deployed observers on domestic longliners since 2001 as part of a program to test the effectiveness of seabird mitigation devices. Since July 2003, observers have been deployed more broadly across the fishery with the aim of collecting additional fishery data, including information on fishing gear and the size and species composition of catches. In 2009, observers monitored 564,408 hooks in the longline fishery (6.4 percent of the total number of hooks deployed).

50. AFMA is currently working towards the introduction of quota based management in the form of individually transferable quotas into the ETBF scheduled for March 2011.

#### ***Belize***

51. Belize's long line tuna fishing fleet operating in the WCPFC Convention Area has shown a steady decrease in its catch and effort from 2003 to 2009. There has been a reduction from 30 vessels fishing exclusively in 2003 to 6 in 2009, all of which were licensed exclusively for operation in the WCPFC area. Belize also has one reefer carrier currently operating in the WCPFC Area. Due to the reduction in fishing effort, all of Belize's catches have decreased when compared with earlier years.

There has been a 94% reduction in overall catches from 3,445.99 mt in 2003 to 213.23 mt in 2009. However, this reduction is as a result of four of the vessels being laid up for a little over six months due to socio-economic costs. Albacore was the main target species from 2003 to 2006. However, our catches of yellowfin tuna exceed those of albacore in 2007 and 2009. The average size of our vessels has also risen from 191 GT in 2003 to 497 GT in 2008, and 576 GT in 2009. The majority of the vessels that operated during the period 2003–2006 were between 51 GT and 200 GT. In 2009 six of our vessels were over 500 GT.

52. Blue marlin is the most common non-tuna bycatch in Belize's long line fishery followed by black marlin and sailfish. The large reductions in our longline effort have also resulted in the reduction in catches of major bycatch species.

53. Belize received no reports of seabird and sea turtle interaction by Belize vessels in 2009. In 2008 measures were introduced to mitigate the impact of highly migratory fish stocks on seabirds and sea turtles, and Belize advised the Secretariat of the measures currently being utilized by its vessels.

54. Belize's fishing vessel owners/operators are required to submit data of their fishing operations based on Belize's format for such reporting, and in compliance with the WCPFC's reporting guidelines. For the purposes of ensuring compliance, surveillance is conducted on a regular basis or as a result of an investigation.

55. In the future, Belize intends to re-expand its long line fishing fleet to 10 fishing vessels exclusively in the Convention Area, to fish within the limits set by WCPFC.

### ***Canada***

56. Catch, effort and catch per unit of effort (CPUE) data for the Canadian albacore (*Thunnus alalunga*) fishery in the WCP-CA for 2009 are summarized in this document. The Canadian tuna fishery is a troll fishery that uses jigs and targets albacore exclusively. The Canadian fishery was inactive within the WCP-CA in 2009, with no effort or catch reported in statistical zones within the convention area in either the North or South Pacific Oceans. The total Pacific albacore tuna catch from 2002–2008 by the Canadian albacore troll fishery within the convention area has ranged from 83 mt in 2005 to 453 mt in 2003 and effort has ranged from 56 vessel days in 2007 to 408 vessel days in 2002. Both catch and effort by the Canadian fleet in the WCP-CA have declined since 2002. Canada participated in two ISC-Albacore Working Group workshop meetings in 2009 and implemented an on-board size-sampling program by harvesters.

### ***China***

57. China has two types of tuna fisheries in the WCP-CA: purse seine and longline, including ice fresh tuna longline (IFLL) and deep frozen tuna longline (DFLL). In 2009, the total tuna catch from the longline fishery was estimated to be 41,519 mt, and from the purse-seine fishery 76, 649 mt. There are 219 longliners and 12 purse seiners.

58. The Chinese deep longline fishery bigeye catch is exported to Japan for sashimi, and the longline albacore catch is sold for cannery products. The catch by purse seine fishery for skipjack is also sold for cannery products. There were two scientific observers for Chinese deep longliners in 2009 in the entire Pacific Ocean. One observer trip collected fishery data and biological data during June 19, 2009 to December 31, 2009, covering areas S2°05'~S7°51' and W159°48'~W168°10', with 137 sets (346,720 total hooks) and 3,291 sampled fish. Another trip was made from June 8, 2009 to January 31, 2010

covering areas S1°36'~S16°15' and W125°32'~W141°58', with the 147 sets (476,920 total hooks) and 4,530 sampled fish. Size data for BET, YFT and SWO has been submitted to WCPFC. Data coverage of catch and effort was 100%, with 100% logbook coverage for longline fishery, which will promote quality data collection.

### ***Cook Islands***

59. The Cook Islands issued a total of 44 licenses last year to vessels authorized to fish within the WCP-CA. A total of 21 licenses were issued authorizing vessels to fish in areas beyond national jurisdiction, within the WCPFC-CA. Sixteen of these vessels also held licenses authorizing fishing activity within the Cook Islands EEZ, while the remaining five licenses were held by vessels based in foreign ports. A total of 23 licenses were issued to vessels authorizing fishing activity within the Cook Islands EEZ.

60. Total provisional catch by Cook Islands vessels within the WCP-CA for 2009 is 2,142.9 mt. Provisional total albacore catch estimates within the WCP-CA is 1,542 mt, with 1,460 mt attributed to in-zone catch. Within the Cook Islands EEZ, effort and total catch trends continue to be driven by the albacore fishery in the northern Cooks. In recent years, increases in effort have been attributed to charter and foreign (since late-2008) fishing vessels operating in the northern Cooks. On average albacore makes up 76% of total catches. In 2009, albacore catches taken in the southern fishery made up 5.2% of total in-zone catches, while albacore catches from the northern fishery contributed 73.6%. Although swordfish catches have diminished in recent years, vessels operating from Avatiu, Rarotonga, continue to actively target this species during the winter months. A total of 10.6 mt was reported from within the Convention Area; however, 9.9 mt of this was taken within the zone.

### ***El Salvador***

61. El Salvador is a small developing coastal country that borders the Pacific Ocean. The tuna industry has become one of the country's main economic revenues and represents the livelihood of a large number of families who live directly and indirectly from it.

62. El Salvador's tuna purse seine fleet consists of only four vessels whose main tuna catches are made within the Eastern Pacific Ocean. These vessels are fully controlled by two effective monitoring tools: VMS (hourly messages are received) and 100% observer coverage by the IATTC program, with observers remaining onboard even when the vessel operates outside of IATTC Convention Area. In addition, El Salvador complies with regulations such as: fishing capacity limits, prohibition of at-sea transshipments, and also strong bycatch conservation measures regarding shark fining, dolphin protection, and sea turtles, among other species, as well as implementing fisheries closures in both the WCPFC and IATTC areas.

63. El Salvador's monitoring and control system is highly effective, and our record of compliance in the IATTC and AIDCP is excellent. In the Western Pacific, our fisheries have been conducted pursuant to licensing of coastal states of the region and high seas fishing.

64. In relation to longliners, El Salvador has two operating vessels but these are not authorized to fish in the WCPFC. Finally, we emphasize that El Salvador is a small coastal state with interest and dependency of our communities on the tuna fishery and therefore, very respectful of the management dispositions implemented in order to promote sustainable fisheries. As a CNM, it is our complete commitment to not only give full compliance to the measures emanating from the WCPFC but actively participate within the Commission.

### ***European Community***

65. There are two EC-Spain fishing fleets operating in the Pacific Ocean: a purse seine fleet targeting tropical tuna, and a surface longline fishery targeting swordfish.

66. In 2009, four EC-Spain purse seiners, all with a gross registered tonnage (GRT) over 1500, fished in the WCPFC Convention Area. Data from the observers of the Agreement on the International Dolphin Conservation Program (AIDCP) and, in the case of one vessel, logbooks (100% coverage) indicate a total landed catch of 25,462 mt (3,767 mt of bigeye, 18,686 mt of skipjack, and 3,009 mt of yellowfin). Effort, aggregated catches, discards and bycatch data are also presented.

67. A total of nine Spanish-flagged longline vessels targeting swordfish were fishing in the WCPFC Convention Area in 2009, either year-round or temporarily. The vessels involved in the fishery presented the same average characteristics as in previous years (291.8 GTR, 861.8 HP and 40.8 m in length). The gear used is monofilament surface longline gear (Florida style modified), using an average of around 1,100 hooks per set. The 2009 swordfish landings, as well as estimations of bycatch, aggregated catches and effort distribution, are provided. The estimations of landings available for 2009 indicate a total swordfish catch of 1,721 mt from the WCPFC Convention Area (674 mt from the WCPFC-CA east of 150° W).

### ***Federated States of Micronesia***

68. The current estimate of the total catch by the 31 FSM purse seine and longline vessels within the WCPFC Convention Area for the year 2009 is 20,195 mt of skipjack, yellowfin and bigeye. The key target species accounted for 97% (predominantly by the purse seiners), with the remaining 1% being non-target species. Approximately 95% of the total catch is by purse-seine gear and 5% by longline gear, which are the only two gear types employed by FSM vessels within the Convention Area. In 2009, FSM employed 31 vessels (6 purse seine and 25 longline vessels). The total catch of FSM-flagged vessels in the Convention Area for 2009 was 29,195 mt.

69. The 2009 catch by FSM's domestic fleet was predominantly (87%) skipjack (116,208 mt), with yellowfin at 12% (2,257 mt) and bigeye <1% (93 mt), and other species of <1%. In general, catch for our domestic fleet within the Convention Area has increased 55% over 2008, and 30% over 2007 catches.

70. Totals for FSM-EEZ purse-seine, longline, and pole and line catches in 2009 cannot be reported to SC6 as FSM is having difficulties with its data/database for positive reporting; a resolution is being pursued with assistance from SPC.

71. The FSM Observer program operates with a pool of 32 observers. In 2009, there were 119 successful placements, including 20 aboard longliners and 99 on purse seiner vessels. The sudden increase of trip numbers by observers for 2009 is mainly due to the FAD closure period, when approximately 87% of all observer trips for 2009 were made. Coverage for observers per fleet and gear type will be reported in FSM's SC6 Annual Report, as soon as we are able to calculate observed sea days versus the number of days fished in zone.

72. NORMA achieved port sampling coverage rates of 82% for purse seiners and 96% for longliners in 2009, based on unloading records. NORMA continues to strive for 100% port sampling coverage of longline transshipments in FSM ports.

73. A total of 162 purse seine vessels reported transshipping in FSM ports in 2009, with a volume of 106,209 mt of tuna transhipped. Skipjack accounted for 96%, with 3% of mixed yellowfin and bigeye and

1% other species. Pohnpei remains the only active port in FSM. The majority of the purse seine vessels unloading in FSM were from Chinese Taipei, accounting for 94 transshipments, followed by China (24), FSMA (22), FSM (15), and Korea (7) unloading for 2009.

74. A total of 674 longline unloadings were indicated for 2009, for a total of 2,321 mt (56% bigeye, 18% yellowfin, and 26% other species). Most of the unloaded volume by longliners was by vessels flagged in China (60%), with 40% by FSM-flagged vessels. There were 419 unloadings by China-flagged vessels, and 255 by FSM-flagged vessels.

### ***Fiji***

75. In the early 1990s, when fishing activity was relatively low, albacore accounted for about 50% of the tuna catch, but this increased to around 70% – 80% from 1995 onwards. The yellowfin catch has remained at 15% – 25% of the total tuna catch, with the highest recorded in 2004. The percentage composition for bigeye has accounted for some 8% of total catch. The 2009 catches of these three tuna species totaled 10,419 mt, or 75% of the total catch.

76. The nominal CPUE for albacore increased steadily from 1.03 in 2003 to 1.93 in 2006, before dropping to 1.49 in 2009. Bigeye nominal CPUE appears relatively stable over the time series. Yellowfin nominal CPUE remained consistent at and around the 0.2 levels in 2005 and 2006 before increasing to an average of 0.33 fish per 100 hooks in recent years.

77. The national observer records for the interaction rates of Species of Special Interest showed a higher level of interaction in 2009 compared to the previous years. This is attributed to the improved reporting by the national observer programme. The following interactions were observed in 2009: 2 loggerhead sea turtles, 1 hawksbill, 1 leatherback, 2 olive ridley turtles, 2 dolphins and 2 toothed whales.

### ***French Polynesia***

78. The tuna fishery is a major component of the French Polynesian economy. The overall nominal catch for the commercial tuna fisheries in 2009 is estimated at 8,800 mt, of which 68% was caught by longliners and the remainder by artisanal coastal fisheries. Albacore, the target longline species, accounted for 43%, with yellowfin tuna comprising 15%, bigeye 7% and skipjack 15%, which is targeted by a part of coastal fishery fleet.

79. The longline fleet usually exploits one-half to two-thirds of the EEZ, but the core fishing ground remains (as it historically has been) in the northern part of the EEZ (10°–20°S and 140°–150°W), and around Tahiti. Since 2001, no foreign fleets have operated in French Polynesia

80. Port sampler and observer programmes occurred in 2009. The longline fleet is entirely based in Papeete, and this facilitates port sampling operations. The observers collected biological samples of albacore tuna (gonads and otoliths) during the year, with the samples sent to SPC. During the year, observers were trained by staff from CSIRO to tag swordfish with popup markers. The first specimen was tagged in December 2009, and eight additional specimens should be tagged during 2010.

### ***Indonesia***

81. The Indonesia Fisheries Management Areas (FMAs) located within WCPFC Convention Area are: FMA 716 (Sulawesi Sea, Halmahera Sea), FMA 717 (Pacific Ocean). The main types of fishing gear targeting highly migratory species in these areas are purse seine, longline, pole and line, surface and deep hook and line. The number of large purse-seine vessels increase by 46 %, with 438 purse seiners

registered in the FMA 716 and FMA 717 areas. The number of tuna longliners decreased 13.8% – 33.5%, with 264 longliners in the 716 and 717 areas; trends are stable for other fishing gear types.

82. The fishing fleet size structure was as follows < 30 GT (2.09%), 30 < 50 GT (12.5%), –50–100 GT (54.5 %) , –100–200 GT (21.38%), 200–300 GT (1.56 %), 300–500 GT (5.48 %), 500–1000 GT (1.96 %) and > 1000 GT (0.5 %). Longliners of 300–500 GT increased by 58 %, with 21 vessel now in operation.

83. The annual catches from 2003 to 2009 remained relatively stable, ranging from 105,403 mt to 151,554 mt. The catch composition was skipjack (52.4%), yellowfin (18.4%), longtail (8.9%), bigeye (6.7%), albacore (5.7%), frigate tuna (4.5%), eastern little tuna (3.4%), sailfish (0.1%) and black marlin (0.02%).

84. Research related to highly migratory species, and particularly skipjack, yellowfin and bigeye tuna in the Convention Area of Indonesian waters, was conducted intensively in 1999. Since then it has not been possible to regularly undertake research on highly migratory species. The research addressed biology dynamics and exploitation, mainly for yellowfin, bigeye and skipjack.

85. Indonesia faces difficulties in producing appropriate catch and effort data due to the complexities of its fisheries. Indonesia is participating in the WPEA OFM Project in an effort to solve those shortfalls.

### ***Japan***

86. This abstract describes recent trends in the Japanese tuna and billfish fishing activities by longline, pole-and-line, purse seine and the other fisheries mostly in the WCPFC Convention Area (WCP-CA), including fleet size, catch and fishing effort statistics. There were 402 commercial longline vessels (larger than 10 GRT) in 2009, 63 vessels (14%) less than in 2008. There were 97 pole-and-line vessels (larger than 20 GRT) in 2009, or 2 vessels (2%) less than in 2008. In 2009, 38 purse seine vessels over 200 GRT operated in equatorial waters, 3 vessels more than in 2008. Thirty five distant-water purse-seine vessels were allowed to operate in tropical waters in 2009; this figure has been stabilized since 1995.

87. The total WCP-CA catch of tunas (Pacific bluefin, albacore, bigeye, yellowfin and skipjack) by the Japanese fishery was 410,861 mt in 2009, corresponding to 91% of 451,780 mt in 2008, although the 2009 catch statistics are preliminary. In 2009, the catch of tunas by the purse-seine fishery was 237,599 mt (58% of the total catch of tunas), with 104,282 mt (25%) by the pole-and-line, 53,738 mt (13%) by the longline, and the remaining (3%) by the other gears.

88. Japan has conducted several research activities in relation to biological and stock assessment studies on tuna, billfish and other bycatch species in the WCP-CA in 2009 and early 2010, including the tagging study for tropical tunas and sharks, several research cruises on Pacific bluefin tuna larval sampling, a research cruise to reduce the catch of juvenile bigeye in the purse seine fishery, and bigeye migration. In addition, research was conducted related to bycatch-species, including the experimental use of circle hooks in reducing hooking mortality of sea turtles and at-sea experiments on the longline side setting method, and a sea turtle nesting survey.

### ***Kiribati***

89. Tuna fishing in Kiribati consists of foreign fishing fleets licensed to fish tuna in Kiribati's EEZ and the artisanal fishery, which is important in providing food security for the local people. The license fees of foreign fishing fleets composed significant revenue to Kiribati. In 2009, this offshore licensing revenue comprised 35% of total government revenue.



90. The major type of licensed foreign fleets includes purse-seine and pole-line vessels targeting skipjack and yellowfin tuna. The third type comprises longline vessels, which mostly caught bigeye and yellowfin tuna. In 2009, Kiribati licensed a total of over 500 foreign fishing vessels, including supporting vessels, the highest number recorded over the last 5 years.

91. Kiribati also engaged in a joint-venture fishing vessel, owning one purse-seine vessel (Kao no.1) that currently fishes under the FSM arrangement. In addition three purse-seine and one pole-line vessels operated in the Convention Area under Kiribati's flag. The total catch for Kiribati national fleets in 2009 was over 20,000 mt, which was three times larger than the average catch for the last 13 years. This increase results from the increase in the number of national fleets introduced to fish during that period.

92. Tuna remain the most important of Kiribati's resources, and therefore the sustainable development and management of this resource is critical for the country. Kiribati will unite with other countries at both regional and international levels to ensure sustainable management of the resource.

### ***Korea***

93. Two types of Korean tuna fisheries — distant water purse seine and distant water longline — operate in the Convention Area. Over the past 5 years, the number of longline vessels was reduced from 153 to 111, while the number of purse seine vessel was maintained at 28. The size of purse seine vessels ranged from 201 to 2,023, with vessels larger than 2,000 GRT launched since 2006. The size of longline vessels ranged from 408 to 498 GRT.

94. The purse seine catch estimates over the past 5 years ranged from 204,500 mt to 283,300 mt, with an average of 249,585 mt; the trend was increasing. The main species caught were skipjack (82.6% of the total catch) and yellowfin tuna (17.2% of the total). Longline catch estimates for the past 5 years ranged from 22,900 mt to 38,400 mt, made up of bigeye tuna (46.5%), yellowfin tuna (32.2%) and albacore (6.3%). Billfish (swordfish, blue marlin, striped marlin, black marlin and sailfish) comprised 12.6% of the total catch; blue marlin was the dominant billfish species caught, making up 44.5% of the billfish catch.

95. In 2009, three observers were deployed to monitor tuna fisheries in the Convention Area and reported 2 shark species and 1 turtle species from purse seiners and 5 shark species from longliners. They conducted a tag-release on 19 yellowfin tuna and 6 bigeye tunas, with 223 tags recaptured by tuna purse seine and longline vessels and canneries reported to relevant tuna RFMOs and SPC. The National Fisheries Research and Development Institute (NFRDI) is currently developing sampling methods for canneries. From 2010, NFRDI started a 5-year research project on the biology and ecology of Pacific bluefin tuna in Korean waters. Fishers were directed to submit their logsheets to the NFRDI electronically to improve catch data collection coverage rates.

### ***Marshall Islands***

96. The tuna fishery in the Republic of the Marshall Islands (RMI) is comprised of foreign flagged purse seine, pole-and-line and longline vessels and RMI-flagged purse seine and longline vessels. Most of the foreign flagged longline vessels operate in support of domestic development activities and are based locally.

97. With a new purse seine vessel joining the fishery in 2009, total catch of the national fleet operating throughout the Western and Central Pacific Ocean was 44,342 mt, an increase of around 27% compared to the previous year. There was also an increase in catch from the national longline fleet, but the increase was not as pronounced.

98. Overall catch estimates from licensed foreign fleets operating in the RMI EEZ in 2009 amounted to just over 20,000 mt, with 76% of the catch attributed to the purse seine fleets; Skipjack tuna accounted for the majority of the catch.

### *Nauru*

99. There are some new developments in Nauru's fisheries data and research activities since the last report. These include

- a) The WCPFC gave interim authorization to the National Observer program to participate in the WCPFC Regional Observer Program, after the program demonstrated that it had met the minimum standards required by the Commission. In addition to the PNA 3rd Implementing Agreement Observer requirements, this has given Nauru's observers more opportunity to expand their coverage rates and provide more useful data to the Commission.
- b) Authorisation was given to SPC to release operational log sheet data for fishing vessel activities in its EEZ to the WCPFC. There are no Nauru-flagged vessels operating in the WCPO, and this authorisation will allow full and complete coverage of the activities of all licensed fishing vessels operating in the Nauru's EEZ, thereby meeting Nauru's reporting obligations.

### *New Caledonia*

100. Fishing for tuna and associated species by New Caledonian vessels started in 1981 with pole-and-line (less than 3 vessels), which stopped very rapidly (catches were 228 mt in 1981, 998 mt in 1982, and 492 mt in 1983). Longliners began operating at the same time. However, it took almost 20 years before this domestic fleet had significant activity.

101. In 2009, 21 domestic longliners fished in the New Caledonian EEZ. No licenses have been issued to foreign vessels since early 2001. A 7% increase in the total catch was reported in 2009 as a consequence of a similar increase in fishing effort. The annual catch of 2,545 mt was mainly composed of albacore, which accounts for 65% of the total (1,649 mt). Yellowfin was second (487 mt and 19%).

102. No New Caledonian vessel targets bigeye, sharks, marlins or swordfish. Therefore, all the catch reported for these species are bycatch. Catches of sharks have been decreasing since 2006, due to the increasing use of monofilament branch lines. The shortfin mako is the only shark retained and sold for meat consumption in New Caledonia, totalling less than 15 mt in both 2008 and 2009.

103. Observer coverage of longline sets reached 8% in 2009, during which only one turtle interaction was observed; there was 41% port sampling coverage. The main objective of these activities is to collect information to be checked with the other sources of data, particularly logsheets. The local VMS (which dates back to early 2005) also provides data for close monitoring of fishing activity. Through the ZoNéCo programme New Caledonia continues to participate in regional efforts to improve the knowledge of tuna behaviour, in particular South Pacific albacore as the species of major interest for its fishery. In particular, some funds are provided to help carry out tagging operations.

### *New Zealand*

104. Since 2002, skipjack has comprised the greatest part of the New Zealand catch of all tuna species, both within and beyond New Zealand fisheries waters; the 2009 catch equalled 26,676 mt, nearly all of which was taken by purse seine. Outside New Zealand fisheries waters, yellowfin (1,264 mt) makes up most of the balance. Yellowfin are rarely part of the purse seine catch within New Zealand fisheries waters because the domestic purse-seine fishery targets only free schools of skipjack. The second most

important component of New Zealand's domestic fisheries is albacore (1,115 mt) which are taken mostly by troll gear, but are also landed as target and bycatch in the longline fishery. The domestic longline fleet targets both bigeye and southern bluefin tuna and more recently swordfish, but the greatest part of the catch consists of albacore. Almost 180 mt of striped marlin are caught annually by the recreational fleet, with well over half the fish tagged and released. Most highly migratory species caught in New Zealand waters are exported; the destination of exports varies depending on the species.

105. New Zealand has four Class-6 purse seiners fishing offshore in the EEZs of Pacific Island States and in high seas areas of the equatorial WCPO. These vessels have also fished domestically from time to time along with six smaller capacity domestic-based purse seiners. The number of purse-seiners has been relatively stable at between 10 and 13 vessels since 2005. The New Zealand longline tuna fleet consists of domestically owned and operated vessels (mostly between 15 to 25 m in length) and a limited number of foreign-owned vessels that operate under charter. The number of longline vessels operating in New Zealand has declined from 151 vessels in 2002 to 40 in 2009.

106. Blue shark is the most common non-tuna bycatch species in the longline fishery followed by lancet fish and Ray's bream. Recent reductions in longline effort have resulted in reductions in catches of the major bycatch species.

107. Longline vessels fishing for tuna or swordfish in New Zealand fishery waters are required to use tori lines, and may only set their lines at night unless using approved line weighting. New Zealand longline vessels fishing on the high seas south of 30°S must use two mitigation measures as specified in CMM 2007-04. New Zealand longline vessels have been provided with turtle de-hooking and mitigation equipment. As the purse seine fishery in New Zealand fishery waters is based on free schools of skipjack, bycatch is minimal (e.g. 1% by mass). No interactions with non-fish bycatch (e.g. seabirds, turtles, and marine mammals) have been observed in the purse-seine fishery.

108. New Zealand has an observer programme and two active domestic port sampling programmes. In 2009, 26% of the longline effort (hooks) was observed, and almost 35% of the New Zealand purse seine sets were observed, in addition six troll trips were observed. A considerable amount of research is directed at tunas, tuna-like and bycatch species in New Zealand. Fishers and fish receivers are required to furnish returns (monthly reports) to the Ministry of Fisheries. New Zealand has four data collection systems in place to collect catch and effort data. New Zealand also has a system for collecting information on non-fish bycatch from fishers.

### *Niue*

109. The development of a large-scale commercial fishery has long been an aspiration of Niue. Despite resource limitations Niue continues to work progressively over the years researching and implementing viable operations while factoring in some of the constraints in pursuing such a venture.

110. Fishing activity in Niue is undertaken within a relatively small EEZ and consists of three components, an artisanal boat and canoe fishery, a tourism related sport fishery and the developing commercial domestic longline fishery.

111. Niue's commercial domestic longline fishery operations within the Niue EEZ targeting albacore tuna and associated bycatch. Since the commencement of the fishery in 2005 albacore has comprised the greatest part of catches for all tuna species within Niue's longline fishery. In mid 2009 Niue resumed operation under its joint fishing venture arrangement and issued 9 licenses for longline vessels.

112. The total longline catch from the Niue EEZ over a four month period was estimated to be approximately 202.5 mt dominated by albacore (~147.2 mt) with lesser amounts of yellowfin (~19.5 mt) and bigeye (~10.0 mt). Catches of albacore and other pelagic species vary seasonally, impacting local abundances and therefore catch rates.

113. Longline vessels of Pacific Island Countries and Territories have operated in the Niue EEZ including vessels from Samoa, American Samoa, Cook Islands, French Polynesia and Taiwan/Vanuatu under charter arrangements with Niue. Taiwanese, Korean and USA flagged longline vessels have been licensed under access agreements to fish within Niue's EEZ in the past.

114. Niue aims to undertake a Wahoo tagging project in late 2010 as Wahoo is a significantly high value fish of importance to food security for Niue. Catch rates have displayed relatively minor seasonal fluctuations however a longer time series of data is required to better determine temporal and spatial patterns of catch rates in the Niue EEZ supported by biological data.

### *Palau*

115. To be provided

### *Papua New Guinea*

116. The Papua New Guinea (PNG) tuna fishery is made up of both the Purse-seine and longline sectors with a small, but important handline sector. The longline and Handline sector is a citizen only activity and all vessels fish exclusively in the waters under PNG national jurisdiction. The purse-seine sector is a mix of both domestic and foreign access vessels. The domestic sector comprises the PNG flag vessels and PNG chartered vessels which support processing facilities onshore in PNG. While the PNG flagged vessels fish primarily in PNG waters, but occasionally in the adjacent high seas, the chartered vessels fish both in PNG waters and waters outside of PNG. Foreign vessels under access arrangements fish in PNG waters whenever there is fish to catch.

117. Total catch in 2009 within PNG waters was 455,346 mt, a 9% drop from the 2008 catch of 500,433mt. This catch is estimated to be about 11% of global catch and 19% of WCPO catch in 2009. The decline in total catch is attributed to the decline in the total fishing effort. The catch contribution was, seventy percent (71%) by foreign vessels that fish under Access arrangements, 21% from PNG chartered vessels and 8% from the PNG flag vessels. Small amount <0.5% (2,217mt) is from the longline sector. Catch by PNG flagged vessels outside PNG waters was 544mt and was from the high sea pockets north and adjacent to the PNG EEZ. The Catch by PNG chartered vessels outside of PNG waters was 70,855mt and was mainly from the high seas and the waters of the other PNA countries.

118. A total of 227 vessels were active in the PNG waters in 2009. Thirty-two (32) were longline and handline vessels and 195 were purse-seine vessels. Nine (9) of the 195 vessels were PNG flagged, 31 were PNG chartered and 155 were foreign vessels fishing under Access arrangements. The total purse-seine effort in 2009 was 13,348 days fished and searched, a 2% drop from 13,675 days in 2008. Longline effort also dropped from 42,805 hundreds of hooks (hhk) in 2008 to 36,574hhks in 2009. Sets by purse-seine vessels in PNG were mainly associated sets which accounted for 81% of the total sets. About sixty percent (60%) of the associated sets was by Foreign vessels and the other 40% by PNG flagged and PNG chartered vessels.

119. Data collection in PNG is very good with above 80% Catch & effort data coverage for all fleets. For size and species composition data, PNG runs a port sampling program as well as an observer program that covers the vessels based out of PNG and foreign vessels fishing the PNG fisheries Zone. The PNG

observer program runs 200 man/women program with the aim to beef up the strength to 400 observers by the next 3-4 years. Observer coverage on vessels fishing in PNG waters on average range from 30% on foreign vessels to 83% on PNG flag vessels. PNG chartered vessel has a 58% observer coverage on average.

120. PNG is striving towards building a fishing industry, therefore fishing licenses are linked to onshore investment. At full capacity PNG is looking to processing all fish caught in PNG waters, back in PNG. The rights to fish in PNG, will also be linked to onshore investment in the near future.

### *Philippines*

121. The Philippines expresses its strong commitment to promote effective management in order to achieve the long-term conservation and sustainable use of highly migratory fish stocks in the WCPO in accordance with the 1982 Law of the Sea Convention, the UN Fish Stocks Agreement, and the WCPF Convention. In giving effect to the provisions of the WCPF Convention, the Philippines upholds the conservation and management measures developed by the Commission, including CMM 2008-01 on the conservation and management of bigeye and yellowfin. On 31 May 2010, new Fisheries Administrative Order (FAO) 236 was issued to regulate operations of Philippine purse seine and ringnet vessels in order to reduce fishing mortality of bigeye and yellowfin tuna, as stated in the WCPFC-CMM-2008-01.

122. The ongoing research activities of the National Stock Assessment Program (NSAP) have continued to collect data on species composition, length frequency, vessel catch and effort information on key tuna landing sites around the country. The WPEA-OFM Project, which began in January 2010, will help strengthen national capacity and international cooperation on priority transboundary concerns relating to the conservation and management of highly migratory fish stocks in the West Pacific Ocean and East Asia (Indonesia, Philippines and Vietnam).

123. The Bureau of Fisheries and Aquatic Resources (BFAR) strongly encourage the tuna industry to continue supporting the catch documentation scheme, which includes the catch and effort logsheet system for all purse seine and ringnet vessels. Aside from this BFAR also requires canneries to submit monthly cannery unloading data. These efforts are geared towards improving tuna statistics/data gathering.

124. BFAR conducts regular (twice yearly) observer training. There are currently 86 trained observers ready to board vessels, especially those vessels intending to fish during the FAD closure period (1 July to 30 September 2010).

125. The provisional catch estimates for the three species of concern of the WCPFC in 2009 are as follows: skipjack: 251,254 mt; yellowfin: 152,437mt; and bigeye: 5,735 mt (Bureau of Agricultural Statistics, 2009).

126. The Philippines, through the BFAR-NFRDI and other concerned agencies, together with the tuna industry, is striving to improve data collection and strengthen its national capacity and international cooperation on transboundary concerns in relation to the sustainable conservation and management of highly migratory fish stocks.

### *Samoa*

127. Samoa tuna fisheries consist of tuna longline and troll fishing fleets. Both fleets operate exclusively in Samoa's EEZ.

128. Albacore tuna continue to dominate the catch from Samoa's tuna longline fishing fleet. It landed an estimated 2,816 mt of albacore tuna in 2009, an increase of 474 mt (20%) from 2008. Albacore constitutes over 78% of the total longline catch for 2009 followed by yellowfin tuna (11% of total catch). An estimated 412 mt of yellowfin was landed in 2009, about a 30% increase from the 2008 yellowfin catch and the highest recorded over the last five years. Bigeye catches also increased in 2009 by over 10% at 117 mt. An estimated 85 mt of skipjack tuna was caught from the troll fleet in 2009, comprising over 88 % of the total troll catch. This is a decline of over 39% from the 2008 skipjack catch. Most of the skipjack catch was taken from free swimming schools. The skipjack increased steadily from 2006 to 2008 before falling in 2009, and was recorded as the lowest catch for the past 4 years (2006–2009).

129. The number of fishing vessel actively fishing for albacore tuna in 2009 (42) dropped compared to 2008 (44), and is the lowest recorded since the recovery of the fishery in 2006. The number of fishing vessels engaged in trolling is steadily increasing.

130. A new Tuna Management and Development Plan is currently being developed for the Samoa tuna fishery which will see a reduction in the number of fishing licenses available.

### ***Solomon Islands***

131. The total catch estimates for the commercial tuna fishery in Solomon Islands in 2009 increased slightly to 105,186 mt, compared to 96,108 mt in 2008. The total estimates are obtained from the catch and effort logsheets for both the national and foreign fleets. The total tuna catch for 2009 consists of 79,312 mt of skipjack tuna, 24,383 mt of yellowfin tuna and 1,490 mt of bigeye tuna. These catch estimates are for both the foreign and national fleets.

132. In 2009 the foreign fleet recorded about 87,434 mt, including 79,312 mt of skipjack tuna, 16,288 mt of yellowfin tuna and 1,298 mt of bigeye tuna. The national domestic fleet recorded only 17,752 mt, including 9,464 mt of skipjack tuna, 8,095 mt of yellowfin tuna and 1,298 mt of bigeye tuna. The majority of the tuna catch in Solomon Islands EEZ is taken by purse seining, with a total of 97,477.2 mt in 2009; the longline and pole and line fisheries caught the remaining 7,709 mt. Generally, most purse seine fishing efforts in 2009 were widely distributed, mainly in the northern part of the EEZ, with the national fleet spreading towards the west and the foreign towards the eastern side. The foreign longline fleet fishing effort distribution was scattered mostly to the south, towards the east of the EEZ.

### ***Chinese Taipei***

133. There are three types of Taiwanese tuna fishing vessels operating in Convention Area. In 2009, there were 75 large tuna longline fishery vessels, 1,220 small tuna longline fishery vessels and 33 distant-water purse seine fishery vessels operating in the Convention Area. The total 2009 catch of the large tuna longline fishery was 22,318 mt; for the small tuna longline fishery 38,704 mt, and for the distant-water purse seine fishery 192,075 mt. In 2009, the number of scientific observers was 21, with 31 observation trips conducted. Logbook data collection for the large tuna longline fishery in 2009 was modified, and now includes more shark species (i.e., thresher shark, tiger shark, white shark, porbeagle, crocodile shark, hammerhead shark and oceanic white tip shark).

### ***Tokelau***

134. There have been no significant changes to fisheries in Tokelau from 2008 except for a very slight increase in the local small-scale artisanal fleet that mainly targets free schools of skipjack by trolling, and yellowfin and bigeye tuna using the vertical handline method; catches of skipjack, yellowfin and bigeye by these artisanal fishers have fluctuated over time, and not as a result of fleet size.

135. The majority of commercial fishing activities in Tokelau waters are carried out by the US purse seine fleet under the USML Treaty; the number of these treaty vessels fishing in Tokelau waters for 2009 was unchanged from 2008 period, with an increase in total catch of 1,084 mt from 2008 (3,946 mt) to 2009 (5,030 mt).

136. In 2008 period Tokelau licensed 3 NZ-flagged purse seiners, 3 US-flagged longliners and 2 Cook Island longliners, and in 2009 Tokelau licensed the same 3 NZ flagged purse seiners and 1 US flagged longliner. In October 2009 Tokelau deployed 6 near-shore FADs for the local artisanal fleet.

### ***Tonga***

137. Operation of tuna longline fleet in Tonga in 2009 was similar to that in previous years, but was affected by various factors, particularly economic problems faced by fishing companies. Tonga's domestic longline fleet has been operating since 2005, and operates mainly within Tonga's EEZ.

138. The 2009 total tuna fishery catch declined in both quantity and value in from 2008, and is the lowest recorded for the last five years; it peaked in 2007. This is due to various factors including a 69% reduction in fishing effort (no. of hooks) from 2007, and is consistent with the decline in the number of active fishing vessels. This reduction in effort was due to some fishing vessels switching to the beche de mer fishery, which started in Tonga in 2008; other factors such as environmental and oceanographic conditions also contributed. However, the total annual fishery CPUE increased from 2005 to 2008, and dropped in 2009, but seems irrelevant to the decline in catch. The total CPUE is mostly affected by the CPUE for yellowfin, with opposite CPUE trends for albacore and bigeye. Albacore accounted for the highest proportion of the total tuna catch for 2009, with a high percentage of yellowfin and bigeye. The tuna catch composition indicated that most of the longline vessels and the structure of the fleet are targeting bigeye and yellowfin tuna for the fresh fish market, with a high proportion of albacore tuna in the catch. Dolphinfish and moon fish dominated the bycatch composition. From observer reports, Tonga's tuna fishery has no impacts on species of special conservation interest (e.g. turtle, marine mammals and birds).

139. SPC continued to provide assistance to Tonga Fisheries, including relevant information about tuna stocks in Tongan water relative to the entire WCPO stock. The total 2009 tuna catch by the Tongan fleet continues to have an insignificant impact on the regional WCPO stock. Despite ample room for improvement and development of the tuna fleet in Tonga, high operational costs restricted the operation of fishing vessels to areas near the main fishing port of Nuku'alofa.

140. Tonga's research program for tuna namely (i.e., data collection and observer deployment) were improved in 2009, with port sampling coverage of 86 %, and the observer coverage of 12 %. At the same time, the measures and resolutions of the Commission are being implemented and monitored by Tonga Fisheries.

### ***Tuvalu***

141. The total number of fishing vessels licensed to fish in our EEZ has increased by 81% from 2008 to 2009. The year 2009 is the highest record with 217 licensed and flag vessels. By contrast, the lowest records in 2006 constitutes 69 licensed and flag vessels; an increase of over 300% against 2009 records. The composition of fishing vessels in 2009 is such that purse seine constitutes 63% of the total number of licensed vessels active in Tuvalu's waters; followed by 28% longline. In 2009 Tuvalu had one flag purse seiner, 1 bunker and 7 carriers. Tuvalu fishing capacity continues to grow with the United States, New Zealand and Korean fleet maintained strong dominance.

142. A record catch of 66,819.4 tonnes of tuna was made in 2009 by the two fleets, PS and LL. Of this total the purse seine fleet accounted for 99%. 77% of this came from the effort of the three fleets (the US, NZ and Korea) put together. The long line fleet landed a total of just 515 tonnes, it is second lowest in most recent years.

143. Tuvalu will engage in partnership arrangements through charters and joint ventures under its new fishery policy. This means level of effort and catch is expected to increase not only in Tuvalu EEZs but also in the high seas and other zones under bilateral arrangements. These domestic developments are responsible and legitimate. Tuvalu continues to enjoy >30% of annual total government revenues directly from its fishing sector.

## USA

144. Large-scale fisheries of the U.S. and its Participating Territories for highly migratory species (HMS) in the Pacific Ocean include purse seine fisheries for skipjack tuna (*Katsuwonus pelamis*) and yellowfin tuna; longline fisheries for bigeye tuna, swordfish (*Xiphias gladius*), albacore, and associated species; and a troll fishery for albacore. Small-scale fisheries include troll fisheries for a wide variety of tropical tunas and associated species, handline fisheries for yellowfin and bigeye tuna, and a pole-and-line fishery for skipjack tuna. Associated species include other tunas and billfishes, mahimahi (*Coryphaena hippurus*), and wahoo (*Acanthocybium solandri*). The large-scale fisheries operate on the high seas, and some also operate within the U.S. EEZ, and within the EEZs of other nations. The tropical troll fisheries operate in nearshore waters around Hawaii and the U.S. Participating Territories of American Samoa, the Commonwealth of the Northern Mariana Islands, and Guam. The other small-scale fisheries (tropical handline, pole-and-line) operate in Hawaiian waters.

145. Overall trends in estimated annual catch by U.S. and Participating Territory fisheries in the WCPFC statistical area in 2009 are dominated by the largest sector, the purse seine fishery. Preliminary 2009 purse seine estimates are known to be significant underestimates of actual catch due to data management delays. U.S. purse seine catch in 2008 have been revised upwards to 209,374 mt from last year's preliminary estimate of about 158,000 mt. Revised catch estimates include 159,740 mt of skipjack tuna, 45,363 mt of yellowfin tuna, and 4,220 mt of bigeye tuna. Updated estimates for 2009 are expected to be greater than the updated 2008 estimates. Longline catch estimates in 2009 decreased from 2008 after peaking in 2007. Bigeye tuna and albacore catch by longliners declined from record highs of 5,599 mt and 5,426 mt, respectively, in 2007 to 4,029 mt and 4,086 mt, respectively, in 2009. Excluding catch by the U.S. Participating Territories (i.e., American Samoa), longline catch of bigeye tuna declined to 3,709 mt in 2009 from 4,649 mt in 2008, and from the peak of 5,381 mt in 2007. Swordfish longline catch of 1,209 mt in 2009 remained virtually the same as in 2008, slightly less than the peak of 1,441 mt in 2007. Small-scale (tropical) trollers and handliners operating in Pacific Island waters represented the largest number of U.S. flagged vessels but contributed a small fraction of the catch. The longline fleet was the next largest fleet, numbering 151 in 2009.

146. The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NOAA Fisheries) conducted a wide range of research on Pacific tuna and associated species at its Southwest and Pacific Islands Fisheries Science Centers and in collaboration with scientists from other organizations. NOAA Fisheries Service conducts fishery monitoring and socio-cultural research on tunas, billfishes, and animals caught as bycatch in those fisheries. In 2009, NOAA Fisheries Service continued to collect billfish distribution, catch and angler effort information for the International Billfish Angler Survey, summarized shark catch in the Hawaiian longline fishery, and began a study to understand the market impact of regulations on fisheries. Stock assessment research was conducted in collaboration with



member scientists of the WCPFC and the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC). The stock assessment work is not described in this report.

147. NOAA Fisheries conducted biological and oceanographic research on tunas, billfishes, and sharks that addressed fish movements, habitat preferences, post-release survival, feeding habits, abundance, maturity, and age and growth. Oceanographic influences on the American Samoa longline fishery for albacore were studied, as well as billfish migration and life history. Several studies on sharks focused on their survival after capture and release. Shark tagging studies continued, and provide an increasing body of migration data. Research on sea turtles and sharks focused bycatch mitigation. The change in seabird bycatch resulting from new regulations was also evaluated.

### ***Vanuatu***

148. Vanuatu is a member of RFMOs such as IATTC, ICCAT, IOTC and WCPFC. The membership of Vanuatu in these RFMOs has enabled Vanuatu's fishing fleet to fish waters of these RFMOs for tuna and other highly migratory fish species. Vanuatu's fleet is comprised of 19 purse seiners and 76 long-liner fishing vessels. Catch and effort coverage for the Vanuatu fleet has been high but the size data coverage is uncertain due to a lack of observers on board the vessels, particularly the long distant long-liners, and also due to lack of unloading data sought from the landing ports.

149. In Vanuatu's EEZ the only foreign fleet with high catch and effort data coverage is the Fiji fleet. In the period 2004–2009 the annual catch estimates of the Vanuatu fleet have generally increased, as did the fishing effort (sets) and number of fish per 100 hooks, where as for the purse seiners, there were more sets on unassociated than associated schools. The purse seine fleet's total catches have increased from 52,304 mt to 144,893 mt, comprising 89% skipjack, 10% yellowfin and 0.12 % bigeye. Unraised and provisional 2009 data show that catches of all major tuna species have increased with around 129,000 mt of skipjack, 15,000 mt yellowfin and 174 mt of bigeye harvested. Some of these purse seine vessels fished under the FSM Arrangement 'home party' criteria as Papua New Guinea, and therefore may have been included in the PNG-fleet catch statistics. The major tuna species in the longline fleet catch were dominated by albacore (60%), yellowfin (16%) and bigeye (10%). Unraised and provisional estimates for the longline fleet in 2009 were 8,030 mt for albacore, 1,300 mt for bigeye, and 510 mt for yellowfin, but if raised could be higher.

150. Data for the Vanuatu EEZ were based on unraised logsheet data. Fishing in the Vanuatu EEZ was by foreign fleets from China, Fiji, Taiwan and Korea. The Taiwanese fleet has decreased but the Chinese and Fiji fleet have increased rapidly, based on the number of license issued in 2009. In 2009 Vanuatu had a 100% Observer coverage for the locally based foreign fishing vessels and 100% port sampling during port unloading and transshipments.

151. The Vanuatu observer programme started late in 2008 to early 2009 with 100% observer coverage for locally based foreign fishing vessels, with 100% sampling operation during unloading in port and during transshipments. To date there have been 12 transshipments since 2008.

### ***Vietnam***

152. Vietnamese waters are also the distributions areas of tuna resources in the Pacific Ocean. Thus in recent years, tuna fisheries in Vietnam have developed rapidly and are becoming one of the very important fisheries contributing to Vietnam's exports.

153. The three main fisheries targeting tuna species are longline, purse seine and gill net, and the main species caught in Vietnamese waters are skipjack, yellow fin and bigeye tuna. Average catch of longline

fleets/trip reached from 0.8 to 1.3 mt (trip duration was 14–24 days). In particular, some longline vessels gained 2.5–3 mt/trip; species composition of this fishery was 15% yellowfin and 10.5% bigeye tuna. For the purse seine fishery, tuna species accounted for about 18–35% of total catch, but most were frigate and spotted tuna, and small bigeye and yellowfin tuna. The fisheries data collection system for tuna fisheries of Vietnam is lacking and insufficient, and thus exact annual catch data for the tuna fisheries are not available. It is very important to produce estimates of annual tuna catch by gear types, species and regions in order to provide relevant and essential advice for the management of these highly migratory species. This report seeks to provide some existing information referred from previous studies on Vietnamese tuna fisheries to support ongoing tasks in monitoring and management of tuna fisheries resources in Vietnam, as well as to contribute to management strategies in the WCPO.

### ***Discussion***

154. The following discussions and clarifications were offered during the presentation of national reports:

- i. In response to an inquiry, Australia briefly outlined its current and previous initiatives to minimise sea turtle bycatch, and improve post-release survivorship. These included the development of a sea turtle mitigation plan that was approved at WCPFC6, circle hook trials, compulsory carriage of dehookers, and experiments on the bait types deployed. Australia also indicated that its sea turtle mitigation plan highlighted the low interaction rates with sea turtles in the Eastern Tuna and Billfish Fishery.
- ii. There was discussion regarding ambiguity regarding the spatial extent of the data presented in the EU annual report primarily due to the fact that fishing occurs in both the WCPFC and IATTC convention areas and in the overlap between the two. The EU advised that its interest was to present as comprehensive data as possible and the SC agreed that this was informative and desirable. It was requested that future reports explicitly refer to the WCPFC convention area for clarity. In response to a comment, Indonesia provided additional information about the research and management programs started in the northern part of its fishery, which have include biological and tagging studies and research on the impact of FADs.
- iii. Japan clarified that it lacks data on the number of active small vessels as a result of government resourcing constraints.
- iv. New Caledonia clarified that the use of monofilament branch lines in its fishery is currently voluntary but that a fisheries policy towards shark conservation will be imposed in the future; it was also noted that New Caledonia has general catch rate of about 0.5 kg per hook, and catches have remained relatively stable from 2008 to 2009.
- v. SPC advised that it holds a significant amount of logsheet data that may be useful to the US in providing more accurate catch estimates.

### **2.4 Reports from regional fisheries bodies and other organisations**

155. An observer made a presentation urging the Scientific Committee to recommend the following measures to decision makers attending WCPFC7:

- i. Ban all tuna fishing in the four high seas enclaves between Pacific Island countries;
- ii. Implement an immediate and necessary 50% effort reduction in tuna fishing effort across the entire WCPO fisheries based on the average 2001–2004 levels;
- iii. Immediately ban the use of FADs in association with purse seine fishing;
- iv. Implement the ecosystem-based approach to the management of tuna resources within well defined precautionary limits.

## **AGENDA ITEM 3 — FISH BIOLOGY THEME**

156. The convener of the Fish Biology Theme, M. Ogura (Japan), opened the session.

157. N. Davies (SPC) and S. Nicol (SPC) were appointed as rapporteurs.

### **3.1 Review of new biological information**

158. The convenor of the BI theme presented the following paper on behalf of the authors, who were unable to attend: “Assessment of male skipjack tuna spawning activity in the tropical Western and Central Pacific Ocean. Rev. 1” (WCPFC-SC6-2010/BI-WP-02). Spawning activity of male skipjack tuna *Katsuwonus pelamis* in the tropical western and central Pacific Ocean was examined. Testis maturity was classified on the basis of histological observation. The estimated minimum size at first maturity was 35.5cm FL and the size at 0.5 maturity (FL<sub>50</sub>) was 40.7 cm in FL. Mature individuals dominated throughout the year with no seasonal peak. All Gonad Index classes (GI) contained mature fish classified by the testis observation. This indicated that it is difficult to differentiate the maturity stage based on the GI class only.

### **Discussion**

159. The SC acknowledged the high quality of this work, and noted that it provided important information on male skipjack, and its direct relevance for stock assessment.

160. Clarification was provided on whether any analyses had been undertaken to determine if the differences in estimates from this study in comparison to others were related to the methods applied, environmental correlates, or fishing history. The SC was advised that the differences between this and historical estimates were most likely due to the more reliable histological methods used in this study and that presented for female skipjack at SC5. The differences in the estimated maturity schedule for male (this study) and female (presented at SC5) skipjack were not considered to be artefacts of any spatial bias, as the fish were sampled from the Japanese fleet which operated in a similar locations for both studies. The laboratory methods were the same for both studies. The SC was advised that most samples come from areas where SST exceeds 25°–26° (the lower limit for spawning) but environmental correlates were not specifically evaluated in the study. It was not possible to speculate if fishing has caused the difference in estimates as no previous study using reliable histological methods is available for comparison.

161. The SC acknowledged that the paper provided further evidence that the use of Gonad Index methods are not reliable for the estimation of maturity schedules for skipjack tuna.

### **3.2 Review of biological research projects**

#### **a. Project 35 (Bigeye tuna age and reproductive biology)**

162. S. Nicol (SPC) presented “Bigeye tuna age, growth and reproductive biology (Project 35) – progress report, Rev.1” (WCPFC-SC6-2010/BI-WP-03), which reported on the progress of Project 35, a 2-year pilot study in the EEZs of Palau and Micronesia to determine the sampling requirements for the broader Pacific-wide bigeye age, growth and reproductive biology project (Phase 2). The work plan for the pilot project scheduled sampling of bigeye for the period October 2009 to January 2010 with presentation of results and recommendations at SC6. A total of 73 observers have been trained in biological sampling procedures, however the low level of observer coverage on longline vessels over the past 12 months has restricted the opportunities for collection of otoliths and gonads from medium to larger individuals and the minimum sample size required for data analysis has not yet been achieved. This problem is being rectified through the assistance of the Luen Thai Fishing Venture (LTFV). LTFV operate in Palau, FSM and RMI and have negotiated with the vessels they manage to collect samples for

the project. Sampling is expected to be completed in August 2010. Laboratory analysis is now scheduled for September to November 2010 and the final report provided to the WCPFC secretariat in December 2010. A consequence of the longer time frame required to collect samples for the pilot study is that no definitive advice can be provided to SC6 on the implementation of Phase 2. The SC may wish to postpone any decision on Phase 2 until it considers the final report. Consideration of this report could occur either out of session, at the pre-assessment workshop or at SC7.

## **Discussion**

163. The SC noted the progress of the project, and the difficulty in getting good observer coverage on longline vessels over the past 12 months due to priority given to placement of observers on purse seine vessels arising from the FAD closure measure. The SC expressed appreciation at the willingness of Luen Thai Fishing Ventures operating in Palau, FSM and RMI to support the collection of samples, which has temporarily rectified the situation. In general, however, the SC would like priority to be given to using observers trained in this kind of work. In this regard, many longline vessels continue to operate primarily in the high seas.

164. Clarification on the use of frozen gonads was provided, with discussion that due to sample damage from freezing, the project is collecting double samples. This should ensure that the minimum number of samples required is available for analyses. The use of frozen samples prevents the estimation of spawning frequency but is suitable for estimation of batch fecundity.

165. The SC noted that Phase 2 will require substantial financial resources to fully implement and encouraged that the results from the pilot study identify not only the minimum number of samples required but also the size ranges of fish where sampling should be prioritized, or where sampling may not be needed (e.g. small fish less than 30 cm FL for maturity estimation).

166. The SC expressed some concerns regarding postponing a decision on whether to fund Phase 2 of Project 35, as Phase 2 may then have to incur additional costs associated with re-establishment of sampling infrastructure. However, the preference of the SC was to delay the scientific review of the pilot study and recommendations for implementation of Phase 2 until SC7.

### **b. Project 39 (South Pacific Albacore age and reproductive biology)**

167. S. Nicol presented “Regional study of South Pacific Albacore population biology: Year 2 – biological sampling and analysis” (WCPFC-SC6-2010/BI-WP-01), a summary report on the progress of Project 39 (a regional study of South Pacific albacore population biology). The main activity for 2010–2011 was the collection of biological samples of albacore in the southwest Pacific region, and to initiate otolith reading and histological analysis of gonads to ensure that unbiased estimates of biological parameters (age, growth and reproduction) can be obtained for albacore. Biological samples have been collected from over 2,500 albacore caught in the southwest Pacific since early 2007. Over the past 12 months, CSIRO continued to sample albacore caught in Australia’s Eastern Tuna and Billfish Fishery (ETBF) off Queensland and New South Wales, with supplementary sampling from the recreational fisheries in Victoria and Tasmania. SPC continued to collect biological samples from albacore caught in the wider South Pacific through their SCIFISH project. Fish were sampled in New Caledonia, New Zealand, Fiji, American Samoa, French Polynesia, Tonga and the Cook Islands. In addition, New Zealand MFish and NIWA sampled albacore caught in New Zealand’s domestic troll fishery over the 2010 summer fishing season. The majority of the biological material that has been sent to CSIRO has been processed in the laboratory (gonads), archived into CSIRO’s ‘hardparts’ collection (otoliths and dorsal spines) or frozen (muscle tissue). Some material remains in the sampling ports waiting for freighting to

Hobart. Otoliths from fish caught in Australia, New Caledonia and New Zealand were sectioned for annual age (n=314) and daily age (n=18) estimation by laboratories in Australia. Age was estimated by 1-3 readers and an inter-laboratory comparison was undertaken to assess the level of precision of increment counts between readers/laboratories. There was clear evidence that past experience in reading tuna otoliths influenced the age estimate. An additional 219 otoliths and 100 dorsal spines were selected for ageing. Histological sections prepared from 197 ovaries were read and staged. An additional 220 ovary samples have been sent for histological preparation. All ovaries selected for histological analysis so far were from fish >70 cm FL sampled in Australia, New Caledonia, New Zealand, Fiji, and French Polynesia. Updated length-weight parameters were estimated for albacore caught in Australia and New Zealand. A significant difference was detected in the length-weight relationship between sexes where females were heavier on average for their length compared to males.

## **Discussion**

168. The SC is very supportive of the two biological research projects currently being undertaken to identify and define regional variability of key biological processes in the WCPO, which will support stock assessments of bigeye and albacore tuna. The regional study of the stock structure and life history characteristics of South Pacific albacore involves tasks in which many WCPFC members are participating (mainly biological sampling and ageing), to ensure that unbiased estimates of biological parameters such as age, growth and reproduction are obtained. The aim of the first phase of the albacore project has been achieved. The SC expressed appreciation to those involved, and looked forward to the successful completion of the albacore research project and of the work of the scientific service provider in taking into account such newly acquired biological parameters when next updating the albacore stock assessment.

169. The SC acknowledged the close association between this project and the efforts to tag South Pacific albacore to obtain information on movement and exploitation rate for use in stock assessment (GN-IP-06). The SC understood the difficulties of tagging albacore and encouraged the science provider to persist with their efforts to find a solution to this issue.

### **3.3 Other activities**

170. The SC noted that Project 38 (otolith microchemistry), funded by the Pelagic Fisheries Research Program, was near completion and scheduled to be reported on at the next regular meeting of the Biology Theme.

## **Recommendations**

171. To assist the SC in determining the priority of Phase 2, the SC requested that the report to the 2011 meeting include outcomes from 3 runs of the 2010 bigeye stock assessment model; specifically (i) the use of the growth curve estimated from the pilot study; (ii) the use of the maturity ogive estimated from the pilot study; and (iii) a combination of (i) and (ii).

The SC encouraged all Flag States to achieve the 5% observer coverage of such vessels as required by the observer CMM to facilitate the collection of biological samples.

172. SC6 also recommends that:

- Maturity schedules for stock assessments should be estimated using histological methods. GI values can be used for evaluating spawning distributions but should not be used for estimating maturity schedules.

- Presentation of the Project 35 (the bigeye age and reproductivity pilot study) be deferred to SC7. Included in the report to SC7 will be three sensitivity analyses (revised growth curve, new maturity ogive and both combined) using the 2010 BET assessment.

173. The SC recognizes the importance of the South Pacific albacore biological sampling and noted the progress of Project 39 (the South Pacific albacore age and reproductive biology study), and supports the project through to completion.

174. The SC encourages the science provider to take any new biological parameters into account when next updating the South Pacific albacore assessment.

#### **AGENDA ITEM 4 — FISHING TECHNOLOGY THEME**

175. The convener of the Fishing Technology Theme, D. Itano (USA), opened the session and reviewed the agenda, which focused on efforts to reduce non-target catch and small tuna captured by purse seine floating object effort with an emphasis on reducing bigeye mortality.

176. S. Nicol (SPC) and K. Schaefer (IATTC) were appointed as rapporteurs.

#### **4.1 Acoustic discrimination**

##### **a. FT WP-01(Application of broadband dolphin mimetic sonar for discriminating target fish species)**

177. H. Okamoto presented “Application of broadband dolphin mimetic sonar for discriminating target fish species” (WCPFC-SC6-2010/FT WP-01), which describes research to investigate acoustic species discrimination. Broadband response was measured for three tuna species; bigeye tuna, yellowfin tuna and skipjack tuna which were separated by species in each enclosure. Ultrasonic broadband sound (70kHz–140kHz) was projected nearly horizontal to the fish body. Three major echoes were detected from a fish. The delay time between earlier and last echo corresponded to the body width of the target fish. These echoes seemed to come from the left and right body surface of each fish when the acoustic beam projected transversally to the fish body. The dominant echo at the middle between body surface echoes was considered to come from the center of the body of each fish. Suspected reflectors were the swim bladder and the spine. As already known, bigeye tuna have a swim bladder where as skipjack tuna does not. Yellowfin tuna has a smaller swim bladder than that of bigeye tuna. The relative intensity of the body surface echo to the body center echo was large for skipjack tuna and small for bigeye tuna. This is consistent with the large target strength of the swim bladder rather than the spine or other unidentified reflectors in the body of the fish. This could be a key for the species discrimination. Larger sample sizes and experiments including numerical simulation are needed.

#### **Discussion**

178. The SC conveyed its appreciation to the authors for the work described in FT-WP-01. Sophisticated sonar, underwater cameras and other remotely operated vehicles with onboard camera systems were recognized as some of the latest technologies that could be useful in verifying the accuracy of acoustic estimates. Such instruments could also serve as a means by which to avoid catching small fish and unwanted bycatch often associated with floating objects. The SC acknowledged the importance of this work and recommended further efforts to develop methods that estimate the number of individuals and aid in species discrimination.

179. The SC noted that commercial multi-frequency echo sounders are used for species discrimination (such as between small pelagics) and requested clarification on the reliability of these sounders for discriminating different tuna species. The SC was advised that the data collected by commercial echo sounders was not generally suitable for tuna species discrimination and more work was needed in this field.

180. Clarification was sought on progress towards species discrimination and the sample sizes used in the experiment. The number of individuals used in the sonar experiment varied between 12 –20 individuals, with distances of several tens of centimetres between individual bigeye and yellow fin swimming in tanks; the distance between individual skipjack was smaller. The SC supported further research on size and species discrimination using acoustic methods.

#### **b. FT-IP-04 (Technical options for the utilization of underwater video)**

181. The convenor noted “Technical options for the utilization of underwater video to characterize species, size composition and spatial distribution of tunas and bycatch species aggregating around floating objects” (WCPFC-SC6-2010/FT-IP-04), which describes greatly improved image quality of tuna useful for size and species discrimination of tuna and bycatch on floating objects using higher resolution video equipment; he observed that field trials with the higher resolution gear would continue during 2010 – 2011 at no cost to the Commission.

#### **4.2 Behavioral studies of tuna on FADs**

182. The convenor drew attention to two information papers on behavioral studies of tuna on FADs, which describe the use of electronic tagging technologies to reveal tuna behaviour on FADs: “Vertical behavior and the observation of FAD effects on tropical tuna in the warm-pool of the Western Pacific Ocean” (WCPFC-SC6-2010/FT IP-01), and “Telemetry study on juvenile yellowfin tuna *Thunnus albacares* around a payao in the Philippines” (WCPFC-SC6-2010/FT-IP-05).

#### **4.3 FAD and gear modifications to improve selectivity**

183. The convenor noted “Analysis of the catch rate of juvenile bigeye depending on the depth of the purse-seine net used by the tropical fleet” (WCPFC-SC6-2010/FT-WP-03). The paper describes a large-scale study that documented purse seine fishing characteristics using TDR equipment mounted to the chain line of purse seine nets. The study determined that tuna seines used to target tropical tunas become fully pursed at an average depth equal to 56.7% of the maximum net depth, which is comparable to the findings of similar studies. However, it was noted that the catchability of tuna that may be influenced by the net hanging deeper in the water before pursing remains unknown. The convenor noted the importance and need to accurately document the fishing depth characteristics of longline and purse seine gear operating in the WCPO, which is useful for effort standardization.

#### **4.4 Technical solutions to bycatch mitigation.**

##### **a. FT WP-02 (Study on the methods to reduce the bycatch of juvenile bigeye tuna by purse seine operation on FADs)**

184. Y. Semba presented “Study on the methods to reduce the bycatch of juvenile bigeye tuna by purse seine operation on FADs in the western and central Pacific Ocean” (WCPFC-SC6-2010/FT WP-02), which presents preliminary results of a research cruise for mitigating the catch of juvenile bigeye tuna caught by purse seine operations on FADs, conducted in the WCPO. This research was conducted

through collaboration between the fisheries administration, research institutions and industry. The observations of response of fish/schools to large mesh netting, the purse seine net and intermittent light were the main results. In the observation of large mesh, the escape of tuna species was not observed while the escape of silky shark was documented by video camera. The vertical and horizontal movements of tuna schools inside the purse seine after the cessation of intermittent light was confirmed with experiments using coded transmitters. Behavioral response was different depending on the time of the experiment and distance between fish and the light source. The response of fish schools in response to the intermittent light stimulus was observed by scanning sonar which indicated that fish schools dispersed “left and right” or “up and down” in apparent reaction to the intermittent light stimulus. Further work is necessary to confirm the general trend of bigeye tuna behavior in response to different stimuli.

## **Discussion**

185. The SC conveyed its appreciation to the authors for the research described in FT-WP-02. The SC noted strong support for the bycatch mitigation work and would like to see more of this type of research. The SC noted that PNG is also planning to support this type of work within PNG waters and commended the Government of Japan for the collaborative nature of the research; it encouraged other CCMs to initiate complementary studies in their waters. Studies such as these were considered important for addressing the issue of reducing catches of STFO and other bycatch species.

186. It was noted that despite these research undertakings, no potential measure or methods have been identified that would avoid or reduce setting on associated schools with a high proportion of small fish at an industrial level, and no promising methods have been developed that would allow fishers to continue to set on such schools while avoiding the catch of juvenile fish. SC members supported maintaining the advice given to WCPFC6 on this issue—that collaborative projects with industry are a cost-effective and operationally sound approach—and requested the support of the Commission in facilitating such opportunities. The purse seine industry has a strong record of innovation and development, and the SC noted it seeks to see those qualities used to find ways to reduce catches of unwanted bycatch and small tuna from FAD fishing. The Commission is already considering a range of restrictive management measures such as longer FAD closures, and it is hoped that these will provide incentives to industry, Flag States and markets to resolve the wider issue. Without any progress in these areas, there will be no option but to extend FAD closures.

187. SC members suggested the Commission expand its focus beyond identification of mitigation measures to include the provision of incentives for the tuna industry to proactively implement such mitigation measures. The SC further commented that methods to avoid and reduce inadvertent catch of small fish on floating objects are urgently needed; CCMs suggested that any prolonged experimental studies in this area be closely focused on achieving solutions that can be applied at the commercial level.

188. Clarification was sought on whether purse seine mesh acts as a visual barrier that tuna will avoid despite the fact that experimental large mesh may be easily large enough for the fish to pass through. The SC was advised that this appears to be the case and more studies under various light conditions are required to resolve this issue.

189. Clarification was also sought on the affect that movement of the net and currents may have on this type of experiment. The SC was advised that these studies are verified by the use of underwater cameras and ROVs to observe tuna behavior, and that the gear and observation itself cannot be effectively deployed under strong current situations.

### **b. FT WP-04 (ISSF initiatives to develop and test bycatch mitigation options for tropical purse seine fisheries)**



190. V. Restrepo (ISSF) presented “International Seafood Sustainability Foundation initiatives to develop and test bycatch mitigation options for tropical purse seine fisheries” (WCPFC-SC6-2010/FT-WP-04), describing a research program to test technical options to mitigate bycatch in tropical tuna purse seine fisheries. The priority will be on seeking ways to reduce bycatch of bigeye tuna of undesirable sizes, but other bycatch issues will be addressed as well. The project will test multiple techniques that are being proposed by skippers and scientists worldwide and is projected to last three years (including 24 months of dedicated purse seine vessel charters) and cover all oceans. Overall guidance of the research plan will be provided by the ISSF Scientific Advisory Committee composed of scientists from major tuna RFMOs and other organizations. The development of detailed research plans will be the responsibility of a project steering committee while individual scientists will conduct approved research projects. Primary results from the project will be disseminated in peer reviewed journals as well as more timely cruise reports, research project reports and educational materials. Funding will include a significant component for training and capacity building.

191. The Convenor noted two information papers that provide supplemental information relevant to FT-WP-04: “ISSF Meeting on mitigation of by-catches in the Tuna Purse seine Floating Object fisheries: Sukarrieta, Spain 24-27 November 2009” (WCPFC-SC6-2010/FT-IP-02), and “Purse seine by-catch mitigation techniques” (WCPFC-SC6-2010/FT-IP-03).

## **Discussion**

192. The SC expressed their support for the ISSF project, and advised the ISSF of the importance of timely and open consultation with the various entities of the WCPFC and FFA to facilitate obtaining necessary permits and notifications to successfully undertake the research. The presenter clarified that such consultations were seen as essential, and that ISSF would soon initiate contacts with the region through the WCPFC. The SC was advised that the ISSF proposes to use vessels which are already licensed and operating in the WCPO. The presenter and the SC concurred with the importance and utility of using a fully chartered vessel that would allow complete scientific control of the fishing and loading operations and enumeration of total catch without concern for economic loss.

193. Clarification was sought on the proposed experimental design and how the ISSF proposed to potentially test various FAD types. The SC was advised that one proposal already received was to test the efficacy of “ecological FADs” that are designed to be bio-degradable and bycatch friendly while noting that large numbers of experimental replicates for FAD experiments would be difficult to achieve. Details of testing bycatch mitigation by area and between drifting and anchored FADs will be developed by the research steering committee with input from industry.

194. The Science Manager stated that issues related with Project 55 were being funded through a \$25,000 voluntary contribution from PNG, and that the Secretariat would advertise for proposals on its website. It was clarified that the PNA Chair would be consulted in the development of the TORs.

## **Recommendations**

195. SC recommended the continuation of research or the review and analyses of research in the following areas:

- The use of “acoustic technology” for discriminating species on floating objects.
- Bycatch and small tuna on floating objects (STFO) reduction research in collaboration with industry and Pacific Island nations.

- Studies on the behavior and distribution of target and non-target species around FADs, and on the various specifications and use of FADs and fishing gears in influencing purse seine catches taken in association with FADs.

196. The SC further recommended studies to: (a) quantify changes in fishing efficiency; (b) identify and refine gear, vessel and operational attributes necessary for global standardization; (c) document and analyze fishing efficiency and historical changes in gear, vessel and operational characteristics of fisheries; and (d) quantify changes in fishing efficiency of purse seine fisheries operating in the WCPO.

197. The SC in principle recommended support for the proposal by ISSF and would recommend that ISSF undertake a consultation process with “coastal state” Commission members to enable their full participation

### **AGENDA ITEM 5 — METHODS THEME**

198. The convener for the Methods Theme, R. Campbell (Australia), opened the session and outlined the agenda.

199. D. Wilson (Australia) was selected as rapporteur.

#### **5.1 Changes in MULTIFAN-CL**

##### **a. ME-WP-01 (Update of recent developments in MULTIFAN-CL and related software for stock assessment)**

200. N. Davies (SPC) presented “Update of recent developments in MULTIFAN-CL and related software for stock assessment” (WCPFC-SC6-2010/ME-WP-01). MULTIFAN-CL (MFCL) is a statistical, age-structured, length-based model routinely used for stock assessments of tuna and other pelagic species. The model was originally developed by Dave Fournier of Otter Research Ltd for application to South Pacific albacore tuna. Each year the MFCL development team works to improve the model to accommodate changes in understanding of the fishery, to fix software errors, and to improve model features and usability. This paper reports changes made since August 2009 to the model and other components of the MFCL project, and updates the report for the previous period, 2008-09. These changes include the main developments to model functions, software management, and improvements to the utilities supporting MFCL.

201. The first and most significant development was to include stochasticity in the recruitments used for population projections. This feature facilitates using MFCL for risk analysis by incorporating natural variability in estimates of future biomass. The second main development was to extend the estimation of tag recapture reporting rates to be specific to individual tag release groups. This was to take account of factors affecting the voluntary reporting of recaptures that are unique to each release programme. Both of these developments have been applied in studies presented to SC6.

202. A formal procedure has also been developed for incorporating new developments in the source code, testing these calculations, compiling the new executables, and updating the software in the project repository. This ensures traceability of new developments and reversal if required.

203. Finally, substantial improvements have been made to the utilities supporting MFCL since increasingly MFCL is being called within high-level analysis rather than simply from command line operations. For example, analyses such as management strategy evaluations, risk analysis, and the estimation of uncertainty due to structural assumptions. The library of R scripts that support these

operations has been added to, the source code maintained, and further developments have been proposed for 2010–2011.

## Discussion

204. A request was made of SPC to produce an operating manual for MFCL that would be made publicly available. This was regarded as an important issue given the complexity of the MFCL software. SPC indicated that such a manual was currently in production and would be made available via their website in the near future.

## 5.2 Developments in CPUE Analyses

### a. ME-WP-02 (Application of the Tweedie distribution to zero-catch data in CPUE analysis)

205. H. Shono presented “Application of the Tweedie distribution to zero-catch data in CPUE analysis” (WCPFC-SC6-2010/ME-WP-02). This paper focused on the zero-catch problem of CPUE (catch per unit effort) standardization. Because the traditional CPUE model with a log-normal error structure cannot be applied in this case, three methods have often been utilized as follows: (1) Ad hoc method adds a small constant value to all response variables, (2) Catch model with a Poisson or negative-binomial (NB) error structure, or (3) Delta-type two-step method such as the delta-normal model (after estimating the ratio of zero-catch using a logit or probit model, a model such as CPUE log-normal or Catch-Poisson is applied to CPUE without zero-data).

206. However, there are some statistical problems associated with each of these methods. In this paper, an alternative fourth method based on the Tweedie distribution model was discussed together with its application to i) by-catch data (silky shark, *Carcharhinus falciformis*, in the North Pacific Ocean caught by Japanese training vessels) where most (more than two-thirds) of the observations have a zero-catch, and ii) a target species data (yellowfin tuna, *Thunnus albacares*, in the Indian Ocean caught by Japanese commercial vessels) where the proportion of zero-catch observations is not so high (<one third). The Tweedie model is an extension of the compound Poisson model derived from a stochastic process where the weight of the counted objects (i.e., number of fish) has a gamma distribution and has an advantage of handling the zero-catch data in a unified way.

207. The statistical performance of the above four models was also compared using the Mean Square Error and Pearson’s correlation coefficient of the observed CPUE and the corresponding predicted CPUE using an n-fold cross-validation process. Differences in the trend of CPUE between years and model performance between the ad hoc method and Tweedie model were found to be not so large in the example of yellowfin tuna (target species). However, the statistical performance of Tweedie distribution is rather better than Delta-lognormal model, the Catch-NB distribution and ad hoc method in the example of silky shark (by-catch species). The standardized CPUE year trend for the ad hoc method was also found to be quite different from that of the Tweedie distribution and other two models. Model performance of the Tweedie distribution was found to be good judged from the 5-fold cross-validation using the fishery data that included many zero-catch data, such as for by-catch species example presented.

208. The Convener noted the need to develop statistical techniques to model catch and effort data having a high proportion of zero-catch records. This was particularly relevant given the new analyses being undertaken on operational level data where the proportion of zero-catch records is significantly higher than for aggregated data.

**b. ME-WP-03 (Confidence interval estimation of CPUE year trend in delta-type two step models)**

209. H. Shono presented “Confidence interval estimation of CPUE year trend in delta-type two step models” (WCPFC-SC6-2010/ME-WP-03). This paper presented a procedure for estimation of the approximate confidence intervals of the extracted catch per unit effort (CPUE) year trend in the delta-type two-step model used for CPUE standardization with a high proportion of zero-catch data. This method is a simple way to combine the Taylor expansion and delta method and is suitable for practical use. This model was applied to the catch and effort data with more than 80% zero catch for silky shark in the North Pacific Ocean caught by Japanese training vessels. As a result, realistic values of the 95% confidence interval of CPUE year trend are obtained. A method for left–right unsymmetrical interval estimation based on the asymptotic normality of the natural logarithm of CPUE is also suggested. In the example of silky shark, both CPUE year trends obtained from these two methods are similar.

**Discussion**

210. The SC supported the development of the method presented for estimating confidence intervals of the CPUE trend, and noted that it has direct utility to the analyses of CPUE being undertaken by SPC.

211. The Convener noted the five research topics currently listed on the SC Work Programme, which address methodological developments, and invited the meeting to identify additional projects. It was agreed to defer this issue until after discussion of the Stock Assessment and the Ecosystems and Bycatch Themes.

**Recommendations**

212. The SC noted the research presented and encouraged further research on technical questions related to analytical methods used for fishery management.

213. The SC recommended that the method-related projects currently included in the Scientific Research program continue to be supported.

**AGENDA ITEM 6 — STOCK STATUS THEME**

**6.1 WCPO bigeye tuna stock assessment**

214. K. Bigelow (USA) served as convener of the theme, with N. Davies, V. Chan, S. Nicol, K. Schaeffer, D. Tagami, H. Nakano, and H. Kiyofuji serving as rapporteurs.

215. Five Working Papers addressed the bigeye tuna stock assessment and evaluation of CMM2008-01. Discussion on all five papers is integrated into one section and supplied after the abstract of SC6-SA-WP-05.

**a. Summary of SA-WP-01 (Background information for the 2010 bigeye assessment)**

216. S. Harley (SPC) presented “Background analyses in the development of the 2010 WCPO bigeye tuna assessment” (WCPFC-SC6-2010/SA-WP-01). This paper describes background analyses undertaken in the development of the 2010 bigeye tuna (BET) stock assessment for the western and central Pacific Ocean (WCPO). Most of the analyses focus on attempting to resolve the principle concern in the 2008

and 2009 assessments, namely the strong recruitment patterns estimated in recent BET assessments. We attempt to identify the key data inputs and model assumptions that are responsible for the trends and see if improvements can be made. The document draws on work undertaken for the SPC Pre-Assessment workshop held in Noumea in April 2010 and subsequent analyses.

217. There were three steps to the analyses described in this paper:

- i. Exploration of the key data indicators (specifically catch, CPUE and size data) from the 2009 BET assessment;
- ii. Evaluation of the current grouping of longline fleets within fisheries in the MULTIFAN-CL assessment ; and
- iii. An initial suite of sensitivity analyses using the 2009 BET assessment.

218. These analyses indicate that:

- There is significant data conflict among the various data sources (e.g. size, catch, and CPUE data) in region 3 which provide the model conflicting signals regarding recruitment and ultimately stock status trends
- Fleets flagged to FM, MH, and PH, previously included in the LL ALL fishery, have fishing patterns more similar to the TW OS fleet, and hence would be more appropriately modelled as a separate fishery (from LL-ALL) in future assessments.
- There are strong patterns within the JP length data which appear to be driven by spatial patterns in fish size.
- JP length data may not be representative of the catches in some regions/years.
- The CPUE trend in region 3 appears to be the primary factor driving the recruitment trend in that region and the relatively stable CPUE is strongly inconsistent with the increased catches seen in that region at the estimated biomass level.
- The CN/TW-OS size data are extremely influential on the assessment, in particular the early estimates of recruitment and growth
- The high (and incorrect) estimates of ID longline and small fish catches were resulting in a more pessimistic view of stock status.

**b. Summary of SC6-SA-WP-02 (Analysis of Japanese longline operational catch and effort for bigeye)**

219. S. Hoyle (SPC) presented the paper “Analyses of Japanese longline operational catch and effort for bigeye tuna in the WCPO” (WCPFC-SC6-2010/SA-WP-02). Analyses of operational-level, longline catch and effort data for bigeye tuna in the Western and Central Pacific Ocean were carried out under an agreement between the Secretariat of the Pacific Community and the Japan National Research Institute of Far Seas Fisheries. The objectives of the collaboration were to standardize bigeye CPUE, and to estimate the historical trend of longline catchability using a finer scale of data than had been previously available. The goal was to better understand the role of vessel effects, in particular the role of fleet composition and fishing behaviour, which are otherwise concealed when using aggregated catch and effort data. In this analysis vessel effects were estimated as the average effect over the fleet of factors such as engine type, vessel speed, well capacity, fishing techniques, targeting strategies, technology and crew effects during the modelled period.

220. The data used in this analysis consisted of Japanese longline logsheets from 1976–2009 with location set to the nearest 1 degree of latitude and longitude; depth of set represented by the variable “hooks between floats” (HBF); international call sign used as the vessel identifier; and fishing categories (offshore or distant water), target (swordfish, shark, other), line type and a number of other operational variables included. All sets south of 35°S and with HBF < 5 were removed to avoid southern bluefin tuna

and swordfish targeted effort, respectively. However, sets targeting albacore or yellowfin rather than bigeye tuna could not be easily distinguished. Delta lognormal and offset lognormal models were applied in the standardization with an explicit term for vessel effect. The western and central Pacific was divided into six areas and an indicative regional scaling factor was estimated for each.

221. The results of the analysis revealed many new and interesting perspectives on catch trends. Region 3 (western Pacific between 20°N and 10°S) proved difficult to characterize due to the complexities of separating yellowfin targeted from bigeye targeting operations. The analysis suggests that the trends in catch rate in this region may be affected by market factors as well as abundance. Contrary to expectations, bigeye catch rates were higher at shallower depth in the equatorial area. Also it is suspected that differences in trends between region 3 as a whole and its equatorial regions are likely to result from a combination of changes in the fleet, changes in fishing methods by individual vessels, and changes in the concentration of fishing effort. Due to lack of sufficient fishing effort, regions 5 and 6 (south of 10°S) were not allocated reliable regional scaling factors.

222. Vessel effects, which were estimated broadly for the first time in this analysis, reflected both fishing power increases and the fleet's ability and intention to target bigeye, and were found to have a potentially large effect on abundance indices. Significant changes in fishing power have been caused by vessels with poor catch rates exiting the fleet. Furthermore, it was noted that given a situation in which effort becomes increasingly concentrated over time, operational data may give a consistently more optimistic trend than aggregated data because it gives more weight to regions with more sets and higher CPUE.

223. Given the great potential of operational data they are recommended as the basis for abundance indices in future stock assessments. In addition to confirming several advantages arising from the use of operational catch and effort data for CPUE standardization, some areas requiring further research were identified. Multivariate techniques such as principal components analysis and cluster analysis are recommended to separate effort targeted at different species and thus identify alternative fishing strategies. In addition, simulation studies are recommended to examine bias arising from lack of independence among sets from factors such as an increased focus of the fleet on hot spots, changes in fishing location in response to catch rates of different species, catch rates of other vessels, and ability to locate oceanographic features. Finally, abundance indices estimated from operational data should be constructed to extend from the 1950s onward and should be weighted by the number of strata per time-area stratum.

**c. Summary of SC6-SA-WP-03 (CPUE standardization for bigeye and yellowfin tuna in the western and central Pacific Ocean)**

224. S. Hoyle (SPC) presented "Analyses of Japanese longline operational catch and effort for bigeye tuna in the WCPO" (WCPFC-SC6-2010/SA-WP-03).

225. Indices of catch per unit effort are presented for bigeye and yellowfin tuna in the WCPO from 1952 to 2009, based on analyses of aggregated Japanese distant water longline data. One change was made to the methods for estimating indices of abundance for the bigeye and yellowfin stock assessments, with removal of the targeting indicator based on CPUE of other species. This change had little effect on the CPUE trends. An alternative CPUE trend for a subset of region 3 was estimated based on the area south of 10N. The trend for this sub-regional model was more optimistic in recent years. The full region 3 series may be biased by significant albacore-targeted effort in the north since 1995, so an index based on the southern region may be more reliable. Both the bigeye and yellowfin indices may be affected by increasing targeting of bigeye tuna in recent years.

**d. Summary of SC6-SA-WP-04 (Stock assessment of bigeye tuna in the western and central Pacific Ocean)**

226. S. Harley (SPC) presented “Stock assessment of bigeye tuna in the WCPO. The Executive Summary is as follows with several figures regarding stock status” (WCPFC-SC6-2010/SA-WP-04)

227. This paper presents the 2010 assessment of bigeye tuna in the western and central Pacific Ocean. This assessment is supported by several other analyses which are documented separately, but should be considered when reviewing this assessment. These include detailed examinations of input data and sensitivity analyses (Harley et al. 2010), evaluation of paired spill/grab sample trials leading to alternative purse seine catch histories (Lawson 2010), reviews of the catch statistics of the Philippines and Indonesia (Williams 2010), and standardised CPUE analyses for both aggregate (Hoyle 2010) and operational level (Hoyle et al. 2010) longline catch and effort data.

228. The assessment includes several model runs describing stepwise changes from the 2009 assessment (run 14) to develop a new “base1” model (run3d) and then several other key model runs which represent a set of plausible model runs for consideration in developing management advice. These key model runs represent a single change from the base model run.

229. One of the major features of the 2010 assessment is that for the first time the assessment includes catch estimates for all fleets for the last year of the assessment (2009). This is a significant improvement, but data for several key fleets were submitted late and therefore the complete model inputs only became available in the first week of July. This delayed the assessment. Other data changes from the 2009 assessment include: revised longline fishery definitions to group together more similar fleets; revised catch estimates for all fleets from the Indonesia and Philippines; exclusion of further length samples from the Philippines “small fish” fishery which include large bigeye tuna; new standardised CPUE series for the main longline fisheries based on an improved methodology; exclusion of some historical size data from the Philippines which was ‘contaminated’ with samples from two different fisheries; exclusion of some early Japanese length data which was inconsistent with other data; and revised spill sample purse seine estimate incorporating the results of recent experimental work.

230. Other changes to the assessment included: increased flexibility for temporal changes in purse seine catchability, and decreased weight given to certain length and weight frequency data sets

231. The key assumptions from the “base” model from the 2009 assessment (run 10), the base model for the 2010 assessment (run3d), and the alternative assumptions in the other main model runs are provided below:

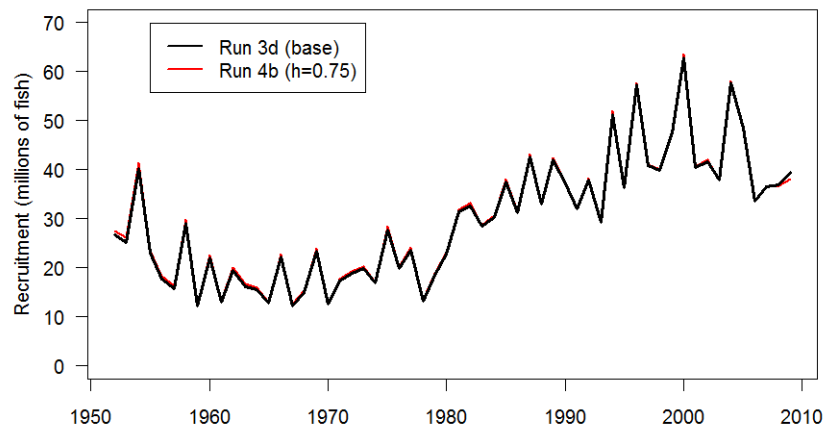
<b>Component</b>	<b>2009 assessment (run 10)</b>	<b>2010 assessment (run 3d)</b>	<b>2010 alternatives</b>
Longline CPUE	Aggregate indices	Aggregate indices	Excluding all CPUE prior to 1975
Steepness	Estimated	Estimated	0.55, 0.75, 0.95
Purse seine catches	Grab sample (s_best)	Spill sample corrected	Grab sample (s_best)
Fleet catchability adjustment	None	None	0.47% per year (non-compounding)
Longline size data	Up-weighted	Down-weighted	Up-weighted
Natural mortality	Base	Base	Increased for juveniles

<sup>1</sup> While run3d is designated the “base” model for the purpose of structuring the modelling analyses, the most appropriate model run(s) upon which to base management advice will be determined by the Scientific Committee.

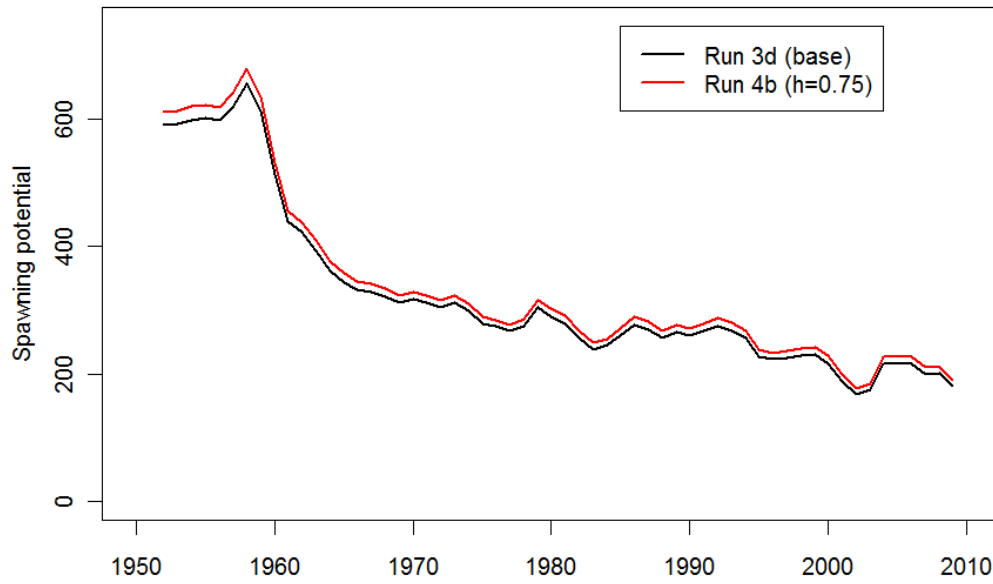
232. The main conclusions of the current assessment are as follows.
- i. The estimated recruitment trends from recent bigeye assessments appear to be primarily the result of conflict (disagreement) among the various data sources, in particular between the longline CPUE indices and the reported catch histories, and between and within some of the size composition data sets. The current assessment has indentified some of these conflicts and includes some model runs that begin to address them.
  - ii. Recruitment in all analyses is estimated to have been high during 1995–2005. This result was similar to that of previous assessments, and appears to be partly driven by conflicts between some of the CPUE, catch, and size data inputs. Recruitment in the most recent years is estimated to have declined to a level approximating the long-term average, although these estimates have high uncertainty. If we consider the recruitment estimates in the second half of the time series to be more plausible and representative of the overall productivity of the bigeye stock, then consideration might be given to basing stock status estimation only on this period. This could in effect be implemented simply by estimating the stock-recruitment relationship for this latter period and applying that in the yield analyses.
  - iii. Total and spawning biomass for the WCPO are estimated to have declined to about half of their initial levels by about 1970, with total biomass remaining relatively constant since then ( $B_{current} / B_0 = 42\%$ ), while spawning biomass has continued to decline ( $SB_{current} / SB_0 = 32\%$ ). Declines are larger for the model with increasing longline catchability and increased purse seine catches.
  - iv. When the non-equilibrium nature of recent recruitment is taken into account, we can estimate the level of depletion that has occurred. It is estimated that spawning potential is at 17% ( $SB_{current} / SB_{(current, f=0)} = 0.17$ ) of the level predicted to exist in the absence of fishing considering the average over the period 2005–2008, and that value is reduced to 15% ( $SB_{current} / SB_{(current, f=0)} = 0.15$ ) when we compare using the 2009 spawning potential levels.
  - v. The attribution of depletion to various fisheries or groups of fisheries indicates that the purse seine and other surface fisheries have an equal or greater impact than longline fisheries on the current BET biomass. The purse seine and Philippines/Indonesian domestic fisheries also have substantial impact in region 3 and to a lesser extent in region 4. The Japanese coastal pole-and-line and purse-seine fisheries are also having a significant impact in their home region (region 1). For the sensitivity analysis with lower purse seine catches, the longline fisheries are estimated to have a higher impact.
  - vi. Recent catches are well above the *MSY* level of 73,840 mt, but this is mostly due to a combination of above average recruitment and high fishing mortality. When *MSY* is re-calculated assuming recent recruitment levels persist, catches are still around 10% higher than the re-calculated *MSY*. **Based on these results, we conclude that current levels of catch are unlikely to be sustainable in the long term even at the recent [high] levels of recruitment estimated for the last decade.**
  - vii. Fishing mortality for adult and juvenile bigeye tuna is estimated to have increased continuously since the beginning of industrial tuna fishing. For all of the model runs  $F_{current} / F_{MSY}$  is considerably greater than 1. For run 3d (base) the ratio is estimated at 1.41 indicating that a 29% reduction in fishing mortality is required from the 2005–2008 level to reduce fishing mortality to sustainable levels. If we consider historical levels of fishing mortality, a 31% reduction in fishing mortality from 2004 levels is required (consistent with the aim of CMM 2008-01), and only a 20% reduction from average 2001–2004 levels. The results are far worse with lower values of steepness or when a higher weight is given to the size data. **Based on these results, we conclude that overfishing is occurring in the bigeye tuna stock, but possibly at a lower level than previously estimated.**



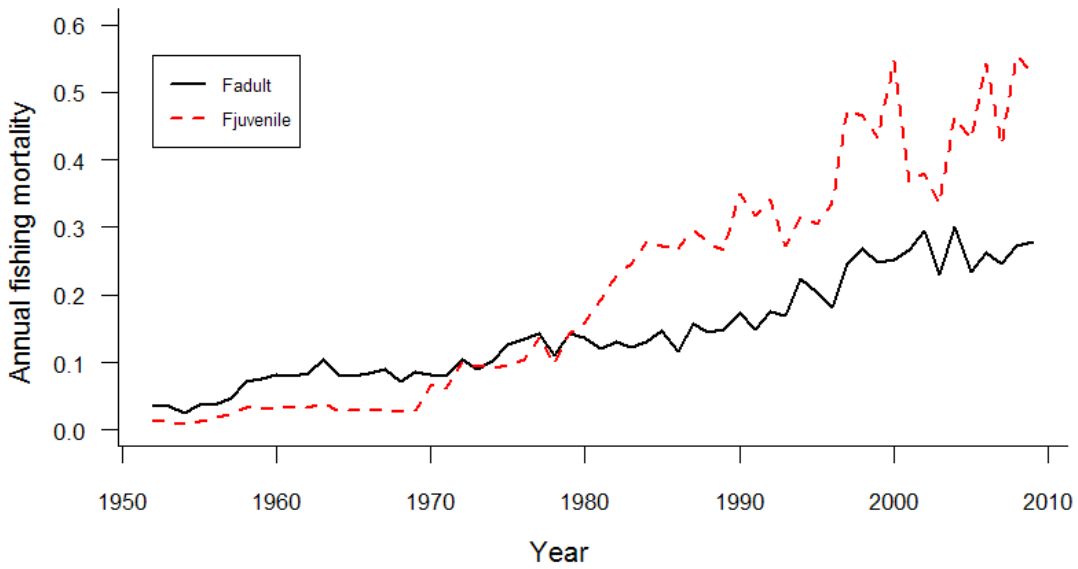
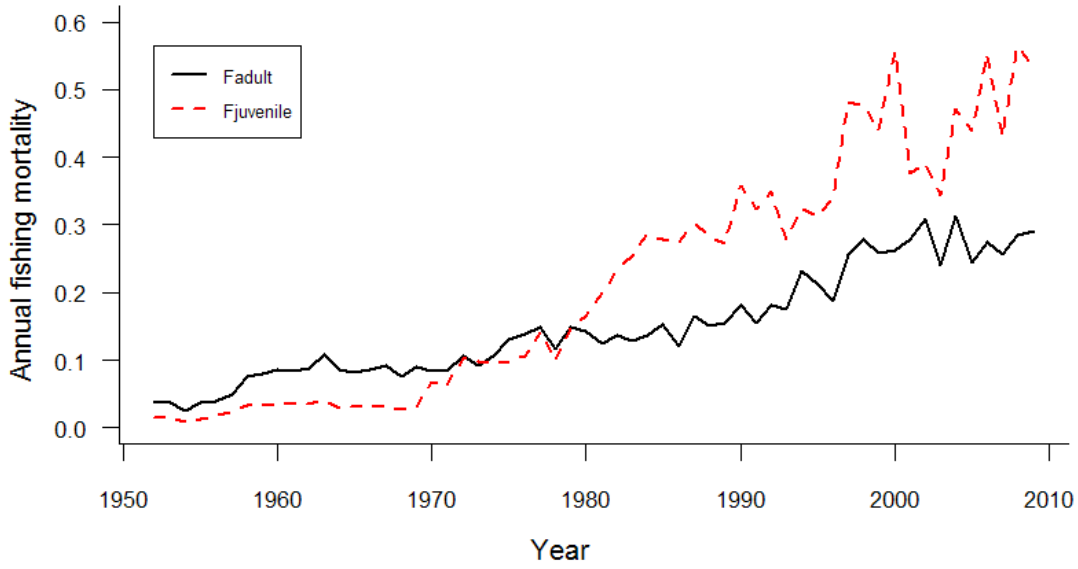
- viii. The reference points that predict the status of the stock under equilibrium conditions are  $B_{F_{current}} / B_{MSY}$  and  $SB_{F_{current}} / SB_{MSY}$ . The model predicts that biomass would be reduced to 64% and 56% of the level that supports *MSY*. In terms of the reduction against virgin biomass the declines reach as low as 13% of spawning potential. Current stock status compared to these reference points indicate the current total and spawning biomass are higher than the associated *MSY* levels ( $\frac{B_{current}}{B_{MSY}} = 1.39$  and  $\frac{SB_{current}}{SB_{MSY}} = 1.34$ ). The likelihood profile analysis indicates a 0.5% probability that  $SB_{current} < SB_{MSY}$  which increases to 60% if a lower value of steepness is assumed. Some of the more plausible alternative models are more pessimistic as are the conclusions of the structural uncertainty analysis based on the grid. **Based on these results above, and the recent trend in spawning biomass, we conclude that bigeye tuna is approaching an overfished state, if it is not already slightly overfished.**
- ix. Analysis of current levels of fishing mortality and historical patterns in the mix of fishing gears indicates that *MSY* has been reduced to less than half its levels prior to 1970 through harvest of juveniles. Because of that and overfishing, considerable potential yield from the bigeye tuna stock is being lost. Based on these results, we conclude that *MSY* levels would rise if mortality of small fish were reduced which would allow greater overall yields to be sustainably obtained.



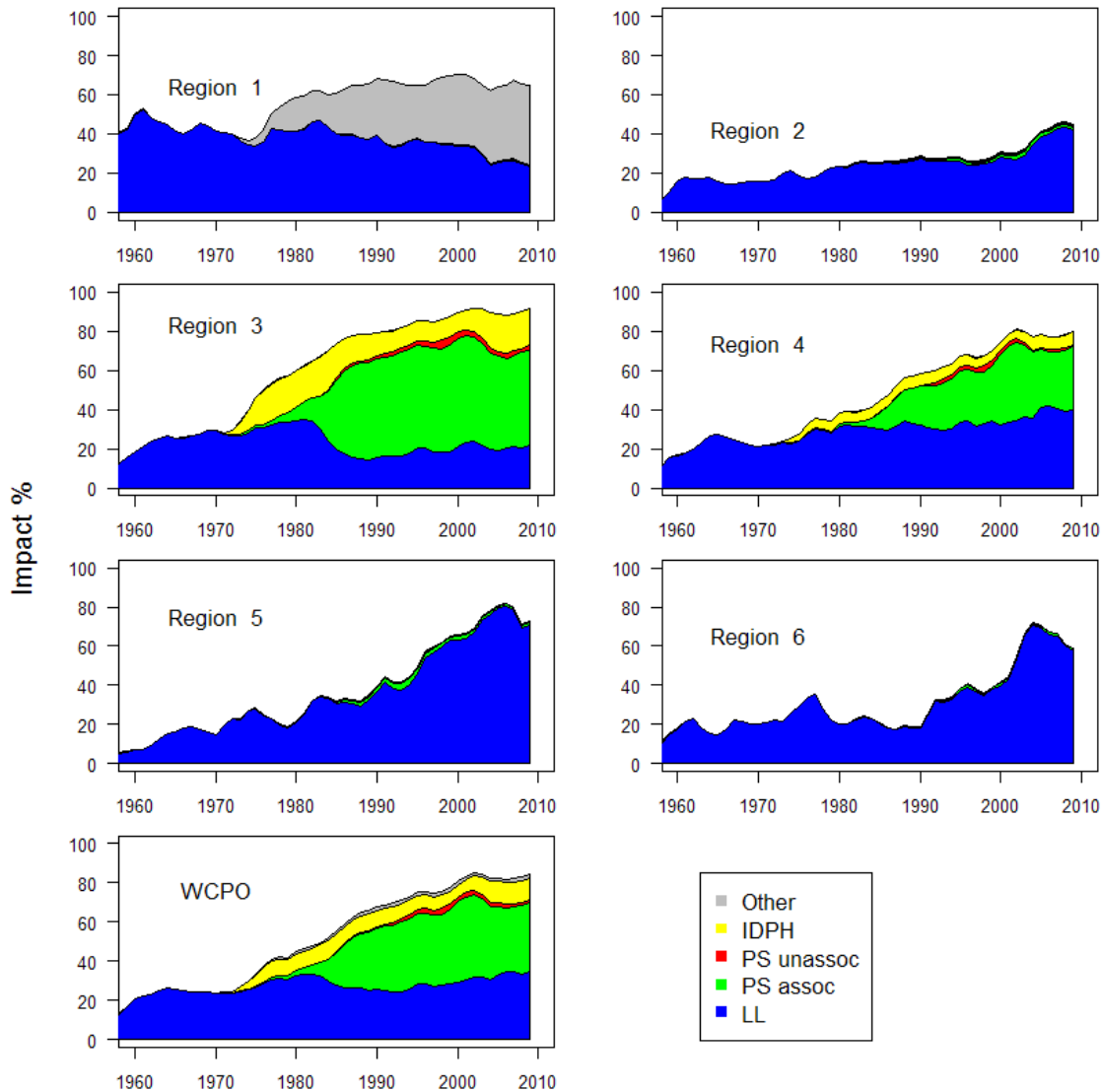
**Figure BET1.** Estimated annual recruitment (millions of fish) for the WCPO obtained from the base model (run 3d) and alternative run 4b considering lower steepness (0.75).



**Figure BET2.** Estimated average annual average spawning potential for the WCPO obtained from the base model (run 3d) and alternative run 4b considering lower steepness (0.75).



**Figure BET3.** Estimated annual average juvenile and adult fishing mortality for the WCPO obtained from the base model (run 3d, top) and alternative run 4b (bottom) considering lower steepness (0.75).



**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 (base case model). L = all longline fisheries; PH/ID = Philippines and Indonesian domestic fisheries; PS assoc = purse seine log and FAD sets; PS unassoc = purse seine school sets; Other = pole and line fisheries and coastal Japan purse-seine.

**e. Summary of SA-WP-05 (Further analysis of CMM2008-01)**

233. J. Hampton presented “Further analysis of CMM2008-01” (WCPFC-SC6-2010/SA-WP-05). This paper presents a series of bigeye tuna stock projections to evaluate the effects of various exemptions and exclusions in CMM-2008-01, as requested at the 5th annual session of the WCPFC scientific committee. Consistent with previous work, the projections employed two key model runs from the 2009 bigeye tuna assessment (run10 and run14) combined with two assumptions regarding future bigeye tuna recruitment (SRR recruit and AV recruit). A total of 11 projection scenarios were devised and the key indicators (F/FMSY and SB/SBMSY in the terminal year of the projections) estimated for each scenario/assessment model/recruitment assumption combination. For the most part, the individual exemptions have a

relatively modest impact on the indicators. It is again demonstrated that measures need to be implemented across all fishery sectors with significant bigeye catches if meaningful reductions of fishing mortality are to be achieved.

**f. Discussion (Addressing five BET assessment working papers and evaluation of CMM2008-01)**

234. There was general agreement that the 2010 bigeye assessment made improvements to the population model used. These improvements included: incorporating analyses of operational level catch-effort data, excluding inconsistent catch size-composition observations, applying revised selectivity functions for the Philippines domestic fishery and longline fisheries, using purse seine catches corrected for grab sampling bias, and revising the assumptions for the relative weight of longline catch size-composition data.

235. The developments respond to issues raised in relation to the 2009 assessment, in particular the conflicts among the input data, and the model's evolution was examined in a stepwise manner towards a base model from which a large number of sensitivity analyses were conducted to explore parameter and structural uncertainty, as well recommendations being provided for future research. An evaluation of CMM2008-01 using the 2009 bigeye assessment model investigated potential effects of hypothetical management measures on bigeye stock status. There followed discussion on five main topics: (i) input data, (ii) model structure and parameterization, (iii) evaluation of CMM2008-01, (iv) management advice, and (v) recommendations for future research, that are outlined below.

***Input data***

236. Descriptive examinations of input data were discussed to review the decisions made to exclude certain data from the assessment model. Concern was expressed for the possible effects of removing non-Japanese length observations from the LL-ALL fishery input data, but this was necessary because insufficient data were available to create a new fishery to hold these data, which were inconsistent with the rest of the fishery. This was recognized as being an interim step; ideally, new fisheries will be defined as the amount of data increases. Also, small-scale temporal and spatial variation in size data within model regions was noted as a complex feature in the catch size-composition data; however, this is difficult to investigate in the absence of associated operational data that would aid in defining fisheries that accommodate this variation.

237. Factors affecting long-term trends in size composition were discussed including changes in sampling protocols, and operational factors such as depth of set. It was suggested that historical sampling designs employed for bigeye be documented as it may assist with resolving trends in these data. Japan's assistance with this was requested. It was noted that a reanalysis of purse seine catch size composition data is required to be consistent with the substantial adjustment made to the catch weights for grab sampling bias. This reanalysis is proposed for the next bigeye assessment.

238. The discussion of analyses of operational level catch-effort data highlighted suggested areas for additional work, although some were noted as not achievable. Despite being potentially very useful as covariates of catch rates, no information on the time of set or the introduction of technological aids (e.g. GPS) has been recorded. Similarly, data for the period before the 1970's may be usefully added to the analysis, but it currently includes no records for vessel ID. Fishing master is a potential covariate, but the records are either unreliable due to recording differences or simply unavailable. Areas noted as worthwhile for future analyses of these data included separating the records for distant water (DW) and offshore (OS) operations. It was noted that the analysis identified a spatial stratification within region 3 in

respect of areas north of 10°N where targeting for albacore occurs. Although the bulk of bigeye catch occurs south of this latitude, it was proposed in future assessments to consider this stratification for other input data, i.e. catch size compositions.

239. Discussion of analyses of aggregate catch-effort data identified the potentially unreliable steeply declining trends in standardised CPUE indices for regions 1 and 2 for the early period of the time series. This has not been investigated in detail, but may be related to the phenomenon of high initial catchabilities upon establishment of a large-scale fishery. However, assessing this feature within the standardisation is not immediately tractable.

240. The SC expressed appreciation regarding the information presented on data conflicts and members encouraged the continued cooperation in improving the datasets used in the model.

241. CCMs noted the importance of the timely provision of input data to stock assessments, in order to ensure there is sufficient time to undertake comprehensive stock assessments for reporting to the Scientific Committee. Support was expressed for the TCC to review the lateness in the provision of data for the 2010 assessments by some CCMs.

### ***Model Structure and Parameterization***

#### ***Recruitment and MSY***

242. Steepness was identified as major source of uncertainty in the bigeye assessment, and there was lengthy discussion of this point in exploring means for better estimating this parameter.

243. S. Harley (SPC) explained that the effect of overestimating steepness was to increase  $F_{MSY}$  and to reduce  $SB_{MSY} / SB_0$ , i.e., to overestimate the population's productivity and resiliency. Using the results of the structural uncertainty analysis, the effect of varying steepness on estimates of stock status was illustrated. All model runs assuming low steepness ( $h = 0.55$ ) indicated an overfished state, while almost all runs assuming high steepness ( $h = 0.95$ ) indicated the stock not to be over-fished. A direct relationship between steepness and the trend in annual recruitments was noted, where for low steepness the increasing trend in recruitments became magnified and implausible, making model results difficult to interpret. However, high values of steepness, as estimated in the base model, were also considered to be implausible. On this basis, it was not possible to regard any one of the assessment models presented as being "most plausible".

244. The relationship between steepness and the annual recruitments was discussed, and most likely results from model parameters being estimated that attempt to reconcile conflicts among the input data. The detailed analysis of longline operational catch-effort data showed the progressive spatial contraction of the fleet through time, which is consistent with the process of hyperstability in catch rates, i.e., CPUE may not be proportional to relative abundance. This was offered as a potential factor contributing to the model's estimate of an increasing trend in recruitment. Also, the one-off model runs indicated that, to some extent, resolving or accounting for conflicts among input data produces lower steepness values, and further work in this area may produce steepness estimates that are more plausible. In the absence of this, a detailed meta-analysis of recruitment estimates for tuna and tuna-like species was suggested as being useful for developing an approach to estimate steepness for bigeye, or to specify a range over which management advice would be robust. It was recognised that estimating steepness is a problem experienced globally among RFMOs and has been an item considered within the Kobe process. Support was expressed for a meeting of RFMO representatives to examine this issue and draft guidelines for plausible values of steepness in the absence of supporting information.

245. Interpretations of the estimated trends in recruitment, and hence biomass should be made cautiously so as not to readily attribute these to real changes in stock productivity. These trends are sensitive to the CPUE time series used in the model fit, and it was noted that the trend commenced coincident with the introduction of large-scale purse seine operations in the mid-1980's. Given uncertainty in the causes of this trend, which may be related to data for the early period, it was suggested to the group that estimates of stock status may be more reliable if based upon data for the most recent period, which are more informative of the current population state.

246. The influence of the adjustment for grab sampling bias in purse seine catches on MSY estimates was discussed, evident in a comparison of model runs including or excluding this adjustment. The higher adjusted catches result directly in higher estimates of MSY, but the estimates of stock status are not substantially different. The effect of differences in the recent trends in the adjusted and unadjusted catches is likely to account for this feature.

#### *Growth*

247. The importance of growth on model estimates of stock status was discussed, because in EPO tuna assessments, tuna population models exhibit high sensitivity to the  $L_{inf}$  parameter. It was explained that the growth parameterisation in MFCL is specific to the model age classes such that  $L_{inf}$  is an extrapolation beyond this range. No explicit examination had been done of the sensitivity of the current bigeye assessment to this parameter. It was acknowledged that natural variability in growth occurs in tunas, with temporal trends observed for southern bluefin, and temporal-spatial differences in growth observed from inferences from length-frequency data for WCPO bigeye. This variability may be correlated to environmental changes, making growth difficult to estimate.

#### *Selectivity*

248. Some uncertainty in the selectivity estimates was acknowledged that relates closely to the size composition data (i.e., lack of information on the sampling methods used) and to temporal-spatial variation in vessel operations using the same method. Consequently, differences in selectivity estimates for similar or related fisheries were identified in the assessment, but it is not clear what effect this has upon estimates of stock status.

249. The assumption for asymptotic selectivity for the Chinese-Taiwanese longline fleet was discussed, and it was explained as being reasonable given the generally larger catch size compositions compared to the Japanese longline fleet. No speculation was offered for the effects of an alternative assumption.

250. The impact on MSY associated with the introduction of large-scale purse seine fishing was well noted. This was illustrated through a comparison of the yield-per-recruit obtained under a purse seine selectivity versus that from a longline selectivity. The significantly lower yield-per-recruit obtained from purse seining produced the precipitous decline in the dynamic or annual MSY at the time when this fishery commenced large scale operation in the WCPO.

#### *Evaluation of CMM2008-01*

251. Following the presentation of an evaluation of the predicted effects of components of CMM 2008-01 in deterministic projections of the bigeye model, there was discussion of the implications of this work and that compared differences in the projection scenario results.

252. It was clarified that the evaluations undertaken were simply to demonstrate the likely effects of components of the measure or other potential measures, and do not represent firm management recommendations.

253. The beneficial effect on stock status from reductions in sub-adult bigeye mortality in the ID/PH fisheries was noted in a comparison of runs 6 and 11. This benefit is significantly offset by high potential fishing mortality in the longline fishery, which is latent when not constrained by catch limits in the future, evident in run 11. It was identified that model runs evaluating different measures could produce similar outcomes. For run 2 the longline fresh fish exemption was removed, and for run 8 purse seine effort was decreased by 30%. Both runs produce similar, and relatively modest, reductions in fishing mortality. It was explained that run 11 implements the objective of the measure to reduce effort by 30% from 2001–2004 levels, whereas in practice under the measure, purse seine effort levels can, and in fact have increased relative to the 2001–2004 levels; the provisional 2009 purse seine catches of bigeye are already higher than 2008 levels.

254. It was agreed that this work would best be repeated using the updated 2010 assessment and the latest available data. A suggestion was made that future evaluations that include measures to close High Seas areas redistribute this effort to other areas (High Seas or EEZs), rather than completely removing this effort from the fishery, as this may be more realistic. It was also suggested that evaluations be repeated using stochastic projections; although this would be very informative, it would not be possible within the timeframe of the next Commission meeting.

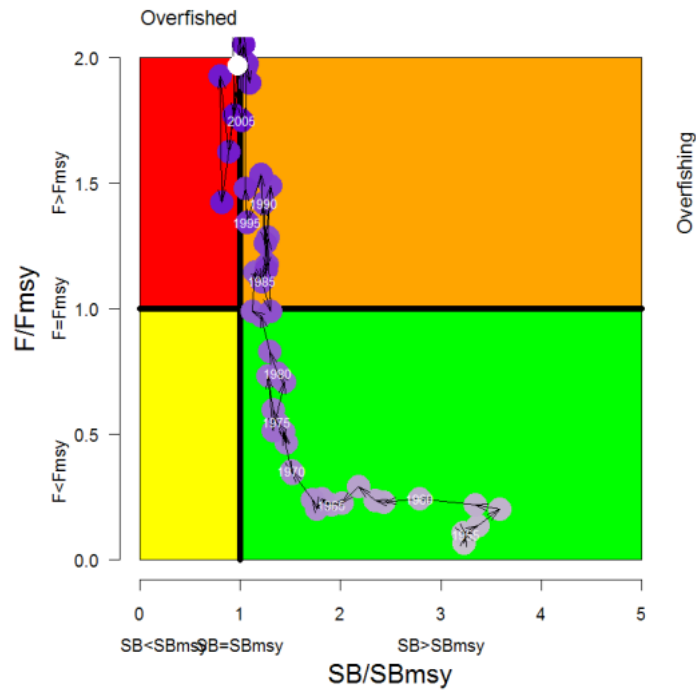
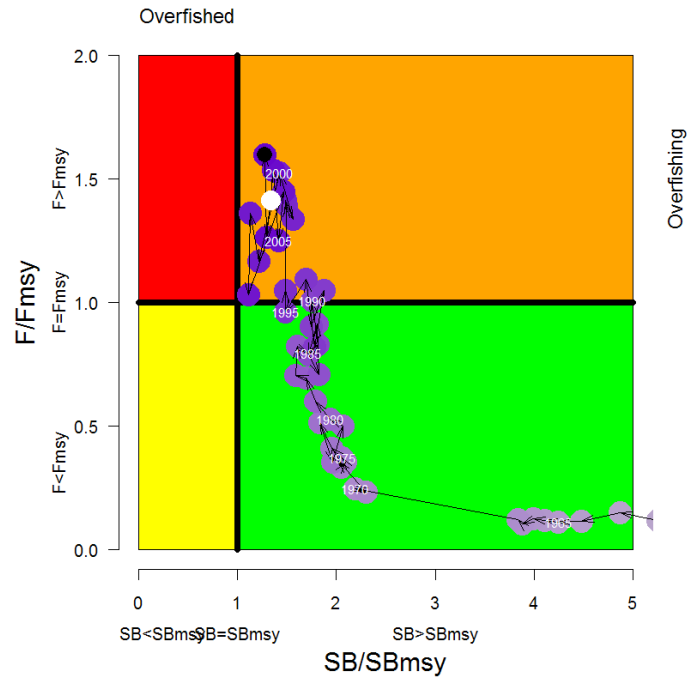
255. Suggestions were made for considering other management measures in undertaking future model evaluations, including closures in the eastern High Seas areas, and extending FAD closures. Also suggested were substantive measures to reduce fishing mortality levels, involving complete closures to High Seas pockets for both purse seine and longline fishing, and large (50%) reductions in fishing effort relative to 2001–2004 levels.

#### ***Recommendations for future research***

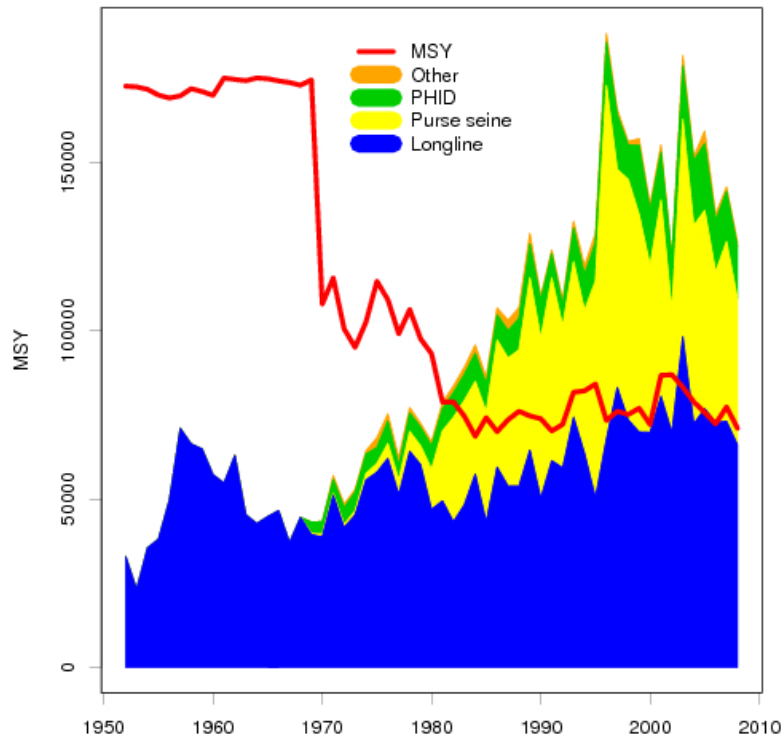
256. Strong support was expressed for continuing the analyses of operational level catch-effort data. It was also accepted that for future analyses of these data that records for distant water (DW) and offshore (OS) operations be separated.

257. It was suggested that when input data (including catch size compositions) is collated for the next assessment, region 3 should be spatially stratified in respect of the areas north of 10°N, where targeting for albacore occurs. Also, reanalysis of purse seine catch size composition data is required to be consistent with the substantial adjustment to the catch weights for grab sampling bias. This reanalysis is proposed for the next bigeye assessment.





**Figure BET5.** Temporal trend in annual stock status, relative to  $SB_{MSY}$  (x-axis) and  $F_{MSY}$  (y-axis) reference points for the base model (run 3d, top) and alternative run 4b (bottom) considering lower steepness (0.75).



**Figure BET6.** History of the annual estimates of *MSY* compared with catches of four major fisheries sectors. The declining *MSY* results from the change in selectivity of fishing gear and increases in catches of small bigeye.

**g. Stock status for bigeye tuna**

258. SC6 selected run 3d which had a steepness estimated at 0.98 (hereafter referred to as the base model) to represent the stock status of bigeye tuna and considered run 4b to illustrate status assuming a lower value to steepness (0.75) (Table BET1).

259. The SC agreed that the value of steepness is difficult to estimate in assessment models and the estimated value of 0.98 should be considered uncertain. Most of the estimated values of steepness in sensitivity runs were  $>0.95$ ; however, the actual value of steepness for the WCPO bigeye stock currently remains unknown. As a comparison to the base model, the SC choose to also represent stock status with a value of 0.75 which was the mid-point of five steepness values (representing the range 0.55-0.95 of plausible steepness values) considered in sensitivity runs in the 2010 assessment.

260. For the base model,  $F_{current} / F_{MSY}$  is estimated at 1.41 indicating that overfishing is occurring for the WCPO bigeye tuna stock and that in order to reduce fishing mortality to  $F_{msy}$  a 29% reduction in fishing mortality is required from the 2005–2008 level (Figure BET5). Considering historical levels of fishing mortality, a 31% reduction in fishing mortality from 2004 levels is required (consistent with the aim of CMM2008-01), and a 20% reduction from average 2001–2004 levels.

261. Current stock status in the base model indicates the current total and spawning biomass are higher than the associated MSY levels ( $\frac{B_{current}}{B_{MSY}} = 1.39$  and  $\frac{SB_{current}}{SB_{MSY}} = 1.34$ ). This indicates that that the WCPO bigeye stock is not in an overfished state (Table BET1, Figure BET5 top) if the spawning biomass reference period is 2005–2008. However, if the spawning biomass period is considered as 2009, then the spawning biomass is further reduced ( $SB_{latest} / SB_{MSY} = 1.17$ ).

262. Stock status results with regard to MSY reference points are far worse when a lower (0.75) value of steepness is assumed, run 4b requires a 49% reduction in fishing mortality is required from the 2005-08 level to reduce fishing mortality to  $F_{msy}$ . The stock is in a slightly overfished state ( $SB_{latest} / SB_{MSY} = 0.97$ ) when the lower value of steepness (0.75) is assumed.

263. The bigeye assessment in 2010 is comparable to the 2008 and 2009 assessment (Table BET2) though there are differences in catch and effort data, size frequency and a few different structural assumptions. The primary differences are revised catch estimates for all fleets from the Indonesia and Philippines; exclusion of some size data from the Philippines and increased purse seine catches based on experimental spill samples.

264. In comparing the 2009 and 2010 assessment using the same MSY time window (2001–2004) the 2010 base model is more optimistic with an  $F_{current} / F_{MSY}$  estimate of 1.25 compared to 1.53 in the run 14 of the 2009 assessment (Table BET3).

265. An analysis of current levels of fishing mortality and historical patterns in the mix of fishing gears indicates that MSY has been reduced to less than half its levels prior to 1970 through harvest of juveniles (Figure BET6).

**Table BET1.** Estimates of management quantities for selected stock assessment models from the 2010 for the base model (run 3d) and alternative run 4b considering lower steepness (0.75). For the purpose of this assessment, ‘current’ is the average over period 2005–2008 and ‘latest’ is 2009.

	run3d (base)	run4b (h=0.75)
$C_{current}$	147,506	147,774
$C_{latest}$	126,769	127,040
$MSY$	73,840	65,840
$C_{current} / MSY$	2.00	2.24
$C_{latest} / MSY$	1.72	1.93
$F_{mult}$	0.71	0.51
$F_{current} / F_{MSY}$	1.41	1.97
$SB_0$	651,500	722,400
$SB_{MSY} / SB_0$	0.24	0.31
$SB_{current} / SB_0$	0.32	0.30
$SB_{latest} / SB_0$	0.28	0.26
$SB_{current} / SB_{MSY}$	1.34	0.97
$SB_{latest} / SB_{MSY}$	1.17	0.85
$SB_{curr} / SB_{curr F=0}$	0.17	0.18
$SB_{latest} / SB_{latest F=0}$	0.15	0.16
Steepness ( $h$ )	0.98	0.75

**Table BET2.** Comparison of WCPO bigeye tuna reference points from the 2010 base model (steepness estimated as 0.98), shown in parentheses is the alternative 2010 run (steepness assumed as 0.75), ranges of six sensitivity analyses in the 2009 assessment and base model and sensitivity analyses in the 2008 assessment.

Management Quantity	2010 assessment Run3d (Run4b)	2009 Assessment	2008 Assessment
<b>Most Recent Catch</b>	126,769 mt (2009)	134,315 mt (2008)	143,059 mt (2007)
<b>MSY and MSY (recent R)</b>	73,840 mt (65,640 mt) 132,403 mt (131,495 mt)	Range: 52,120 ~ 67,800 mt Range: 110,000 – 146,114 mt	Base case: 64,600 mt Range: 56,800~65,520 mt
$F_{current} / F_{MSY}$	1.41 (1.97)	Range: 1.51 ~ 2.55	Base case: 1.44 Range: 1.33 ~ 2.09
$B_{current} / B_{MSY}$	1.39 (1.09)	Range: 1.11 ~ 1.55	Base case: 1.37 Range: 1.02 ~ 1.37
$SB_{current} / SB_{MSY}$	1.34 (0.97)	Range: 0.85 ~ 1.42	Base case: 1.19 Range: 0.76 ~ 1.20
$Y_{Fcurrent} / MSY$	0.94 (0.56)	Range: 0.12 ~ 0.92	Base case: 0.94 Range: 0.50 ~ 0.97
$B_{current} / B_{current, F=0}$	0.23 (0.24)	Range: 0.18 ~ 0.29	Base case: 0.26 Range: 0.20 ~ 0.28
$SB_{current} / SB_{current, F=0}$	0.17 (0.18)	Range 0.11 – 0.19	Not available

**Table BET3.** Comparison of the fishing mortality related quantities for assessments conducted in 2009 and 2010 bigeye stock assessments based on various MSY-calculation time periods.

Run	$F_{\text{mult}} (F/ F_{\text{current}})$			$F_{\text{current}}/F_{\text{msy}}$		
	2001-04	2004	2005-08	2001-04	2004	2005-08
2009 run14	0.65	0.50		1.53	1.99	
2010 base model run3d	0.80	0.69	0.71	1.25	1.45	1.41
2010 run4b (steepness=0.75)	0.57	0.49	0.51	1.76	2.05	1.97

#### **h. Management recommendations and implications**

266. The SC recommended a minimum of a 29% reduction in fishing mortality from the average levels for 2005–2008 with the goal of returning the fishing mortality rate to  $F_{\text{msy}}$ . Recommended reductions in fishing mortality change between stock assessments and between the time window in which MSY levels are calculated. The current recommendation is equivalent to a minimum 31% reduction in fishing mortality from the 2004 levels, and a minimum 20% reduction from average 2001–2004 levels. Current stock status indicates the current total and spawning biomass are higher than the associated MSY levels ( $\frac{B_{\text{current}}}{B_{\text{MSY}}} = 1.39$  and  $\frac{SB_{\text{current}}}{SB_{\text{MSY}}} = 1.34$ ).

267. The base model estimate of the  $F_{\text{current}}/F_{\text{MSY}}$  ratio in the 2010 assessment was 1.25 and lower than the estimate (1.53) in the run 14 of the 2009 assessment when estimated over the same MSY window (2001–2004), thus stock status is more optimistic in the 2010 assessment.

268. Interpretation of stock status with regard to MSY reference points and associated fishing mortality reductions are highly dependent on the steepness in the stock recruitment relationship. Steepness is difficult to estimate and therefore generally uncertain. The SC notes that the current stock status may be overly optimistic as estimated steepness (0.98) is essentially one (1) whereby recruitment is completely independent of spawning biomass. If steepness is substantially less than 1, then the interpretation of stock status is more pessimistic and greater reductions in fishing mortality will be required to obtain  $F_{\text{msy}}$  suggesting that the stock may be in an overfished state.

269. Overfishing and the increase in catch of juvenile bigeye have resulted in a considerable reduction in the potential yield of the WCPO bigeye stock. The SC concludes that *MSY* levels would increase if the mortality of juvenile bigeye was reduced.

270. Considering the late submission of bigeye data, the SC highlighted the importance of improving the timely provision of all data necessary for stock assessment purposes and encourages all CCMs to provide data in accordance with the WCPFC data rules for scientific data to be provided to the Commission.

271. The SC reiterated advice from SC5 on the efficacy of CMM-2008-01 in reducing fishing mortality:

- i. CMM-2008-01 is likely to achieve one of its objectives: not exceeding levels of fishing mortality on the WCPO yellowfin tuna stock beyond the level experienced either in 2004 or the annual average of the period 2001–2004.
- ii. However, even if fully implemented and complied with, CMM-2008-01 is extremely unlikely to achieve its most important objective: reducing fishing mortality on the WCPO bigeye tuna stock to at least 30% below the level experienced either in 2004 or the annual average of the period 2001–2004. Furthermore, if the high seas pockets closure results in effort being transferred to

high seas areas to the east, where bigeye tuna generally form a greater proportion of the purse-seine catch, the objectives of CMM-2008-01 will be even less likely to be achieved.

#### **i. Further evaluation of CMM-2008-01**

272. WCPFC6 requested that work be undertaken at SC6 and TCC6 to support bringing forward a new package of measures for consideration at WCPFC7. Some of the changes made to the assessment this year such as the improved data on Philippines and Indonesian catches, may improve the quality of scientific advice.

273. In considering this request, the SC recommended that the Service Provider undertake the following analyses for WCPFC 7:

- A set of generic projections based on the following specifications
  - Based on bigeye run 3d from the 2010 assessment
  - Using recent average recruitment in deterministic projections
  - Considering stepped changes in catch and effort from 2012 (30% increase to 50% decreases) for:
    - Longline catch
    - Purse seine associated effort
    - Domestic fisheries in Indonesia and the Philippines<sup>2</sup>
  - Repeated for the base case model for yellowfin and skipjack tuna
- Additionally, three specific projections will be undertaken
  - Continuation of the provisions of CMM2008-01 into the future, incorporating any new information regarding the implementation in 2009 and 2010.
  - As above, but with all the exemptions and special provisions removed.
  - Continuation of provisions of CMM2008-01 into the future with the additional High Seas purse seine closure as announced by the PNA (Attachment H) with an assumption of no redistribution of effort.
  - Assumed patterns of catch and effort for 2010 and 2011 will be based the provisions of CMM2008-01. It will also incorporate fishery behavior observed during 2009 and 2010 under CMM2008-01.
  - Changes in catch and effort for the generic projections will be from 2012 onwards and will be relative to 2011 levels (as allowed under CMM2008-01 assuming full compliance), but will also be reported relative to “2001-2004 levels” from previous agreements (e.g. see Attachment F of CMM2008-01 for longline values as an example).

## **6.2 WCPO yellowfin tuna Stock Assessment**

274. No new information on the stock status of this species was presented to SC6; therefore, management recommendations from SC5 are maintained.

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<sup>2</sup> "Domestic fisheries" in this context is the term used to cover all fisheries based in Indonesia and the Philippines within the Convention Statistical Area that catch tuna. The scientific work of the WCPFC requires data from all fisheries (that is, through the range of the stocks), including archipelagic waters, to ensure that stock assessments are able to incorporate the total fishery removals from the stocks. However, the Commission's management measures (CMMs), including CMM 2008-01, do not extend to the domestic fisheries in archipelagic waters or territorial seas of the Convention Statistical Area, which are considered the sovereign territory of countries".

### **6.3 Requests from CMM-2008-01**

275. The Secretariat reported that no information was submitted in accordance with paragraph 39 of CMM-2008-01 for fishing effort or proposals of effort data from other commercial tuna fisheries provided by CCMs.

276. The review of CMM-2008-01 and recommendations are contained under 6.1.

### **6.4 WCPO skipjack tuna**

#### **a. Summary of SC6-SA-WP-07 (Recent status of Japanese skipjack fishery in the vicinity of Japan)**

277. K. Uosaki (Japan) presented the paper “Recent status of Japanese skipjack fishery in the vicinity of Japan” (WCPFC-SC6-2010/SA-WP-07).

278. Japan’s fisheries indices are reviewed for the skipjack in the vicinity of Japan. Although skipjack catch and nominal CPUE shows no sign of the decrease of skipjack population in the equatorial region in the WCPO, there was some signs possibly indicating decrease of the population in the vicinity of Japan. Those are (1) sharp decrease occurred in skipjack catch in 2009 at region northeast for the middle-sized pole-and-line and offshore purse seine fisheries, (2) The nominal CPUE for skipjack for the middle-sized pole-and-line fishery somewhat shifted from a high level during 2000-2006 to a lower level during 2007-2009, (3) end of fishing season became earlier for the middle-sized pole-and-line fishery in recent 3 years (2007-2009), and (4) the skipjack catch for the troll have been a low level at least since 2005. It is necessary to monitor fisheries indicator carefully for skipjack in the vicinity of Japan and to conduct stock assessment for the WCPO skipjack covering entire distribution of its population, so that population dynamics can be explained not only for the population in the equatorial region but for northern region.

### **Discussion**

279. The SC noted that in 2009 and so far in 2010 that catches of tuna have also been low in Australia and it has also been hypothesised that the increase in exploitation in the equatorial region may be impacting the fisheries in the temperate region. An alternative hypothesis proposed is that the inter-annual variation observed is explained by changes in oceanography and environmental conditions. The SC was advised that in Japan they expect the Kuroshio Current to impact the troll fishery in the coastal region; however, oceanography is unlikely to explain all variation, and it is likely that other environmental or population dynamics have impacted the catch over the last few years.

280. The SC also noted that there was anecdotal evidence that 2010 skipjack catches may have improved in Japan. The SC was advised that catches in the first half of 2010 are a little higher than those observed in the first half of 2009 but less than those in the recent 10-year average, however it is not yet possible to estimate the 2010 catch reliably.

281. The SC also sought clarification on whether the pole and line vessels used live bait and if bait availability may be impacting the catch. The SC was advised that in Japan live anchovy is the most commonly used bait and its population level is high. It is unlikely that any variation in the anchovy live bait supply is impacting skipjack catch.

#### **b. Summary of SC6-SA-WP-08 (A standardized CPUE analysis of the Japanese distant-water skipjack pole-and-line fishery in the WCPO, 1972-2009)**

282. A. Langley (SPC) presented the paper “A standardized CPUE analysis of the Japanese distant-water skipjack pole-and-line fishery in the western and central Pacific Ocean (WCPO), 1972–2009” (SC6-SA-WP-08).

283. Since 2000, stock assessments of skipjack tuna in the WCPO have incorporated standardized CPUE indices derived from the analysis of catch and effort data from the Japanese pole-and-line fishery. The resulting indices represent the principal index of stock abundance in each of the model regions and, consequently, are highly influential in the assessment. The methodology used to derive the skipjack CPUE indices was reviewed at the pre-assessment workshop held at SPC in April 2010. A key recommendation of the workshop was to initiate a collaborative study between SPC and the National Research Institute of Far Seas Fisheries (NRIFSF) to analyze the operational CPUE data and provide revised CPUE indices for inclusion in the 2010 skipjack stock assessment.

284. The study applied a delta-lognormal GLM approach to derive indices for the two equatorial regions of the WCPO from the distant-water fleet logsheet data. The resulting indices differ considerably from the indices incorporated in previous assessments. The indices for the western equatorial region exhibit a decline over the study period (1972–2009), although most of the decline in the indices occurs during the late 1980s and early 1990s. There is concern regarding potential sources of bias in the indices related to large changes in the operation of the pole-and-line fleet during that period. The indices for the eastern equatorial region are relatively stable from 1972 to 2001 and then tend to be lower for 2002–2009. Despite concerns regarding the reliability of the indices, it is concluded that the current indices represent the best available indices for incorporation in the 2010 WCPO skipjack assessment.

## **Discussion**

285. The SC asked for clarification on whether operational data included zero catch, and if not, whether this would impact the use of the binomial component of the delta lognormal. The SC was advised that the Japanese pole and line data includes zero catch and that for pole and line the schools are predominately skipjack with few bycatch species. Searching for schools is a very important factor for standardising effort, and the zero in the binomial is useful as a proxy for encounter rate.

286. The SC agreed that the use of the delta lognormal was sensible, because during periods of high abundance (with few zero's) the binomial can become saturated. Inclusion of the lognormal is an appropriate method for modelling such situations. The SC also suggested that the use of WCPO tagging data (pole and line tagged fish) and Japanese training vessel data might be worth interrogating to provide insights into the dynamics of vessel operations and frequency of school encounter. The SC was advised that the operational data only includes a midday location and aggregated catch for that day, and consequently it is not possible to include time of day effects in the standardisation.

287. The SC noted that it is likely that the year and bird radar 1 effects may be confounded as evident through the tight confidence intervals on the index before 1986 and increased uncertainty after 1986 when the bird radar 1 was first introduced into the fishery. The GLM cannot disentangle such effects and it was noted that more work is required to resolve this issue.

288. The SC also noted that careful attention needs to be applied when scaling the delta lognormal as an index of abundance.

### **c. Summary of SC6-SA-WP-09 (Standardized CPUE for a skipjack caught by Japanese offshore pole and line fishery in the northern region of the WCPO)**



289. H. Kiyofuji (Japan) presented the paper “Standardized CPUE for a skipjack caught by Japanese offshore pole and line fishery in the northern region of western and central Pacific Ocean” (WCPFC-SC6-2010/SA-WP-09).

290. The same method used by WCPFC-SC6-2010/SA-WP-08 (Langley et al., 2010) was applied. As results, CPUE indices showed different results from the last stock assessment in 2008 and the sharp increase after 1990 were not identified. This indicates that the effects of vessel ID (good or poor catchability) were highly considerable.

## **Discussion**

291. No comments

### **d. Summary of SC6-SA-WP-10 (Stock assessment of skipjack tuna in the WCPO)**

292. Simon Hoyle (SPC) presented “Stock assessment of skipjack tuna in the western and central Pacific Ocean” (SC6-SA-WP-10).

## **Discussion**

293. The SC thanked the science provider for presentation of the skipjack assessment and supported the principal conclusions that skipjack is moderately exploited; that the stock is neither subject to overfishing nor overfished; and that the biomass trends are now more realistic. The SC endorsed that the base case (run 41) of the stock assessment should be the basis for the Committee’s advice on skipjack. The SC appreciated the improvements made, particularly the revised standardised pole and line effort series, and thanked SPC, Japan, and the Japanese and SPC scientists for this work. The SC noted that this was an excellent example of collaborative work. The skipjack stock is critically important to the sustainable development of many Pacific Island countries. Although the assessments continue to show that the stock is currently only moderately exploited and fishing levels are sustainable, they also indicate that current catch levels are supported by relatively high recruitment and could decline, and the SC would like to see work to improve the skipjack model continued as a priority so that CCMs can clearly understand what is happening if there are any changes in the status of this stock. The SC noted that it is important that future improvement includes the provision of information to assist with TAE.

294. The SC agreed with the identification of the run with steepness of 0.75 as the base case for the purpose of advice on stock status. The SC recognised that steepness has previously been estimated at higher levels and that the steepness assumption is a large source of uncertainty in the assessment. However, as a matter of practice, given the influence of steepness, the SC suggested that in general, when steepness is assumed for the base case, one model option could be run with estimated steepness. However, the SC was advised not to interpret steepness estimates as informative about the true value of steepness.

295. The SC noted that this assessment indicates fishing is now having a significant effect on stock size, especially in the western equatorial region. The choice of steepness has important consequences for interpreting stock status; however, it was evident from SA-WP-10 that, although the stock may not be experiencing overfishing or be in an overfished state, it was likely that significant increases in effort would result in only minor increases in catch. Some CCMs stated that the management of fleet numbers in the WCPO should recognise this, because reducing existing capacity is a difficult task.

296. Clarification was provided that the SA-WP-10 used run 41 as the base case, and that this model included Japanese, RTTP and SSAP tagging data. The SC noted that the inclusion of smaller-scale or

opportunistic tagging campaigns in the skipjack stock assessment was an excellent development and encouraged further work to include such data in the future stock assessments.

297. The SC encouraged that data preparation and analyses required on the PTTTP data be undertaken promptly to allow its use in future stock assessments, possibly in the next year. The SC discussed that improving the modelling of the large number of tag returns occurring during the mixing period in the PTTTP data may be an initial area of work that is pursued. The SC noted that estimating F level using the PTTTP data as well as RTTP and SSAP data, independently of the MultifanCL model estimate, will provide information to understand the status of stock utilization.

298. The SC suggested that work should be undertaken to develop a usable purse seine CPUE index, recognising the difficulties that this might entail, and would appreciate further information on how this might be approached.

299. The SC noted that the addition to MFCL to include reporting rates associated with fisheries and tagging programs was an excellent development and has significantly improved the skipjack assessment. The SC was also informed that different growth rates for different regions could not be modelled explicitly in MFCL. This is currently managed by modelling the data outside of MFCL or by excluding particular data sets. The SC was informed that there are plans to modify MFCL to include priors on movement rate. This will allow for time variant movement rates and the option of including environmental covariates on this prior.

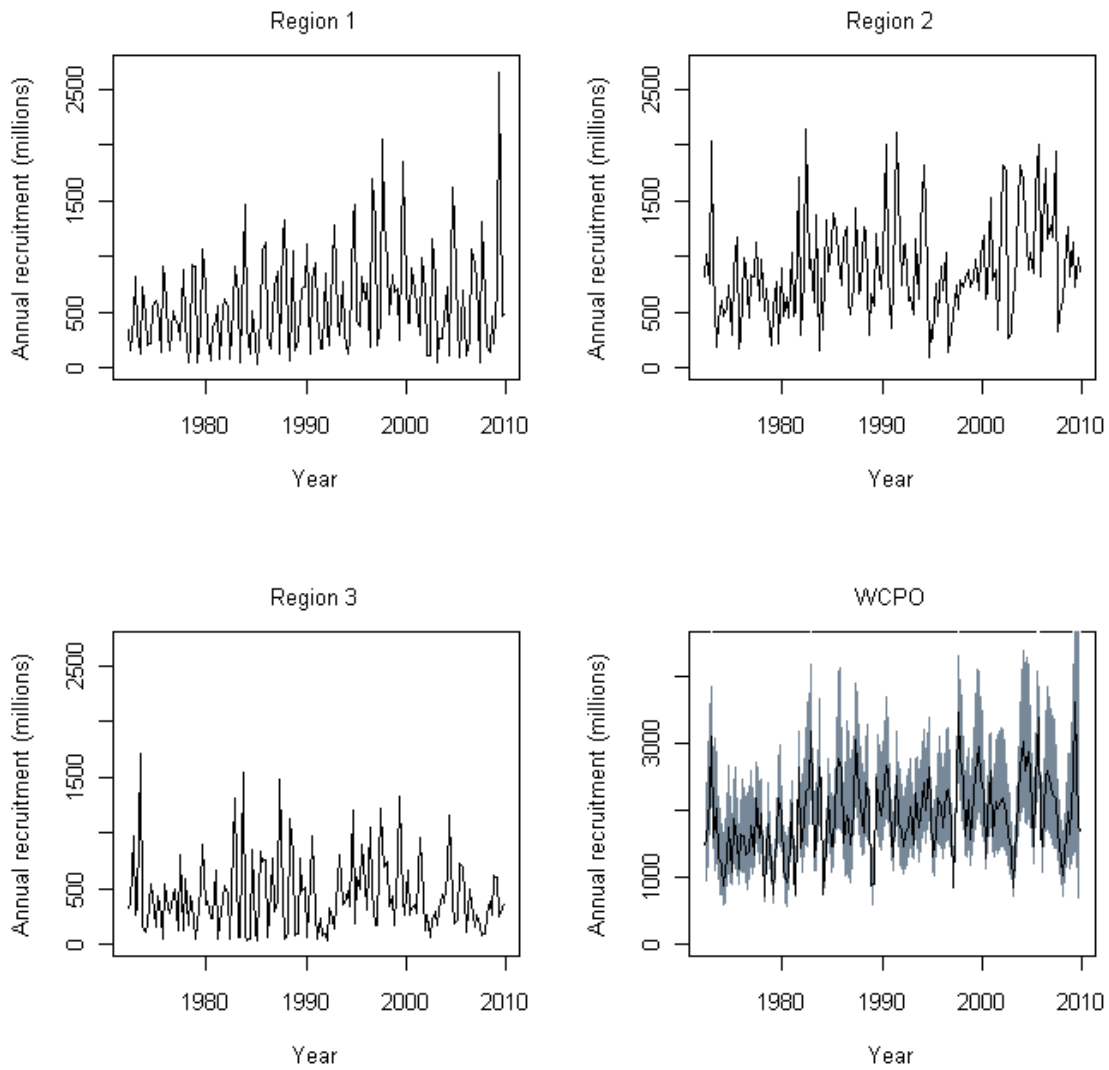
300. The SC discussed the strong influence that the growth curve has on the stock assessment for skipjack and the difference between that estimated by the stock assessment model and that estimated from otoliths in the study by Tanabe et al 2003. The SC did note that the growth rate estimated by Tanabe et al 2003 may be more suited to temperate habitats where the majority of the fish were sampled. MFCL currently uses length data for estimation of the growth curve and inclusion of supplementary age at length data would be beneficial. The commencement of an otolith collection program for skipjack was identified as an important future task of the SC. The SC was informed that an estimate of skipjack growth from fish collected in waters of Vietnam is apparently higher.

301. The SC was also advised that the natural mortality estimates for fish <6 months of age are poorly estimated as they do not enter the fishery until a later age.

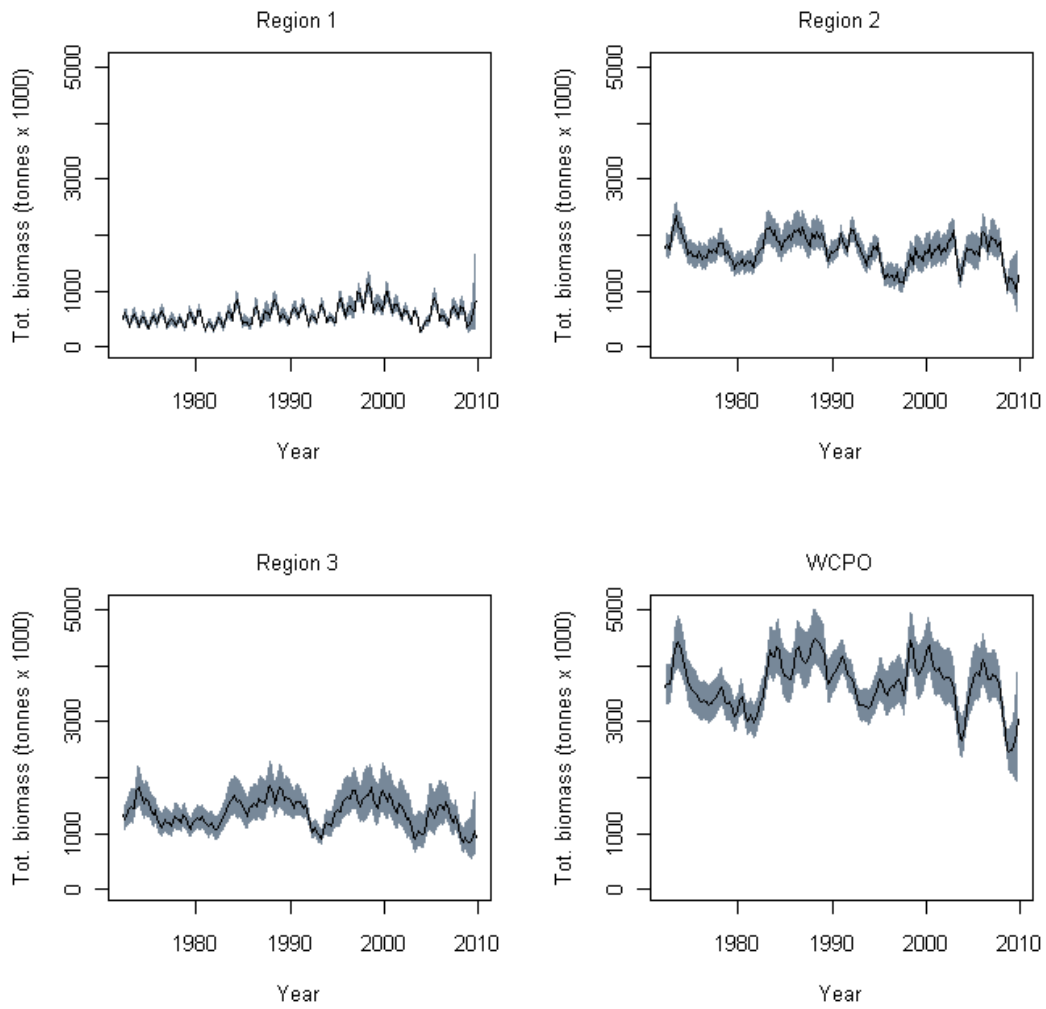
302. The SC was also advised that the base case recommended in SA-WP-10 modelled the entire stock. This was considered an improvement to the 2008 base case, which was restricted to equatorial regions. The revised spatial structure of the 2010 stock assessment removes many of the issues (e.g. cryptic biomass) that restricted the 2008 stock assessment base case to equatorial regions. It was noted that the MSY estimates for 2008 and 2010 for the equatorial regions were similar.

303. It was noted by the SC that it would be desirable for the assessment team to conduct a future projection considering that fishing mortality has increased significantly in recent years and gave greater impact to the stock biomass in the western equatorial region. It was agreed that run 41 would be used for this projection. The projections for skipjack in MI-WP-01 use the 2008 stock assessment and are presented to illustrate the stochastic projection methodology only.

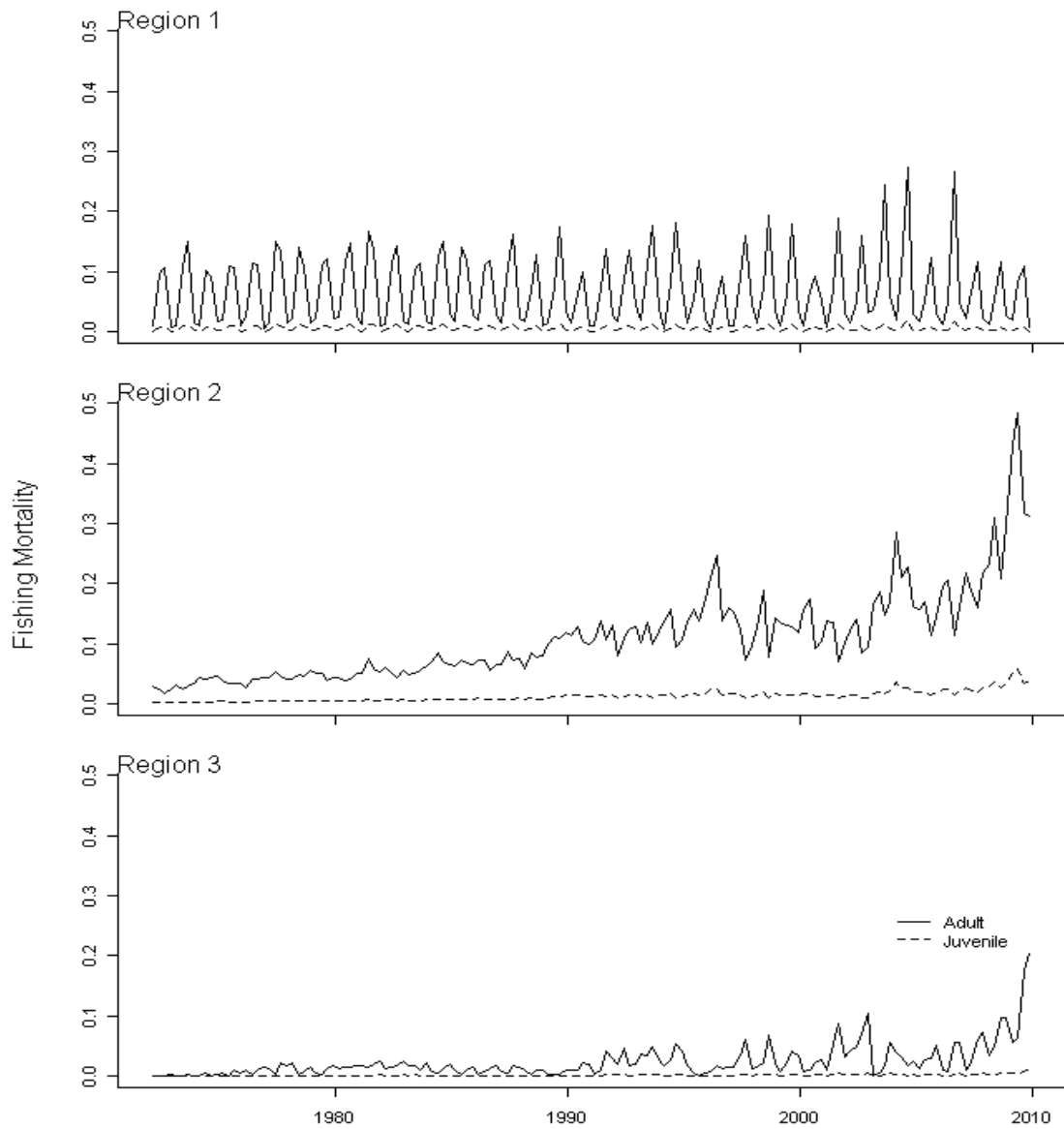
304. The SC was informed that spawning biomass estimates were not provided as skipjack are estimated to be mature in the model at age 1 and consequently estimates differ little from total biomass. The SC was also advised that SB estimates are likely to vary when the maturity ogive is altered to include spawning potential, but this has not yet been included in the skipjack stock assessment.



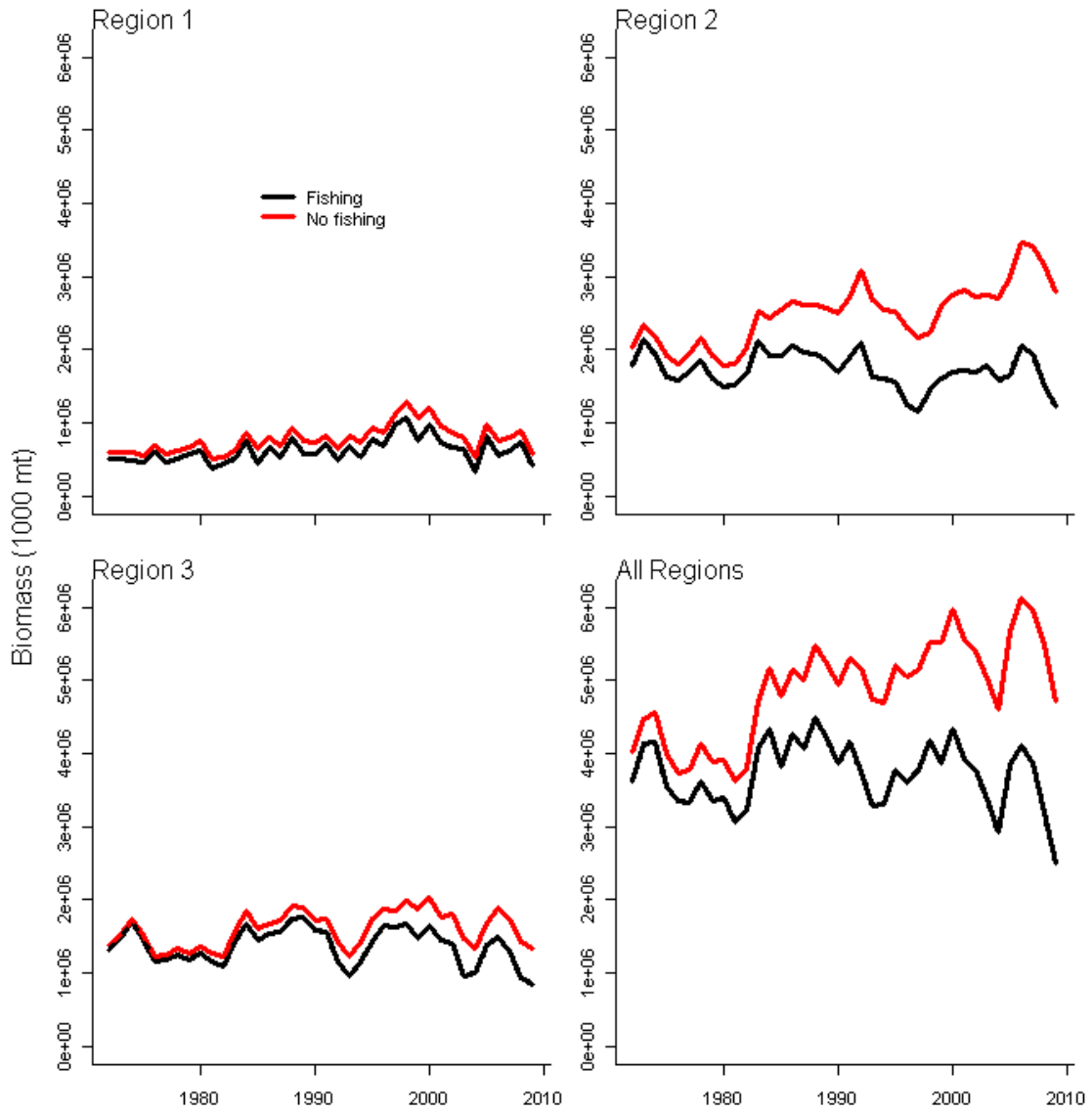
**Figure SKJ1.** Estimated quarterly recruitment (millions) by region and for the WCPO for the base-case analysis. The dashed line represents the average recruitment for the entire period. The shaded area for the WCPO indicates the approximate 95% confidence intervals.



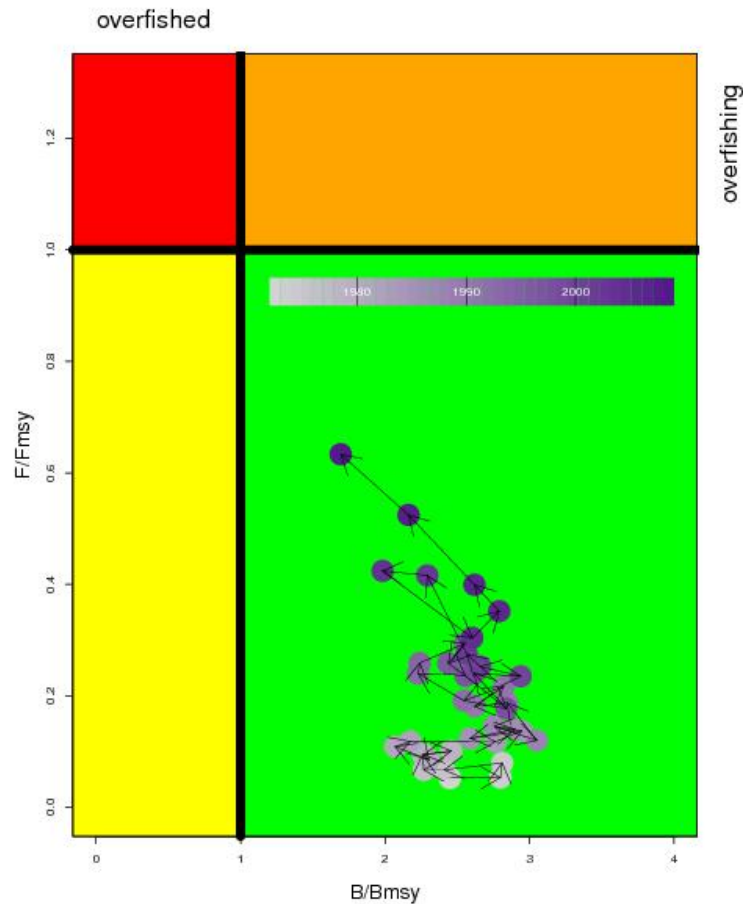
**Figure SKJ2.** Estimated annual average total biomass (thousand t) by region and for the WCPO for the base-case analysis. The shaded areas indicate the approximate 95% confidence intervals.



**Figure SKJ3.** Estimated quarterly average fishing mortality rates for juvenile (age classes 1 and 2) (dashed line) and adult age-classes (solid line).



**Figure SKJ4.** Comparison of the estimated biomass trajectories (lower black lines) with biomass trajectories that would have occurred in the absence of fishing (red lines) for each region and for the WCPO as a whole.



**Figure SKJ5.** Temporal trend in annual stock status, relative to  $B_{MSY}$  (x-axis) and  $F_{MSY}$  (y-axis) reference points, for the model period (1972–2009). The colour of the points is graduated from white (1972) to dark purple (2009).

**e. Stock status for skipjack tuna**

305. SC6 selected run 41 as the base model to represent the stock status and Committee’s advice on skipjack tuna. A value of 0.75 was chosen as the mid-point of the range of steepness values considered in the 2010 assessment. Similar to bigeye tuna, the actual value of steepness for the WCPO skipjack currently remains unknown.

306. Fishing mortality rates tended to be higher during the last decade than for the preceding period and fishing mortality and biomass indicators relative to MSY started to move to 1.0, although they remained substantially below the  $F_{MSY}$  level ( $F_{current}/\tilde{F}_{MSY} = 0.34$ )(Table SKJ1). The stock is not in an overfished state as biomass is above the  $B_{MSY}$  ( $B_{current}/\tilde{B}_{MSY} = 2.42$ ). Table SK2 compares reference points between the 2010 and 2008 assessments and the key conclusions based on MSY quantities between assessments are similar.

**Table SKJ1.** Estimates of management quantities for the 2010 base model. For the purpose of this assessment, ‘current’ is the average over period 2005–2008 and ‘latest’ is 2009.

	2010 base case
$C_{current}$	1,406,358
$C_{latest}$	1,575,287 (spill sampling)
$MSY$	1,375,600
$C_{current} / MSY$	1.02
$C_{latest} / MSY$	1.15
$F_{mult}$	2.94
$F_{current} / F_{MSY}$	0.34
$SB_0$	4,433,000
$SB_{MSY} / SB_0$	0.27
$SB_{current} / SB_0$	0.72
$SB_{latest} / SB_0$	0.61
$SB_{current} / SB_{MSY}$	2.67
$SB_{latest} / SB_{MSY}$	2.27
$SB_{curr} / SB_{curr F=0}$	0.60
$SB_{latest} / SB_{latest F=0}$	0.55
Steepness ( $h$ )	0.75

**Table SKJ2.** Estimates of reference points from the 2010 and 2008 skipjack tuna stock assessments. The spatial domain of the 2008 assessment was limited to the equatorial region of the WCPO.

Management Quantity	2010 Assessment	2008 Assessment
<b>Most Recent Catch</b>	1,575,287 mt (catch based on spill sampling) <sup>a</sup>	1,546,436 mt (2007 <sup>b</sup> ) 1,726,702 mt (2007 <sup>c</sup> ) 1,410,389 (WCPO catch based on spill sampling)
<b>MSY</b>	1,375,600 mt	1,280,000 mt
$Y_{F_{current}} / MSY$	0.80	0.70
$B_{current} / B_{current, F=0}$	0.63	0.66
$F_{current} / F_{MSY}$	0.34	0.26
$B_{current} / B_{MSY}$	2.24	2.99
$SB_{current} / SB_{MSY}$	2.67	3.82

Notes: <sup>a</sup>Total catch in 2009 of 1,789,979 mt based on grab sampling; <sup>b</sup>Equatorial region, based on grab sampling; <sup>c</sup>WCPFC region mt, based on grab sampling.



## **f. Management recommendations and implications**

307. Catches in 2009 increased to a historical high of ~1.8 million mt. This is significantly above the estimated MSY of ~1.35 million mt. The assessment continues to show that the stock is currently only moderately exploited and fishing mortality levels are sustainable. Catch rate levels are likely to decline and catch should decrease as stock levels are fished down to MSY levels. Due to the rapid change of the fishing mortality and biomass indicators relative to MSY in recent years, increases of fishing effort should be monitored.

308. Fishing is having a significant impact on stock size especially in the western equatorial region and can be expected to affect catch rates. Additional purse seine effort will yield only modest gains in skipjack 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 recognise this.

309. There is concern, yet to be substantiated, that high catches in the equatorial region could result in range contractions of the stock, thus reducing skipjack availability to higher latitude (e.g. Japan, Australia, New Zealand) fisheries.

310. Noting the uncertainty in purse species composition, the SC urged the Commission to continue improvement of estimates of purse seine composition data. SC requested CCMs port states, flag states and vessel operators to support efforts for paired spill and grab sampling together with the effort to collect cannery data.

## **6.5 South Pacific albacore**

### **a. Status and trends**

311. The SC noted that it may be necessary to obtain progress on some of the biological studies that were discussed in the Biology Theme before useful results can be obtained from a new assessment, but noted that there have been substantial differences between different assessments over time and between model configurations, and it is important to reduce the uncertainty in the assessment to support work on more comprehensive management arrangements than those included in CMM2005-02.

312. The SC noted that the albacore assessment should be kept up to date, because of the increasing effort on this stock. CCMs also encouraged that any future work on south Pacific albacore tuna should include the effect of oceanographic change and address possible local depletion.

### **b. Management recommendations and implications**

313. No new information on the stock status of this species was presented to SC6; therefore, management recommendations from SC5 are maintained.

## **6.6 South Pacific swordfish**

### **a. Status and trends**

314. WCPFC8 is anticipated to review CMM 2009-03 in 2011. Several CCMs noted that a new assessment for south Pacific swordfish should be planned for next year and additional discussion should consider any information available on this assessment, including how it may be possible to extend the spatial scope of previous assessments to include the south-central Pacific.

**b. Management recommendations and implications**

315. The advice from SC5 should be maintained pending a new assessment or other new information.

**6.7 Southwest Pacific striped marlin**

**a. Status and trends**

316. The SC noted that following Australia's request to SC5 to add southwest Pacific striped marlin to its work plan as a high priority, Australia, New Zealand and SPC collaborated in the development of two funding proposals in 2010. However, despite the high priority ranking for such an assessment, both from the WCPFC SC and the Australian Fisheries Management Authority, the proposals did not receive funding in 2010. The SC noted that Australia has sought domestic funding for a revised southwest Pacific striped marlin stock assessment several times since the last assessment without success. It was noted that given the last stock assessment was carried out in 2006, an updated assessment is urgently needed. It was proposed that SPC be tasked with carrying out a revised stock assessment for presentation at SC7.

**b. Management recommendations and implications**

317. The SC noted that no stock assessment was conducted for southwest Pacific striped marlin in 2009; therefore, the stock status description and management recommendations from SC2 are still current.

**6.8 North Pacific striped marlin**

**a. Status and trends**

318. A 2010 published study refined the ISC2007 assessment by conducting two assessment scenarios to account for different hypotheses about the steepness (0.7 and 1.0) of the stock-recruitment dynamics. The probable status of North Pacific striped marlin indicated that  $F/F_{MSY}$  (2001–2003) was 3.67 under scenario 1 and 1.90 under scenario 2. Corresponding estimates of striped marlin biomass were below  $S_{MSY}$  and ranged from 29% of  $S_{MSY}$  under scenario 1 to 44% of  $S_{MSY}$  under scenario 2. In relation to MSY-based reference points, striped marlin was experiencing overfishing and the stock was considered depleted under each steepness scenario. The ISC reported that a two stock scenario (WCPO and EPO) stock assessment for striped marlin will be completed in 2011.

**b. Management recommendations and implications**

319. The SC recommended that WCPFC7 further develop a measure for the conservation of North Pacific striped marlin given the high fishing mortality.

320. The SC noted that considerable effort towards a CMM was made by an informal working group at WCPFC6. However after four rounds of revisions the proposed CMM was unsuccessful. As a consequence, this species was identified at that meeting as a priority for CCMs' consideration this year towards the development of a CMM. A new stock assessment is scheduled for 2011 under a different stock scenario. The SC recommends as a precautionary measure that the Commission consider adopting an interim measure for 2011, which would be revised pending a new striped marlin assessment.

321. If the WCPFC decides to control the fishing mortality rate on North Pacific striped marlin as advised by the ISC, it could do so through limits either on fishing effort or on catch, or through other controls. If it decides to limit catches, it would be helpful to know the levels of catch that correspond to a

range of reference fishing mortality rates. Therefore, pending a new striped marlin assessment to be conducted by the ISC, the Science Committee recommends that the WCPFC7 request the ISC to provide estimated catch levels corresponding to average fishing mortality during 2001–2003 and fishing mortality reference points including  $F_{msy}$  and  $F$  at various spawning potential ratios.

322. The SC requests a clear direction on how the WCPFC Science Service Provider will work with ISC scientists on the assessment planned for 2011. The stock assessment report on this species must be discussed in full at SC7 like any other new stock assessments.

## **6.9 Northern stocks**

323. An ISC representative, per the SC's request, agreed to provide SC7 with an overview of ISC recent assessments for each stock and management advice.

### **6.9.1 North Pacific albacore**

#### **a. Status and trends**

324. The most recent ISC stock assessment for North Pacific albacore was completed in 2006 and a full stock assessment will be conducted by ISC in 2011 and reviewed at ISC11. No formal update of stock status has been conducted since the 2006 assessment. However, at its 12–13 July 2010 meeting, the albacore working group (ALBWG) undertook a qualitative update using available fisheries data from 2006 to 2009 and an index of spawning stock biomass (Japanese longline CPUE age 6–9+). Based on these update, the ALBWG concluded that:

- i. A new stock assessment will be necessary to fully understand the implications of the new data available since the last stock assessment;
- ii. The 2006 stock assessment estimated that albacore spawning biomass reached an historical high in 2005 and then projected a decline thereafter. The age 6–9+ index shows that SSB has declined from previous high levels and appears to be relatively stable since the last stock assessment;
- iii. The ALBWG did not focus on recruitment in its latest qualitative review and is unable to provide insight into recruitment in recent years beyond observations in previous Plenary reports; and
- iv. Nominal effort in most fisheries (as measured by the number of vessels) appears to have declined slightly or been stable since 2005. Although catches exhibit more interannual variability than effort, with the largest variation occurring in the Japan pole-and-line fisheries, most fisheries catches have declined or remained relatively stable over the same period. This could mean that  $F_{2009}$  is less than the  $F_{2002-2004}$  (0.75 yr<sup>-1</sup>) used in the 2006 stock assessment projections. Alternatively,  $F_{2009}$  may be as high as the value used in the stock assessment projections since the level of recruitment after 2005 is not known.

325. Based on analyses conducted by the ALBWG since ISC9, the following points are highlighted:

- i. Both the ISC9 and ISC10 Plenaries note that there is increasing uncertainty concerning the status of North Pacific albacore in the absence of a new stock assessment.
- ii. The ISC10 Plenary notes that there is no strong positive or negative signals in the age 6–9+ SSB index since the last stock assessment.
- iii. The next stock assessment is expected to be completed in early 2011 and the results will be presented at ISC11.
- iv. The ISC9 Plenary reported that the estimated value of  $F_{SSB-ATHL}$  is 0.75yr<sup>-1</sup> for a 25-year projection period using fishery data through 2008. This value is similar to  $F_{2002-2004} = 0.75$  yr<sup>-1</sup>, estimated in the last stock assessment.

## *Discussion*

326. The SC6 thanked the ISC Chair for his report on North Pacific Albacore and supported decisions taken by ISC10 that the next stock assessment is expected to be completed in early 2011 and the results will be presented at ISC11. Concern was expressed that there is increasing uncertainty concerning the status of North Pacific albacore in the absence of a new stock assessment.

### **b. Management recommendations and implications**

327. The ISC10 had no new information to alter its conservation advice from that provided at ISC9 in July 2009. The SC recommended that the WCPFC adopt the ISC conservation advice provided on North Pacific albacore.

## **6.9.2 Pacific bluefin tuna**

### **a. Status and trends**

328. In 2010, the ISC Pacific bluefin working group (PBFWG) conducted an update of the 2009 analysis along with a complete set of sensitivity analyses and stock projections using data through 2007. Data used in the 2010 update were analyzed using the same methods and parameters in the stock assessment model as in 2009.

329. The updated “current” fishing mortality rate was calculated as a three-year average (2004–2006) with the terminal year of the model results (2007) excluded due to unreliable estimates. The PBFWG reviewed the results of the update with the objectives of characterizing the recent relative change in fishing mortality rate and spawning biomass. It should be noted that even the most recent estimates of fishing mortality would not yet reflect any actions with regard to the fishery management decision for Pacific bluefin taken by WCPFC6 (CMM 2009-07, Dec. 2009).

330. A summary of the 2010 update is as follows:

- i. A number of sensitivity runs were conducted in 2010 to investigate uncertainties in biological assumptions and fishery data. Results indicate that the assumption of adult  $M$  is particularly influential to the estimate of absolute spawning biomass and fishing mortality. Although absolute estimates from the stock assessment model were sensitive to different assumptions of  $M$ , relative measures were less sensitive.
- ii. The estimate of spawning biomass in 2008 (at the end of the 2007 fishing year) declined from 2006 and is estimated to be in the range of the 40–60 percentile of the historically observed spawning biomasses.
- iii. Average Fishing Mortality 2004–2006 ( $F_{2004-2006}$ ) had increased from  $F_{2002-2004}$  by 6% for age-0, approximately 30% for ages 1–4, and 6% for ages 5+.
- iv. 30-year projections predict that at  $F_{2004-2006}$  median spawning biomass is likely to decline to levels around the 25th percentile of historical spawning biomass with approximately 5% of the projections declining to or below the lowest previously observed spawning biomass. At  $F_{2002-2004}$  median spawning biomass is likely to decline in subsequent years but recover to levels near the median of the historically observed levels. In contrast to  $F_{2004-2006}$ ,  $F_{2002-2004}$  had no projections (0%) declining to the lowest observed spawning biomass. In both projections long-term average yield is expected to be lower than recent levels.

## *Discussion*

332. The SC thanked the ISC for the report on Pacific bluefin tuna and indicated that it would be beneficial to see further analyses in 2010 including a complete set of sensitivity analyses and stock projections using data through 2007. It is also encouraging to see consistency in the methodology used to generate estimates of recruitment for the years 2008, 2009 and 2010. Similarly, the same analytical methods and stock assessment model parameterization was used in the 2010 update of 2009 analysis. Results on the characterization of the recent relative change in fishing mortality rate and spawning biomass were noted. The updated “current” fishing mortality rates calculated as a 3-year average (2004–2006) has increased from the average fishing mortality 2002–2004: by 30% for ages 1–4, and 6% for the other age groups.

333. The recent estimates of fishing mortality would not yet reflect any actions in relation to limits in the new measure. Despite that, the SC remained concerned that the impact of the new measure in reversing trends in spawning stock biomass and fishing mortality of this species, particularly on juvenile age classes (ages 0–3), remains to be seen.

#### **b. Management recommendations and implications**

334. ISC’s plenary reached consensus on the management advice for Pacific bluefin tuna as follows: given the conclusions of the July 2010 PBFWG workshop, the current (2004–2006) level of F relative to potential biological reference points, and the increasing trend of F, it is important that the level of F is decreased below the 2002–2004 levels, particularly on juvenile age classes.

335. The SC recommended that the WCPFC adopt the ISC conservation advice provided on Pacific bluefin tuna.

### **6.9.3 North Pacific swordfish**

#### **a. Status and trends**

336. In 2010, the EPO stock assessment was updated to include missing swordfish catch from the IATTC area. Results of the updated EPO stock assessment were consistent with the previous 2009 assessment of the EPO stock.

337. Based on the 2009 stock assessment results, the exploitable biomass of the WCPO swordfish stock was estimated to be about 75,000 mt in 2006 (B2006), roughly 30% above BMSY. The exploitation rate on the WCPO stock in 2006 was estimated to be 14% with a total catch of roughly 9,900 mt or roughly 69% of MSY (MSY=14,400 mt). There was very high probability that B2006 was above BMSY, a 93 out of 100 chance, and there was a 0 out of 100 chances that the exploitation rate in 2006 exceeded the rate to produce MSY. Based on the 2010 stock assessment update results for the EPO stock only, the exploitable biomass of the EPO swordfish stock was estimated to be about 69,000 mt in 2006, over 200% above BMSY.

338. Exploitation rate on the EPO stock in 2006 was estimated to be 6% with a total catch of roughly 3,900 mt or roughly 78% of MSY (MSY=5,000 mt). There was very high probability that B2006 was above BMSY, a 99 out of 100 chance, and there was a two out of 100 chance that the exploitation rate in 2006 exceeded the rate to produce MSY. The exploitable biomass of the WCPO swordfish stock was 31% above BMSY and the exploitation rate was 46% below FMSY in 2006. Similarly, exploitable biomass of the EPO swordfish stock was over two-fold greater than BMSY and the exploitation rate was 62% below FMSY in 2006. Based on results of the updated North Pacific EPO stock assessment and the 2009 North Pacific WCPO stock assessment, the billfish working group proposed that the ISC Plenary maintain the existing conservation advice for this species.

## ***Discussion***

339. The SC noted from the ISC10 report that the exploitable biomass of the WCPO swordfish stock estimated in 2006 is roughly 30% above BMSY; and that the exploitable rate on the WCPO stock in 2006 estimated at 69% of FMSY. In contrast the EPO swordfish exploitable biomass stock was over 2-fold greater than BMSY and the exploitation rate was 62% below FMSY in 2006. These estimates point to the healthy state of this species both in WCPO and EPO, and above the level required to sustain recent catches.

340. Despite the results of the update 2010 assessments, it is not clear if any progress on investigating the two-stock structure assumptions in the updated assessment. As discussed last year, there is uncertainty on the use of fishery data by the southern boundary of the eastern Pacific stock and if this boundary has been reviewed at ISC10.

### **b. Management recommendations and implications**

341. ISC concluded that both swordfish stocks in the North Pacific are healthy and above the level required to sustain recent catches. No management advice was provided.

342. The SC recommended that the WCPFC note the ISC conservation advice provided on North Pacific swordfish stocks.

## **General Discussion**

343. The SC noted that the ISC has dissolved its bycatch working group and formed a shark working group. When questioned on who would provide advice to the NC pertaining to seabirds and sea turtles, the ISC representative advised the SC that the NC will consider advice on seabirds and sea turtles from the SC.

### **6.10 Responses to Commission's Requests**

344. The SC6 reviewed the further evaluation of CMM2008-01 as requested by the Commission. The review of CMM-2008-01 and recommendations are contained under Agenda Item 6.1.

### **6.11 Research Planning**

345. Following consideration of the stock assessment working papers, a number of suggestions were made in relation to future research priorities. The following areas of further research were suggested for incorporation into assessments.

346. It is proposed that the following changes be made to MULTIFAN-CL for undertaking the next bigeye assessment:

- i. MULTIFAN-CL be modified to allow the incorporation of direct ageing observations to improve the estimation of growth.
- ii. MULTIFAN-CL be modified to allow the estimation of the spawner recruitment relationship over a given time period rather than the entire model domain.
- iii. Alternative functional forms, including length-based selectivity, be considered for the Indonesia and Philippines small-fish domestic fisheries (fisheries 18 and 24).
- iv. Any available tagging data, in particular from the Pacific Tuna Tagging Programme, be incorporated into the next assessment.

347. A number of recommendations for future research were made in SA-WP.4. In undertaking the next assessment for bigeye tuna, and improving bigeye tuna assessments undertaken in the medium to long term, the following activities should be considered:

*Data analysis*

- Alternative approaches to the modelling of CPUE data that incorporate the spatial extent of fishing operations should be considered. This is the highest priority activity to support the assessment.
- Detailed investigations be undertaken of the Japanese longline length data throughout the WCPO and other length and weight frequency data from longline fisheries in regions 3 and 4. Such investigations will require details of sampling protocols and operational level CPUE data. Collaborations with national scientists will be important.
- Analyses of operational data for the fishery 5 fleets (“off-shore” operations) to determine the most appropriate grouping of the fleets and time periods into MULTIFAN-CL fisheries.
- Analysis of available tagging data to further examine the differences in juvenile mortality of bigeye and yellowfin tuna.

*Research*

- Continued experiments and activities to improve purse seine catch estimates, in particular spill sampling trials with consideration of corrections to length frequency samples. Further development of cannery data sources may also be useful.
- Continuation of the work to refine both the species composition and total catches from the domestic fisheries that occur in Indonesia and the Philippines.
- Direct ageing of bigeye tuna, in particular large bigeye tuna in different regions throughout the WCPO.

348. A number of recommendations for future research were made in SA-WP-10. In undertaking the next assessment for skipjack tuna, and improving skipjack tuna assessments undertaken in the medium to long term, the following activities should be considered. Recommended research and monitoring required to improve the skipjack tuna assessment include the following:

- Further development of the PTPP data set for inclusion in the assessment. Critical work includes maximizing the number of returns that can be assigned to recapture fisheries with reasonable certainty and the further development of estimates of the tag reporting rates, particularly for the PTPP releases, and also Japanese tag releases in the northern waters. Incorporating more tagging data into the assessment, as it becomes available, will provide additional information on recent levels of fishing mortality, refine estimates of natural mortality and possibly allow some time-series behaviour in movement to be incorporated into the model. Additional tagging in the northern region would provide additional information to parameterize relative stock levels among model regions.
- This and recent skipjack assessments have used standardized CPUE from the Japanese pole and line fisheries as the key abundance index that drives trends in estimated abundance in the model. However, this fishery now makes up less than 4% of the total WCPO skipjack catch, and an even smaller percentage in the main equatorial zone. Future research is required to better understand the factors impacting CPUE in the purse seine fishery, which now comprises 88% of the total WCPO skipjack catch, with a view to developing an index of abundance based on this major fishery.
- The assessment model estimates of skipjack growth are not well determined by the available data. The estimation of growth would be assisted by the development of the MULTIFAN-CL

software to incorporate age-length and length-increment observations, and the inclusion of such data into the assessment.

- Further research on environmental and biological influences on skipjack tuna recruitment, distribution, and movement are required. The application of fine-scale spatial models such as SEAPODYM to skipjack tuna could potentially provide a useful source of auxiliary information that could be included in MULTIFAN-CL-based assessments.

### **Recommendations relating to future stock assessments**

349. The SC requested that the Scientific Services Provider continue to:

- resolve data and methodological issues associated with bigeye and yellowfin fisheries as assessment inputs; and
- advance the analyses of the PTPP data to incorporate these into the skipjack assessment.

350. The SC requested stock assessments in 2011 for WCPO bigeye and skipjack tuna, to be reviewed at SC7.

351. If the external peer review of yellowfin tuna assessment can be provided by December 2010, a decision will be made at WCPFC7 on the feasibility of conducting an assessment for SC7.

352. The SC recommended that the south Pacific albacore base model assessment be updated and include catch and effort data from 2009 and 2010, and be presented to SC7 with improved biological data parameters that may be available.

353. For future assessments:

- i. The SC requested that following the completion of the biological study in 2011, that south Pacific albacore be considered for a full assessment in 2012, and that a stock assessment be conducted in 2012 for south Pacific striped marlin, as the most recent assessment was in 2006. The SC recommended that data preparations occur in 2011 to support the assessment.
- ii. If a yellowfin assessment is not conducted in 2011, the SC requested a stock assessment in 2012.
- iii. The SC recommends that a review of the data holdings relating to swordfish in the South Pacific together with the resolution of any outstanding data issues be undertaken during 2011 and reported to SC7. If the data for the assessments are deemed sufficient, SC7 can make a recommendation to conduct the swordfish assessment during 2012, with presentation to SC8.

### **AGENDA ITEM 7 — MANAGEMENT ISSUES THEME**

354. The Convenor for the Management Issues theme, R. Campbell (Australia) opened this session and outlined the agenda.

355. F. Forrester (ISSF) and T. Lawson (SPC) were selected as rapporteurs.

356. The Convenor informed the meeting that as this was the first meeting of this new theme, he was acting as an interim Convenor on the invitation of the SC Chair. He noted that a Convenor would be elected under Agenda Item 13 (Administrative Matters).

357. The Convenor also informed the meeting that there were no Terms of Reference for this theme and recommended that after a Convenor is elected that they facilitate the drafting of Terms of Reference for the theme, and that this draft be presented to SC7 for discussion, review and adoption. The SC supported this recommendation.



## 7.1 Identifying Limit Reference Points for the WCPFC

358. The Convenor introduced this topic by reminding the meeting that, acting on a directive agreed by the Commission at WCPFC5 in December 2008, a Special Workshop on Reference Points had been held at SC5. The aims of this workshop were to provide capacity building on this issue and review some of the technical characteristics of reference points. SC5 had endorsed the recommendation from this workshop that a work program should be undertaken during 2010 to assist SC6 identify candidate reference points (both type and value) for each of the key target species in the WCPFC and make suitable recommendations to the Commission.

359. The Convenor listed the inter-sessional work program agreed at SC5 (and identified as Project 57 on the Scientific Research Plan):

1. Identify candidate indicators (e.g.  $B_{current}/B_0$ ,  $SB/SBMSY$ ) and related limit reference points (e.g.  $B_{current}/B_0=X$ ,  $SB/SBMSY=Y$ ), the specific information needs they meet, the data and information required to estimate them, the associated uncertainty of these estimates, and the relative strengths and weaknesses of using each type within a management framework.
2. Using past assessments, evaluate the probabilities that related performance indicators exceed the values associated with candidate reference points.
3. Evaluate the consequences of adopting particular limit reference points based on stochastic projections using the stock assessment models.
4. Undertake a literature review/meta-analyses to provide insights into levels of depletion that may serve as appropriate limit reference points and other uncertain assessment parameters (e.g. steepness).

360. The Convenor noted that this work program had unfortunately not been completed before SC6 as initially hoped, but that some progress had been made on aspects of issues (1–3). The following two presentations could therefore be viewed as progress reports.

### a. MI-WP-02 (Identifying possible limit reference points for the key target species in the WCPFC)

361. R. Campbell (Australia) presented “Identifying possible limit reference points for the key target species in the WCPFC” (WCPFC-SC6-2010/MI-WP-02). This presentation provided an outline of the rationale behind the use of limit reference points (LRPs) in fisheries management and provided some examples of LRPs which could be considered within the WCPFC. These examples were drawn from two recently completed reviews on reference points as well as the limit reference points incorporated into the harvest strategies adopted by Australia and New Zealand in recent years. LRPs attempt to constrain harvesting within safe biological limits for a stock. i.e. to protect the stock from serious, slowly reversible or irreversible fishing impacts, and are usually expressed as fishing mortality rates (F) or biomass levels (B) which must not be exceeded. Six general classes of reference points were identified, but three of these (those based on economic, empirical or historical observations of the spawner-recruit relation) were not seen as been possible to use or applicable for identifying LRPs in the WCPFC. The remaining three types of reference points are those based on MSY, yield-per-recruit or depletion indicators. The two reviews both identified  $F_{MSY}$  as an appropriate LRP while the review undertaken by Sainsbury (2008) also recommended three biomass-based LRPs (including 30% of the unfished biomass). The two harvest strategies both used 50%  $B_{MSY}$  (or 20%  $B_0$  as a proxy) as LRPs, with New Zealand also using 25%  $B_{MSY}$  (or 10%  $B_0$ ) as a hard LRP. The results of past assessments undertaken on the key target species in the WCPO are then used to evaluate the performance of the fisheries in the WCPO against five example LRPs. These examples were provided for illustrative purposes only, and as each example used only a

small number of point estimates for each indicator they do not provide a full evaluation of the probability that the indicator is in breach of the related LRP.

## Discussion

362. A query was raised regarding what would trigger stock rebuilding when using both an F-based LRP and a B-based LRP. In the case of bigeye, current estimates of  $F$  exceed  $F_{MSY}$  but as biomass is estimated to be about at the level of  $MSY$ , rebuilding wouldn't be needed if an LRP was based on biomass alone. The presenter was also asked whether institutions that made use of RPs used F-based RPs as limits or targets, and how uncertainty was to be considered in placing a probability on breaching the RP, as greater uncertainty would mean the RP would be breached more often.

363. R. Campbell responded that  $MSY$ -based RPs historically were generally used as target RPs. However, in recent times there has been a shift towards using  $F_{MSY}$  as a LRP, though he was not sure if any organization had actually adopted that as a LRP to date. He noted that although the recommendation from the Sainsbury review is that the "best practice" is to have both F-based and B-based reference points, he acknowledged that in the case of bigeye in the WCPO, the stock may be in breach in one reference point but above it in respect to the other. He agreed that of the things that need to be looked at is whether the WCPFC should use both types or just focus on one type of reference point. He suggested that the biomass based reference point may be the more appropriate option for a LRP as protecting biomass is perhaps the more important aspect in this situation.

364. In response to the second question, R. Campbell acknowledged that if the uncertainty in the stock assessment is high, then there would be a greater chance of exceeding the probability associated with breaching an LRP even though the true state of the stock may be the same if the uncertainty is less. He acknowledged that there is a trade-off between uncertainty in stock assessment outcomes and the probability of breaching a LRP and this would need to be considered carefully when defining the situations when a RP is breached.

365. A question was raised in respect of the uncertainty of initial biomass estimations and the use of  $B_0$ -related points, citing stocks which show very wide stock fluctuations due to environmental shifts. As the  $MSY$  of the stock experiences large fluctuations, it was considered very difficult to apply a LRP. R. Campbell noted that it was interesting to mention natural fluctuations in populations, as this point had been considered by the comprehensive review undertaken by Sainsbury. Where the estimated unfished biomass is estimated to fluctuate widely the value of  $B_0$  doesn't seem to have much meaning in regards to being an appropriate reference point and the unfished biomass level was perhaps more appropriate. An example was provided in presentation by the IATTC, which indicated that the EPO bigeye stock appears to exhibit large natural variation. He also noted that while several different considerations should be taken into account when setting reference points, the focus for identifying appropriate LRPs should be largely on the biology of the species in question in order to provide adequate protection of the stock. On the other hand, when discussing target reference points, there is the opportunity to take into account broader consideration, such as socioeconomic impacts.

### **b. MI-WP-01 (A Framework to Evaluate the Potential Impacts of Limit Reference Points, Including Multi-Species Considerations)**

366. S. Harley (SPC) presented "Stochastic and Deterministic Projections: A Framework to Evaluate the Potential Impacts of Limit Reference Points, Including Multi-Species Considerations" (WCPFC-SC6-2010/MI-WP-01). This paper describes alternative approaches to addressing activity 3 in the inter-sessional work program listed above. It provides a brief overview of some of the theoretical basis for LRPs and then describes how the question of the consequences of adopting particular LRPs can be

addressed using stochastic projections. This approach is applied to bigeye tuna using run 14 from the 2009 bigeye tuna stock assessment. This example involves some hypothetical LRPs since the outcomes from activities 1 and 4 listed above were not available at the time of writing. Finally, using the results of the bigeye tuna example the estimates of the effort reductions required to achieve the hypothetical LRPs were applied to yellowfin and skipjack tuna to determine the potential multi-species implications of adopting particular LRPs for bigeye tuna. The focus of the paper is on the theoretical and methodological aspects of the analysis rather than the LRPs themselves. Subject to the approval of this approach by the SC, and the selection of some candidate LRPs, it would be possible to apply this methodology to the latest assessments of bigeye, yellowfin, and skipjack tuna. This information could assist the WCPFC in its consideration of reference points.

## **Discussion**

367. It was noted that placing limitations on fishing effort on one species would likely result in a change in the fishing patterns on the other species, so that the effects on these other species may not be as large as modelled. S. Harley responded that the situations modelled in the paper could be viewed as representing the worst-case scenarios as fleets could change targeting practices.

368. The time period used in the projection to compute risk was queried, as the time period choice is an important factor in how risk is treated. S. Harley agreed, noting that the time period used was the last 3 years. If the stock is experiencing low recruitment, a narrower time window would be used in projections than if there were no clear, recent pattern in recruitment.

369. The WCPFC Science Manager queried whether the SC could provide the most plausible types of reference points and the rationale behind their use at the next Commission meeting. However, the Convener noted that the presentation was used to show a methodology for assessing reference points, rather than to provide any explicit recommendations. At this stage, there is more work to be done before making recommendations to the Commission on reference points for the WCPFC stocks. The Science Manager also asked whether the simulations could be presented to the managers as options of what type of work is possible. The Convener noted that a request had been made to provide SC6 with a biological basis for identifying LRPs, but that this task had not been completed. The SC could inform the Commission what managers in other areas have done, but not with regard to the specific stocks in the region. The Convener noted that SPC has developed a good methodology, and that further analysis could be undertaken to help identify candidate LRPs, for presentation to SC7.

370. CCMs noted that, following the reference point workshop at SC5 and the series of recommendations made to WCPFC6, they expected work on reference points to be somewhat further advanced by this time. They thanked SPC for the working paper, and noted its application to the two reference points selected for demonstration purposes. It was indicated that the technical changes made to MFCL and the modelling framework, particularly the recognition of multi-species implications, will provide a good basis for future work on reference points. Members also thanked R. Campbell for the supplementary paper submitted in the last few days, which will provide a useful perspective for the completion of tasks identified by SC5; more detailed comments would have to await a more detailed review of the results. In the absence of more comprehensive information on the suite of potential reference points and their implications for stock assessment and management recommendations, CCMs noted they were not in a position to progress this issue. As such, it was recommended that part of the work (tasks 1 and 4) be put to tender as a priority in order to provide information regarding the pros and cons of various indicators and reference points. The more specific modelling tasks in items 2 and 3 were seen as best suited for completion by SPC after the initial work is completed.

371. Concern was expressed regarding the use of RPs based on virgin biomass, noting that in the case of BET B0 appears to be an artifact of the model, and it was requested that more effort be put towards proper estimation of B0 for use in establishing RP.

372. A query was raised about how exceptions and special areas would be treated if LRPs are accepted and implemented as conservation measures. S. Harley responded that all projections would be of a particular management strategy, and while these can be quite complex the simulation would be able to account for these special cases.

373. A query addressed the sources of uncertainty used in the stochastic model as well as the length of the projection period. S. Harley responded that rather than make several projections from a single model, a grid of models could be used to make projections from each model. He noted that it was an interesting question in regards to using that type of approach. He then addressed the second query, noting that in the case presented, the long projection resulted in the stock coming towards a sort of equilibrium. It would not be useful to do a short projection starting from the same point, as in the short term, all the models would behave similarly.

## **Recommendations**

374. Based on the above discussion, the SC made the following recommendations:

- SC6 recommended that the Project 57 on Reference Points identified at SC5 be completed. Specifically, tasks 1 and 4 to be put out to tender and tasks 2 and 3 be completed by the SPC. The results are to be reported to SC7 and, if appropriate, to the proposed Management Objectives Workshop to be held in 2011.
- After reviewing the results of the above Project, that SC7 make a recommendation to the Commission on candidate reference points (both type and value) for each of the key target species in the WCPFC.

375. It was noted that the Management Objectives Workshop should occur after SC7 in order to allow the results of Project 57 to be first reviewed by the SC.

## **7.2 Limiting Catches of Juvenile Bigeye: Assessment of the FAD Closure**

376. The Convenor introduced this agenda item by informing the meeting that the aim of this issue was to allow the SC to assess the objective of the conservation and management measure CMM-2008-01 to reduce the mortality of juvenile bigeye tuna by investigating the effectiveness of the FAD closures during 2009.

### **a. MI-WP-03 (Analysis of fishing activities during the 2009 FAD closure)**

377. Shelton Harley (SPC) presented “Analysis of fishing activities during the 2009 FAD closure” (WCPFC-SC6-2010/ MI-WP-03). The seasonal restriction (two months in 2009, and 3 months during 2010–2011) on the use of FADs is one of the key measures within the WCPFC conservation and management measure for bigeye and yellowfin tunas (CMM2008-01). Predicting the impact of this restriction on the catches and stock status of bigeye, yellowfin, and skipjack tunas is difficult as the way in which vessels choose to comply with the measure could differ by fleet and depend on the prevailing fishing conditions at the time of the restriction. This paper compares fishing activities during the 2009 two month FAD closure (1 August–30 September) to the fishing activities that have taken place during the same period in previous years (2001–2008). The key findings were that:

- Overall effort in terms of sets and days fished was the highest on record (2001–2009) during the 2009 FAD closure

- Almost all effort from associated sets was transferred to unassociated sets, but there was some evidence of non-compliance.
- Total catches of skipjack, yellowfin, and bigeye tuna combined were comparable to previous years, though bigeye tuna catches were the lowest on record.

378. This analysis was based on logsheet data as not all relevant observer data were available for the time of the closure and therefore it is critical that the conclusions made in the paper be verified. For example, logsheet-reported positional data need to be verified with VMS data and logsheet-reported positional, set type and species composition data need to be verified with observer data, when available.

## **Discussion**

379. It was commented that during the FAD closure the CPUE on unassociated schools could be expected to be lower than normal as some skippers would be unused to setting on unassociated schools, and a question posed whether available information reflected that fact. The point was also raised that industry feels that the FAD closure occurred at a time where it was inappropriate to be avoiding small fish. S. Harley noted that Figure 5 in the paper does address unassociated school set CPUEs for August and September, and that the value of skipjack catch/day in 2009 is comparable to the highest levels previously seen in the fishery.

380. SPC noted that the observer reports for this time period were not yet available, and consequently that the reported low catch of bigeye during the FAD closure was an estimate based on past data that would need to be verified when the new observer data is available. S. Harley noted that immediately after the FAD closure ended the catch was high across all set types, almost double the average monthly catch of the past 10-year period. It appeared that skipjack had been accumulating at the unfished FADs during the closure, making skipjack catches very high after the end of the closure, although this is not the case for yellowfin.

381. FFA members expressed their thanks and noted that while these conservation efforts are in the early stages, it is useful to see an analysis that shows that apparently the FAD closure had achieved the aim of reducing incidental catch of small BET while maintaining continuity of fishing opportunities and product supply.

382. Support was offered for the preliminary analyses, and a comment made that it would be useful to examine trends in fish size. There was also a query whether there was any information on the level of compliance within Indonesian EEZ waters for the FAD closure. It was pointed out that this closure only applied to PNA members, and that other non-PNA members have agreed to adopt similar measures, but that this wording is open to interpretation.

383. An Observer thanked SPC for their work to provide these results from the FAD ban period and looked forward to the verification of this data, noting that it is excellent to know just how effective the FAD ban is on reducing the catch of bigeye tuna. They noted that even with greatly increased fishing pressure during the ban period catch levels of bigeye were estimated to be greatly reduced. To ensure that annual FAD caught bigeye remains low they asked the SC to consider an extension to the seasonal closure of FADs to ban their use in association with purse seine fishing as an effective means of meeting the objective of reducing fishing mortality of bigeye tuna.

384. A query was raised regarding the high catches of skipjack after the FAD closure. The presenter noted the FAD closure had not increased fishing effort on skipjack but rather that previous effort would have been related to FADs and that effort would have been transferred to unassociated schools of

skipjack. It was noted that CPUE effort on free schools was much lower than on FADS, and that there was less fishing mortality on skipjack during the FAD closure.

385. Members of PNA joined other CCMs in noting it was encouraging to observe reduced catch of bigeye without reducing the flow of skipjack to consumers, and stated that they will consider impacts of FAD closure in their waters. PNA members noted the SPC-OFP explanation on the lack of impact of FAD closure in totality throughout the year. However, PNA members reiterated that the short window during the FAD closure achieved a specific objective and the alternative of doing nothing would be undesirable.

386. The presenter noted that as an overall measure, the FAD closure did not have an impact over the entire year but was effective only during the small window of the actual closure. He also noted that the overall year had FAD effort sets higher than in the past 5 years. The Convenor also commented that the estimated purse-seine catch of bigeye during 2009 was the second highest on record and around 40% higher than the average over the period 2001–2004, while the aim of the CMM had been to reduce catches by 10% below this level.

387. It was observed that one feature of large aggregations of skipjack on FADs is that the school will be in residence in the night but may move away from the FAD during the day. This feature has been proposed by the IATTC scientists as a way to potentially avoid capture of bigeye but still target skipjack, and SPC noted that this behaviour has been documented in observer reports. The SPC commented that this information is only included in the observers narrative reports, that these reports should be queried on these points.

388. Indonesia stated in response to a previous query about the use of the FAD closure in EEZ of countries not affiliated with the PNA that they required more time to study and understand the possible socioeconomic impacts on fishermen. In response a CCM encouraged all CCM to adopt comparable methods in their EEZs.

389. It was noted that while the catch/set may appear low, it could be the result of zero catches throughout the day until the entire school is caught in one set.

390. A CCM thanked R. Campbell for his presentation on the work done on reference points and noted that in regards to the FAD issue, they believed the time period for the closure was based on when the highest catch of small bigeye were taken. PNG suggested that this work be continued to determine the best time for the FAD the closure.

## **Recommendations**

391. Following the discussion on this issue, the SC made the following recommendations:
- The Commission and the TCC note the analysis of fishing activities during the 2009 FAD closure presented in working paper MI-WP-03 when reviewing the implementation of CMM-2008-01.
  - That further analyses be undertaken as additional data and information comes forward to investigate the effectiveness of FAD closures on reducing juvenile bigeye mortality.
  - That observer reports that document purse seine effort during the 2009 FAD closure be examined to investigate the setting characteristics of unassociated effort in proximity to drifting objects.
  - That observer reports be used to characterise the details of FAD sets made in contravention to CMM-2008-01.
  - That the Commission give additional support to allow timely analysis of the observer data including the analysis of the size-trends in the catch to assist with the understanding of the FAD closure.

### **7.3 Review of Kobe II Joint RFMOs Workshop Outcomes**

392. The SC reviewed the outputs of the Kobe II Workshop on the Provision of Scientific Advice and Workshop on Tuna Management. P. Flewwelling (WCPFC Compliance Manager) presented a draft report of the small working group that had met the previous day to consider Working Paper WCPFC-SC6-2010/GN-WP-06, “Joint tuna RFMOs workshops in 2010: Reports and recommendation”. The small working group completed the columns ‘SC Response’ and ‘SC Comments’ in the table of recommendations in the working paper. Most of the recommendations considered by the small group concerned the Workshop on the Provision of Scientific Advice, but some recommendations from the Workshop on RFMO Management of Tuna Fisheries were also considered. Consideration of the recommendations from the Workshop on Bycatch had been deferred until the meeting of the Ecosystems and Bycatch Theme.

393. The SC considered each recommendation in turn, except for those concerning the Workshop on Bycatch, which were again deferred for consideration during the Ecosystem and Bycatch Mitigation Theme.

394. Regarding Recommendation #14 from the Workshop on the Provision of Scientific Advice, which states “Chairs of Scientific Committees should jointly develop checklists and minimum standards for stock assessments,” the small group could not reach a consensus on exactly what was being requested and the SC agreed to request clarification from the chair of the workshop.

395. Regarding Recommendation #19, which states “Chairs of Scientific Committees should establish an annotated list of common issues that could be addressed jointly by tuna RFMOs and prioritize them for discussion at the Kobe III meeting,” The Compliance Manager noted that SPC had been asked to prepare the list, rather than the Chair of the SC, but that this could be justified since the SC Chair could delegate the task to SPC. The list will be finalised by October 2010 and discussed at WCPFC7 and at Kobe III in July 2011.

396. Regarding the recommendations from the Workshop on RFMO Management of Tuna Fisheries, it was decided to agree on Recommendations 4 to 7 and defer the others to the TCC. Regarding Recommendation #11 concerning measures of capacity, it was agreed that in the absence of a WCPFC definition of capacity, the FAO definition should be used in the interim.

397. The table of recommendations together with the SC response and comments is presented in Attachment M.

### **7.4 Workshop on Management Objectives**

398. The Convenor introduced this topic by noting that at the Special Workshop on Reference Points held at SC5, it had been recommended that the Commission hold a workshop on management objectives. The purposes of the workshop were to (i) assist managers identify the information required to guide management decisions, and how these can be quantified; (ii) provide guidance on identifying stock specific limit and target reference points; and (iii) provide advice on how uncertainty in the estimation of performance indicators can be incorporated into management decisions. He also noted that at WCPFC6 CCMs had stated their strong support for articulation of the Commission’s fisheries management objectives and the development of reference points as tools for effective implementation of these objectives. To this end, the 2010 budget approved at WCPFC6 included USD 90,000 to support a Management Objectives Workshop.

399. The Convenor stated that the intent of this agenda item was to consider what guidance the SC could provide to the preparation and convening of the Commission's proposed workshop on Management Objectives that is now scheduled for 2011. He noted that issues that would need to be considered include identifying the organiser of the workshop, the agenda, the venue, the timing, appointment of a chair, who would attend, and what preparatory work may need to be conducted. However, he stated that the Secretariat would likely organise the workshop and would be in the best position to choose a venue. Following some discussion, it was agreed that the logistical details could be left to the Secretariat (or other workshop organiser).

400. Regarding the timing of the meeting, the Convenor noted that during the discussion on Reference Points it was suggested that the workshop should be held after SC7 had first reviewed the inter-session research to be undertaken and prior to WCPFC8 in December 2011. Several CCMs provided comments supporting this suggestion. The WCPFC Science Manager also informed the meeting that if the USD 90,000 is not used during 2010, then the Commission would have to re-allocate an amount to support this workshop to the budget for 2011.

401. The Convenor also suggested that in addition to preparatory work that may be done by SPC, it may be useful for additional international experts on reference points and fisheries management issues to be invited to participate. He suggested that Dr Keith Sainsbury could be a candidate and referred to the recent review of reference points that K. Sainsbury had completed. One delegate stated that it would be best for any invited experts to be seen as being independent.

402. Following the discussion, the SC6 reiterated its support from SC5 for holding a Workshop on Management Objectives and agreed that such a workshop would provide an excellent opportunity for scientists and managers to jointly consider and discuss this important topic.

## **Recommendations**

403. In supporting this Management Objectives Workshop, the SC made the following recommendations, and requests the Commission takes these recommendations into consideration when organising the workshop:

- i. That WCPFC7 renew their support and the required funding provided at WCPFC6 for holding a Workshop on Management Objectives.
- ii. In order to allow SC7 to first review the results of the inter-session work project on reference points, the workshop should be held between SC7 and WCPFC8.
- iii. That an independent international expert(s) be invited to the workshop to provide expert guidance on the use of reference points and other issues of relevance to identifying fisheries management objectives. The science service provider (SPC), with the assistance of other regional scientists, contribute to the Management Objectives Workshop in order to provide technical advice on the adoption of reference points to the key WCPFC stocks.
- iv. The SC also noted that in order to assist the success of the workshop that some preparatory scientific work will need to be undertaken. It identified the SPC as the agency in the best position to undertake this preparatory work. The Commission is requested to take this into consideration when addressing the level of funding support required for the workshop.

## **AGENDA ITEM 8 — ECOSYSTEM AND BYCATCH MITIGATION THEME**

404. The Ecosystem and Bycatch Mitigation theme was convened by P. Dalzell (USA). V. Chan (USA) was selected as the rapporteur.

### **8.1 Fisheries impacts**



**a. EB-IP-02 (SEAPODYM applications in WCPO – progress report)**

405. J. Hampton (SPC) reported that work on SEAPODYM is continuing and that applications of SEAPODYM are becoming more extensive. SPC hopes to use this tool to document environmental and fishing impacts in EEZs of member countries, to hone in on impacts occurring in individual subregions, and to discriminate between effects of fishing and the environment.

**b. Kobe II Workshop on Bycatch**

406. The SC agreed in principle to all the Kobe II workshop recommendations developed for bycatch and recommended that the Commission consider the appropriate participation for the working group described in recommendation No. 12 in WCPFC-SC6-2010/GN-WP-06 (p.5). A comment was added to recommendation 2 stating, “The rules of scientific data to be provided by CCMs should be expanded to include bycatch data reporting.” A recommendation was also made that the WCPFC take a lead on the formation and organization of bycatch working group.

**8.1.1 Sharks**

**a. EB-WP-01 (A proposal for a research plan to determine the status of the key shark species)**

407. S. Clarke (SPC) presented “A proposal for a research plan to determine the status of the key shark species” (EB-WP-01). The Fifth Regular Meeting of the Scientific Committee (SC5) of the Western and Central Pacific Fisheries Commission (WCPFC) in August 2009 considered the feasibility of quantitative stock assessments for sharks and recommended that preliminary assessments should proceed in parallel with development of a shark research plan to fill data gaps. The paper presents a proposed shark research plan in response to the Commission's approval in December 2009 of SC5's recommendation.

408. An introduction to the Commission's eight current key shark species was presented, including a brief review of the history of their designation and species profiles containing information on habitat, life history and ecological risk, conservation status, current catches in the WCPO, and existing assessments or management. A review of existing fishery and biological information was then presented and data gaps were summarised. Major difficulties in the use of logsheet data for shark assessment are anticipated due to lack of data provision, as well as issues of species mis-identification, under-reporting and changes in targeting strategies. Observer data coverage, especially for longline fleets, is low and may not be representative of all areas where sharks are caught. Other commercial, research and recreational fishery data sources have some potential to inform the analyses but will require further work. Fishery specific biological data are available mainly in the form of observer data on shark lengths, sex, fate and condition, and through a limited number of studies on bycatch mitigation methods (i.e. post-release mortality rates). It was concluded that there is a reasonable amount of information available on the biology of most key shark species although studies are concentrated in a few geographic regions.

409. The extent of shark tagging data was difficult to characterize but appears primarily available for blue and mako sharks. A number of proposed shark assessments by other organizations were noted, including silky and oceanic whitetip assessments for the eastern Pacific Ocean by IATTC; assessments of blue, mako and potentially bigeye and pelagic threshers by ISC; and data compilation for makos by CSIRO.

410. A research plan is proposed as three phases: assessment, research coordination and fishery statistics improvement. Progress in all three phases will be necessary to assist the Commission in meeting its responsibilities for ensuring the sustainability of shark stocks. Phase 1 consists of three assessment

steps to be undertaken on the basis of existing data. The first step will involve constructing indicators of the degree of fishing pressure on the key shark species. The second step will involve plotting these indicators against various measures of shark species' productivity. The third step will involve stock assessments using simple surplus production and age structured models, if possible. However, without additional inputs from Phases 2 and 3, stock assessments for some species will be severely compromised and may not be able to provide a meaningful basis for Commission decision-making. For this reason CCMs are invited to consider potential activities identified under Phases 2 and 3 (i.e. research coordination and fishery statistics improvement) as collaborative work and in-kind contributions.

## **Discussion**

411. The SC expressed support for the shark research plan and recommended it to be forwarded to WCPFC7 for approval. CCMs were encouraged to comply with relevant data provisions of the current shark measure during the plan's implementation.

412. It was clarified that the Scientific Services Provider was currently unable to provide an assessment on shark stocks, and would provide preliminary information on the eight shark species identified in the shark research plan to WCPFC7. The SC noted that this would make it impossible to determine the status of the key shark species as requested by WCPFC6, and indicated this could be addressed in detail by SC7. CCMs noted that, in the absence of shark stock assessments, the Regional Plan of Action (RPOA) for sharks and the FAO IPOA on sharks could be usefully applied to potentially develop and implement appropriate measures and address requirements under the shark CMM, as a proactive approach to shark conservation and management. It was also noted that the only official stock assessment for sharks in the Pacific is for the north Pacific blue shark.

413. Discussion was held regarding which species should be given priority for future assessments, with agreement reached to place priority on assessment of the status of blue, silky and oceanic white tip sharks.

414. The problems associated with collection of data on some species (e.g. thresher sharks, which are in some instance caught by the tail and released without being landed) were discussed. It was noted that observer data is generally more reliable than log book data, and that expanding observer coverage is a slow process. Problems with data collection — including the difficulty faced by many observers in identifying non-target shark species — were noted, and the SC agreed on the need to ensure data logbook and observer data is reliable. Support was also expressed for collaboration to improve access to data sources beyond that collected by observers, including shark catch data from commercial fisheries managed by the WCPO.

415. The Scientific Service Provider stated that CCMs likely currently hold valuable logbook and observer data that has not been analyzed, and suggested that a review and consolidation of this data be undertaken. The SC encouraged CCMs to ensure that all available data be reported to the Commission in a timely manner. Both New Zealand and China indicated they had data on sharks, which they would be willing to share with SPC. A CCM expressed concern that it does not currently make measurements on sharks caught as bycatch in its tuna fisheries.

416. Concern was expressed regarding potential duplication of effort in shark assessments to be made using Commission shark data in the WCPO by (i) the Shark Task Force Group of the ISC and, (ii) the WCPFC Science Service Provider. It was noted that no shark species had been defined as northern stocks, and the view expressed that any work undertaken on sharks should be in the context of the entire Commission Area. The ISC Chair indicated that the ISC is working with RFMOs on assessment of shortfin mako and blue sharks, and considering assessment of other species; they will restrict their

involvement to species where ISC can contribute to meeting the requirements of interested parties. It was requested that ISC coordinate shark data sharing and shark stock assessments with SPC-OFP, particularly on key shark species assessments undertaken by the ISC, and present these in full to the SC.

417. It was noted that the last year of the ERA was used to fund work on the shark plan and if the SC wishes to move forward with the shark plan that monies will need to be allocated for 2011–2012.

418. The SC agreed to hold an informal working group to discuss the programming of actions listed under phases 2 and 3 of the timetable, which include actions to be conducted by CCMs and other interested parties, as the timing of these activities may influence the scheduling of the planned shark assessments.

**b. Addition of porbeagle and hammerhead sharks to list of key species under CMM-2009-04 (Conservation and Management of Sharks)**

419. Discussion was held regarding the distribution of the porbeagle and hammerhead shark species. It was noted that some fisheries have no catch of these species, and that most porbeagle data is from the New Zealand and Australian fisheries, with some catch by Japanese vessel operating in those waters. SPC indicated that a review of observer data revealed no porbeagle interactions north of about 25° S over the last 13 years. There is very little hammerhead data in the logsheet database; the observer data that is present appears to be a function of certain fisheries. There is hammerhead data from Fiji, Hawaii, PNG and Australia, with few sharks reported, from very disparate locations. It was noted that the absence of data made accurate determination of the actual distribution difficult, and that both species were recently discussed at CITES.

420. The SC expressed support for including porbeagle and hammerhead shark species in the list of key species, while noting that any reporting requirements relating to porbeagle should be worded in a manner that limits applicability to the area where this species is found, in order to avoid placing unnecessary reporting burdens on CCMs. SPC observed that the addition of these species would add 5 species to the key species list as there are four species of pelagic hammerhead sharks in the Pacific.

**c. Update of CMM-2009-04**

421. A discussion was held regarding whether reporting on shark species should be made mandatory; changing the rules in the “Scientific Data to be provided to the Commission” was thought to be more effective than modifying the management measure.

422. CCMs explored options for ensuring that data on key species (including commercial species and species of concern) would be collected, while avoiding placing unnecessary burdens on members. It was recognized that collection of data on a species would not necessarily result in preparation of an assessment, and that there was a need to provide direction regarding which species would be priorities for preparation of stock assessments. Concern was expressed for several non-commercial species including pelagic stingray, hammerheads and crocodile sharks.

423. The SC agreed that a method for future nomination of key shark bycatch species was needed.

**Recommendations**

424. SC6 recommends to the Commission that:

- The shark research plan be approved.

- WCPFC7 add porbeagle (south of 20°S)<sup>3</sup> and hammerhead sharks to the list of key shark species.
- The “key shark species” listed in CMM2009-04 be added to relevant sections of the Commission Rules on Scientific Data to be Provided to the Commission, namely: (1) Section 1 on estimates of annual catches; (2) Paragraphs 1.3 to 1.6 of Annex 1 on operational level data, and (3) where possible recreational catch and effort information.
- CCMs should endeavour to collect catch and effort data for porbeagle sharks (south of 20°S)<sup>4</sup> and hammerhead sharks that reflects the spatial and temporal extent of their longline and purse seine fisheries. Together with advice from the K2B specialist bycatch working group on data reporting requirement in 2011, SC7 will consider adding these two species to paragraphs 1.3 to 1.6 of Annex 1.
- SPC-OFP develop a process for the nomination of a key shark species for consideration at SC7, and identify a subgroup of key shark species for which stock assessments will be conducted.
- Any work undertaken on sharks should be in the context of the entire Commission area, given that no shark species have been defined as Northern Stocks.
- The commission request that ISC coordinate shark data sharing and shark stock assessments with SPC-OFP, and present the results of the shark stock assessments in full at SC.

### 8.1.2 Seabirds

#### a. EB-WP-02 (Experimental comparison among four types tori line designs in the western North Pacific)

425. D. Ochi (Japan) presented “Experimental comparison among four types tori line designs in the western North Pacific” (WCPFC-SC6-2010/EB-WP-02). This paper presented results of two experiments to evaluate four tori line designs using both commercial and research longline boats. The first experiment was conducted by 20 offshore commercial longliners with 567 sets, and the seabird abundance and bycatch number was compared between tori lines with long and light streamers, as well as between ones with red and yellow colored light streamers. During line setting, albatross species (black-footed and Laysan albatross) are mainly aggregated and other seabirds including shearwater species were rarely observed. There were no significant differences in albatross bycatch number among different streamer types, and no bycatch of petrels and shearwaters were observed. During deployment of long streamer tori line, serious tangling problems were reported many times. The second experiment was conducted by a chartered longline boat deploying three types of tori-lines (light, hybrid and modified light streamers) tested in each set. Difference in seabird attacking behavior and bycatch number were compared among these tori lines with data of 72 observations obtained by 24 operations. The most primary attacks were recorded by albatrosses and that by shearwaters were rare, and also, most of secondary attacks were caused by albatrosses. There were no difference in primary attacking rate and bycatch number of albatrosses among the three tori lines. The results in this study indicated that four types of tori line have same ability of seabird bycatch mitigation. It was also revealed that further improvement of design would attain that further reduction of seabird bycatch as the effective design of tori-line supposed to be changed by area, season as well as the shape and size of vessel. Observed rather low interaction of shearwaters and petrels with longline baits indicated that the bycatch system in the North Pacific may different from the South Africa, where many albatross bycatch caused by petrels. From sighting study during gear setting, improvement of bait casting method supposed to reduce the seabird bycatch. Further studies should be needed to develop appropriate mitigations majors of seabird in the North Pacific.

<sup>3</sup> Until biological data shows this or another geographic limit to be appropriate.

<sup>4</sup> Until biological data shows this or another geographic limit to be appropriate.

## Discussion

426. Discussion was held regarding the tori-line research, and clarification requested regarding attack rate by shearwater and albatross, which was lower immediately aft of the fishing vessel, as compared to 25–100 m astern. The presenter indicated they were awaiting additional data from the fishing master, which might help explain this. It was noted that small, low-powered vessels experienced problems with long streamers, and that the presence of streamers appeared to be the most important factor in reducing seabird interactions. Attack rates have been observed to vary spatially, by seabird species and feeding behavior. There appears to be a correlation between the length of the tori line and depth to which baited hooks sink. Once large tuna are caught, lines have been observed to rise to the surface. The need to conduct research beyond the wake zone and during hauls was noted. CCMs observed that there is a need for additional research, and spoke in favor of improvements in methodology, continued collaborations and peer review in such studies.

### **b. EB-WP-05 (Options for Differential Management and Monitoring of Seabird Bycatch)**

#### *Seabird Spatial Ecological Risk Assessment*

427. W. Papworth (ACAP) presented “Options for Differential Management and Monitoring of Seabird Bycatch” (WCPFC-SC6-2010/EB-WP-05). At SC5 it was agreed to undertake further work to validate the spatial risk assessment (ERA) on seabirds to determine initial spatial zones for the differential management and monitoring of seabird bycatch. This paper considers some of the management options available to reduce seabird bycatch, including area or seasonal closures, application of bycatch mitigation measures and monitoring and data collection. Some recommendations are also provided on the type and level of monitoring that may be required to further validate the spatial risk assessment.

## Discussion

428. It was commented that results of ecological risk assessments (ERAs) indicate that the area in the South Pacific where the capture of vulnerable birds was most likely extends north to 25° S. The IOTC recently passed a resolution extending the region where management measures are required to 25° S, and it was suggested that the SC recommend modifying its CMM to include the area between 25°S and 30° to bring the WCPFC in line with IOTC practice. It was noted that the annual reports from CCMs do not include an assessment of data on the number of seabirds caught, and that including this would help to validate and support the ERA process. Japan indicated it was undertaking a regional observer program and expected to collect a wider range of information on seabird interaction; it stressed the importance of adequate data in evaluating the need for additional mitigation measures.

429. Potential differences in the effectiveness of mitigation measures between the northern and southern hemispheres were noted, and the possibility was raised of adopting different mitigation measures in the northern and southern parts of the Convention Area, as appropriate. Difficulties in determining vulnerability in areas with low observer coverage (e.g. south of 20°S and east of New Zealand) were noted, as were seasonal changes in vulnerability. CCMs welcomed further analyses that include more observer data in order to better validate spatial risk assessments, and the view was expressed that current findings do not justify the need to extend the area of application of mitigation measures into equatorial waters. CCMs recognised that observer data can be used to validate spatial risk assessment, although coverage rates in some areas may be insufficient to achieve this, and limited budgets may preclude expansion of observer programs.

### **c. Update of CMM-2007-04 (CMM to Mitigate the Impact of Fishing for Highly Migratory Fish Stocks on Seabirds)**

**(i) EB-WP-04 (Review of seabird bycatch mitigation measures for pelagic longline fishing)**

430. W. Papworth (ACAP) presented “Review of seabird bycatch mitigation measures for pelagic longline fishing” (WCPFC-SC6-2010/EB-WP-04). Since the last meeting of the SC a considerable amount of research has been undertaken on seabird bycatch mitigation measures for pelagic longline fishing operations. Evidence is emerging that the use of appropriate configurations of weights on branch lines is currently the most effective means of reducing seabird access to baits, although it still needs to be used in conjunction with other measures, such as tori lines and night setting. The results of this research have been reviewed by ACAP’s Seabird Bycatch Working Group (SBWG) and a summary of key findings are provided to assist SC6 in its consideration of the efficacy of seabird bycatch mitigation measures currently in use within the convention Area, in accordance with CMM 2007-04.

431. W. Papworth highlighted results from two papers: “Effect of line shooter and mainline tension on the sink rates of pelagic longlines and implications for seabird interactions” (WCPFC-SC6-2010/EB-WP-07), and “Shrink and defend: A comparison of two streamer line designs in the 2009 South Africa tuna fishery” (WCPFC-SC6-2010/EB-IP-09). It was noted that recent research shows that combinations of mitigation measures are still required, and only combinations that take bait to depth of 10m or remove access to baited hooks will be effective in some fisheries. The need to modify CMM 2007-04 to focus on combinations that achieve this was emphasized.

**(ii) EB-WP-06 (Experimental determinations of factors affecting the sink rates of baited hooks to minimize seabird mortality in pelagic longline fisheries)**

432. D. Wilson (Australia) presented “Experimental determinations of factors affecting the sink rates of baited hooks to minimize seabird mortality in pelagic longline fisheries” (WCPFC-SC6-2010/EB-WP-06) on behalf of the authors.

- i. While line weighting and other mitigation measures are required in the pelagic longline fishery off Australia's east coast, some seabirds are still caught, suggesting that mitigation measures are not fully effective in all conditions. An experiment was conducted in that fishery to establish a scientific basis for potential changes to reduce seabird mortality; in particular, by evaluating different combinations of line weighting and other variables affecting line sink rates.
- ii. The experiment examined the effects of different bait species (blue mackerel, yellow-tail mackerel and squid), bait life status (dead or alive), weight of leaded swivels (60 g, 100 g and 160 g) and leader length (distance between leaded swivel and hooks: 2 m, 3 m and 4 m) on the sink rates of baited hooks from 0-6 m deep.
- iii. On average, live bait sank much slower than dead bait, greatly increasing the exposure of baited hooks to seabirds. Sink rates of individual live bait were highly variable. Many were < 2 m underwater 18 seconds after deployment, including some on the heaviest swivels, and some were < 10 m deep after 120 seconds.
- iv. Within the dead bait group, gear with 60 g and 100 g swivels on the same leader length sank at similar rates, as did all three swivel weights on 4 m leaders. The 160 g x 2 m combination sank the fastest, averaging 0.27 m/s and 0.74 m/s from 0-2 m and 4-6 m, respectively. The 60 g x 4 m combination sank the slowest, averaging 0.16 m/s to 2 m depth and failing to attain 6 m depth after 18 seconds. Initial sink rates (0-2 m) were increased by placing leaded swivels close to hooks and final sink rates (> 4 m) by increasing the weight of the swivels.
- v. The results indicate that the small (incremental) changes to the weight of leaded swivels and the length of leaders typically preferred by the fishing industry are unlikely to make an appreciable reduction in seabird mortality because resultant increases in sink rates will be insubstantial.

- vi. rates close to the surface (i.e. 0-2 m) in addition to cumulative rates to the deeper depths. It is suggested that to substantially reduce seabird mortality compared to that associated with 60 g swivels and ~3.5 m leaders (the preferred option by industry) may require branch lines be configured with swivels  $\geq 120 \text{ g} \leq 2 \text{ m}$  from hooks. An alternative to the latter regime would be to place a smaller amount of weight at or very close to the hook. The exact amount of weight would have to be determined experimentally.

**(iii) EB-WP-07 (Effect of line shooter and mainline tension on the sink rates of pelagic longlines, and implications for seabird interactions)**

433. D. Wilson also spoke to the “Effect of line shooter and mainline tension on the sink rates of pelagic longlines, and implications for seabird interactions” (WCPFC-SC6-2010/EB-WP-07).

- i. The likelihood seabirds will be hooked and drowned in longline fisheries increases when baited hooks sink slowly. Fishermen target different fishing depths by setting mainline through a line shooter which controls the tension (or slackness) in the line. An experiment was conducted in Australia’s pelagic longline fishery to test the hypothesis of no difference in sink rates of baited hooks attached to mainline set under varying degrees of tension.
- ii. Mainline was set in three configurations typically used in the fishery: a) surface set tight with no slackness astern; b) surface set loose with two seconds of slack astern and; c) deep set loose with seven seconds of slack astern. Sink rates of baited hooks were measured using time depth recorders.
- iii. Tension on the mainline had a powerful effect on sink rates. Baited hooks on branch lines attached to tight mainlines reached 2 m depth nearly twice as fast as those on the two loose mainline tensions, averaging 5.8 s (0.35 m/s) compared to 9.9 s (0.20 m/s) and 11.0 s (0.18 m/s) for surface set loose and deep set loose tensions, respectively. The likely reason for the difference is propeller turbulence. Tight mainline entered the water aft of the area affected by turbulence whereas the two loose mainlines and the clip ends of branch lines were set directly into it about 1 m astern of the vessel. The turbulence presumably slowed the sink rates of baited hooks at the other end of the branch lines.
- iv. The results suggest that mainline deployed with a line shooter (as in deep setting) into propeller turbulence at the vessel stern slows the sink rates of baited hooks, potentially increasing their availability to seabirds. Unless mainline can be set to avoid propeller turbulence the use of line shooters for deep setting should not be accepted as an effective deterrent to seabirds.
- v. It is recommended that the WCPFC revise CMM 2007-04 by deleting deep setting line shooter from the list of accepted seabird bycatch mitigation measures in Table 1 of that measure.

**(iv) EB-IP-07 (Progress in development and testing of an underwater bait setter for pelagic longline fisheries)**

434. D. Wilson spoke briefly to “Progress in development and testing of an underwater bait setter for pelagic longline fisheries” (WCPFC-SC6-2010/EB-IP-07). He noted that it has the potential to:

- eliminate mortality of surface-seizing seabirds (e.g. albatrosses)
- reduce or eliminate mortality of diving seabirds (e.g. petrels, shearwaters)
- eliminate bait loss to seabirds
- allow fishing at any time day/night, potentially without tori line
- remove threat of seasonal closures
- allow use of line weighting options more acceptable to fishers
- undertake tamper-resistant data gathering on SD cards
- reduce need for observers to monitor mitigation measures

435. Preliminary trials are encouraging, compared to hand setting. There is slightly improved bait retention, and similar setting speed. It is currently testing in a bird "hot spot" in a pelagic longline fishery in Uruguay, with further work planned in Australia later in 2010 and early 2011. Australia will report progress to SC7 in 2011.

## **Discussion**

436. CCMs thanked scientists for their research on seabirds, including work on seabird interactions, hot spot identification and spatial risk assessment. It was noted that CCMs have slowly adapted the binding technical specifications of the seabird measure in their national policies and the operation of their fleets, both in areas with historical seabird interactions and other localities. They welcomed research and trials of existing or alternative seabird mitigation measures by CCMs, particularly those that illustrate decreases in interaction rates without impacts on or reduction in the catches of target species. Discussion was held on various methods of line weighting, and the impact on the sink rate of live vs. dead bait and its potential impact on seabird interactions.

437. The importance of line-weighting research was acknowledged, and the need for additional research on the effectiveness of line shooters highlighted, in particular effectiveness across different fisheries sectors. Discussion was held regarding the utility of deep-setting line shooters in reducing seabird interactions, with differing views expressed regarding their efficacy. It was noted that the deep-setting line shooters in combination with weighted hooks are very effective in the Hawaiian longline fishery, and that different situations may demand different remedies. Some CCMs suggested that a review of the way that line shooters are used may be needed by TCC. The potential burdens on fishermen from increase of observer coverage were noted, and the possibility that catch rate or fishing operations may be affected.

438. CCMs suggested consideration be given to monitoring and mitigation measures in relation to flag vessels, to ensure that those flags likely to contribute most to risk are adequately monitored.

## **Recommendations**

439. The SC made the following recommendations:

- i. The SC noted that extensive research is currently underway aimed at providing a scientific basis for additional changes to CMM 2007-04. The SC agreed that minor proposed amendments to CMM 2007-04, as recommended by the SC, should not be incorporated into the CMM until such time as there are sufficient changes to warrant revision.
- ii. *On the use of weighted branch lines:*
  - a. The SC agreed that line weighting of pelagic longlines is likely to be one of the most effective mitigation measures in reducing or eliminating seabird interactions with baited hooks, and that further research be undertaken to refine the 'weighted branch lines' specifications contained in CMM 2007-04.
- iii. *On the use of dead baits versus live baits:*
  - a. The SC noted the findings in EB-WP-06, carried out in the southern hemisphere, that indicate the use of live bait in pelagic longline fisheries may increase seabird mortality above that associated with the use of dead bait, based on the slower sink rates of live bait.



- b. The SC agreed that the use of live bait should be discouraged in fisheries operating in areas of high seabird abundance that do not already use live bait.
    - c. The SC recommended that additional research be undertaken to confirm the findings presented in EB-WP-06, and to include different line weighting regimes, in areas north of 23 degrees North and in areas south of 30 degrees South, for consideration by the SC. Seabird interaction rates for these experiments should also be reported.
- iv. *On the use of blue-dyed bait:*
  - a. The SC noted recent research suggests that blue-dyed squid bait may be more likely to decrease seabird bycatch in pelagic longline fisheries than other blue-dyed baits such as fish.
  - b. The SC recommended that additional research be carried out on the efficacy of blue-dyed squid bait over other blue-dyed baits, including during both setting and hauling, for consideration by the SC.
- v. *On the location of the southern latitudinal boundary:*
  - a. The SC noted that the purpose of the Productivity-Susceptibility Analysis in EB-IP-01, was to determine the probability of seabird-fisheries interactions and the risk of adverse effects of fishing-induced mortality on populations of seabirds. The results suggest that the southern boundary (30 degrees South) of the seabird mitigation measure (CMM 2007-04) may need to be moved further north to ensure adequate spatial protection for seabird high risk areas.
  - b. The SC recommended that SPC-OFP and ACAP provide advice on observer data and information on seabird distribution to the Secretariat after which a decision could be made on whether to proceed with a formal new analysis of risk levels of longline fishing to seabirds in the southern hemisphere. Members with observer programs in this area should collaborate with SPC to assist in improving the data holdings for assessing risk levels of longline fishing to seabirds.
- vi. *On the use of deep setting line shooter:*
  - a. The SC noted the findings in EB-WP-07, carried out south of 25 degrees South, that suggest mainline deployed with a line shooter (as in deep setting) into propeller turbulence at the vessel stern slows the sink rates of baited hooks.
  - b. The SC recommended that testing of the deep setting line shooter be carried out north of 23 degrees North, to determine its utility in mitigating seabird interactions and other at risk species (e.g. marine turtles, marine mammals, sharks) in that area.
  - c. The SC noted that there are currently no specifications for the use of deep setting line shooters in CMM 2007-04.
  - d. The SC recommended that the TCC consider the development of specifications for 'deep setting line shooter', for inclusion in CMM 2007-04.
- vii. *On the format of Table 1 in CMM 2007-04:*
  - a. The SC noted that there are clear operational differences of longline fleets and seabird species composition in the areas north of 23 degrees North and south of 30 degrees South.
  - b. The SC recommended that when CMM 2007-04 is next modified, the TCC should consider the utility of separating Table 1 into two separate tables, one each for the area north of 23 degrees North and the area south of 30 degrees South.

### 8.1.3 Other Species

**a. EB-WP-03 (Evaluation of longline mitigation to reduce catches of North Pacific striped marlin in the Hawaii-based tuna fishery)**

440. K. Bigelow presented “Evaluation of longline mitigation to reduce catches of North Pacific striped marlin in the Hawaii-based tuna fishery” (WCPFC-SC6-2010/EB-WP-03). Given the high estimated fishing mortality of the North Pacific stock of striped marlin, the objectives of this study were to conduct analyses of potential longline catch reductions of North Pacific striped marlin while maintaining target bigeye tuna catches. The analysis was conducted on the Hawaii-based longline fishery and is well suited to analyses of longline mitigation because detailed operational and catch data have been gathered by the Pacific Islands Regional Observer Program since 1994. Aspects of gear mitigation considered in the study were the efficacy of removing shallow hooks adjacent to longline floats and conversion of terminal gear from Japanese style tuna hooks to 18/0 circle hooks. A spatial and temporal analysis was conducted to investigate the existence of striped marlin catch rate (CPUE) hot spots. An evaluation of establishing tuna longline fishery closures was conducted with the trade-off between striped marlin catch reductions and loss of target bigeye catch. The largest longline catch reductions in terms of percentage occurred for striped marlin of 19%, 34%, and 47% by removing the hooks #1, hooks #1–2 and hooks #1–3 adjacent to the float. Target bigeye catches declined 1.5%, 4% and 7.8% by removing similar hooks. Using large (18/0) circle hooks instead of tuna hooks had a larger effect on catch rates (42% reduction) than removing shallow hooks. The spatial and temporal analysis did not identify any consistent areas of catch rate hot spots. The closure analysis did not identify areas of potentially high striped marlin reductions with minimal reductions of target bigeye catch as there is a co-occurrence in catch of both species.

**Discussion**

441. In response to inquiries, the presenter noted that all sets were deployed at 0600, with a median depth of 250 m (BET fishery), and 60 m (in swordfish fishery), with a branch line length of 15 m. Japan indicated that it recently developed new similar approach that seeks to put gear in deeper water throughout the set. A CMM asked if branch lines could be placed closer together to reduce time for line deployment, but the United States indicated this would not be practical since the baiting process is already quite efficient.

**AGENDA ITEM 9 — DATA AND STATISTICS THEME**

442. K. Duckworth (New Zealand) convened the data and statistics theme. V. Jollands was selected as the rapporteur.

**9.1 Data Gaps**

**a. Progress in Addressing Data Gaps**

443. Peter Williams (SPC) presented “Scientific data available to the Western and Central Pacific Fisheries Commission” (WCPFC-SC6-2010/ST-WP-01) and reported on the major developments over the past year with regard to filling data gaps. These included:

- i) For Indonesia, the first annual catch estimates workshop was convened in March 2010 and produced annual catch estimates by gear and species for years 2000 – 2009. There was also continued progress with the implementation of their logbook data collection program over the past year;
- ii) For the Philippines, a WCPFC study investigating sources of bigeye catch estimates was conducted in late 2009. This study identified several issues that contributed to the revision of the national bigeye tuna catch estimate to a more realistic level;

- iii) For Vietnam, the first tuna data collection workshop was held in March 2010 and resulted in a plan to establish logsheets and port sampling in longline fisheries immediately, extending to the other gears (purse seine and gillnet) in 2011.

444. Another recent development relates to the WCPFC6 decision to add a paragraph in Section 4 (aggregate catch/effort data) of “Scientific Data to be provided to the Commission”, to facilitate the generation of WCPFC public domain data - “CCMs are to provide, to the extent possible, the number of individual vessels per stratum and area covered by their operational data with the aggregated catch and effort data they submit to the Commission.” Chinese Taipei was the only CCM with a distant-water longline fleet to have provided information on the number of individual vessels per stratum in their provisional 2010 submission of data (covering fishing activity for 2007, 2008 and 2009). However, their data submission had been filtered to remove cells representing the activities of less than four vessels. It was noted that the three-vessel rule only applies to the dissemination of public domain data, and not to submissions of data to the WCPFC. Submissions of data should be complete (unfiltered) data.

445. Two new types of data were made available to the WCPFC in the past year to assist verification and estimation of purse seine catches: (i) Japanese purse seine landings data for 2009 comprising weighed catch by species and size composition, and (ii) International Seafood Sustainability Foundation (ISSF) requested their participating fishing companies to provide WCPFC with cannery receipt data, by vessel trip, species and size category on a quarterly basis.

446. The timeliness and quality of annual catch estimates and aggregate data were clearly better than last year (e.g. 92% of CCMs had provided annual catch estimates by the 30 April 2010 deadline compared to only 66% last year), but late submissions of some aggregate data delayed the stock assessments in preparation for SC6.

447. There have been substantial Regional Observer Programme (ROP) purse-seine data collected during 2010 as a result of the CMM 2008-01 requirement for 100% observer coverage, but there are significant delays in the availability of ROP data to the WCPFC, mainly due to the lack of resources to manage the submission of hard-copy data for processing and the lack of data entry staff.

448. SPC, as the designated WCPFC data-managing agency, continued to transmit the scientific data (annual catch estimates, aggregate and operational catch/effort data, size data and ROP data) to the WCPFC Secretariat on a regular basis (e.g. November 2009, April 2010 and July 2010).

## **Discussion**

449. The full and timely submission of data was discussed. CCMs noted that full data submission is critical to the functioning of the Commission; both for science and compliance purposes. The working paper was noted to demonstrate the implications of the incomplete, late or inaccurate data that is currently being provided, and specifically the impact that this is having on the Commission’s ability to produce timely and reliable stock assessments. It was indicated that the full provision of all agreed information, including operational level data, is fundamental to good stock assessment. It was also stated that the information in the paper and the tables available on the WCPFC website are useful in assessing compliance with data reporting obligations.

450. Recent positive developments in the provision of data to the Commission were acknowledged. For example, section 2 of ST-WP-01 describes recent developments from a range of CCMs including the Philippines, Indonesia and Vietnam with respect to the provision of vessel numbers. Participants acknowledged the receipt of unloading data from Japan, the ISSF assistance in obtaining data from ISSF-affiliated fishing, and the announcement by the USA that it had amended its domestic regulations to

facilitate the release of operational level data. CCMs thanked the SPC, and in particular Peter Williams, for their ongoing work to resolve data gap issues.

451. In relation to the data gaps identified in section 3.3 of ST-WP-01, APAC noted it has seabird data that may assist the WCPFC with the implementation of the ecosystem approach to fisheries, and that such data could be provided under the MOU between itself and the WCPFC.

## **Recommendation**

452. The Scientific Committee recommended that SC6-ST-WP-01 be forwarded to the TCC for their consideration.

### **b. Species Composition of Purse-Seine Catches**

453. Tim Lawson (SPC) presented “Update on the estimation of selectivity bias based on paired spill and grab samples collected by observers on purse seiners in the Western and Central Pacific Ocean” (ST-WP-02).

454. At SC5, in 2009, Tim presented a working paper in which a method for estimating the size selectivity bias of grab samplers using paired spill and grab samples was developed and the bias was estimated from paired samples that were collected during four trips onboard vessels of Papua New Guinea in 2008. In a grab sample, five fish are selected by the observer from each brail. In a spill sample, 300 to 400 fish from every tenth brail are spilt into a bin and all fish in the bin are measured; the spill sample thus avoids any selectivity bias on the part of the observer. In the current paper, size selectivity bias was estimated using an additional 13 trips collected in 2009 and 2010, including 11 trips onboard vessels of Papua New Guinea and two trips on a United States vessel, for a total of 17 trips.

455. Size selectivity bias was estimated for 5 cm and 10 cm length intervals. The probability that a fish is selected by a grab sampler increases with increasing length; however, the estimates are less reliable for fish greater than 54 cm because of the relative lack of data covering larger fish. Size intervals for fish less than 35 cm and greater than 69 cm were combined because statistically significant estimates could not be achieved for separate size intervals in those size ranges, and also because of a relative lack of data.

456. Polynomial splines were also used to examine selectivity bias and indicated that for lengths less than about 75 cm, availability increases almost linearly with length, as when availability is estimated for each length interval individually. For lengths greater than about 80 to 90 cm, availability decreases. This suggests that grab sampler’s under-select very large fish as well as very small fish; however, it should be noted that these results are based on a relatively small sample of large fish.

457. The estimates of the selectivity bias were used to correct grab samples taken from 27,999 sets from 1995 to 2009. The corrected grab samples were in turn used to adjust the purse-seine catch data used in the MULTIFAN-CL (MFCL) assessments. When the MFCL data are adjusted, the proportion of skipjack drops from 77.2% to 68.4%, compared to the unadjusted MFCL data, while the proportions of yellowfin and bigeye increase from 20.9% to 26.5% and 1.9% to 5.2% respectively.

458. The collection and analysis of paired spill and grab samples is funded under the Commission’s Project 60; a review of the project and plans for future work were also presented. Paired samples may take place onboard a Korean purse seiner in August 2010 and negotiations are underway to collect paired samples onboard another United States vessel and a Chinese Taipei vessel. It would be useful to collect paired samples for vessels for which cannery receipts together with port samples of landing categories can also be obtained, so that the species compositions determined from each type of data can be compared.

## Discussion

459. The figures within ST-WP-02 were discussed. A query was raised regarding figure 7 in ST-WP-02 (species compositions for unadjusted and adjusted catch data used in MFCL analyses, 1972–2009, 20°S to 20°N and 120°E to 150°W) and clarification requested on the discrepancies between the proportion of skipjack and bigeye in Figure 7 compared to Figure 2 (estimates of purse-seine species composition determined from paired spill and grab samples collected by observers during seven trips in 2008–2009). The presenter indicated the proportion of bigeye in grab samples is generally greater than in spill samples; however, it was noted that the proportion of bigeye determined from the adjusted MFCL data was greater than from the unadjusted data. It was explained that the proportion of (i) skipjack and (ii) yellowfin and bigeye combined, in the unadjusted data, were determined primarily from logsheet data and not grab samples; grab samples (not corrected for selectivity bias) are used only to determine the proportions of yellowfin and bigeye in the combined catch of yellowfin and bigeye. In contrast, the species composition of the adjusted data is determined entirely from grab samples that have been corrected for selectivity bias using spill samples, with no reference to logsheets. If the MFCL data were adjusted entirely with grab samples that had not been corrected for selectivity bias, the proportion of bigeye would have increased even more.

460. The ability to reliably estimate catch composition was noted to be a critically important issue. It was observed that the negative impact on stock assessments of uncertainty in catch composition data had been previously discussed, and urgently needs to be addressed.

461. CCMs thanked SPC for the additional paired sampling undertaken since SC5, and for the updated paper. It was noted that the results of the larger sample size are broadly consistent with the data presented in 2009, and that this was encouraging; it was observed that this type of work needs to be increased significantly and resourced appropriately, and that insufficient information is available for the SC to make a decision on how historic purse seine catch data should be corrected.

462. Participants observed that the methods used to correct the historic catch logsheet data are complex and poorly understood by most CCMs. It was requested that better information on the methods used to correct historic catch logsheet data be made available to Participants (including a flow diagram – Attachment I).

463. It was observed that the data presented by SPC in ST-WP-02 significantly assists in resolving issues regarding species composition. However, the difficulties inherent in using such limited data sets as the basis for significant fisheries management decisions were also noted. It was suggested that the information be expanded, with data collected (i) from vessels flagged to all major CCMs; and (2) from vessels fishing throughout the range of the fishery with an emphasis on covering all set types. It was also stated that the results of the paired sampling should be verified against other data such as unload monitoring, port sampling and cannery receipts. The importance was noted of ensuring that members understand not only the differences between the sampling methods, but also how they relate to actual catch composition.

464. FFA members stated they saw an urgent need for the paired sampling to be stepped up and supplemented with other data, and that this was a requirement of all Commission members.

**(i) ST-WP-04 (Accuracy of species identification of yellowfin and bigeye in three canneries of Kingdom of Thailand)**

465. H. Okamoto (Japan) introduced ST-WP-04 and reported on species identification of yellowfin and bigeye in three canneries in the Kingdom of Thailand. In the Convention Area and Indian Ocean the catch of four tuna species (skipjack, yellowfin, bigeye and albacore) was over 3,400 thousand metric tons in 2008; of this approximately 750 thousand tons (22 %) was landed in the Kingdom of Thailand. In April 2010 the accuracy of the yellowfin and bigeye identifications made by three canneries in the Kingdom of Thailand was investigated. In these canneries yellowfin and bigeye were sorted into five market categories according to their sizes (<1.4 kg, 1.4–1.8 kg, 1.8–3.4 kg, 3.4–9.0 kg and >9.0 kg) for each species. The study conducted species identification for 2,572 individuals from 25 market categories (only excluding the largest category of >9.0 kg), measured body lengths, weighed up to 20 individuals for each category, and then calculated the mixture rates of species (% of BET (or YFT) / (YFT+BET)) by market category and cannery (and in some cases by individual fishing vessels). For the smallest categories the mixture rates were found to be relatively high (12.6% on average by weight, but ranging from 0.0% to 21.7%) and to vary between factories. The mixture rates for the larger three categories were much lower (2.8% on average, and ranging from 0.0% to 6.8%). The estimated accuracy of the market reports generated by the canneries (corrected catch / market report) ranged from 98.7 % to 113.3 % for bigeye, and from 98.0 % to 105.1 % for yellowfin. The market reports from the three Thai canneries investigated seem to be reliable, although the accuracy is lower when there are more fish of the smallest category.

## Discussion

466. The accuracy of species identification by the Thai canneries was noted, and Japan informed the SC that it has established a data collection scheme with the Thai government. Members were encouraged to collect cannery and other landing data for their purse seiners.

467. Research into species identification using canneries was discussed. One CCM noted its interest in seeing more sampling of this sort and for the research to continue (in particular with regard to the identification of small fish). SPC noted that the 6,000 tags that have been returned from Thai canneries could potentially be used to verify the accuracy of cannery identifications.

### **(ii) ST-WP-05 (Comparison of length frequency and species composition using observer and port sampling data) and ST-WP-07 (Size and species composition of the PNG purse seine catch)**

468. T. Usu (Papua New Guinea) presented two working papers: “A descriptive analysis of the size and species composition of the Papua New Guinea purse seine catch” (ST-WP-07) and “A Preliminary Comparison of Length Frequency and Species Composition Using Observer and Port Sampling Data” (ST-WP-05), and reported on size and species composition using observer and port sampling data.

469. Independent port sampling was conducted on catches landed or transhipped by purse seiners and carriers in Papua New Guinea from May 2009 to April 2010. The size of sampling reflected approximately 20% of the catch for the respective vessels sampled. The species composition was dominated by skipjack (71.3%), yellowfin (24.3%) and bigeye (1.7%) with other species making up the remaining 2.7%. Percentages of skipjack increased from the last quarter of 2009 through to 2010, from 52.7% – 70.5% (low) to 71.3% – 78.6% (high); while yellowfin decreased from 23.3% – 42% (high) to 17.8% – 24.6% (low). Inter-annual trends in length frequencies were observed for all the major tuna species (skipjack, yellowfin and bigeye) with a shifting of the modal and mean lengths indicating progressive changes in fish sizes. More rigorous analysis is needed to compare these results with previous studies and inter-annual variations for management purposes. Other species were mainly made up of bullet tuna (62%), frigate tuna (22%), mackerel scad (7%), triggerfish (4%), rainbow runner (2%) and black triggerfish (1%); while the rest were below 1% composition. These non-target species should be the priority in future analysis.

470. The Papua New Guinea National Fisheries Authority has been carrying out an independent port sampling study. Unlike other port sampling, the study protocol comprises sampling of all fish from wells stratified into three layers (top, middle and bottom). This is the first attempt to compare results of this port sampling with the results from other data sets. Eight vessels were initially sampled by observers using the grab-sampling technique and subsequently by port samplers. The results showed that port samplers were reporting a higher proportion of skipjack. Observer grab-sampling indicated higher compositions of large skipjack and yellowfin than port sampling; however there were no significant difference in the mean lengths for all species. Future work should involve analysis of other averages, higher and lower tails of the length distribution, and comparisons with more data sets and in particular observer spill-sampling data.

## **Discussion**

471. Participants thanked the presenter for the working papers describing their port sampling programme, and noted similar studies carried out in the past by the USA and Japan. The results of the spill and grab sample research were broadly consistent with results obtained previously using smaller samples, but the need to undertake further research before drawing conclusions regarding the accuracy of spill sampling was stressed. CCMs were urged to make a commitment to increase species composition sampling, especially spill sampling, which was noted to be the most accurate of the alternatives.

472. There was a discussion of the pre-sorting of fish aboard fishing vessels, and how this can bias port sampling data. The presenter explained that Papua New Guinea uses the port sampling data they collect in estimating bycatch and analyzing and managing the impact of FADs on small BET and YFT. The similarities in the results of the Papua New Guinea port sampling and the spill sampling being undertaken by SPC were noted.

## **Recommendations**

473. The Scientific Committee recommended that:

- i. the current work (Project 60) on paired spill / grab experimental sampling should have continued funding and be extended to include fleets, areas and set types where no representative sampling has taken place. Where possible the results of the paired sampling should be verified against cannery, unloading and port sampling data. A standard spill sampling methodology should be documented once the trials are complete;
- ii. CCMs collect species and size composition data in cooperation with the factories and canneries where catch is landed;
- iii. a flow diagram, illustrating how sampling biases can affect species composition data, should be made available to Participants. This should document the method used to correct historic logsheet data; and
- iv. a follow-up workshop on species composition issues to the workshop held in Sete, France in June 2009 should be held, in collaboration with all relevant RFMOs.

### **c. Progress Report on Reconciliation of WCPFC and ISC Data Holdings**

474. The WCPFC Science Manager presented the “Progress report on the reconciliation of WCPFC and ISC data holdings” (ST-WP-03). He noted that:

- i) the WCPFC data inventory was provided to the ISC Statistics Working Group and ISC10;
- ii) the recently recruited ISC data administrator will work on the recovery of historically missing data with relevant Members of the ISC, and produce a more complete data inventory for review in the ISC Statistics Working Group in July 2011, which then will be provided to WCPFC; and

- iii) two proposed options (establishing an MOC on data exchange or convening an Annual Consultative Meeting) for the periodic exchange of data to address data gaps between WCPFC and ISC for consideration at SC6.

## **Discussion**

475. A preliminary comparison table of the WCPFC and ISC data holdings was provided to SPC, and a complete analysis of their respective data holdings will be provided to SC7.

476. FFA members noted their disappointment with the apparent continued reluctance of the ISC members to share operational-level catch and effort data relevant to the assessment and management of WCPO stocks. Some ISC members noted that they had provided data for the North Pacific Ocean to WCPFC, and that SC5 recommended that the WCPFC Secretariat, ISC, SPC-OFP and interested CCMs, complete a reconciliation of ISC and Commission data holdings for N Pacific stocks, to identify any data gaps, by 1 October 2010. The advice presented to SC5 (that, in general, ISC does not hold fine scale data, but relies on each member to conduct analyses of its own data and subsequently contribute these analyses to collective stock assessments) was noted. It was commented that the process for reconciling the data held by the respective organisations that was previously agreed by the Commission was important; if followed, it would allow the WCPFC to resolve the issue. All CCMs were strongly encouraged to actively participate, and the Secretariat was thanked for developing a draft agreement that would facilitate information sharing within the already agreed rules for data dissemination.

## **Recommendations**

477. The SC:

- i. acknowledged the progress made to date, but reiterated the decisions made by the Commission at WCPFC6 on the process of reconciling the different data held by the WCPFC and ISC.
- ii. requested the science service provider to provide specific tables that show provisions of operational level catch and effort data for the North Pacific region from all CCMs.

## **9.2 Regional Observer Programme**

478. The ROP Coordinator, K. Staisch, presented a report on the WCPFC ROP. He reported that audit procedures have been developed to meet the Commission requirements for a full audit of all national observer programmes for certification prior to June 2012. Commission-approved data fields to be collected by ROP observers for scientific and monitoring purposes are now being collected by a number of national and sub regional observer programmes. The Commission CMMs are being monitored and have a direct influence on the mandate and duties of the observers when on board vessels. Debriefing of observers is being upgraded in most Pacific Observer landing ports. Monitoring of the fleets, to ensure 100% purse seine coverage between 20°N and 20°S, continues to be an important role for the Secretariat.

479. A survey of Pacific Island national observer programmes in July 2010 indicates that there are 551 authorised observers available for ROP trips; Programmes surveyed also indicated that approximately 90 debriefers across all programmes would be required.

480. It was noted by the ROP Coordinator that ROP data collected by national programmes on ROP trips should be available for analysis. However, the WCPFC Secretariat has not been able to receive data in time from the data provider or the national programmes to be able to provide a



report based on the ROP collected data for 2009 or 2010 to date. The Coordinator urged all FFA/SPC members to give the Data provider (SPC) permission to send the ROP data collected by their observers to the Secretariat.

481. The coordinator reported on recent events, where murder charges were made against crew members of a purse seine vessel following the death of an observer while on duty. The safety and health of observers who are on board vessels collecting often sensitive data have become a major concern to all programmes.

482. The ROP Coordinator noted that a more comprehensive report on data management costs, cross endorsement and other issues would be available for the TCC6 meeting.

## **Discussion**

483. Concern was expressed regarding the safety of observers aboard fishing vessels. The Observer Coordinator and some CCMs noted that ensuring safety was not the responsibility of the ROP, but rather of Flag States. It was also highlighted that the issue should be treated seriously, but that the programme's large size meant some issues of this type were likely to occur over time.

484. The Observer Coordinator noted that national vessels within their own waters are not included in the ROP data.

485. CCMs who are members of the PNA expressed their support for the report and commented on the 100% coverage on purse seine vessels. They expressed their anticipation that 100% coverage will result in much better scientific data and the effective implementation of CMMs.

486. CCMs expressed their strong support for the ROP and their appreciation to those involved in setting it up. ST-WP-06 highlights some initial problems with the ROP, and in particular with regard to the absence of long-term arrangements for ROP data management. It was noted that at WCPFC6 the Commission decided that ROP data management should be carried out by SPC for one year. The longer-term option for ROP data management was still to be determined. It was noted that the role of the SC is to emphasize the importance of timely provision of observer data to support scientific analyses and verification of catch and effort data, and that many of the issues with the ROP are beyond the scope of the SC, and should be considered by the TCC.

487. SPC clarified that they were only partially funded to carry out ROP data entry. SPC also noted a new joint SPC and FFA initiative funded by NZAID, which is aimed at building capacity in national observer programs, but does not cover data processing. SPC also stated that they believe the ROP data they hold remains the property of national observer programmes, and that it is not SPC's role to determine who this data should be released to.

488. The matter of cross-endorsement of WCPFC/IATTC Observers was noted as being an issue of interest to FFA Members. The WCPFC Secretariat has prepared a draft IATTC-WCPFC agreement on cross-endorsement which is attached to ST-WP-06. It was noted that the late availability of this paper hampered review of the draft agreement. It was requested that any further work by the WCPFC Secretariat to progress this agreement be deferred until TCC6 has reviewed the draft proposal.

489. Japan commented on the efforts it has made toward achieving 5% observer coverage on longline vessels, and noted the difficulties encountered in acquiring observers; it stated that some countries have been unable to provide Japan with observers when these were requested.

490. It was highlighted that at MAWP04 the comparability of the data on seabirds and IATTC data collection forms were discussed. It was suggested that bycatch data should also be collected on sea turtles, marine mammals, and sharks. It was highlighted that the IATTC data collection form is still in draft form and will be discussed at their December 2010 meeting; concern was expressed that the ROP was in the process of being initiated and that changes in the required data fields could confuse the situation. It was noted that Kobe II proposed a technical working group, including representatives from all tuna RFMO's, which would deal with issues of observer programmes. Participants decided that a draft recommendation on ROP collection of bycatch data should be transferred to the ecosystem and bycatch theme.

### **Recommendations**

491. The SC:
- i. notes the ROP matters raised in ST-WP-01 and ST-WP-06, and emphasises the importance of timely provision of observer data to support the verification of catch and effort data and for undertaking the evaluation of fishing activities for stock assessment and bycatch mitigation purposes;
  - ii. encourages the commission to finalise the outstanding matters relating to ROP data management and ROP data provision as a matter of priority; and
  - iii. notes the lack of adequate funding support provided for data compilation and analysis in the current commission budget and request that this be addressed at WCPFC7.

### **9.3 West Pacific East Asia Oceanic Fisheries Management Project**

492. The SC agreed that as almost all participants attended the earlier meeting of the WPEA Steering Committee there was no need for a further presentation or discussion on this agenda item. A record of the WPEA Steering Committee meeting is available as GP-WP-03.

### **Recommendations**

493. The Scientific Committee:
- i. noted the WPEA steering committee report;
  - ii. noted the excellent progress achieved by the WPEA over the past 12 months; and
  - iii. indicated its continuing support for this project.

### **9.4 Tagging Initiatives (PTTP)**

494. The SC agreed that as almost all of participants attended the earlier meeting of the PTTP Steering Committee there was no need for a further presentation or discussion on this agenda item. A record of the PTTP Steering Committee meeting is available as GP-WP-05.

### **Recommendations**

495. The Scientific Committee:
- i. noted the good progress achieved by the PTTP over the past 12 months;
  - ii. endorsed the PTTP's 2010–2011 work plan;
  - iii. noted and endorsed the tagging programmes underway or planned in Hawaii, the EPO, the coastal and offshore areas off Japan, Korea, Indonesia, Philippines and Papua New Guinea; and

- iv. encouraged the scientific service provider to undertake further analysis to integrate the PTTP data into future stock assessments as soon as possible.

## **AGENDA ITEM 10 — COOPERATION WITH OTHER ORGANISATIONS**

### **10.1 Review of existing MOU and relations with other organizations**

496. The SC Chair introduced a discussion of the existing MOUs between WCPFC and other organizations. He noted that:

- i. WCPFC6 approved the memorandum of cooperation (MOC) on the “Exchange and Release of Data” with IATTC developed by the WCPFC Secretariat on the basis of Appendix 4 of WCPFC’s Rules of Procedures for the Protection of, Access to, and Dissemination of Data compiled by the Commission; it was signed on 11 Dec. 2009.
- ii. An MOC with the North Pacific Anadromous Fisheries Commission (NPAFC) was sent to the WCPFC Chair for signature.

497. CCMs, on behalf of FFA members, provided comments on two of the current MOUs between WCPFC to other organisations. Regarding the MOU between WCPFC and SPC, they expressed satisfaction with the decision of the Commission at WCPFC6 in approving the three-year MOU. It was suggested that a longer-term budgetary commitment by the Commission would assist the organisation with improved resource planning, and that this might be considered as a future as part of the MOU with SPC. Regarding the MOU between WCPFC and ISC, FFA members reaffirmed their position consistent with the Convention that the SC is the primary provider of scientific advice to the Commission, for all stocks in the Convention Area under the competence of the WCPFC. Consistent with this, they indicated their desire that the SC should be able to directly request advice from the ISC on north Pacific stocks, particularly those species that are not northern stocks, and requested that the ISC present full presentations, stock assessments and advice to the SC. CCMs that are members of the ISC were urged to make data used in ISC stock assessments available to SPC-OFI for use in stock assessments.

498. The Science Manager clarified the Commission has a 3-year contract with SPC that includes key elements that over a 3-year period; direction on specific activities and funds are provided on a yearly basis.

### **Recommendation**

499. SC6 noted that the MOU with ISC will be reviewed at WCPFC7.

## **AGENDA ITEM 11— CONSIDERATION OF THE SPECIAL REQUIREMENTS OF DEVELOPING STATES AND PARTICIPATING TERRITORIES**

### **11.1 Special Requirements Fund**

500. The Science Manager noted that the balance of the special requirements fund was approximately USD 160,000. He noted that members interested in applying for the special requirements fund should refer to the guidelines on the website.

501. A statement was made on behalf of the FFA members, including the 15 members that are small island developing States. It was noted inclusion of this item (Consideration of the Special Requirements of Developing States, pursuant to Part 8 of the Convention) is required by the WCPFC Rules of Procedure: specifically, Rule 2. At WCPFC6 the WCPFC Chair noted the suggestion by FFA members for a special agenda item for developed CCMs to report annually on initiatives to implement Article 30 of

the Convention. FFA members proposed that during SC6, in addition to interventions from Pacific Island countries, developed CCMs provide reports on implementation of Article 30, specifically in relation to the activities and work program of the SC.

502. The USA noted that it is making contributions that, although not directed to the special requirements funds, will support capacity building for Pacific Island members. Approximately USD 350,000 will be used for a number of projects, with a focus on a variety of activities, including observer support. The USA funded a recent ROP debriefing workshop in Cairns, and has supported attendance by Pacific Islanders at other meetings. All these activities support the work of the Commission, and assist with capacity building for Pacific Island members.

503. The Chair thanked the USA for their support on these matters, and specifically for support provided for the observer program.

504. It was noted that the current balance of the Special Requirements Fund is just over USD 163,000. Members of the SC expressed their appreciation for the support provided through the Special Requirements Fund, and acknowledged the contributions made by the USA and FSM. Members also welcomed the recent pledge of 30,000 to the Special Requirements Fund that Australia announced during the July Forum Joint Ministerial Meeting on MCS in Canberra.

505. Eleven projects were approved for the Japanese Trust Fund in 2010, and most relate to database capacity building activities in Pacific Island countries and territories. Two of the 2010 projects were delivered through SPC, and provided support to regional activities of observer programme training standards and fisheries database development in Pacific Island countries. The JTF has also provided co-financing support to the WPEA in Indonesia, Philippines and Vietnam, and to projects in individual Pacific Island countries. FFA members expressed their appreciation to Japan for financing science and database capacity building activities under the JTF since 2007. Pacific Island countries noted they would appreciate continuing assistance for fisheries database development and support. FFA members encouraged developed CCMs who did not contribute to the Special Requirements Fund, or otherwise contribute to capacity building activities in Pacific Island countries in the areas of science and data collection, to consider providing in-kind contributions to the Special Requirements Fund.

506. FFA members noted the value of the stock assessment workshops and national database training and support provided by SPC, noting that these workshops make a major contribution to the technical and scientific understanding of Pacific Island countries and territories, as well as database management. They stressed that, in addition to short-term training, members felt it was important to create opportunities for higher-level, longer-term academic training in the areas of stock assessment and science to ensure Pacific Islanders can fully participate in WCPFC scientific work. CCMs noted that the scope of the Special Requirements Fund and other capacity building funds could accommodate such training, but that the balance of these funds is insufficient. FFA members urged developed CCMs to consider supporting opportunities for long-term academic training in the areas of stock assessment and scientific analyses for Pacific Islanders, noting recommendation 23 from the Kobe workshop on Best Practices on the Provision of Scientific Advice calling for assistance funds covering various forms of capacity-building, including training of technicians and scientists, scholarships and fellowships.

507. The Secretariat thanked CCMs for their expressions of appreciation to Japan and the USA for the support provided to them. It also noted that several indirect contributions to the work of the Commission by Australia, EU, France, Korea, New Zealand, PNG, Chinese Taipei, and others.

508. FSM, Nauru, Niue, Samoa and the Solomon Islands all expressed on behalf of their governments their appreciation for the JTF for funding the 2010 tuna data workshop and the SPC tuna stock assessment

training workshop. These CCMs also expressed their appreciation for the assistance received, many delivered with support from SPC under individual country project proposals which have been instrumental in capacity building and the development and enhancement of their science and database storage programs and data collection protocols.

## **AGENDA ITEM 12 — FUTURE WORK PROGRAMME AND BUDGET**

### **12.1 Strategic Research Plan of the Scientific Committee**

509. The Strategic Research Plan (SRP) for 2007–2011 was reviewed in the margins of SC6 by an informal small group (ISG). D. Wilson presented the modifications proposed by the ISG, and highlighted the current requirement in the SRP for an independent review every 5 years. It was noted that if an independent review were to be undertaken in 2011, terms of reference would need to be developed by the SC. Discussion focused on whether a peer review of the SRP was required, and what would be gained by holding such a review at present. A decision was reached to modify the existing SRP to make external peer review optional. SC6 adopted modifications to the SRP (Attachment J). A new draft SRP for 2012–2016 will be developed at SC7 for consideration by the Commission.

#### **Recommendation**

510. The SC recommended that the revised strategic research plan for 2007–2011 be noted by the Commission, adding that the SRP was modified by SC6 so that there is no requirement for a mandatory external peer review every five years.

### **12.2 Review of the Scientific Committee Work Programme**

511. The SC noted that Project 39 and Project 56 were completed or will be completed in 2010.

### **12.3 Progress of 2010 work programme, 2011 work programme and budget, and 2012-2013 provisional work programme and indicative budget.**

512. The Science Manager presented a progress report on the 2010 work programme activities.

- The continuation of Project 14 was supported with allocated funds of USD 25,000 used in the co-financing of the project.
- The report for Phase 1 of Project 35 will be submitted to the WCPFC7. The Phase 1 report and a proposal for Phase 2 will be considered at SC7.
- The second year progress report of Project 39 was presented and the contract for the third year will be finalized in late August. The budget for the final year's contract 2010–2011 was endorsed by WCPFC6.
- USD 10,000 was used to support the Review Workshop of the Pacific Tuna Tagging Project in February 2010.
- Project 56 funding was terminated in 2010, however, work relating to the project will continue and be reported to SC7.
- Tasks 1 and 4 under Project 57 will be put out to tender. Tasks 2 and 3 will be carried out by SPC. An allocation of USD 20,000 will be halved between SPC and the successful tender.
- The second year project report and progress report for Project 60 have been provided to SC6 by SPC.

513. The SC noted that four projects were ongoing, with additional work items identified during SC6 for inclusion in the proposed 2011 work programme and budget. Project 60 was extended for additional work in 2011.

514. SC6 identified several high priority projects and recommended funding in 2011. These projects include:

- Collation of South Pacific striped marlin data for a planned stock assessment in 2012 (USD 30,000).
- Work on seabirds to continue the ERA analysis of areas of high seabird interactions (USD 10,000). This project is contingent on the Secretariat's advice arising from SPC's advice on seabirds.

515. The SC agreed that the budget allocation for scientific services (SPC) for 2011 would be USD 720,000, including data services, stock assessments and the shark research program. An additional USD 40,000 was proposed for SPC to complete the aforementioned projects on South Pacific striped marlin (30,000) and seabirds (10,000). The SC6 recommended completion of 4 assessments, (3 full and 1 updated) for SC7; therefore an additional allocation of USD 100,000 will be required for SPC. Therefore SC6 recommended a total budget for SPC of USD 860,000.

516. Unobligated budget will be used for the following additional high-priority projects via a tender process:

- Project 18: Determination of appropriate sample sizes for length frequency sampling strategies
- Project 19: Identification and description of operational characteristics of the major WCPO fleets and identification of important technical parameters for data collection
- Project 31: Improve existing and explore alternative models for standardization of fishing catch and effort for construction of stock assessment indices
- Project 36: Study on age and growth of target tuna species
- Project 37: Analysis of FAD impacts on trophic dynamics
- Project 61: North Pacific striped marlin mitigation methods
- Management Objectives Workshop: noting that additional budgetary resources may be required if any preparatory consultancy work or independent international expert[s] are required to support the workshop (Project 58).

## **Recommendations**

517. The SC recommended that:

- i. Project 35 (Refinement of bigeye parameters Pacific-wide: A comprehensive review and study of bigeye tuna reproductive biology) be allocated USD 31,000 for 2011.
- ii. Project 60 (the collection and evaluation of purse-seine species composition data) be funded for 2011 with an allocation of USD 60,000.
- iii. An additional USD 30,000 was proposed for SPC to complete the project on South Pacific striped marlin (identified in para. 510).
- iv. An additional USD 10,000 was proposed for SPC to complete the project on seabirds (identified in para. 510).
- v. An amount of USD 100,000 for scientific services to provide additional support to complete the three full assessments and one updated assessment. The undertaking of one of the full assessments is dependent on the completion of the yellowfin stock assessment peer review before WCPFC7. The SC budget submitted to WCPFC7 may be revised if the peer review is not completed by WCPFC7.

- vi. Funding (USD 90,000) allocated for the Management Objectives Workshop, postponed from 2010 and to be held in 2011, be approved by the Commission to be reprogrammed in to the Commission's 2011 Part 1 budget.

**Table 1.** List of SC work programme titles and budget for 2010, and indicative budget for 2012-2013, which require funding from the Commission's core budget (in USD). Table 6 in the SC4 Summary Report includes a detailed description of each project.

Strategic Research Activity or Project with priority identified at SC3	2011		2012		2013	
	Core	Other	Core	Other	Core	Other
<b>Project 14.</b> (Priority = High) West Pacific East Asia Project	25,000		25,000		25,000	
<b>Project 35.</b> (Priority = High) Refinement of bigeye parameters Pacific-wide: A comprehensive review and study of bigeye tuna reproductive biology	31,000		62,000		75,000	
<b>Project 42.</b> (Priority = High) Pacific-wide tagging project	10,000	2,500,000	10,000		10,000	
<b>Project 57.</b> (Priority = High) Identifying Provisional Limit Reference Points for the key target species in the WCPFC	20,000		20,000			
<b>Project 60.</b> (Priority = High) Collection and evaluation of purse-seine species composition data	60,000					
Striped marlin (priority = high)	30,000					
Seabirds (priority = high)	10,000					
SUB-TOTAL	186,000		117,000		110,000	
UNOBLIGATED BUDGET	60,000		110,000		121,000	
SPC-OFP BUDGET	720,000		792,000		871,200	
SPC-OFP Stock assessments	100,000 <sup>a</sup>					
GRAND TOTAL	1,066,000		1,019,000		1,102,200	

Notes: <sup>a</sup> Relates to the additional costs of a third full stock assessment, noting that costs of two full stock assessments and one updated assessment is currently included in the SPC-OFP budget figure.



## AGENDA ITEM 13 — ADMINISTRATIVE MATTERS

### 13.1 Rules of procedure

518. The Chair opened a discussion on proposals to alter the rules of procedure. None were proposed.

### 13.2 Peer review of stock assessments\*

519. A discussion was held on the need for peer review of stock assessments, and of a peer review of the bigeye assessment in particular. The peer review process for the 2010 WCPO bigeye assessment had been approved by SC5 (WCPFC6 Report paragraph 67). Reviewers could include CCMs or other RFMOs. WCPFC7 would adopt the peer review process and endorse the budgets. Once a peer reviewer is selected, they would examine the BET 2010 assessment, and submit a report to the April Stock Assessment Preparatory Workshop (SAPW). The peer review report will be finalized after the 2011 bigeye assessment is prepared (June–July 2011), and then submitted to SC7, which would submit comments to WCPFC8. The Science Manager noted the budget implications.

520. The USA noted it had provided support for a peer review of the 2009 yellowfin tuna assessment, which would be provided to SC7. The US further noted that they might also be able to support the 2010 BET assessment, and would be able to advise on this at WCPFC7. A query was raised whether there would be value in reviewing an ISC assessment model, which are quite different from those used by SPC. The ISC Chair clarified that its initial stock assessment review was examining procedures and functions, and that a second review would examine the actual stock assessment results.

521. CCMs noted their support for undertaking peer reviews of WCPFC stock assessments, while noting that there were a range of options for undertaking peer reviews, some of which would have budgetary implications. FFA members noted that the independent review of science structure and function had recommended the parallel review of a northern stock with the WCPO stock, and proposed that it was important that the same process of peer review for bigeye and yellowfin be undertaken for a northern stock during 2011. They suggested North Pacific albacore might be a suitable candidate for peer review.

### Recommendations

522. The SC recommended that:

- i) the Commission allocate a budget to carry out the bigeye stock assessment peer review, if required;
- ii) that the Northern Committee consider allocating funds for peer review of a northern stock assessment. The SC further noted that North Pacific Albacore is a possible candidate for review of the stock assessment scheduled to be completed in 2011.

523. The SC further noted that:

- i) the USA is currently funding the review of the 2009 yellowfin tuna stock assessment. The SC thanked the USA for this initiative.
- ii) the SC would undertake a consultation with IATTC for information with respect to the external review process for the stock assessments in the WCPFC, based upon the recently completed external review of the IATTC bigeye stock assessment; and
- iii) the USA will investigate the possibility of providing financial support for the peer review of the 2010 bigeye stock assessment. This will be confirmed at WCPFC7.

### **13.3 Future operation of the Scientific Committee**

#### **a. Review of the Structure and Functions of the Scientific Committee Meetings**

524. R. Campbell reviewed the proposal for streamlining the structure of the SC. He noted that SC5 considered several topics relating to improving the efficiency and effectiveness of the future SC operations, and that it was generally agreed that the revised structure incorporating themes (used for SC6) had proven more efficient than the former structure that included separate working groups. He then outlined options for further streamlining of the SC meeting, based on the review that was done for SC5.

#### **Discussion**

525. Several CCMs recommended ways in which the structure of the meetings could be further streamlined. Various proposals were discussed, most of which included scheduling meetings of the BI, ME and FT themes on a biennial or triennial basis, with issues essential to the work of the SC incorporated in the SA, MI or other themes as appropriate. It was suggested that issues relevant to stock assessment could be raised at the annual SAPW meetings convened by SPC. The utility of the national reports presented at SC meetings was also discussed, and suggestions made to hold steering group meetings (e.g., for PTPP and WPEA) during an evening or weekend session. A proposal was put forward to expand the Management theme to include a discussion of economic issues, and strong support expressed for the importance of the FT theme. Consideration was given to whether expanded SAPW meetings would be held under the auspices of the WCPFC or SPC, with funding provided for attendance by Pacific Island countries.

#### **Recommendation**

526. Following discussion of the new meeting structure adopted at SC6, and after considering options for further improving the efficiency and effectiveness of the future operation of the Scientific Committee, SC6 recommends that the Commission adopt the following structure for the meeting of SC7:

- i) The meeting will meet over 9 days (one day less than SC6). It is desirable that the days over which the meeting is to be held minimise the time required for attendees to fly to and from the meeting (i.e. avoid the need to fly on weekends).
- ii) Together with the other usual non-Theme Agenda Items (i.e. Agenda Items 1, 2, 10–15 at SC6) the meeting will include the following Themes (duration in parentheses):
  - a. Data and Statistics Theme (3 sessions)
  - b. Stock Assessment Theme (10 sessions)
  - c. Ecosystems and Bycatch Theme (4 sessions)
  - d. Management Issues Theme (2 sessions)
- iii) The Biology Theme, the Methods Theme, and the Fishing Technology Theme are to be included in an expanded SC, which is to be held less frequently, as deemed necessary. To allow for the inclusion of these three additional Themes the duration of these SC meetings will be expanded by one or two days, as specified by the preceding SC. Convenors for these three Themes will be identified at the SC meeting held the year before the expanded SC meeting. Scientists who would like to present their work during each Theme are requested to contact the relevant Convenor who will then decide on whether this work should be presented and discussed.
- iv) Issues relating to Biology, Methods and Fishing Technology that are of relevance to the stock assessments to be undertaken that year, and which are to be considered by the SAPW, are to be included in this workshop. As the SPC is the convenor of the SAPW, those scientists who would like to present their work to the SAPW are requested to contact SPC who will then decide on whether this work should be presented and discussed.
- v) Issues of significance in relation to stock assessment outcomes and/or the evaluation of CMMs, and which would have been covered by the Methods, Biology and Fishing Technology Themes, are to be included in the Stock Assessment Theme. These issues should be identified by the SAPW and the Convenor of the Stock Assessment Theme in consultation with the SC Chair and

Vice-Chair. To help facilitate the inclusion of such presentations the duration of the Stock Assessment Theme has been expanded by one session.

- vi) In recent years special sessions relating to presentations and discussions of large projects of interest to the SC (such as the session on the WPEA held during SC6) have been held on Saturday afternoons. This practice is to continue. In the event that a second special session is required (as for the PTTP during SC6) then this is to be held as an evening session on a suitably specified day.
- vii) Sunday is to continue to be a non-meeting day.

527. SC7 will review the performance of the above structure, and if required, recommend revisions to be applied to the future SC meetings.

**b. Selection of officers**

528. N. Miyabe was nominated by the SC and recommended to the Commission to continue his service as Chair of the Scientific Committee.

529. P. Dalzell was nominated by the SC to continue his service as convener of the Ecosystem and Bycatch Theme, with A. Batibasaga serving as co-convener; R. Campbell was nominated to serve as convener of the Management Issues Theme; and P. Maru and V. Marsh were nominated as co-conveners for the Data and Statistics Theme. The convener[s] for the Stock Status Theme will be decided intersessionally.

**c. Outstanding issues from the Independent Review**

530. The SC reviewed the paper GN-IP-03 *Issues to be addressed from the Independent Review of the Commission's Transitional Science Structure and Functions* which outlines outstanding issues to be addressed by the SC. SC6 responses to the paper are attached in Attachment K.

531. In relation to this agenda item, GN-WP-04 *Stock Assessment Preparatory Workshop: Revised Terms of Reference* was considered. This paper is attached as Attachment L for the Commission's consideration.

**13.4 Next Meeting\***

532. The SC welcomed the offer from Palau to host the 7<sup>th</sup> regular session of the Scientific Committee to be held in Koror, Palau, which is provisionally scheduled for 9-17 August 2011.

**AGENDA ITEM 14 — OTHER MATTERS**

533. No other matters were raised by the SC.

**AGENDA ITEM 15 — ADOPTION OF THE REPORT OF THE SIXTH REGULAR SESSION OF THE SCIENTIFIC COMMITTEE**

534. The SC adopted the Summary Report for the Sixth Regular Session of the Scientific Committee. The Secretariat was requested to prepare an Executive Summary to assist with presentation of this report to other subsidiary bodies and to the Commission.

## **AGENDA ITEM 16 — CLOSE OF MEETING**

535. The SC Chair thanked all participants for their contributions to the meeting, and in particular noted the efforts of the theme conveners.

536. K. Sisor, the representative from Palau, expressed her country's pleasure at being able to host SC7, and extended a welcome to all participants in 2011.

537. The WCPFC Science Manager and Interim Executive Director thanked all participants for making the meeting a success, and thanked the Government of Tonga for its financial and logistical support for the meeting. He acknowledged the efforts made by the staff of the Tonga Fisheries Department, and several tokens of appreciation were presented to the meeting participants.

538. S. Vailala, Head of the Tonga Department of Fisheries, thanked the Secretariat and expressed appreciation to all staff and participants who contributed to the meeting outcomes. Tokens of appreciation were presented to the SC Chair, SC Vice-Chair, and the Interim Executive Director.

539. A. Mobiha, the representative of Papua New Guinea, spoke on behalf of all participants in thanking the participants and theme conveners for their hard work. He also paid tribute to the welcome extended by the Government of Tonga, and for the efforts made by both the staff of the Tonga Fisheries Department and of the WCPFC Secretariat.

540. The meeting closed at 7:10 pm on Thursday, 19 August, 2010.