**WCPFC10**
**Tenth Regular Session**
2th December – 6th December 2013
Cairns, AUSTRALIA

# SC9 SUMMARY REPORT

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**15 November 2013**


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

**Scientific Committee**
**Ninth Regular Session**

**Pohnpei, Federated States of Micronesia**
**6–14 August 2013**

# SUMMARY REPORT

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**Scientific Committee**
**Ninth Regular Session**

**Pohnpei, Federated States of Micronesia**
**6–14 August 2013**

# EXECUTIVE SUMMARY

## AGENDA ITEM 1 — OPENING OF THE MEETING

1. The Ninth Regular Session of the Scientific Committee (SC9) was held in Pohnpei, Federated States of Micronesia (FSM) from 6–14 August 2013. L. Kumoru chaired the meeting.

## AGENDA ITEM 2 — REVIEW OF FISHERIES

2. The provisional total tuna catch for 2012 in the Western and Central Pacific Fisheries Commission (WCPFC) Statistical Area was estimated at 2,613,528 mt, the highest on record, eclipsing the previous record in 2009 (2,603,346 mt) by 12,000 mt. This catch represents 82% of the total Pacific Ocean catch of 3,205,980 mt, and 59% of the global tuna catch (the provisional estimate for 2012 is 4,456,605 mt, which is the second highest on record).

3. The 2012 WCPFC Statistical Area catch of skipjack (1,664,309 mt – 64% of the total catch) was the third highest recorded and around 110,000 mt less than the record catch of 2009 (1,775,462 mt). The WCPFC Statistical Area yellowfin catch for 2012 (655,668 mt – 25%) was a clear record and more than 70,000 mt higher than the previous record catch taken in 2008 (581,948 mt) primarily due to relatively high catches by Indonesia's purse-seine fishery and the artisanal fisheries in Indonesia. The WCPFC Statistical Area bigeye catch for 2012 (161,679 mt – 6%) was the highest since 2004, the record catch year at 183,355 mt. The 2012 WCPFC Statistical Area albacore catch (131,872 mt – 5%) was the second highest on record (after 2009 at 135,476 mt), and relatively stable compared with the previous three years. The 2012 WCPFC Statistical Area albacore catch includes catches of North and South Pacific albacore in the WCPFC Statistical Area, which comprised 78% of the total Pacific Ocean albacore catch of 168,537 mt in 2012. The South Pacific albacore catch in 2012 was 87,012 mt, the second highest on record (Fig. 1).

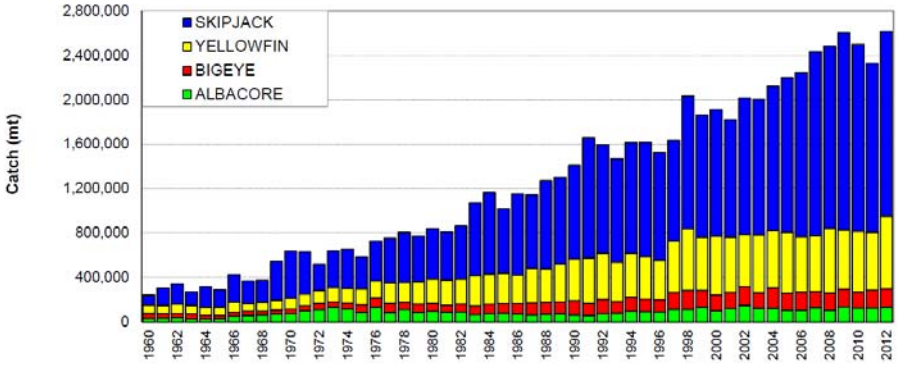


**Figure 1:** Catch (mt) of albacore, bigeye, skipjack and yellowfin tunas in the WCPFC Statistical Area.

4. The provisional 2012 purse-seine catch of 1,816,503 mt was the highest catch on record and more than 30,000 mt higher than the previous record in 2009 (1,785,626 mt) (Fig. 2). The number of purse-seine vessels in the tropical fishery was an all-time high (294 vessels) and effort (both in terms of days fishing and number of sets) was the second highest (to that expended in the fishery during 2011). The 2012 pole-and-line catch (224,207 mt) was the lowest annual catch since the late 1960s, continuing the trend in declining catches for three decades. The Japanese distant-water and offshore fleets (78,838 mt in 2012), and the Indonesian fleets (133,306 mt in 2012), account for most of the WCPFC Statistical Area pole-and-line catch. The provisional WCPFC Statistical Area longline catch (262,076 mt) for 2012 was the fifth highest on record, at around 15,000 mt lower than the highest on record attained in 2009 (279,012 mt). The 2012 South Pacific troll albacore catch (2,925 mt) was similar to the 2011 catch level, mostly by the New Zealand troll fleet (168 vessels catching 2,727) and the United States of America (USA) troll fleet (9 vessels catching 198 mt).

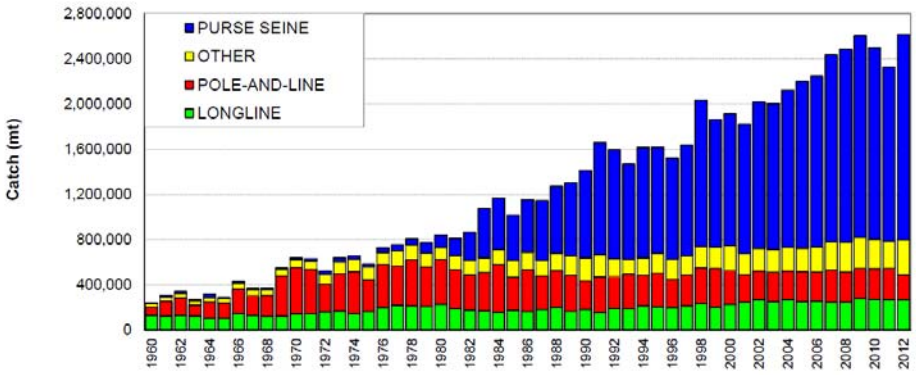


**Figure 2:** Catches (mt) of albacore, bigeye, skipjack and yellowfin tunas in the WCPFC Statistical Area, by longline, pole-and-line, purse-seine and other gear types.

## AGENDA ITEM 3 DATA AND STATISTICS THEME

### 3.1 Data gaps

**Data gaps of the Commission**

5. The Secretariat of the Pacific Community (SPC) reported on major developments over the past year with regard to filling gaps in the provision of scientific data to the Commission (SC9-ST-WP-01).

6. SC9 recommended that:

a) Working paper SC9-ST-WP-01 be forwarded to the Ninth Regular Session of the Technical and Compliance Committee (TCC), recommending specific action in regards to each of the following important data gap issues:

i) The Members, Cooperating Non-members and participating Territories (CCMs) that have yet to provide operational level catch and effort data should provide, as soon as possible:

- annual catch estimates by gear type and species for waters of national jurisdiction and high-seas areas separately, as per the Scientific Data to be Provided to the Commission;
- the number of vessels for each spatial unit in their aggregate data provisions, as per the Scientific Data to be Provided to the Commission; and
- operational data improvement plans, as agreed to at WCPFC7.

ii) The need for improving the submission of annual catch estimates for the key shark species and the reporting of discard estimates.

b) TCC9 should consider alternative measures for collecting operational data such as increasing observer coverage for fleets of CCMs for which the Commission holds little or no operational level data.
c) The Commission note the advice set out in para. 34 of working paper SC9-ST-WP-01 on the implications for the Commission's science programme of the failure to provide operational data that was requested by WCPFC9.
d) The WCPFC Secretariat formally contact each of the CCMs identified as either i) not providing operational data and/or ii) not providing the number of vessels for each spatial unit in their aggregate data, and request the following:
    - That they provide these data to the Commission in order to meet their obligations of Scientific Data to be Provided to the Commission.
    - That information is provided on what constraints hinder their ability to provide operational data to the Commission, and actions being taken to address this issue.
    - That CCMs confirm whether their aggregate data, as provided, can be included into the WCPFC public domain data.
e) A summary of "other" gear catches of the tropical tuna species (Table 1 in SC9-ST-WP-01) should be forwarded to TCC9 for its consideration in relation to para. 29 of conservation and management measure (CMM) 2012-01 with a modification to the Table to reflect the exclusion of those fisheries that take less than 2,000 mt of bigeye, yellowfin and skipjack tunas, as identified in para. 30 of the measure.
f) As proposed in working paper SC9-ST-WP-06, stock assessments to be undertaken and presented for SC10 should use catch and effort data up to and including 2012 data only, but that the projections use data up to and including 2013.

**Species composition of purse-seine catches**

7. SPC presented working papers SC9-ST-WP-02 and SC9-ST-WP-03 on the results of Project 60 to improve the collection and representative nature of species composition data caught by purse-seine fisheries in the western and central Pacific Ocean (WCPO) in order to improve stock assessments of key target species in the WCPO.

8. SC9 recommended that:
a) the scientific services provider continue with analyses and simulations related to the consultancy reports on species composition in the purse-seine fishery. SC9 requested that the scientific services provider provide to SC10 annual estimates of purse-seine catch based on i) logbook reported species composition, ii) observer grab samples (previous approach), and iii) observer grab samples corrected for selectivity bias from spill sampling. Catch series from any variants on these should also be included. This will allow SC to follow changes in purse-seine catch estimates from historical methods. The work should also include any guidance on the implications of future estimates if only grab sampling occurs (e.g. Can the selectivity bias correction be used into the future?).
b) the scientific services provider update the "Plan for Improvement of the Availability and Use of Purse-Seine Catch Composition Data" (presented to TCC8) according to the recent work described in SC9-ST-WP-02, highlighting i) there are no budget implications for the WCPFC for work in 2014, and ii) considering the following specific work areas identified at SC9:
    - Complete the analyses comparing different sources of data collected at Noro, Solomon Islands (SPC).

- Undertake a comparison of unloading data from Japan with observer data (Japan and SPC).
- Undertake a comparison of port sampling data collected in Papua New Guinea (PNG) with observer data (PNG's National Fisheries Authority and SPC).
- Continue the simulation modeling to assess the effectiveness of different approaches to addressing biases in catch composition estimates (SPC).
- Evaluate the scope for the use of pooled observer data, and the possible scope for super-sampling to address layering in brails (SPC and observer providers).

### 3.2 Regional Observer Programme

9. SC9 recommended that:

a) The WCPFC Secretariat and the scientific services provider prepare guidelines for review by TCC9 to develop a clear indication of the coverage level required for each CCM fishery, especially with regard to fishery sectors (e.g. distant waters, offshore, coastal longline fisheries), to satisfy the required level of WCFPC longline observer coverage (5%).

b) TCC9 endorse the indicative budget for the Regional Observer Programme (ROP) data management that now includes the positions of observer data manager, observer data audit officer, and ROP data entry positions.

**Review of FAD data fields**

10. SC9 agreed that the following recommendations be forwarded to the TCC9 for further consideration:

a) The WCPFC Minimum Standard Data Fields on FADs (fish aggregating devices) collected by observers are adequate and no deletions are required.

b) An observer should try and estimate or measure, where possible, the size of mesh used in the construction of the FAD, or any extension hanging under the FAD. It was pointed out that this may be difficult to estimate if the FAD is in the water, but an estimate of size could be measured if the FAD was on deck or was retrieved by the vessel for servicing.

c) Developing a WCPFC "Vessel FAD Data Reporting Log" to be submitted by purse-seine and tender vessels was worthwhile. However, it was noted that the development of a reporting log on FADs by vessels or reporting format may be facilitated by the development of electronic reporting protocols.

d) When developing a "Vessel FAD Data Reporting Log", a number of fields were identified that should be included in the log, such as the FAD's type and design along with highlighted identification marks; whether it was a drifting or anchored FAD; if the FAD had electronics associated with it when deployed; and the FAD's condition when retrieved.

e) There should be no prioritizing of the data entry from Observer FAD Data Forms when received, and the observer FAD data should be entered along with the rest of the observer information collected during their trip. The data collected in other observer forms are required to help explain some of the information collected on the Observer FAD Data Forms.

## AGENDA ITEM 4 – STOCK ASSESSMENT THEME

### 4.1 WCPO tunas

#### 4.1.1 WCPO bigeye tuna

11. SPC presented working papers SC9-SA-WP-08 (Improvement of stock assessments in line with recommendations from the Peer Review for the 2011 bigeye tuna stock assessment), SC9-SA-WP-01 (Bigeye tuna age and reproductive biology progress report) and SC9-SA-WP-06 (Indicator analysis for key tuna species) as requested by the Commission.

12. Most CCMs noted that in order for SPC to complete the enhancements in time for the bigeye stock assessment scheduled for next year, it is critically important for SC to provide support in the following key areas.

a) Encourage Japan to work closely with SPC to ensure that the work already jointly undertaken in analyzing the Japanese operational longline data is completed well in advance of the stock assessment for SC10.
b) In the event that the above work is not completed as planned, enable SPC to convene a workshop in late 2013 or very early 2014 to analyze all available operational catch and effort data for longline vessels.
c) Ensure that the 2014 Pre-Assessment Workshop plays a significant part in providing feedback on new modeling approaches and data inputs.
d) Given the delay in the submission of required data for next year's stock assessment by CCMs, allow SPC to use data through the end of 2012 for the 2014 bigeye assessment and only include the 2013 data later in the year (when it is more complete) for projection analyses.

**Status and trends**

13. SC9 noted that no stock assessment was conducted for WCPO bigeye tuna in 2013. Therefore, the stock status description from SC8 is still current.

**Management advice and implications**

14. SC9 noted that no management advice has been provided since SC8. Therefore, the advice from SC8 should be maintained pending a new assessment or other new information.

15. SC9 also noted that the total catch of bigeye in 2012 was 161,679 mt which was a 2% increase over 2011 and a 7% increase over the average of 2007–2011.

#### 4.1.2 WCPO yellowfin tuna

**Status and trends**

16. SC9 noted that no stock assessment was conducted for WCPO yellowfin tuna in 2013. Therefore, the stock status description from SC8 is still current.

**Management advice and implications**

17. SC9 noted that no management advice has been provided since SC8. Therefore the advice from SC8 should be maintained pending a new assessment or other new information.

18. SC9 noted that the total yellowfin catch in 2012 was 655,668 mt which was a significant (26%) increase over 2011 and a 22% increase over 2007–2011.

### 4.1.3 WCPO skipjack tuna

**Status and trends**

19. SC9 noted that no stock assessment was conducted for WCPO skipjack tuna in 2013. Therefore, the stock status description from SC8 is still current

**Management advice and implications**

20. SC9 noted that no management advice has been provided since SC8. Therefore, the advice from SC8 should be maintained, pending a new assessment or other new information.

21. SC9 also noted that the total skipjack catch in 2012 was 1,664,309 mt, which was a significant (9%) increase over 2011 but the same as the average over 2007–2011.

### 4.1.4 South Pacific albacore tuna

**Status and trends**

22. SC9 noted that no stock assessment was conducted for South Pacific albacore tuna in 2013. Therefore, the stock status description from SC8 is still current.

**Management advice and implications**

23. SC9 noted that no management advice was provided since SC8.

24. The total South Pacific albacore catch in 2012 (89,258 mt) was a 24% increase over 2011 and a 22% increase over 2007–2011. Longline catches (86,064 mt) increased 25% from 2011 and 22% from 2007–2011. Troll and other catches (3,158 mt) were down 8% on 2011, but up 15% on 2007–2011.

25. It should be emphasized that increasing catch and effort on South Pacific albacore has occurred from 2009 to 2012, which is a concern. The current CMM 2010-05 appears not to be effective in constraining effort in the subtropics (south of 20ºS). Given the recent expansion of the fishery and recent declines in exploitable biomass available to longline fisheries in SIDS and territories, and the importance of maintaining catch rates, particularly for the domestic fleets that are highly dependent on this resource, SC9 recommended that longline fishing mortality and longline catch be reduced if the Commission wishes to maintain economically viable catch rates.

## 4.2. Northern stocks

### 4.2.1 North Pacific albacore tuna

**Status and trends**

26. SC9 noted that no stock assessment was conducted for North Pacific albacore in 2013. Therefore, the stock status description from SC8 is still current.

**Management advice and implications**

27. SC9 noted that no management advice has been provided since SC8. Therefore, the advice from SC8 should be maintained, pending a new assessment or other new information.

### 4.2.2 Pacific Bluefin tuna

28. A scientist from the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) presented the 2012 Pacific bluefin tuna stock assessment conducted by ISC (SC9-SA-WP-10), and information that became available after the 2012 stock assessment.

**Status and trends**

29. SC9 noted that the ISC Pacific Bluefin Tuna Working Group provided the following conclusions on the stock status of Pacific bluefin tuna:

> Based on the reference point ratios, overfishing is occurring and the stock is heavily overfished. Model estimates of 2010 SSB (spawning stock biomass) are at or near their lowest level and SSB has been declining for over a decade; however, the 2012 stock assessment, which used data through the first half of 2011, did not find evidence of reduced recruitment. Recently implemented WCPFC (CMM 2010-04, entered into force in 2011) and IATTC (Resolution C-12-09, entered into force in 2012) conservation and management measures, combined with additional Japanese voluntary domestic regulations aimed at reducing mortality, if properly implemented and enforced, are expected to contribute to the recovery of the stock assuming historical average recruitment conditions.
>
> Fishery impact analysis suggests that historically, the Japan coastal fishery group has had the greatest impact (i.e., expected spawning stock biomass) on the Pacific bluefin tuna stock, but since about 1999 the impact of the WPO (western Pacific Ocean) purse-seine fleet has increased, and the effect of this fleet is currently greater than any of the other fishery groups. The impact of the EPO (eastern Pacific Ocean) fishery was large before the mid-1980s, but decreased after the 1990s. The WPO longline fleet has had a limited effect on the stock throughout the analysis period.
>
> Based on newly available fishery data, concerns about stock status were reinforced. The potential risk of decline of the spawning stock may be higher than previously thought. When recruitment is low, the risk of SSB falling below the historically lowest SSB level will increase under F(2007–2009) harvesting conditions while the risk under F(2002–2004) conditions will remain small in the long term, although some short-term risk remains.

**Management advice and implications**

30. SC9 noted the following conservation advice from ISC.

> The current (2010) Pacific bluefin tuna biomass level is near historically low levels and experiencing high exploitation rates above all biological reference points (BRPs) commonly used by fisheries managers. Based on projection results, extending the status quo (2007–2009) fishing levels is unlikely to improve stock status. Continued monitoring of abundance indices is recommended to track SSB.
>
> Preliminary WPO data indicate an unusually low catch of age-0 Pacific bluefin tuna in 2012; this may imply low recruitment, which would adversely affect projected stock rebuilding and increase the risk of SSB falling below its historical lowest level observed. Further reduction

of fishing mortality, especially for juvenile fish, is needed to reduce the risk of SSB falling below its historically lowest level.

Strengthening the monitoring of recruitment is highly recommended to comprehend the trend of recruitment in a timely manner.

31. SC9 could not reach consensus on management advice to the Commission. In lieu of this the following two statements are provided:

Majority view:

Noting the current very low level of spawning biomass (4% $B_0$), which is far below the common reference levels, and the low levels of recruitment observed in 2012, SC9 recommended that the fishing mortality on Pacific bluefin tuna be immediately reduced, especially on juveniles, in order to reduce the risk of recruitment collapse and allow the spawning stock to rebuild. SC9 recommended that candidate limit and target reference points be advanced for Pacific bluefin tuna that are consistent with the Commission's adopted or default reference points.

Minority view:

SC9 endorsed the conservation advice put forward by ISC13, calling for further reductions in fishing mortality, especially for juvenile fish, to reduce the risk of further declines in SSB and strengthening the monitoring of recruitment to comprehend the trend of recruitment in a timely manner.

### 4.2.3 North Pacific swordfish

**Status and trends**

32. SC9 noted that no stock assessment was conducted for North Pacific swordfish in 2013. Therefore, the stock status description from SC6 is still current. SC9 noted that stock projections based on western and central North Pacific Ocean swordfish catches through 2012 indicate that the stock is currently not likely to be overfished and is not likely to be experiencing overfishing.

**Management advice and implications**

33. SC9 noted that no management advice has been provided since SC6. Therefore, the advice from SC6 should be maintained pending a new assessment or other new information.

## 4.3 WCPO sharks

### 4.3.1 Oceanic whitetip shark

**Status and trends**

34. SC9 noted that no stock assessment was conducted for WCPO oceanic whitetip shark in 2013. Therefore, the stock status description from SC8 is still current.

**Management advice and implications**

35. SC9 noted that no management advice has been provided since SC8. Therefore, the advice from SC8 should be maintained, pending a new assessment or other new information.

### 4.3.2 Silky shark

36. SPC presented working paper SC9-SA-WP-03 (Updated stock assessment of silky sharks in the western and central Pacific Ocean).

**Status and trends**

37. Silky shark is a low productivity species and this low productivity is reflected in the low estimated value for $F_{MSY}$ ($F_{MSY}$ = 0.08) and high estimated value for $SB_{MSY}/SB_0$ = 0.39. These directly impact on conclusions about overfishing and the overfished status of the stock. Estimated fishing mortality has increased to levels far in excess of $F_{MSY}$ ($F_{current}/F_{MSY}$ = 4.32) and across nearly all plausible model runs undertaken, estimated F values were much higher than $F_{MSY}$ (the 5$^{th}$ and 95$^{th}$ quantiles are 2.49 and 7.45, respectively). Based on these results SC9 concluded that overfishing is occurring. Estimated SSB has declined to levels below $SB_{MSY}$ ($SB_{current}/SB_{MSY}$ = 0.72) and for the majority of the model runs undertaken, $SB_{current}$ is less than $SB_{MSY}$ (the 5$^{th}$ and 95$^{th}$ quantiles are 0.51 and 1.02, respectively). Based on the distribution of the relative current spawning biomass SC9 concluded that it is highly likely that the stock is in an overfished state.

**Management advice and implications**

38. Current catches are higher than the maximum sustainable yield (MSY) (7,123 mt vs. MSY = 2,937 mt), further catches at current levels of fishing mortality would continue to deplete the stock below $SB_{MSY}$. Current (2005–2008 average) and latest (2009) catches are significantly greater than the forecast catch in 2010 under $F_{MSY}$ conditions (approximately 600 mt).

39. The greatest impact on the stock is attributed to bycatch from the longline fishery in the tropical and subtropical areas, but there are also significant impacts from the associated purse-seine fishery that catches predominantly juvenile sharks. The Commission should consider measures directed at bycatch mitigation as well as measures directed at targeted catch, such as from shark lines (Attachment F), to improve the status of the silky shark population. Existing observer data may provide some information on which measures would be the most effective.

### 4.3.3. South Pacific blue shark

40. SPC presented working paper SC9-SA-WP-04 (Potential catch and CPUE series to support a stock assessment of blue shark in the South Pacific Ocean), which responds to the Pre-Assessment Workshop recommendation regarding blue shark data.

**Status and trends**

41. SC9 noted that no stock assessment was conducted for South Pacific blue shark in 2013.

**Management advice and implications**

42. There was no stock assessment for this species; therefore, SC9 was unable to provide management advice for this stock.

### 4.3.4. North Pacific blue shark

43. ISC presented working paper SC9-SA-WP-11 and SPC presented working paper SC9-SA-WP-02 on the North Pacific blue shark stock assessment, using a Bayesian Production Modeling platform by ISC and a Stock Synthesis 3 modeling platform by SPC and the Inter-American Tropical Tuna Commission.

**Status and trends**

44. SC9 noted that two stock assessments for North Pacific blue shark were undertaken by ISC using different modeling frameworks. The conclusions and resulting stock status and management advice depend heavily on the catch per unit of effort (CPUE) series assumed to describe stock abundance.

45. Based on the CPUE series selected by the ISC Shark Working Group for inclusion in the base case models, both assessment models predict that biomass is increasing and fishing mortality has been decreasing in recent years. The models show similar trajectories but differ in terms of their estimated status with respect to $B_{MSY}$. One model estimated that the stock has been overfished since the 1970s, but is rebuilding; the other model estimated that biomass has been greater than $B_{MSY}$ since the 1990s. However, using an alternative CPUE series for a sensitivity run, both modeling frameworks estimated the stock to be in an overfished state with overfishing occurring.

**Management advice and implications**

46. SC9 could not reach consensus on which CPUE series best reflected changes in the relative abundance and therefore recommended that a revised assessment be presented to SC10.

47. In the interim, SC9 recommended that the Commission consider this uncertainty and adopt a precautionary approach when considering any potential management measures for blue shark in the North Pacific.

### 4.4 WCPO billfish

#### 4.4.1 South Pacific swordfish

48. SPC presented the 2013 stock assessment for swordfish (*Xiphias gladius*) in the southwest Pacific (SC9-SA-WP-05).

49. Noting the inconsistencies in the Australian and Hawaii growth schedules, SC9 recommended that additional work on age, growth and age validation be undertaken.

**Status and trends**

50. The South Pacific swordfish assessment was highly sensitive to growth assumptions. Two different growth models, one from Australia (GA) and the other from Hawaii (GH), were included in alternative model runs. SC could not decide which of these two assumptions was more reliable. Assessment runs using the GA growth data indicated that overfishing was occurring but that the stock was not in an overfished state. Assessment runs using the GH growth data indicate that no overfishing is occurring and that the stock is not in an overfished state.

51. Although the median of the uncertainty grid indicates that overfishing ($F_{current}/F_{MSY}$ = 0.74) was not occurring those sensitivity runs that used the GA growth and maturity schedule indicate that overfishing may be occurring (grid range 5$^{th}$–95$^{th}$ percentiles: 0.51–2.02). Recent preliminary findings from tagging data indicate that this alternative growth schedule (GA) warrants further consideration. Estimates of stock status are highly uncertain with respect to this assumption. The equivalent grid range

of $F_{current}/F_{MSY}$ for the Hawaii schedule (GH) is 0.25–0.97. Across the uncertainty grid of 378 runs, where the Hawaii schedule was assumed, the probability of $F_{current}/F_{MSY}$ being greater than 1.0 was less than 3%, while when the slower Australian schedule was assumed, 54% of runs estimated the stock to be experiencing overfishing (Table SWO2, Fig. SWO4).

**Table SWO2:** Estimates of management quantities from the median of the selected uncertainty grid (excluding runs with the New Zealand CPUE time series), from the 2013 stock assessment. For the purpose of this assessment, "current" is the average over the period 2007–2010 and "latest" is 2011.

| | **Median of the selected grid runs** | **Range** | |
|---|---|---|---|
| | | **5%-ile** | **95%-ile** |
| $C_{current}$ | 10,456 | 10,041 | 11,368 |
| $C_{latest}$ | 10,020 | 9,636 | 10,549 |
| $MSY$ | 8,175 | 5,100 | 14,006 |
| $C_{current}/MSY$ | 1.29 | 0.74 | 2.11 |
| $C_{lastest}/MSY$ | 1.23 | 0.72 | 1.99 |
| $F_{mult}$ | 1.36 | 0.56 | 3.39 |
| $F_{current}/F_{MSY}$ | 0.74 | 0.30 | 1.77 |
| $SB_0$ | 90,535 | 70,849 | 122,190 |
| $SB_{MSY}/SB_0$ | 0.23 | 0.12 | 0.30 |
| $SB_{current}/SB_0$ | 0.47 | 0.32 | 0.59 |
| $SB_{current}/SB_{MSY}$ | 2.07 | 1.18 | 4.50 |
| $SB_{latest}/SB_{MSY}$ | 1.70 | 0.89 | 3.75 |
| $SB_{curr}/SB_{currF=0}$ | 0.49 | 0.32 | 0.60 |
| $SB_{latest}/SB_{latestF=0}$ | 0.43 | 0.23 | 0.56 |

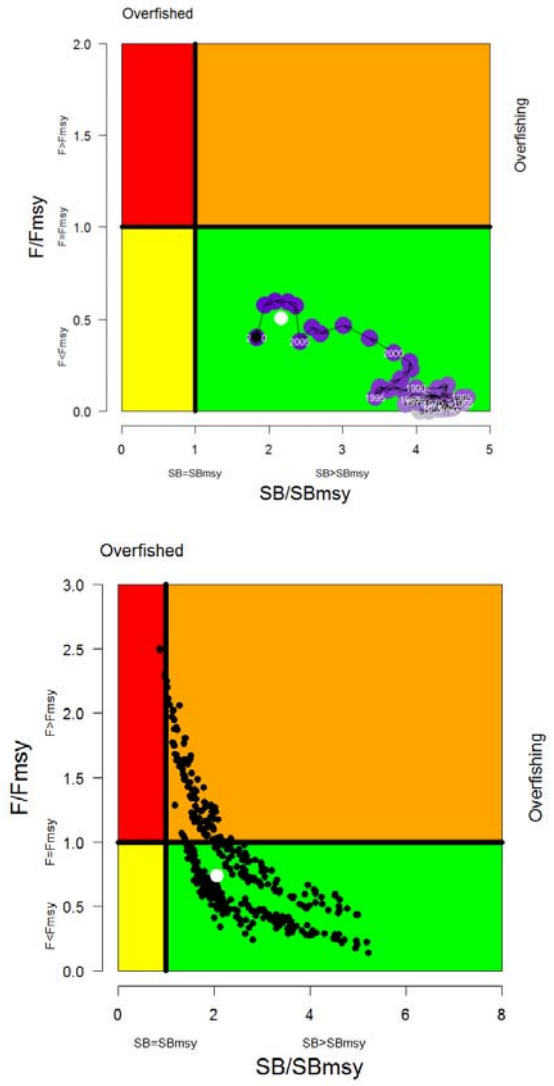


**Figure SWO4:** Temporal trend in annual stock status, relative to $SB_{MSY}$ (x-axis) and $F_{MSY}$ (y-axis) reference points for the Ref.case (top); and $F_{current}/F_{MSY}$ and $SB_{current}/SB_{MSY}$ for the median of the selected uncertainty grid (white circle) and the individual uncertainty grid runs (excluding runs where the New Zealand CPUE series was used; bottom).

**Management advice and implications**

52. SC9 recommended that given the current uncertainty in the assessment, the Commission should adopt a precautionary approach when considering future management arrangements. Given this, SC9 recommended that there be no increase in fishing mortality over current (2007–2010) levels.

53. Noting that recent catches between the equator and 20°S now represent the largest component of the catch in Region 2 (equator to 50°S, 165°E to 130°W), SC9 recommended that the Commission consider developing appropriate management measures for this region, which is not covered by CMM 2009-03.

### 4.4.2. Southwest Pacific striped marlin

**Status and trends**

54. SC9 noted that no stock assessment was conducted for southwest Pacific striped marlin in 2013. Therefore, the stock status description from SC8 is still current.

**Management advice and implications**

55. SC9 noted that no management advice was provided since SC8. Therefore, the advice from SC8 should be maintained, pending a new assessment or other new information.

### 4.4.3. North Pacific striped marlin

**Status and trends**

56. SC9 noted that no stock assessment was conducted for North Pacific striped marlin in 2013. Therefore, the stock status description from SC8 is still current.

**Management advice and implications**

57. SC9 noted that no management advice has been provided since SC8. Therefore, the advice from SC8 should be maintained, pending a new assessment or other new information.

### 4.4.4. Pacific blue marlin

58. An ISC scientist presented the stock assessment of Pacific blue marlin to SC9 (SC9-SA-WP-09: Report of the billfish working group workshop – Assessment of the Pacific blue marlin stock in 2013).

**Status and trends**

59. Based on the finding of the ISC blue marlin stock assessment, the following information on stock status and trends is provided.

- Estimates of total stock biomass show a long-term decline.
- Current fishing mortality on the stock (average F, ages 2 and older) averaged F = 0.26 during 2009–2011 and was below $F_{MSY}$ ($F_{MSY}$ [age-2+] = 0.32).
- The predicted value of the spawning potential ratio (SPR, the predicted spawning output at current F as a fraction of unfished spawning output) is currently $SPR_{2009–2011}$ = 23%.
- The overall trends in SSB and recruitment indicate a long-term decline in SSB and suggest a fluctuating pattern without trend for recruitment.
- Pacific blue marlin SSB decreased to the MSY level in the mid-2000s, and since then has increased slightly.
- The base case assessment model indicates that the Pacific blue marlin stock is currently not overfished and is not subject to overfishing relative to MSY-based reference points.

**Management advice and implications**

60. SC9 noted ISC's conservation advice for the Commission's consideration as follows:

> Based on the results of the stock assessment, the stock is not currently overfished and is not experiencing overfishing. The stock is nearly fully exploited. Stock biomass has declined

since the 1970s and has been stable since the mid-2000s with a slight recent increase. The fishing mortality rate should not be increased from the 2009–2011 level to avoid overfishing.

## AGENDA ITEM 5 — MANAGEMENT ISSUES THEME

### 5.1 Limit reference points

61. SPC presented working papers SC9-MI-WP-02 (Determination of appropriate time windows for calculation of depletion-based limit reference points) and SC9-MI-WP-03 (Proposed F-based limit reference points for bigeye, yellowfin and South Pacific albacore tuna), which responded to SC8's requests.

62. SC9 noted the hierarchical approach and the associated key limit reference points (LRPs) for the key target species in WCPFC adopted by the Commission and the request made by WCPFC9 for SC9 to identify i) the appropriate time window ($t_1$-$t_2$) for estimating the average unfished biomass in the LRP $20\%SB_{F=0,t1\text{-}t2}$, and ii) the appropriate values of X for each species in the LRP $F_{X\%SPR0}$.

63. SC9 noted the work described in working paper SC9-MI-WP-02 and recommended that the time window to be used in the LRP $20\%SB_{F=0,t1\text{-}t2}$ satisfy the following criteria:

a) have a length of 10 years;
b) be based on the years $t_1=y_{last}$-10 to $t_2=y_{last}$-1 where $y_{last}$ is the last year used in the assessment; and
c) the approach used for calculating the unfished biomass levels be based on scaled estimates of recruitment according to the stock recruitment relationship.

64. SC9 also recommended that the selection of this time window be subject to periodic review to ensure that this approach is appropriately representing future conditions for individual stocks.

65. SC9 noted the work described in working paper SC9-MI-WP-03 and recommended that the identification of the appropriate values of X for each species in the LRP $F_{X\%SPR0}$ be based on an iterative search to "match" $F_{X\%SPR0}$ with $20\%SB_{F=0,t1\text{-}t2}$ as described in this working paper.

66. SC9 also noted that working paper SC9-MI-WP-03 had considered two levels of risk (5% and 10%) associated with breaching the LRP. Further noting that the identification of acceptable risk is a management issue, SC9 recommended that WCPFC10 identify what level of acceptable risk should be applied to breaching an LRP. Once this level of risk has been identified, SC9 recommended that the appropriate values of X for each species in the LRP $F_{X\%SPR0}$ be calculated using the updated assessments to be presented to SC10.

67. For stocks for which the Commission has adopted LRPs, SC9 recommended that future assessment summaries (e.g. tables, Kobe-like plots) include stock status relative to those LRPs.

68. SC9 also recommended that SC10 and the Commission give consideration for the need to identify associated early warning or trigger reference points that would alert the Commission that a stock may be approaching an LRP and that appropriate management action may be required. When possible, future consideration should also be given to testing the fishing mortality LRPs within the framework of potential harvest control rules.

### 5.2 Development of WCPFC management objectives

69. SC9 noted the report by the Expert Working Group on management objectives, performance indicators and reference points for WCPFC (SC9-MI-WP-05) and recommended that the 2nd Management Objectives Workshop, which will be held in November 2013, take note of the comments made on this report by SC9 (Attachment G).

### 5.3 Reference points and the characterization of uncertainty

70. SC9 considered working paper SC9-MI-WP-04 on approaches to describe uncertainty in current and future stock status. SC9 recommended that the following hierarchical approach to describe uncertainty:

- Select a representative subset (5–10) from the structural uncertainty grid of assessment model runs to capture the extent of model uncertainty.
- Apply stochastic projections across the chosen subset of models required to integrate across the key uncertainties.
- Undertake the selection of the representative subset by SC after reviewing the associated stock assessment.

71. SC9 also recommended that:

- SC10 give further consideration to the need to assign plausibility weights for each model run, and if needed, how these weights may be developed to further assist in reducing uncertainty in the description of stock status.
- The work to describe uncertainty described above should be undertaken to the extent possible by the assessment scientists, included in the assessment reports, and reviewed by SC.

### 5.4 Implementation of CMM 2012-01

72. SC9 recommended that the WCPFC Working Group on Tropical Tunas (to be held in Tokyo in late August 2013), TCC and the Commission note the following conclusions based on the analyses presented in working paper SC8-MI-WP-01 when reviewing the effectiveness of past management measure CMM 2008-01 (and its extension under CMM 2011-01) and in consideration of any revision of CMM 2012-01.

a) The limits placed on purse-seine operations have not adequately constrained total purse-seine effort with total effort (excluding domestic Indonesian and Philippines) in 2011 being a record high and estimated to be 10% higher compared with effort in 2010. Effort in 2012 was similar to 2011 and was 8% higher than in 2010;
b) Stock assessment results indicate that the effectiveness of purse-seine effort has typically increased on top of the increase in total effort (i.e. effort creep is occurring).
c) A comparison of effort between logsheet fishing days and sets, and vessel monitoring system sources also suggest that for some fleets there has been a change in how days are reported; specifically, days that would have previously been reported as days searching (which are counted as fishing days) are now reported as days in transit (which are considered as non-fishing days), which is inconsistent with effort reported in previous years.
d) Reported activity related to the use of drifting FADs during the FAD closures was considerably lower in the period 2010–2012 (5.6%, 9.6% and 3.2%, respectively) compared with 2009 (19.2%). The observed incidence of vessels drifting at night with fish aggregation lights on increased from 2.4% in 2009 to 4.7% in 2010 but was 2.3% in 2011 and 1.2% in 2012;

e) Despite the FAD closure the total estimated number of FAD sets made in 2011 was a record high, largely due to the increased purse-seine effort overall, with a slight decline in 2012. Nevertheless, several fleets (notably Japan, Philippines, New Zealand) have substantially changed their fishing operations, focusing more on unassociated set fishing in 2010–2012 than they had in the past, while other fleets (e.g. Kiribati and Korea) show notable declines in the 2012 data available.

f) Skipjack and yellowfin tuna catches, and total catches were slightly below average during the 2009 and 2010 closures. Sustained high total catches (particularly skipjack and bigeye) occurred between the 2010 and 2011 closures; however total (and skipjack) catches during the 2011 closure were almost half those seen during the previous closure months. Catches recovered somewhat following the 2011 closure, but did not reach the levels experienced earlier in that year, primarily due to continued relatively low skipjack catches. Catches of skipjack and overall catch levels recovered in 2012, and catches during the closure period were similar to those seen during 2009 and 2010 closures.

g) Bigeye tuna catches were significantly reduced during closure periods compared with the other months of those years.

h) The total average bigeye longline catch for 2001–2004 was 83,923 mt. In recent years, total bigeye longline catch has increased slightly from 66,441 mt in 2010 to 67,557 mt in 2011 to 71,148 mt in 2012 (79%, 81% and 85% of the average catch for 2001–2004, respectively) while some CCMs achieved 30% reduction from the 2001–2004 level. However, in the core area of the tropical longline fishery ($130^{o}$E to $150^{o}$W, $20^{o}$N to $10^{0}$S), the reduced catches have been paralleled by a decline in nominal CPUE (and a ~30% increase in longline effort from the low in 2010 to 2012) These declines in nominal CPUE require further investigation and SC10 will review analyses that provide standardized CPUE (relative abundance) estimates for bigeye tuna that remove effects due to: latitude, longitude, targeting (e.g. yellowfin, albacore), fleet and vessel.

i) For yellowfin tuna, the longline catch in 2001–2004 averaged 75,712 mt. In 2010 and 2011, catches were 75,582 mt and 75,393 mt, respectively, and fell below the 2001–2004 average level in 2012 to 65,582 mt.

j) Stock projections undertaken using the reference case models for the 2011 assessments for bigeye tuna and effort levels observed in the fishery in 2011 results in $F/F_{MSY}$ stabilizing around 1.29 in 2021. However, for the scenario best approximating the reported catch and effort in the fishery in 2010, $F/F_{MSY}$ declines and is at a projected level of 0.96 in 2021. This is driven by several factors: lower than usual FAD use in 2010, lower longline catches, and a large (30%) reduction in reported catches from the domestic fisheries of Indonesia and the Philippines. The difference between 2010 and 2011 fishery outcomes is mainly due to the return to higher levels of FAD-based purse-seine effort in 2011.

k) A series of projections, specifically for the bigeye tuna stock under a range of future of purse-seine-associated set effort and longline fishery bigeye catch level combinations, would be beneficial to identify the conditions in these fisheries that remove 50% and 100% of overfishing in bigeye tuna in the WCPO by 2018.

l) Use the information provided in Tables 3 and 4 of working paper SC9-MI-WP-01 to help design an appropriate package of measures to remove bigeye overfishing.

73. Based on the above observations and analyses, and noting that previous CMMs have failed to reduce the fishing mortality for bigeye to the level intended, SC9 supported the need for additional or alternative targeted measures to reduce the fishing mortality on bigeye. In this regard, SC9 reaffirmed the recommendations made by SC8 (para. 351 of SC8 Summary Report) when considering revisions to the current CMM for bigeye, yellowfin and skipjack tuna stocks and recommended that the WCPFC Working Group on Tropical Tunas and the Commission take these into consideration.

## AGENDA ITEM 6 — ECOSYSTEM AND BYCATCH MITIGATION THEME

### 6.1 Ecosystem effects of fishing

74. SPC presented working papers SC9-EB-WP-04 (Progress on Kobe III Bycatch Technical Working Group) and SC9-EB-WP-03 (Project 62: SEAPODYM applications in WCPO).

75. SC9 recommended that:
   a) WCPFC support the Bycatch Mitigation Information System by working to harmonize data collection across tuna regional fisheries management organizations (RFMOs);
   b) the Commission support the ongoing work and development of the spatial ecosystem and population dynamics model (SEAPODYM);
   c) members support the SEAPODYM work through the provision of fine-scale data; and
   d) the Commission consider an external review of the SEAPODYM model.

### 6.2 Sharks

76. The following papers were presented on shark issues:
   - SC9-EB-WP-06: A progress report on the Shark Research Plan;
   - SC9-EB-WB-12: Fishery interactions and post-release survival rates of silky sharks caught in purse-seine fishing gear;
   - SC9-EB-WP-08: Towards an integrated shark conservation and management measure for the western and central Pacific Ocean;
   - SC9-EB-WP-02: Analyses of the potential influence of four gear factors (leader type, hook type, "shark" lines and bait type) on shark catch rates in WCPO tuna longline fisheries; and
   - SC9-EB-WP-01: Spatial and temporal distribution of whale sharks in the western and central Pacific Ocean based on observer data and other data sources.

77. SC9 considered the issue of draft guidelines for the safe release of encircled animals — including whale sharks — which are included as Attachment H. This draft will be forwarded to TCC9 for further consideration.

78. SC9 recommended the following.
   a) The Commission develop reference points for key shark species.
   b) The development of safe release guidelines to maximize shark survival for species of concern, such as for oceanic whitetip and silky sharks for longline and purse-seine fisheries. Draft guidelines for whale sharks in the purse-seine fishery should be updated in light of any new information.
   c) CCMs be reminded that it is a requirement (CMM 2010-07) to report retained and discarded[1] shark catches by key shark species. CCMs are encouraged to implement a consistent logsheet to estimate retained and discarded key shark species. SC recommended that this item be prioritized by TCC.
   d) The development of an integrated and comprehensive shark CMM to reduce the catch of overexploited shark species.
   e) The Commission consider measures directed at bycatch mitigation as well as measures for targeted shark catch (such as shark lines), if it wishes to reduce mortality on overfished sharks (e.g. silky and oceanic whitetip).

[1] Discards include live and dead releases.

### 6.3 Seabirds

79. ACAP presented working papers SC9- EB-WP-05 (Progress on the development of a seabird identification guide) and SC9- EB-WP-09 (Electronic monitoring of seabird bycatch).

80. SC9 examined the implications of the North Pacific small vessel exemption on seabird interaction rates as requested by CMM 2012-07.

81. SC9 recommended the following.

a) In order to address the impacts of vessels less than 24 m that are fishing in the North Pacific (north of 23°N) without seabird mitigation, seabird bycatch rates for vessels less than 24 m, and equal to or greater than 24 m fishing with longline gear need to be investigated. The investigation is required due to the high overlap between the longline fishery in the North Pacific (north of 23°N) and North Pacific albatrosses, and the paucity of bycatch data; and that nearly 60% of longline vessels in the North Pacific are less than 24 m in length.
b) ACAP forward the seabird identification guide to the WCPFC Secretariat for circulation to all relevant national and regional observer programmes for their advice and input.
c) A pilot project assessing the utility of electronic monitoring be undertaken in the WCPFC longline fishery.

### 6.4 Sea turtles

82. No papers were tabled on sea turtles and there was no discussion.

### 6.5 FAD bycatch and mitigation

83. ISSF presented working paper SC9-EB-WP-07 (Summary of research activities and results of the International Seafood Sustainability Foundation's second bycatch project cruise WCPO-2 in the western central Pacific Ocean).

84. SC9 supports the research objectives of the International Sustainable Seafood Foundation (ISSF) bycatch research cruises and encourages further work by ISSF and all CCMs to develop and test purse-seine mitigation. Priority should be given to work that investigates: i) mitigation of small bigeye and yellowfin tunas; ii) avoidance or selective release of bycatch species from the net to maximize the chances of survival of released animals; and iii) investigations that scientifically verify the post-release condition of bycatch species using pop-up archival tags and other technology.

## AGENDA ITEM 7 — OTHER RESEARCH PROJECTS

### 7.1 West Pacific East Asia Oceanic Fisheries Management Project

85. The Secretariat noted that the West Pacific East Asia Oceanic Fisheries Management (WPEA OFM) Project was completed in March 2013, and the second phase of the WPEA Project, called "Sustainable Management of Highly Migratory Fish Stocks in the West Pacific and East Asian Seas", is in progress.

### 7.2 Pacific Tuna Tagging Project

86. The Pacific Tuna Tagging Project Steering Committee meeting report is contained in SC9-RP-PTTP-02.

## AGENDA ITEM 8 — COOPERATION WITH OTHER ORGANIZATIONS

87. SC9 noted information paper SC9-GN-IP-01 and invited the Southeast Asian Fisheries Development Center to introduce its work and its intention to cooperation with WCPFC.

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

88. The Secretariat reported on the current status and progress of Japan Trust Fund-related matters and urged participants to be ready for the call for next year's funding, which would likely have a closing date of 31 December. While appreciating Japan for its generosity, it was also acknowledged that the Special Requirement Fund (SRF) has also enabled some Pacific Island Forum Fisheries Agency (FFA) small island developing states (SIDS) to implement projects. FFA members encouraged those CCMs that have yet to contribute to the Commission's SRF to comply with their obligations as stipulated in Article 30 of the Convention to support SIDS and territories to implement activities in the following key areas.

a) Scientific research and improved technological capacity in countries that would contribute to the implementation of national priorities.
b) Increased and efficient human resources to help building capacity in countries, in both technical (including science; monitoring, control and surveillance; management; policy; and legal fields) and administrative roles.
c) The development of new initiatives based on best practice.
d) Improved and expanded collection and analysis of data in countries, as well as additional monitoring and evaluation strategies.

## AGENDA ITEM 10 — FUTURE WORK PROGRAMME AND BUDGET

### 10. 1 Review of the 2013 Scientific Committee Work Programme

89. SC9 endorsed the following recommendations on database improvements:

a) Where necessary, research the history of SC projects that have been implemented to fill any missing fields, including missing information in Delivering Agency and Outputs.
b) All project deliverables should be listed, if any additional, in addition to project papers.
c) Separate fields for "Projected Outputs" and "Delivered Outputs" should be included.
d) "Relevant CCMs" and "Links to other Projects" are useful fields and need to be entered.
e) Criteria for designating High, Medium and Low priority need to be developed.
f) Include a column for the allocated budget to be entered if known.
g) The numbering should include a start year as part of the number to avoid duplication.
h) The database should include "End Year" — the last year of funding for the project (the year can be extended if further funding is approved).

### 10.2 Development of the 2014 work programme and budget, and projection of 2015–2016 provisional work programme and indicative budget

90. In order to select high priority projects for funding support using 2013 unobligated budget, the first three projects will be advertised to seek research proposals.

| Title | Score |
|---|---|
| 1) Desktop analysis to develop reference points for elasmobranchs and other bycatch species | 4 |
| 2) Development of a best practice approach to standardize CPUE indices for use in stock assessments | 3.8 |
| 3) Review of Project 60 update — desktop analysis for carrying forward Project 60 | 3.5 |
| 4) Electronic tagging of whale sharks released from purse-seine nets (to examine survival) | 3.1 |
| 5) Development of a Library of Commission Documents | 3.1 |
| 6) Project 19 — Regional Observer Programme (ROP) data fields. Identification and description of operational characteristics of the major WCPO fleets and identification of important technical parameters for data collection | 3 |
| 7) Project 68 — Seabird interaction and bycatch mortality | 3 |

91. SC9 reviewed draft revisions on the "Guidelines outlining the process for formulating the work programme and budget of the Scientific Committee" (Attachment P, SC5 Summary Report) and endorsed the revision (Attachment K).

**Development of the 2014 work programme and budget, and projection of 2015–2016 provisional work programme and indicative budget**

92. SC9 adopted the work programme and budget for 2014 and indicative budget for 2015–2016 as shown in Table WP1. The scientific services provider will conduct stock assessment for bigeye, yellowfin and skipjack tunas in 2014 under the current service agreement for scientific services. SC9 also requested the scientific services provider to conduct shark analysis as follows for presentation at SC10 (assuming a stock assessment for blue shark in the South Pacific in 2015):

- A stock assessment for blue shark in the North Pacific conducted through the ISC process; and
- Analysis of potential mitigation options for silky and oceanic whitetip sharks.

**Table WP1:** SC work programme and budget for 2014–2016.

| List of SC work programme titles and budget for 2014, and indicative budget for 2015–2016, which require funding from the Commission's core budget (in USD). | | | |
|---|---|---|---|
| **Research activity / Project with priority** | **2014** | **2015** | **2016** |
| Project 14. WPEA Project | 25,000 | 25,000 | 25,000 |
| Project 35. Refinement of bigeye parameters | 75,000 | 75,000 | - |
| Project 42. Pacific-wide tagging project | 10,000 | 10,000 | 10,000 |
| Project 57. Limit reference points | 30,000 | - | - |
| Project 66. Target reference points | - | - | - |
| Project 63. Harvest control rules | - | - | - |
| Project 60. Purse-seine species composition | - | - | - |
| Additional resourcing SPC | 160,000 | 160,000 | - |
| UNOBLIGATED BUDGET | 83,000 | 83,000 | 83,000 |
| SPC OCEANIC FISHERIES PROGRAMME BUDGET | 871,200 | 871,200 | 871,200 |
| **GRAND TOTAL** | **1,254,200** | **1,224,200** | **989,200** |

## AGENDA ITEM 11 — ADMINISTRATIVE MATTERS

**Review of scientific aspects of the Commission's Independent Performance Review**

93. As requested by the Commission (para. 429 of WCPFC9 Summary Report), SC9 reviewed recommendations from the Performance Review and responded (Attachment L).

**Election of SC officers**

94. There were no nominations for the position of SC Vice-Chair.

**Next meeting**

95. The Marshall Islands kindly offered to host SC10 in Majuro, Marshall Islands, which is provisionally scheduled for 6–14 August 2014. FSM confirmed that it would host SC11.

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

**Scientific Committee**
**Ninth Regular Session**

**Pohnpei, Federated States of Micronesia**
**6–14 August 2013**

# SUMMARY REPORT

## AGENDA ITEM 1 — OPENING OF THE MEETING

### 1.1 Welcome Address

1. The Chair of the Scientific Committee (SC), Mr L. Kumoru welcomed delegations of the Western and Central Pacific Fisheries Commission (WCPFC) Members, Cooperating Non-Members, Participating Territories and Observers (CCMs) to the Ninth Regular Session of the Scientific Committee (SC9), and opening remarks were presented (Attachment A). WCPFC Executive Director, G. Hurry, welcomed delegates.

2. The following WCPFC CCMs attended SC9: Australia, China, Commonwealth of the Northern Marianas Islands (CNMI), Cook Islands, European Union (EU), Federated States of Micronesia (FSM), Fiji, French Polynesia, Japan, Kiribati, Korea, Marshall Islands, Nauru, New Caledonia, New Zealand, Niue, Palau, Papua New Guinea (PNG), Philippines, Samoa, Solomon Islands, Chinese Taipei, Tokelau, Tonga, Tuvalu, United States of America (USA), and Vanuatu.

3. The Agreement on the Conservation of Albatrosses and Petrels (ACAP), Convention of Migratory Species, Inter-American Tropical Tuna Commission (IATTC), Pacific Islands Forum Fisheries Agency (FFA), Parties to the Nauru Agreement (PNA), Southeast Asian Fisheries Development Center (SEAFDEC), International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC), Bird Life International, Greenpeace, International Seafood Sustainability Foundation (ISSF), Pew Environment Group, and World Wide Fund for Nature (WWF) attended as Observers, and the Secretariat of the Pacific Community (SPC) attended as the Commission's scientific services provider. The list of participants is included as Attachment B.

### 1.2 Meeting arrangements

4. The Chair outlined procedural matters, including the meeting schedule and administrative arrangements, and thanked theme convenors for their cooperation. The Chair also announced that a new Vice Chair may be nominated during SC9.

### 1.3 Issues arising from SC8 and the Commission

5. The Secretariat introduced working paper SC9-GN-WP-03, which lists issues arising from SC8 and WCPFC9. It was noted that most issues in the document will be covered and addressed throughout SC9.

### 1.4 Adoption of agenda

6. The provisional agenda was adopted with no changes (Attachment C).

### 1.5 Reporting arrangements

7. The Chair advised that SC9 will adopt a Summary Report. An Executive Summary will be drafted by the Secretariat and circulated for adoption intersessionally. The Executive Summary will include a synopsis of stock status and management advice implications, research plans, findings or conclusions on stock status, reports and recommendations as directed by the Commission or at the initiative of SC. The WCPFC list of acronyms and abbreviations, and the list of SC8 meeting documents are included as Attachment D and Attachment E, respectively.

### 1.6 SC intersessional activities

8. The Secretariat referred to working paper SC9-GN-WP-04 on the intersessional activities of SC. The paper highlighted the contribution of the WCPFC's scientific services provider (SPC) since SC8, which provided data management, statistical analysis and stock assessment, management analyses, and advisory and technical services. It also reported on progress within the SC work programme, and documented the Secretariat's work in representing the Commission at various science-related meetings, progress on the West Pacific East Asia Oceanic Fisheries Management (WPEA OFM) Project, and the administration of the Japan Trust Fund Project.

## AGENDA ITEM 2 — REVIEW OF FISHERIES

### 2.1 Overview of Western and Central Pacific Ocean fisheries

9. P. Williams (SPC) and C. Reid (FFA) presented working paper SC9-GN-WP-01, which contains a broad description of the major fisheries in the WCPFC Statistical Area, and highlights activities during the most recent calendar year (2012), including the most recent version of catch estimates by gear type and species, and economic conditions of the WCPFC Statistical Area fishery.

10. The provisional total WCPFC Statistical Area tuna catch for 2012 was estimated at 2,613,528 mt, the highest on record, eclipsing the previous record in 2009 (2,603,346 mt) by 12,000 mt. This catch represents 82% of the total Pacific Ocean catch of 3,205,980 mt, and 59% of the global tuna catch (the provisional estimate for 2012 is 4,456,605 mt, which is the second highest on record).

11. The 2012 WCPFC Statistical Area catch of skipjack (1,664,309 mt – 64% of the total catch) was the third highest recorded and around 110,000 mt less than the record catch of 2009 (1,775,462 mt). The WCPFC Statistical Area yellowfin catch for 2012 (655,668 mt – 25%) was a clear record and more than 70,000 mt higher than the previous record catch taken in 2008 (581,948 mt), primarily due to relatively high catches by Indonesia's purse-seine and artisanal fisheries. The WCPFC Statistical Area bigeye catch for 2012 (161,679 mt – 6%) was the highest since 2004, the record catch year at 183,355 mt. The 2012 WCPFC Statistical Area albacore catch (131,872 mt – 5%) was the second highest on record (after 2009 at 135,476 mt), and relatively stable compared with the previous three years. The 2012 WCPFC Statistical Area albacore catch includes catches of North and South Pacific albacore in the WCPFC Statistical Area, which comprised 78% of the total Pacific Ocean albacore catch of 168,537 mt in 2012. The South Pacific albacore catch in 2012 was 87,012 mt, the second highest on record (Fig. 1).

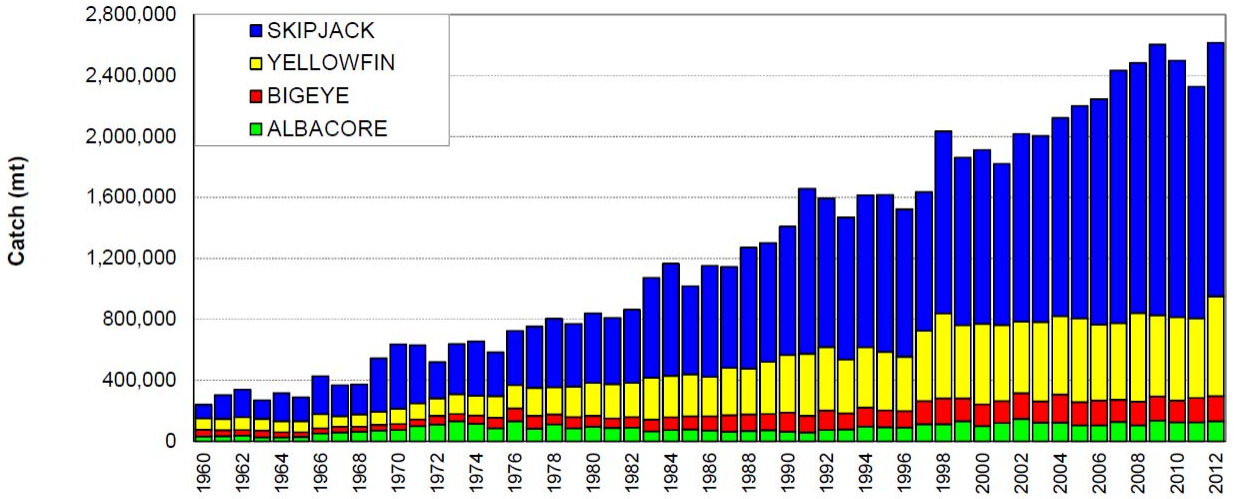


**Figure 3:** Catch (mt) of albacore, bigeye, skipjack and yellowfin tunas in the WCPFC Statistical Area.

12. The provisional 2012 purse-seine catch of 1,816,503 mt was the highest catch on record and more than 30,000 mt higher than the previous record in 2009 (1,785,626 mt) (Fig. 2). The 2012 purse-seine skipjack catch (1,348,554 mt) was the second highest on record (after the 2009 catch) with a slight decline in the adjusted skipjack tuna catch (74%) compared with recent years. The 2012 purse-seine catch estimate for yellowfin tuna (398,464 mt – 22%) was also the second highest on record, just below the record catch of 2008 (400,908 mt), and following a relatively poor catch year in 2011. The provisional catch estimate for bigeye tuna for 2012 (69,164 mt) was again among the highest on record but may be revised once all observer data for 2012 have been received and processed. The high bigeye catch in 2012 coincides with the second highest number of associated sets (WCPFC database), albeit a 15–20% reduction on the record high in 2011. The number of purse-seine vessels in the tropical fishery was an all-time high (294 vessels) and effort (both in terms of days fishing and number of sets) was the second highest (to that expended in the fishery during 2011).

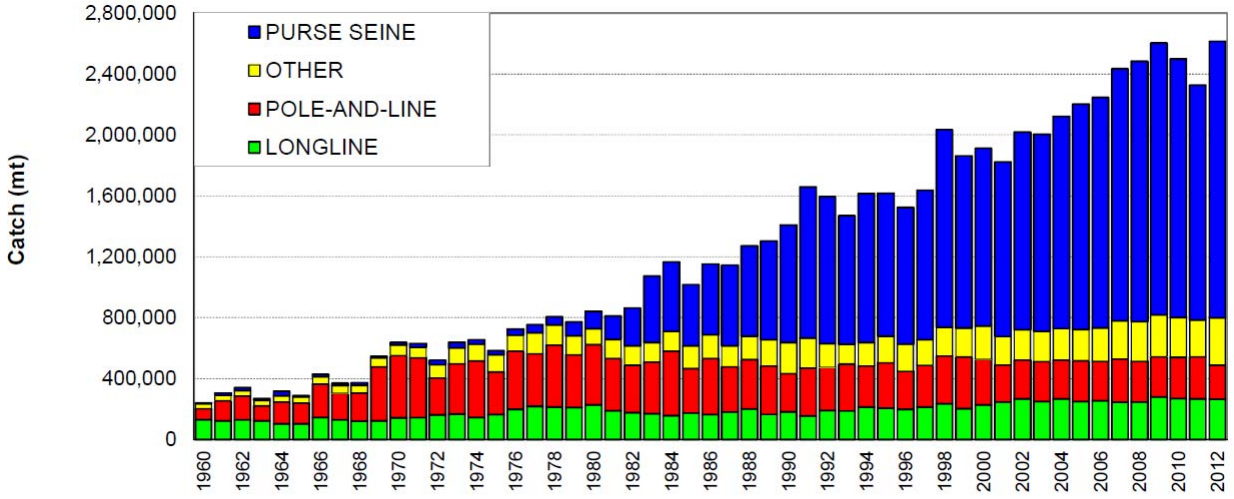


**Figure 4:** Catches (mt) of albacore, bigeye, skipjack and yellowfin tunas in the WCPFC Statistical Area, by longline, pole-and-line, purse-seine and other gear types.

13. The beginning of 2012 experienced neutral El Niño-Southern Oscillation (ENSO) conditions, and other than relatively weak El Niño-type readings in the middle of the year, 2012 was essentially characterized as a neutral ENSO period. In line with these ENSO conditions, purse-seine fishing activity extended farther east than in previous years, with effort split into two main areas: the "typical" area of activity in PNG, FSM and Solomon Islands, and another area of high activity in and around the Gilbert Islands in Kiribati.

14. The 2012 pole-and-line catch (224,207 mt) was the lowest annual catch since the late-1960s, continuing the trend in declining catches for three decades. The Japanese distant-water and offshore fleets (78,838 mt in 2012), and the Indonesian fleets (133,306 mt in 2012), account for most of the WCP–CA pole-and-line catch. 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 2012 reduced to only 90 vessels, the lowest on record). The Solomon Islands fleet recovered from low catch levels experienced in the early 2000s (only 2,773 mt in 2000 due to civil unrest) to reach a level of 10,448 mt in 2003. This fleet ceased operating in 2009, but resumed fishing in 2011 and took 11,221 mt in 2012, the highest catch since 1999.

15. The provisional WCP–CA longline catch (262,076 mt) for 2012 was the fifth highest on record, at around 15,000 mt lower than the highest on record attained in 2009 (279,012 mt). The WCP–CA albacore longline catch (98,854 mt – 37%) for 2012 was the third highest on record, 4,000 mt lower than the record catch of 103,364 mt taken in 2010. The provisional bigeye catch (76,599 mt – 29%) for 2012 was similar to the level in 2011, which is below average for the past 10 years. The yellowfin catch for 2012 (85,245 mt – 32%) was the lowest for four years but similar to the average catch level for this species over the past decade.

16. The 2012 South Pacific troll albacore catch (2,925 mt) was similar to the 2011 catch level. The New Zealand troll fleet (168 vessels catching 2,727 mt in 2012) and the USA troll fleet (9 vessels catching 198 mt in 2012) typically account for most of the albacore troll catch, with minor contributions by fleets from Canada and the Cook Islands when their fleets are active (which was not the case in 2012).

17. With respect to the economic condition of the WCPFC Statistical Area fishery, there was an exceptionally low carry-over of raw material stocks for canning from the end of 2011 as a result of poor fishing conditions and the closure of some PNA exclusive economic zones (EEZs) towards the end of year due to a shortage of vessel day scheme days. Anticipation of periodic surges in demand at the consumer level for final products further exacerbated the demand for adequate raw material supplies, which could not be met at the start of the year. As the year progressed, the supply situation was mixed and along with uncertainties of the supply situation from the fish aggregating device (FAD) management measure and the seasonal closures of the purse-seine fishery in the eastern Pacific in the latter half of the year, pressure was on processors to continuing paying elevated prices. With competition between canneries in Thailand and Latin America, which faced shortages in raw material supply and similar uncertainties during the year, elevated prices were sustained and even pushed to new levels.

18. The supply situation for white-meat raw material was also an issue during the year as it was for the pole-and-line fishery, and prices for albacore and pole-and-line skipjack rose steeply. Sashimi markets for WCPFC Statistical Area products showed mixed performances with Japanese markets underpinned by the long-term, downward trend in consumption while the USA market displayed some improvement.

19. Prices in the major markets for WCPFC Statistical Area skipjack catches continued to rise to unprecedented levels in 2012. The Bangkok benchmark averaged USD 2,074/mt, up 20% over the previous year. The Yaizu average price for skipjack was JPY 168 (USD 2,101/mt), up 17% (17%) from 2011. The price trend for purse-seine caught yellowfin, on the other hand, was mixed with Bangkok

prices up by only 2% to USD 2,478 while Yaizu prices averaged JPY 264/kg (USD 3,304/mt) or 14% (14% in US dollar terms) down from 2011.

20. The estimated delivered value of the entire purse-seine tuna catch in the WCPFC Statistical Area for 2012 is USD 4,054 million, 42% higher than 2011, driven by increases in both skipjack and yellowfin values. Yellowfin values increased by 38% and skipjack 44%.

21. The average pole-and-line price at Yaizu in 2012 averaged JPY 265 (USD 3,321) against an average of JPY 189 (USD 2,369) in 2011, a substantial improvement of 40% in Japanese yen terms (similar in US dollar terms). The estimated delivered value of the total catch in the WCPFC Statistical Area pole-and-line fishery for 2012 is USD 586 million, a slight decline of less than 1% from 2011, caused by the 19% decline in catch that more than offset the increase in price.

22. Japanese longline-caught yellowfin prices (ex-vessel) landed at Yaizu port declined by 10% (similar in USD terms) to JPY 607/kg (USD 7.61/kg). Japanese fresh yellowfin import prices (cost, insurance and freight) from Oceania also fell, down 2% to JPY 875/kg (USD 10.97/kg). In the USA market, fresh import prices of yellowfin averaged USD 9.64/kg (free alongside ship) compared with USD 9.07 in 2011, a rise of 6%.

23. Frozen bigeye prices (ex-vessel) at selected major ports in Japan declined by 7% in 2012 to JPY 946/kg (USD 11.86) while fresh bigeye prices (ex-vessel) increased by 6% to JPY 1,315/kg (USD 16.48). Japan fresh bigeye import prices (cost, insurance and freight) from all sources increased by 6% to JPY 924/kg (USD 11.58) while fresh import prices from Oceania at JPY 1,076/kg (USD 13.49) were only marginally higher than the previous year's prices.

24. Japanese fresh bigeye import prices from Oceania on average remained stable relative to the 2011 average price. A similar trend also occurred in USA fresh bigeye import prices, which increased marginally to an average of USD 8.98/kg, which is the highest to date.

25. The Bangkok albacore market benchmark price averaged USD 3,286/mt in 2012, up 18% from the 2011 average and the highest to date. Thai import prices of frozen albacore in 2012 improved by 16% to USD 3,534/mt (USD 3.53/kg) from USD 3,044/mt (USD 3.04/kg) in 2011. The USA import price of fresh albacore improved 3% to USD 4.71/kg from USD 4.56 in 2011. Prices for fresh landings at major ports in Japan increased by 2% to JPY 295/kg (USD 3.70/kg).

26. The estimated delivered value of the longline tuna catch (excluding swordfish) in the WCPFC Statistical Area for 2012 is USD 1,962 million, a decline of USD 71 million on the estimated value of the catch in 2011. The value of the albacore catch increased by USD 70 million, bigeye declined by USD 15 million and yellowfin decreased by USD 127 million.

27. The total estimated delivered value of the WCPFC Statistical Area catch in 2012 was USD 7.2 billion, an increase of 23% from 2011. The purse-seine fishery accounts for 56% of the total value and the longline fishery accounts for 27%. By species, skipjack represents 49% of the total value, with yellowfin 30%, bigeye 15% and albacore 6%.

**Discussion**

28. In response to questions from SC9, SPC clarified the following points relating to western and central Pacific Ocean (WCPO) fisheries in 2012:

- While yellowfin tuna caught by other fisheries increased in 2012, which includes catches from the Philippines and Indonesia, according to reports from the Philippines, catches have

not increased significantly. It appears from the preliminary assessments of the data that the increase is due to artisanal catches in Indonesia, but a high degree of uncertainty exists. Historical data and reporting issues will be included in the future assessment of the issue.

- There is a recent lack of consistency in vessels reporting days in transit and fishing days. This has strong implications for effort measurement and is under investigation. A comparison of logbook and vessel monitoring system (VMS) data is expected to yield useful indicators to improve effort measurement.
- Albacore prices are higher per tonne than skipjack prices, but the canned price is the same. Because this situation affects fishing activity, work is required on how the landed price discrepancy affects the fishery.
- There has been no specific study referring to the shift in purse-seine fishing grounds between 2011 and 2012, which is possibly related to ENSO effects.
- The change in size composition of the tuna catch from Indonesia and the Philippines warrants a deeper look at the data to determine whether it indicates selectivity in the fishery, increased numbers of small fish, or other effects.
- The change in longline catch in the eastern area will not be explained until all of the aggregated data can be analyzed.

29. Some CCMs noted the recovery in skipjack catch rates, and were concerned that this may be driven by the under-reporting of fishing days and the over-reporting of transit days, and requested that SPC continue to investigate and report on this matter.

30. Further concerns were raised about the increasing catches of bigeye and yellowfin, and the continued high levels of catches of albacore, and the expansion in effort that has been seen recently in the South Pacific albacore longline fishery. These CCMs noted that these increases in catch and effort continue despite conservation and management measures (CMMs) being in place, and undermine efforts to maintain profitable and sustainable fisheries.

31. PNA expressed appreciation for the explanation on page 24 of SC9-GN-WP-01 on the issues associated with longline catch per unit of effort (CPUE) and effort. Given the importance of the levels of effort in WCPO fisheries, PNA requested that overall longline effort, and effort for the major longline fleets, similar to that presented for the purse-seine fishery, be included in the future.

### 2.2 Overview of eastern Pacific Ocean fisheries

32. K. Schaefer (IATTC) presented a summary (SC9-GN-WP-02) of the fishery and assessments of major stocks of tunas exploited in the eastern Pacific Ocean (EPO).

33. The fishing capacity of the purse-seine fleet fishing in the EPO increased rapidly from 1995–2005, but has been fairly steady since about 2006, slightly above 200,000 cubic meters of well volume. The reported nominal longline effort has fluctuated between about 300 million hooks and 100 million hooks set annually over the past 30 years. After the highest peak in 2002–2003 of about 300 million hooks there was a distinct decline to about 100 million hooks, but in recent years has increased to about 150 million hooks. Total tuna catches increased starting in 1996, peaking in 2003, and in 2012 were close to the average of the past nine years.

34. Yellowfin tuna catches have remained fairly stable since the mid-1980s, except for a peak in 2001–2003, followed by a substantial decline in 2006–2008, a slight increase in 2009 and 2010, and another decline in 2011 and 2012. The 2012 catch on dolphin-associated schools was similar to 2011, and substantially less than 2009 and 2010. Catches of yellowfin in unassociated schools in 2012 remained

low, similar to the past seven years. The current stock assessment method being used for yellowfin is Stock Synthesis III. Since 2004 recruitment has been relatively low, although not quite as low as it was from 1977–1983. Recent estimates indicate that the yellowfin stock in the EPO is overexploited ($S<S_{MSY}$), but that overfishing is not taking place ($F = F_{MSY}$). The current status of the stock is considerably more pessimistic if a stock recruitment relationship is assumed, if a higher value is assumed for the average size of the older fish, and if lower rates of natural mortality are assumed for adults.

35. 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 2012 was similar to other peak years over the past decade, and just below the upper reference level. Following a large peak in 1999, the catch per days fished on floating objects has generally fluctuated between an average level and the upper reference level. The value for 2012 was below the 2011 value, which was the highest since the peak in 1999. Except for 2010, biomass and recruitment have been relatively high over the past several years, including 2012, and the exploitation rate has remained relatively high over the past decade. There is uncertainty about the status of skipjack tuna in the EPO, and there may be differences in the status of the stock among regions. However, there is no evidence that indicates a credible risk to the skipjack stock(s).

36. There have been substantial historical changes in the bigeye fishery in the EPO. Beginning in 1994 purse-seine catches increased substantially to targeting tunas associated with drifting FADs in the equatorial EPO. Longline catches have been relatively low during the past 7 years versus the previous 23-year period and the estimated longline catch in 2012 of only about 19,500 mt is the lowest on record in the past 30 years. The current stock assessment method being used for bigeye is Stock Synthesis III. A full assessment was conducted in 2012, which included some major changes in methodology to the previous full assessment done in 2010. Recruitment estimates have been variable since 1975. There were very high peaks in recruitment indices corresponding with major El Niño events in 1983 and 1998. Recent recruitment indices are predominantly below average. Recent estimates indicate that the bigeye stock in the EPO is not overexploited ($S>S_{MSY}$), and that overfishing is not taking place ($F<F_{MSY}$). The current status of the stock is considerably more pessimistic if a stock recruitment relationship is assumed, if a higher value is assumed for the average size of the older fish, and if lower rates of natural mortality are assumed for adults.

37. A tuna conservation resolution was adopted by IATTC in June 2013, for the three-year period 2014–2016, extending the previous resolution that expired at the end of 2013. This includes an EPO-wide closure for purse-seine (>182 mt) fishing of 62 days in each of those years, along with a 30-day closure of a core offshore FAD fishing area. There is a special provision for class 4 vessels (182–272 mt), which permits 30 days of fishing during the EPO closure provided an observer is on board. For longline vessels (>24 m) the resolution includes fixed bigeye catch limits for China, Japan, Korea, Chinese Taipei and other CPCs[2] not to exceed 500 mt or their respective catches in 2001, whichever is greater.

**Discussion**

38. PNA thanked IATTC for its comprehensive report on tuna and billfish in the EPO, and noted that IATTC was now using fishery and biological indicators to assess the status of skipjack because alternative methods were no longer considered appropriate. PNA requested an explanation on the problems experienced with the alternative methods, asking if there was anything to learn from the IATTC experience. IATTC suggested that this be asked later in the session on skipjack.

[2] IATTC Party, cooperating non-Party, fishing entity or regional economic integration organizations are collectively called "CPCs".

39. In response to questions from SC9, K. Schaefer clarified the following points relating to EPO fisheries in 2012:

- There is still not enough information to explain the recruitment and/or productivity regimes for EPO yellowfin in relation to associated periods of increased biomass. Further work is required.
- A full assessment, incorporating the spatial structure of EPO yellowfin, will be undertaken in 2013.
- A Pacific-wide assessment for bigeye tuna is being discussed by IATTC and SPC.

### 2.3 Annual Report (Part 1) from Members, Cooperating Non-Members and Participating Territories

40. Each CCM presented its Annual Report Part 1, highlighting recent changes and developments in their fisheries.

41. Chinese Taipei expressed its willingness to invite SPC scientists to analyze longline operational data jointly.

### 2.4 Reports from regional fisheries bodies and other organizations

42. No reports were presented.

## AGENDA ITEM 3 — DATA AND STATISTICS THEME

43. The Data and Statistics Theme session was convened by L. Kumoru; P. Williams (SPC), M. Kamatie (FFA) and C. Reid (FFA) served as support rapporteurs for the session.

### 3.2 Data gaps

#### 3.2.1 Data gaps of the Commission

44. P. Williams (SPC) reported on the major developments over the past year with regard to filling gaps in the provision of scientific data to the Commission (SC9-ST-WP-01).

45. All CCMs with fleets active in the WCPFC Convention Area have now provided 2012 annual catch estimates. Estimates for the key shark species (in accordance with the change in the requirements to include the key shark species catches) continue to improve and coastal states have begun using the new extended longline logsheets which has the provision for reporting shark at the species level.

46. In general, the timeliness of the provision of aggregate catch and effort data continues to improve with nearly all CCMs providing data by the deadline of 30 April 2013. The quality of aggregate data provided has also improved with a reduction in the number of notes assigned to the aggregate data in recent years. A new structure of notes has been provided for the 2012 data provisions with the separation of data gaps notes from general notes, providing more background on the data provided. Operational data for the longline fleet from American Samoa (2007–2012) was provided for the first time, and annual catch estimates for one new fleet were provided for the first time (Portugal longline). Japan provided aggregated longline catch in weight data for the first time, which facilitated reconciliation with its annual catch estimates.

47. The main data gaps listed in working paper SC9-ST-WP-01 are:

- the non-submission of annual catch estimates by EEZ and high seas for several key fleets (Section 2.4);
- the implications of non-submission of operational data for several key fleets (Section 2.5);
- the non-submission of a number of vessels in the aggregate data for several key fleets (Section 2.7); and
- the need for improvement in the submission of catch estimates for the key shark species and reporting of discard estimates.

48. Further progress was made with the attribution of catch under the latest WCPFC charter notification scheme (CMM 2012-05), and this paper describes the procedures used by the scientific services provider to attribute catch, and ensure that double-counting of catches for chartered vessels is not occurring.

49. The paper deals with three specific requests directed to SC9 (see Section 3):

- Information on the tropical tuna catch and effort for gear types other than purse-seine and longline for discussions on CMM 2012-01.
- Scientific data requirements for whale shark (new key shark species to be added).
- Available information on sailfish.

50. The WPEA OFM Project, which provides support to the Philippines, Indonesia and Vietnam with respect to establishing tuna fishery data collection and management systems, has now terminated, but there are positive indications that the next project will commence in 2014. There remains significant work to be done to improve the coverage and quality of logbook, port sampling and observer data, and the reliability of annual catch estimates for certain gear types. For Indonesia, the main data gaps continue to be the lack of aggregate catch and effort data and the uncertainty of the estimates for their artisanal tuna fisheries. For the Philippines, the main data gap is the reliability of the historical estimates for their small-scale, artisanal hook-and-line fisheries. For Vietnam, the main data gap is the complete lack of historical annual catch estimates prior to 2000.

**Discussion**

51. The EU noted that it was highly desirable for them to gain better access to Regional Observer Programme (ROP) data. The EU also requested that SC make recommendations to the Commission to improve WCFPC public domain data, and asked whether it would be possible to filter the data after it was aggregated, combining all data and not broken down by flag. SPC advised that it is technically possible to do this when they have access to vessel numbers per stratum.

52. Chinese Taipei noted that it will be providing aggregate data for its small-scale tuna longline fleet fisheries from 1997–2003, which were not previously provided.

53. The Philippines sought clarification on the provision of scientific data on whale sharks, noting that it might have difficulty in collecting data on potential interactions, although it can provide data on sightings.

54. SC9 discussed whether CCMs providing aggregate data without vessel numbers would consider agreeing that these data can be made available in the public domain.

55. One CCM suggested a potential solution with regard to filtering WCPFC public domain data: WCPFC Secretariat formally contact each of the CCMs identified as: i) not providing operational data;

and ii) not providing the number of vessels for each spatial unit in their aggregate data, to provide a version of their aggregate data that can be included in the WCFPC public domain data. The WCPFC Secretariat agreed to do this.

56. FFA members noted that with regard to the three-vessel rule that some FFA members have legal constraints relating to the publication of data for individual vessels but that this does not affect the availability of data for Commission purposes, only the availability of data in the public domain. FFA members further noted that if all CCMs provided their data to the Commission in full, then this wouldn't be an issue because SPC could aggregate the data for public domain purposes. FFA members noted their preference that the three-vessel rule remain in place until such time as all CCMs are providing operational level data.

57. SC9 noted the issues related to observer coverage in the longline fishery, which is currently well below the 5% minimum requirement for most CCMs, and will consider what can be done to improve coverage as a matter of priority.

58. FFA members thanked SPC as the scientific services provider for the report, and noted their pleasure in seeing the progress reported, particularly the improvement in estimates of catches of key shark species, while noting that there are still some members who have difficulty in meeting this requirement. FFA also noted several other important data gaps that were of serious concern to them and that the information in para. 34 of SC9-ST-WP-01, inserted below, on the implications for the WCPFC science programme of non-compliance with requirements for provision of operational data was very helpful. FFA members proposed that this information should be included in the SC9 Summary Report as requested by WCPFC9.

> 34. The implications of the ongoing failure in the provision of operational data for the Commission's science include the following:
>
> - There are many instances in the Commission's work where a breakdown of catch and/or effort by areas of national jurisdiction and the high seas is required and this is not possible without operational data. Currently, for example, estimates of EEZs and the high seas catch and effort are constrained by the lack of operational data.
> - The absence of operational data has made it difficult to ensure that double-counting is not occurring when attributing catches from flag States to charter nations.
> - Several studies using fine-scale operational data have identified important trends that are not evident in the aggregate data but need to be considered in the assessments (e.g. Hoyle et al. 2010). Better access to operational data would potentially provide a better understanding of historical trends that are currently not taken into account in the assessments using aggregate data; for example, obtaining a better understanding of declines in longline bigeye tuna CPUE, which are not apparent without access to operational data;
> - Fine-scale models, such as the SEAPODYM model, can only use operational level data as the fishery-dependent data input. Currently, outputs of SEAPODYM models are constrained by the lack of operational data.

59. FFA members noted that the provision of operational data is a binding obligation for all members and that some refuse to meet these obligations. FFA members also noted that in 2010 the Commission requested that CCMs who are not able to provide operational level data due to domestic legal constraints were to provide data improvement plans to SC and that, to date, no such plans have been provided to the Commission.

60. Korea noted that in several parts of the reports on data gaps, Korea was mentioned in relation to both aggregated data and operational data. The Korean delegation stated that once they were fully

informed regarding the precise nature of these data gaps, they would be willing to address the problem and resolve the issue. Korea has agreed for its scientist to travel to Noumea, New Caledonia, to collaborate with SPC on cross-checking and analysis of its operational data.

61. Korea noted that ROP data are important for both Korean scientists and the Ministry of Fisheries staff to analyze scientific data collected by observers, and to check the implementation of ROP on its flagged vessels, and to prepare documents requested by CMMs. Korea does not, however, have access to observer reports from its vessels. SPC noted that Korea can request the data from the WCPFC Secretariat. Korea was advised to refer to para. 14 in the Rules and Procedures for Protection Access to and Dissemination of High Seas Non-Public Domain Data to request observer reports for its own vessels (refer to Commission-09 at http://www.wcpfc.int/guidelines-procedures-and-regulations).

62. Japan requested that observer data be released to flag States' scientists.

63. Japan noted that the release of operational data is a legal issue, not a scientific issue, and should be discussed at the Technical and Compliance Committee (TCC) meeting or at the Commission meeting, not SC. Japan reiterated that it has made operational data available to SPC scientists via collaborative work.

64. One CCM reminded all other CCMs that under the Rules and Procedures for the Protection Access to and Dissemination of High Seas Non-Public Domain Data, CCMs that have not complied with data provision obligations for two years may not be given access to non-public domain data, which includes observer data.

65. FFA members recommended that SC9-ST-WP-01 be forwarded to the Ninth Regular Session of TCC for their consideration under the agenda item that addresses data gaps, and that TCC be asked to focus on two main issues: i) identifying those countries that are not providing operational level data, and devising and recommending mechanisms for these CCMs to report on this issue and address this non-compliance; and ii) implementing alternative measures for collecting these data, including increasing observer coverage for fleets of CCMs for which the Commission holds little or no operational level data.

66. FFA members requested that while the issues of data provision are being worked on, SC noted that those CCMs not providing operational data are required by the WCPFC data provision rules to provide annual catch and effort estimates by EEZs and high seas separately as a part of their aggregate data submission, in addition to the number of vessels for each spatial unit of their aggregate data.

67. FFA members stated that SC should recommend that the scientific data rules be amended to clarify the requirement for CCMs to provide aggregate longline effort in fishing days.

68. FFA members noted that working paper SC9-ST-WP-01 highlights the need for further improvements in the submission of catch estimates for key shark species and reporting of discard estimates, and that FFA members have adopted the use of revised logsheets that capture species-specific reporting for key shark species, and encouraged other CCMs to swiftly address issues they may have in species-specific catches and discards reporting by their fleets.

69. FFA members thanked SPC for its work in resolving some of the issues relating to the catch allocation of chartered vessels, and thanked relevant flag States for their role in the resolution of these matters. FFA members noted that working paper SC9-ST-WP-01 makes reference to some CCMs such as Chinese Taipei, who have yet to identify and remove chartered catch and effort from their annual estimates and data provision, and asked that these CCMs work with SPC to swiftly resolve these outstanding issues.

70. FFA members noted that Table 1 in working paper SC9-ST-WP-01 provides a good basis for identifying which of the "other commercial fisheries" may require management action by the Commission, and suggested that SC recommend forwarding the Table to TCC9 and WCPFC10 for their consideration in relation to para. 29 of CMM 2012-01, but amend the Table to reflect the exclusion of those fisheries that take less than 2,000 mt of bigeye, yellowfin, and skipjack tunas, as identified in para. 30 of the measure.

**Data for use in 2014 stock assessments**

71. S. Harley (SPC) presented a paper on the consideration of data to use in the 2014 stock assessments for bigeye, yellowfin, and skipjack tunas (SC9-ST-WP-06). This paper proposes that the 2014 stock assessments for bigeye, yellowfin, and skipjack tunas be undertaken using data through to the end of 2012, rather than through to the end of 2013, as would normally be the case. The reasons for this are three-fold:

i) WCFPC members usually provided their aggregate catch and effort and size data by the 30 April deadline, but in some cases have acknowledged the data provided for the most recent year are provisional. It is often the case that more complete data, particularly for distant-water longline fleets, are provided after SC meetings. Significant changes to the most recent year's data have occurred on several occasions after an SC meeting in recent years and, therefore, left assessments potentially vulnerable to bias.

ii) In recent years, the first "cut-off" for finalizing the previous year's data for the assessments, has not been possible until the second week of July.

iii) Because this is within 15 days of the due date for the submission of working papers to SC, subsequently the assessment documents are often rushed and sometimes late, giving SC insufficient time to review the documents prior to the SC meeting.

72. S. Harley noted that by finalizing the data for the assessment later this year, it would allow: i) the assessment work to begin in late 2013, ii) the bigeye review tasks to be undertaken using the data that would be used for the 2014 assessment, iii) allow the Pre-Assessment Workshop to have a more thorough review of the model and its data, and iv) allow for the timely submission of the assessment working papers to SC10.

73. More complete data for 2013 would still be available for inclusion in any projection analyses that are undertaken after SC10 to support the Commission's consideration of management measures.

**Discussion**

74. FFA members noted that the proposal in this paper is a prime example of the need for CCMs to meet their data provision obligations and provide operational level data completely and in a timely manner. FFA members will support the proposal to exclude the most recent year of data, but only as a provisional measure for next year's assessments and that the issue will be revisited at SC10. FFA members would also like to ensure that data from the most recent year is still used in projection analyses and that SC should forward this issue to TCC9, highlighting the fact that the proposal is a result of the ongoing non-compliance and lack of provision of operational data by some CCMs.

75. Japan asked whether it would be possible to conduct a full assessment using 2012 data and an update using 2013 for SC10. SPC advised that it would not be possible to do both.

76. SC9 agreed to recommend the use of 2012 as the terminal year for the data to be included in the stock assessments undertaken for SC10, but that the projections use data up to and including 2013.

77. **SC9 recommended that:**

**a) Working paper SC9-ST-WP-01 be forwarded to TCC9, recommending specific action in regards to each of the following important data gap issues:**

**i) CCMs that have yet to provide operational level catch and effort data should provide, as soon as possible:**

- **annual catch estimates by gear type and species for waters of national jurisdiction and high-seas areas separately, as per the Scientific Data to be Provided to the Commission;**
- **the number of vessels for each spatial unit in their aggregate data provisions, as per the Scientific Data to be Provided to the Commission; and**
- **operational data improvement plans, as agreed to at WCPFC7.**

**ii) The need for improving the submission of annual catch estimates for the key shark species and the reporting of discard estimates.**

**b) TCC9 should consider alternative measures for collecting operational data such as increasing observer coverage for fleets of CCMs for which the Commission holds little or no operational level data.**

**c) The Commission note the advice set out in para. 34 of working paper SC9-ST-WP-01 on the implications for the Commission's science programme of the failure to provide operational data that was requested by WCPFC9.**

**d) The WCPFC Secretariat formally contact each of the CCMs identified as either i) not providing operational data, and/or ii) not providing the number of vessels for each spatial unit in their aggregate data, and request the following:**

- **That they provide these data to the Commission in order to meet their obligations of Scientific Data to be Provided to the Commission.**
- **That information is provided on what constraints hinder their ability to provide operational data to the Commission, and actions being taken to address this issue.**
- **That CCMs confirm whether their aggregate data, as provided, can be included into the WCPFC public domain data.**

**e) A summary of "other" gear catches of the tropical tuna species (Table 1 in SC9-ST-WP-01) should be forwarded to TCC9 for its consideration in relation to para. 29 of CMM 2012-01 with a modification to the Table to reflect the exclusion of those fisheries that take less than 2,000 mt of bigeye, yellowfin and skipjack tunas, as identified in para. 30 of the measure.**

**f) As proposed in working paper SC9-ST-WP-06, stock assessments to be undertaken and presented for SC10 should use catch and effort data up to and including 2012 data only, but that the projections use data up to and including 2013.**

### 3.2.2 Species composition of purse-seine catches (Project 60)

78. S. Harley (SPC) presented working papers SC9-ST-WP-02 and SC9-ST-WP-03 on behalf of T. Lawson and F. Lasi (SPC). A consultancy agreement was established between WCPFC and SPC in April 2009 for a project on the collection and evaluation of purse-seine species composition data. The objective of the project is to improve the collection and representative nature of species composition data caught by purse-seine fisheries in the WCPO in order to improve stock assessments of key target species in the WCPO. The initial duration of the project was 1 April 2009 to 31 January 2010. The project was extended to the period 1 April 2010 to 31 January 2011, then to the period 1 February 2011 to 31 January 2012, then to the period 1 February 2012 to 31 January 2013, and then to the period 1 February 2013 to 31 July

2014. The project is intended to satisfy the requirement under the Terms of Reference that a report for the current period shall be submitted to the Commission by 12 July 2013.

79. The scope of work under the project includes the following:
   a) Continue to identify key sources of sampling bias in the manner in which species composition data are currently collected from WCPO purse-seine fisheries and investigate how such biases can be reduced.
   b) Review a broad range of sampling schemes at sea as well as onshore; develop appropriate sampling designs to obtain unbiased species composition data by evaluating the selected sampling procedures; extend sampling to include fleets, areas and set types where no representative sampling has taken place; verify, where possible, the results of the paired sampling against cannery, unloading and port sampling data.
   c) Review current stock assessment input data in relation to purse-seine species composition and investigate any other areas to be improved in species composition data, including the improvements of the accuracy of collected data.
   d) Update standard spill sampling methodology.
   e) In preparing the project report, be cognisant of the SC8 Summary Report discussion sections (paras. 79–88), and the Recommendations (para. 89): a compromise between the size of the spill sample and the necessary volume of data be determined; the practicality of an observer taking spill samples from every tenth brail as well as all other observer duties be considered.

80. Regarding scopes:
   a) Improvements have been made to the models used to estimate species composition from observer data; a simulation model of the brailing and sampling processes has been developed; and an exploratory analysis of pooling of observer data was conducted. Future work will extend the use of the simulation model and further examine pooling and post-stratification.
   b) Field work for Project 60 has almost been completed and the contract of the Data Collection Officer will terminate on 31 August 2013. Spill sampling has been shown to be a more accurate and reliable protocol for the collection of species and size composition data; the recommended spill sampling protocol is given in the Appendix. Analysis of Noro data will occur when all data have been processed.
   c) Both catch data and length frequencies used in the tuna stock assessments are now adjusted regularly on the basis of the analyses discussed under scope (a).
   d) The spill sampling methodology has been updated in the Appendix.

81. Working paper SC9-ST-WP-03: i) updates the estimation of selectivity bias with recent paired sampling data; ii) presents the results of simulations of brailing and sampling, and compares two approaches to the analysis of the paired samples; iii) further develops the models used to estimate species composition by including the proportion of skipjack determined from catch and effort logsheets as a covariate; and iv) presents the results of an exploratory analysis of the use of pooled observer data to estimate the species composition. References are made to recent independent reviews of Lawson (2012) and responses to the reviews are presented.

**Discussion**

82. FFA members thanked the USA for the initiative in undertaking the review of statistical methods used in estimating catch composition from the results of Project 60, and expressed their appreciation to those who participated in the review. FFA members noted that it is clear from the reviewers' papers that there are still some substantial questions about the reliability of estimates that result from the combination of logsheet data, grab sampling and spill sampling, appreciated that the simulation modeling may have clarified some of the issues raised by the reviewers, supported the continuing priority being given to this

work by SC and SPC, and supported additional spill sampling to get improved estimates of the grab sampling bias. FFA members were particularly interested in the results of the comparison between the estimates from the generalized linear model (GLM) results and the pooled observer data and asked what the potential is for this approach and if it is planned to move it beyond an exploratory phase. FFA members also noted that since the 100% observer coverage is still only in an early stage, the quality of observer data for this purpose should improve significantly with time.

83. Japan noted that it was important that accurate estimates be obtained of actual catch levels as well as of catch composition, and that it was important to validate observer catch estimates. Japan offered to provide unloading data and port sampling data for relevant trips in order to conduct the validation analysis through collaborative work with SPC.

84. FFA members noted that they had raised concerns over layering previously, and that they appreciated the coverage of layering in SC9-ST-WP-03. They also noted that it appears that layering in the net is less of a concern but that layering in the brails is still a significant issue and supported priority being given to work on layering. FFA members asked what is needed to address the outstanding concerns about layering, especially within brails and whether the proposal to take more frequent samples from brails using smaller bins potentially increase the risk of bias from layering in brails.

85. PNA members noted that composition of catch data is important and are aware of the difficulty of differentiating between juveniles of yellowfin tuna and bigeye tuna, and asked if this could be addressed and requested that SC8 plan for the collection of catch composition data for purse-seine vessels be improved and updated in line with the review.

86. Tuvalu, on behalf of PNA, made the following statement:

> Purse-seine composition data is important to Tuvalu and other PNA members because it has a big influence on the discussions on cutting FAD use. We understand that it is difficult to distinguish between small bigeye and small yellowfin. But the other main cause of this problem is that the vessels purposefully report all their catches as skipjack and are failing to report bigeye and yellowfin. We appreciate the statistical solutions proposed in the paper to improve the accuracy of the estimates of the purse-seine catch species composition. However, it seems to us that there should be scope for improving it, simply by taking action to reduce the misreporting.

87. SPC noted that the pooled approach could only be applied for periods when data coverage is good and that GLM will most probably have to be applied to obtain a time series back to 1980.

88. SPC thanked Japan for the offer to provide purse-seine unloading data to compare with information collected by observers. Although validation of total catch was important, SPC noted that estimates of species composition from observer data were produced for time/area/set type strata and not necessarily for the vessel trip (which unloading data represent).

89. SPC noted that there was a possibility of addressing the layering issue by super-sampling. SPC further noted that the Center for Independent Experts (CIE) review was for a finite period and additional cost would be required to re-engage the reviewers.

**Recommendations**

90. **SC9 recommended that:**

> **a) the scientific services provider continue with analyses and simulations related to the consultancy reports on species composition in the purse-seine fishery. SC9 requested that**

**the scientific services provider provide to SC10 annual estimates of the purse-seine catch based on: i) logbook reported species composition, ii) observer grab samples (previous approach), and iii) observer grab samples corrected for selectivity bias from spill sampling. Catch series from any variants on these should also be included. This will allow SC to follow changes in purse-seine catch estimates from historical methods. The work should also include any guidance on the implications of future estimates if only grab sampling occurs, (e.g. Can the selectivity bias correction be used into the future?).**
**b) the scientific services provider update the "Plan for Improvement of the Availability and Use of Purse-Seine Catch Composition Data" (presented to TCC8) according to the recent work described in SC9-ST-WP-02, highlighting i) there are no budget implications for the WCPFC for work in 2014, and ii) considering the following specific work areas identified at SC9:**

- **Complete the analyses comparing different sources of data collected at Noro, Solomon Islands (SPC).**
- **Undertake a comparison of unloading data from Japan with observer data (Japan and SPC).**
- **Undertake a comparison of port sampling data collected in PNG with observer data (PNG/NFA and SPC).**
- **Continue the simulation modeling to assess the effectiveness of different approaches to addressing biases in catch composition estimates (SPC).**
- **Evaluate the scope for the use of pooled observer data, and the possible scope for super-sampling to address layering in brails (SPC and observer providers).**

### 3.2.3 Data issues with ISC

91. One CCM noted its concern with regard to the reciprocity of current data-sharing arrangements between ISC and SPC and whether this was evenly balanced.

92. ISC noted there are data sharing agreements between the ISC and SPC and that SPC has access to ISC data.

93. No recommendations were made. The topic was deferred to the Stock Assessment Theme.

## 3.2 Regional Observer Programme

94. R. Ramiscal (Philippines) presented two papers based on observer data from Philippine vessels.

a) SC9-ST-WP-04: Analysis of purse-seine/ring net fishing operations in the Philippine EEZ

An analysis was made on the catch of purse-seine and ringnets within the EEZ during July to September for the years 2010–2012 based on observer reports. The paper was based on the implementation of Fisheries Administrative Orders (FAO) 236/236-1 that required among others deployment of observers to collect information as basis for improving measures in connection improvement of compatible measure during FADs closure under CMM 2008-01. Catch rates indicated 7.1 mt, 5.6 mt and 9.2 mt/fishing day for the three-year period, respectively. Catch composition was 46% skipjack, 21% mackerel scad, 18% yellowfin, 2% bigeye, 1% kawa-kawa and 13% other species. The study also indicated the relatively smaller sized tunas that were observed in Celebes Sea compared to other tuna fishing grounds in the Philippines.

Preliminary analysis also indicated that average catch of bigeye was relatively lower in shallower nets.

b) SC9-ST-WP-05: Preliminary report on the catch of Philippine group seine operations in High Seas Pocket 1-Special Management Area (HSP1-SMA)

The preliminary report on the catch of group seiners that were granted fishing access in HSP1 was based on observer reports. So far, only 16 of the 36 vessels allowable under WCPFC CMM 2011-01/2012-01 and FAO 245/245-1 were able to comply with the guidelines and given access to operate in the HSP1. Operations from October 2012 to May 25, 2013 included 1,915 days in HSP1 and actual fishing days of 636 with a total catch of 6,046 mt or a catch per unit of effort of 9.51 tons/vessel/fishing day. The catch was 75% skipjack, 16.2% yellowfin, 3.6% bigeye and 4.8% other species with size composition of tuna species significantly bigger than those caught within the Philippines' EEZ.

**Discussion**

95. FFA members thanked the Philippines for the papers on the monitoring of the purse-seine and ring net operations in their EEZ and HSP-1. FFA members noted that they are not sure about the basis of the estimate of bigeye catches for sets with a net deeper than 115 fathoms and asked for clarification. They also noted that they were not sure how the compatibility of the net depth limit with a three-month FAD closure is measured. The Philippines responded that the predictions come from a linear regression based on shallower nets. It was also noted that while the 115 fathoms regulation only applied during the closure, the same nets are used throughout the year.

96. One CCM asked whether any analysis was intended to be conducted comparing the situation before and after the restriction was put in place to quantify any reduction in bigeye catches. The Philippines indicated that future research would be examining hotspot areas for bigeye catches.

97. Another CCM noted that observer activities on Philippine vessels were conducted under difficult conditions and the paper provided a valuable insight into the operation of this fleet, which fishes in the high seas. Palau asked if Philippine observers involved were operating under the regional programme and providing data to SPC on the minimum agreed on ROP fields. The Philippines noted that the observers were operating under the ROP as they are accredited by the programme, and that they had consulted the Commission for ROP observers of other nationalities but none were forthcoming so they used their own national certified observers.

98. FFA members noted that it would be particularly important to be able to get some actual observations on vessels using nets deeper than the net depth limit to be able to compare the results and asked if this is possible. FFA members also asked if the net depth limit was still in place in 2013 and whether deeper nets were being used at all outside the FAD closure period.

99. A CCM asked again whether the data collected was sent to SPC. It was noted that the Philippines had provided size composition data and the remaining ROP data would be provided as it was collated and processed.

100. FFA members noted their appreciation for this work and that they look forward to seeing it further developed. They also noted, however, that they think at this point SC is not able to establish from the information provided that the net depth limit had the equivalent effect of a three-month FAD closure in reducing bigeye catches and fishing mortality.

101. FSM also indicated that it would like to discuss with the Philippines the possibility of placing its national observers on its vessels. The Philippines agreed to this.

102. Chinese Taipei asked if there was a comparison undertaken between unloading data and the sampling estimates. The Philippines noted that samples are taken from every brail and sampled for species and size composition. In regard to unloading data, it was noted that four types of data were available: observer, unloading, logbook and national stock assessment, and they were trying to compare these to the analysis of catch composition.

103. A CCM thanked the governments of New Zealand and New Caledonia for the assistance provided in support of data management and processing for ROP.

104. FFA members thanked SPC for information papers SC9-ST-IP-05 and SC9-ST-IP-06, and thanked the governments of New Zealand and New Caledonia for the assistance provided in support of data management and processing for ROP. FFA members, noting that SC9-ST-IP-05 makes reference to the conclusion of New Zealand funding next year, sought information from SPC on the cost of the position of observer data manager and supported the proposal for this position to be funded by WCPFC.

105. SPC noted that the costing for this position is included under the ROP data management line item in the WCPFC Secretariat's indicative budget from 2014 onwards.

106. FFA members noted the importance of ensuring that observer coverage is "spatially and temporally representative of each fishery operating in the Convention Area", as stated by SC in the past. FFA members further noted that this is logistically difficult, except for the purse-seine fleet and its 100% coverage requirement, and would suggest that this information be provided to SC in future.

107. FFA members proposed a general SC recommendation on improving observer coverage, covering these issues and also including the suggestions in SC9-ST-IP-05 section 3.3, points (i) and (iii), as a means to improve coverage estimates and the summaries of data provision, processing and coverage, specifically:

- The mandatory requirement to provide the following essential information (i.e. vessel, flag, departure date, return date, observer programme) for observer trips conducted by the observer provider as soon as possible after the trip has been conducted.
- For longline trips, a review of VMS data to determine whether it is possible to define an ROP trip before observer data have been processed.

108. **SC9 recommended that:**

a) **The WCPFC Secretariat and the scientific services provider prepare guidelines for review by TCC9 to develop a clear indication of the coverage level required for each CCM fishery, especially with regard to fishery sectors (e.g. distant waters, offshore, coastal longline fisheries), to satisfy the required level of WCFPC longline observer coverage (5%).**

b) **TCC9 endorse the indicative budget for ROP data management that now includes the positions of observer data manager, observer data audit officer, and ROP data entry positions.**

**Review of FAD data fields**

109. The Informal Small Group (ISG-8 on FAD Data Fields) met in the margins of the SC9 to review WCPFC FAD data fields currently being collected, and discussed the following items:

- Withdrawal of observer "Minimum Standard Data Fields" on FADs.
- Add new observer "Minimum Standard Data Fields" on FADs.
- Create minimum standard data FAD fields for a vessel reporting format.
- Prioritizing FAD data entry.

110. **SC9 reviewed the outputs from ISG-8 as listed below, and agreed that these recommendations be forwarded to the TCC9 for further consideration**:

a) **The WCPFC Minimum Standard Data Fields on FADs collected by observers are adequate and no deletions are required.**
b) **An observer should try and estimate or measure, where possible, the size of mesh used in the construction of the FAD, or any extension hanging under the FAD. It was pointed out that this may be difficult to estimate if the FAD is in the water, but an estimate of size could be measured if the FAD was on deck or was retrieved by the vessel for servicing.**
c) **Developing a WCPFC "Vessel FAD Data Reporting Log" to be submitted by purse-seine and tender vessels was worthwhile. However, it was noted that the development of a reporting log on FADs by vessels or reporting format may be facilitated by the development of electronic reporting protocols.**
d) **When developing a Vessel FAD Data Reporting Log, a number of fields were identified that should be included in the log, such as the FAD's type and design along with highlighted identification marks; whether it was a drifting or anchored FAD; if the FAD had electronics associated with it when deployed; and the FAD's condition when it was retrieved.**
e) **There should be no prioritizing of the data entry from Observer FAD Data Forms when received, and the observer FAD data should be entered along with the rest of the observer information collected during their trip. The data collected in other observer forms are required to help explain some of the information collected on the Observer FAD Data Forms.**

## AGENDA ITEM 4 — STOCK ASSESSMENT THEME

111. The Stock Assessment Theme session was convened by J. Brodziak (USA) and M. Ogura (Japan). A. Bloomquist, M. Kai, T. Gedamke, H. Kiyofuji, S. Kohin, and K. Uosaki served as support rapporteurs for this session.

### 4.1 WCPO tunas

### 4.1.1 WCPO bigeye tuna

#### 4.1.1.1 Review of research and information

#### a. Progress on Project 70

112. S. Harley (SPC) introduced working paper SC9-SA-WP-08 on implementing the recommendations of the bigeye review, and outlined the activities undertaken in response to these recommendations. He noted that WCPFC prioritized the importance of implementing the review recommendations in December 2012 through an agreement to fund an additional position at SPC's Oceanic Fisheries Programme for three years to focus on this work plus a one year agreement for additional funds to develop MULTIFAN-CL (MFCL).

113. Work in 2013 mostly focused on three key priority areas raised in the review: i) analysis of longline catch and effort data with respect to changes in targeting and the spatial extent of the fishery; ii) the extent of mixing of tagged fish; and iii) developing the capability in MFCL to model the sexes separately. This work resulted in four information papers for SC9: SC9-SA-IP-04, -05, -06, -07.

114. For the remainder of 2013 and the lead-up to the next assessment for bigeye tuna, SPC plans to focus on:

a) developing a full set of longline CPUE series that incorporate the potential impacts of changes in targeting and in the spatial and temporal distribution of fishing effort, including some simulation work to assist in determining which series are most appropriate;
b) examining alternative spatial structures for the bigeye assessment; and
c) further developing MFCL with respect to some of the other important recommendations.

115. SPC recommended that SC9 consider the following:

- The critical need for access to Japanese operational longline data to complete work in some key priority research areas for 2013. While they are highly beneficial, the current arrangements are likely to be insufficient for the breadth of work required to progress satisfactorily, and it may be necessary to develop contingency plans such as analyzing SPC-held operational longline data and/or aggregate catch and effort data.
- Noting the point above, the desirability of a workshop before the end of 2013 or very early in 2014 to analyze all available operational catch and effort data for longline vessels.
- The critical role that the 2014 Pre-Assessment Workshop will play in providing SPC feedback on new modeling approaches and data inputs.
- The proposal in SC9-ST-WP-06 to use data through the end of 2012 for the 2014 bigeye assessment and only including 2013 data later in the year (when it is more complete) for projection analyses.

116. SPC followed this by briefly describing four information papers detailing the results.

- SC9-SA-IP-07 (Recent developments in the MULTIFAN-CL stock assessment software): reported developments to MFCL, in particular those undertaken as part of the bigeye tuna review (sex structure development) and to support the reference point and harvest control rule work (projections).
- SC9-SA-IP-05 (Longline CPUE series that account for changes in the spatial extent of fisheries): reported on the analyses of operational and aggregate longline catch and effort data using a range of imputation methods (substitution and spatial smoothing) to predict CPUE in strata that were not fished in a given time period. These approaches will form the basis of abundance indices generated for the 2014 bigeye tuna assessment.
- SC9-SA-IP-04 (Target changes in the tropical WCPO Japanese longline fishery, and their effects on species composition): reported a joint analysis of Japanese held longline operational catch and effort data with respect to targeting.
- SC9-SA-IP-06 (Tagging data and the spatial structure of WCPO tropical tuna assessments): examined the impact of various tagging datasets on the biomass trajectories from the bigeye and yellowfin tuna assessments and also examined spatial and length-specific patterns in estimated displacement and tag recovery density (i.e. number of tags recovered per unit of catch). Several suggestions were provided to improve both the modeling of the data and the overall assessment, in terms of other data issues potentially being masked by the tagging data.

117. SPC then outlined the changes that will need to be made to the next bigeye tuna assessment, and their implications, and emphasized its request that Japan, Chinese Taipei, China and Korea consider

providing the operational data necessary to improve the stock assessments. Although SPC has around 50% operational data coverage for Japanese longlining as a result of coastal State provision of data for licensed vessels, this is heavily biased towards EEZs.

**b. Progress on Project 69 (Improvement of MULTIFAN-CL)**

118. SPC presented on the progress of Project 69 with information paper SC9-SA-IP-07: Improvement of MULTIFAN-CL Catch at length.

**c. Progress on Project 35 (Refinement of bigeye parameters Pacific-wide)**

119. SPC presented information paper SC9-SA-WP-01 (Project 35: Bigeye tuna age and reproductive biology progress report), which reported on the progress of this multi-year SC project to provide bigeye ageing and maturity information for application in the estimation of depletion-based reference points. The work plan for the first three years of this project (2012–2014) was designed to collect 2,500 otoliths and 300 gonads from the equatorial WCPO (with a concentration of effort to collect gonads from the central Pacific region).

120. The project is on track to achieve this target by December 2014 due to the collaboration between fisheries administrations and national observer programmes of WCPFC members. As requested by SC8, an itemized budget for 2014 was presented to SC9.

121. Project 35 is a multi-year project. Years 2012–2014 are devoted to sampling and 2015 will focus on subsequent analysis on the assumption that adequate samples have been collected.

**d. Indicator analysis for key tuna species**

122. S. Harley (SPC) presented information paper SC9-SA-WP-06 (Indicator analysis for key tuna species). The paper provides a compendium of fishery indicators for the principal target tuna species: bigeye, skipjack, yellowfin, and South Pacific albacore. The main purpose of this paper is to provide empirical information on recent patterns in fisheries for each species for SC's consideration in years for which full stock assessments have not been conducted.

123. The indicators that are documented include: total catch by gear, nominal CPUE trends, spatial distribution of catch and associated trends, size composition of the catch and trends in average size. These include data loaded into the WCPFC databases as of 9 July 2013.

124. Due to the complex interactions between the major species-specific fisheries, it is difficult to correctly interpret stock status-related implications from the trends in any indicators in isolation of other datasets and a population dynamics model. Therefore, commentary provided in this paper typically relates to comparisons of the values of various indicators to previous years, in particular comparisons of 2012 values to 2011 and the average over 2007−2011.

125. This paper covered four WCPO tuna species. Comments on yellowfin, skipjack and South Pacific albacore are presented under the corresponding sections in Agenda Item 4.1.

**Discussion**

126. CCMs discussed two recommendations to collect age and reproductive data on bigeye tuna: continuing the project in 2014, and collecting information on tuna in the main fishing markets in Japan through shipping company data.

127. CCMs noted that during the 1990s there was a shift away from using many more hooks between floats because this had been assumed to imply deeper-setting; however, the buoyancy of the mainline also changed so the depth effect of hooks between floats was not as great as had been assumed.

128. CCMs considered the question on variations in the number of hooks per float in the fishing region. CCMs responded that they either don't have the information about hooks per baskets for 1967–1974 when the target shift occurred, or that longline data with weight and number will be provided to SPC prior to the Pre-Assessment Workshop in 2014.

129. CCMs noted that effort was being directed to fishing in areas where bigeye catch rates were high, but in the latest analyses, fishing was observed to be occurring in areas where bigeye CPUE was lower. This was attributed to a shift towards targeting albacore in parts of area 3, and so these areas were subsequently excluded from the bigeye CPUE series used in the assessment.

130. CCMs noted that vessel movement patterns also provide useful information because vessels tend to stay in areas where they get good bigeye catches, but move and search if catches are low. Vessels were more likely to move if bigeye catch was low than if the yellowfin catch was low, but the combined catch was the biggest driver.

131. SC9 noted that the tagging data component has a strong influence on biomass estimates, so the analysis needs to be assured that the tag mixing assumptions are met. If all tagging data are removed from the model, the estimated bigeye tuna biomass before fishing becomes unrealistic. Short-term recaptures are excluded from the model.

132. SC9 was informed that strong spatial patterns are apparent in the displacement of tagged fish. Bigeye tuna in the east appear to be more mobile and bigeye tuna in the west more resident, but this may be a result of patterns of fishing effort in each region. SPC will investigate the utility of analysing tagged "schools" rather than individual fish.

133. SC9 noted that WCPFC data rules require catches to be reported by weight, and this has led to some difficulties for CCMs whose vessels have traditionally recorded catch by number. The meeting noted that considerable progress had been made by CCMs in overcoming these problems, and catch by weight statistics are now provided.

134. Most CCMs jointly conveyed their appreciation to SPC for the work completed so far in relation to the recommendations made by the bigeye Peer Review Panel, and noted that in order for SPC to complete the enhancements in time for the bigeye stock assessment scheduled for next year, it is critically important for SC to provide support in the following key areas:

a) Encourage Japan to work closely with SPC on ensuring that the work already jointly undertaken in analysing the Japanese operational longline data is completed well in advance of the stock assessment for SC10.
b) In the event that the above work is not completed as planned, enable SPC to convene a workshop in late 2013 or very early 2014 to analyze all available operational catch and effort data for longline vessels.
c) Ensure that the 2014 Pre-Assessment Workshop play a significant part in providing feedback on new modeling approaches and data inputs.
d) Given the delay in the submission of required data for next year's stock assessment by CCMs, allow SPC to use data through the end of 2012 for the 2014 bigeye assessment and only include 2013 data later in the year (when it is more complete) for projection analyses.

135. Two CCMs expressed a desire to collaborate with SPC to improve the data on which assessments are based, especially in relation to data dating back to the 1970s.

136. CCMs noted the importance of consulting with PNG before any analyses of tags released or recovered in PNG's archipelagic waters because these waters are not part of the WCPFC Convention Area.

137. In response to the comment that tagged bigeye move between the western and eastern Pacific Ocean, and the suggestion that SPC collaborate with IATTC to do an assessment across the whole of the Pacific region, SPC pointed out that some interchange between regions does not invalidate the concept of regionally focussed assessments, but that a Pacific-wide assessment is planned for 2015. SPC will collaborate with IATTC on this and will have another year of central Pacific tag returns to work with in 2015.

#### 4.1.1.2 Provision of scientific information

**a. Status and trends**

138. **SC9 noted that no stock assessment was conducted for WCPO bigeye tuna in 2013. Therefore, the stock status description from SC8 is still current.**

**b. Management advice and implications**

139. **SC9 noted that no management advice has been provided since SC8. Therefore, the advice from SC8 should be maintained, pending a new assessment or other new information.**

140. **SC9 also noted that the total catch of bigeye in 2012 was 161,679 mt, which was a 2% increase over 2011 and a 7% increase over the average of 2007–2011.**

### 4.1.2 WCPO yellowfin tuna

#### 4.1.2.1 Review of research and information

141. SPC noted that the presentation of SC9-SA-WP-06 (A compendium of fishery indicators for bigeye, skipjack, yellowfin, and South Pacific albacore tunas) under Agenda Item 4.1.1.1d also covered yellowfin tuna.

142. Korea presented information paper SC9-SA-WP-12 (Updated CPUE standardization for yellowfin tuna caught by Korean tuna longline fisheries in the WCPO), where CPUE standardization for yellowfin tuna caught by Korean longline fisheries in the WCPO (1978–2012) was conducted using a GLM and operational data to estimate a proxy for the abundance index. Explanatory variables for the GLM analysis are year, quarter, area and the number of hooks between floats, and it was suggested that the quarter effect was the largest factor affecting the nominal CPUE. The standardized CPUE (number/1,000 hooks) was about 15 in 1978, but since then it had sharply decreased until the early part of the 1990s, and showed a flat trend within a range of 2–3 in recent years.

**Discussion**

143. Decadal changes of hooks per baskets and number of hooks, caused by the types of target shifts mentioned in the paper indicates that CPUE standardization, especially for the year effect, needs to be considered in analyses.

144. In discussing yellowfin stock status in general, SC9 noted that purse-seine catches (or effort) show a large difference between FAD and unassociated fishing, and operational areas are very different. Pole-and-line and longline data are, therefore, better indicators of fish size.

145. Some CCMs noted the concern of other CCMs regarding the increase in yellowfin catches and the need for accurate data on fishing effort, especially taking into account the recording of transit and fishing days, increasing fishing power and double setting by purse-seine vessels.

146. In response to a question about purse-seine effort creep, and the availability of information to measure this, SPC informed members that compared with longlining and purse-seining in some other regions, the data from the purse-seine fishery is actually very good, and uses observer, logsheet and VMS data. However, many of the new boats built are in the 50–80 m class and will have less capacity than vessels that were previously over 80 m — an apparent response to the PNA vessel-days management scheme size categories. An additional factor to be taken into account is that the average catch per day of many purse-seine vessels appears to have recently increased simply because they are reporting transit days and searching days differently on logsheets, even though there are approximately the same number of days spent on the water, for the same catch in the same number of sets. This results in an apparent higher catch per "fishing day".

147. FFA members jointly extended their appreciation to SPC'S Oceanic Fisheries Programme for its work on fishery indicators, and noted with concern the increase in yellowfin catches. They suggested it would be helpful if a more detailed explanation on "other gear types" could be elaborated on given the concern that fishing mortality for yellowfin tuna is not to be increased. However, as reported in the fishery indicators paper, the catch by other gear types amounts to 136,144 mt and:

- accounts for the second highest after the purse-seine catch of 398,460 mt;
- is almost double the catch taken by longline of 85,249 mt; and
- is a considerable increase from the 2011 catch (by 69%) and the 2007–2011 catch (by 61%) as depicted in Figures 16 and 18 of SC9-SA-WP-06.

148. Some CCMs queried whether this is representative of an actual increase in fishing activity and catch, or simply a result of improved data collection, and sought an explanation of the expected impacts on the next stock assessment.

149. SPC pointed out that the Indonesian artisanal fishery constitutes a major data gap because there are tens of thousands of small boats operating daily out of coastal fishing villages, targeting juvenile tunas.

150. Some CCMs again expressed concern over the significant increase in the catch of juvenile yellowfin tuna. They drew attention to the advice from SC8 that recommended there be no increase in fishing effort in the western equatorial region; indicators, however, suggested that the opposite had occurred, and that yellowfin tuna catches are in excess of the range of maximum sustainable yield (MSY levels in the most recent assessment. This could be further exacerbated by the increased catch of small fish, which may erode the MSY estimate. In light of this concern, these CCMs recommended that stronger wording on the need to reduce yellowfin tuna fishing mortality, particularly in the western equatorial region, should be included in the management advice from this meeting.

#### 4.1.2.2 Provision of scientific information

**a. Status and trends**

151. **SC9 noted that no stock assessment was conducted for WCPO yellowfin tuna in 2013. Therefore, the stock status description from SC8 is still current**.

**b. Management advice and implications**

152. **SC9 noted that no management advice has been provided since SC8. Therefore, the advice from SC8 should be maintained, pending a new assessment or other new information**.

153. **SC9 noted that the total yellowfin catch in 2012 was 655,668 mt, which was a significant (26%) increase over 2011 and a 22% increase over 2007–2011.**

### 4.1.3 WCPO skipjack tuna

#### 4.1.3.1 Review of research and information

154. Two presentations were provided by Japan.

SC9-SA-WP-14 (Decadal and spatial analysis of Japanese pole-and-line fisheries for improving CPUE of skipjack in the WCPO). This paper suggests that the spatial pattern of effort has been shrinking remarkably for both the Japanese offshore pole-and-line fishery and the Japanese distant-water pole-and-line fishery due to a decrease in the number of vessels. Using results from the cluster analysis based on the nominal CPUE time series, three and four areas were characterized for PLOS and PLDW, respectively. Year-quarter trends of standardized CPUE taking each cluster into consideration show similar trend in that of the 2011 stock assessment.

SC9-SA-WP-13 (Comparison of CPUE trends for skipjack tuna between two troll fisheries). This paper was presented to show that estimated skipjack abundance indices caught by the Japanese coastal troll fisheries trends in two separate areas, around Wakayama and Tokyo Hachijyo Islands. Estimated CPUE in Wakayama shows similar trend in previous research and estimated CPUE in Tokyo Hachijyo Islands also shows declining trend and the trend after 2006 is similar to that of Wakayama. This implies that lower trend started from at least 2006 and further analysis should be conducted to investigate the causes.

**Discussion**

155. Following the presentations, it was asked what effect the changes in the boundaries of the assessment regions during the long period over which the data extended had on the assessment. There is no conclusive information available to answer that at present.

156. SPC noted that it is examining coastal fisheries data from intermediate latitudes around 20 degrees to study trends in skipjack abundance in areas from where most of the anecdotal information about declines in skipjack abundance is coming.

157. Concerning skipjack tuna stock status in general, some CCMs pointed out that, given the economic importance of ensuring the sustainability of the skipjack fishery, they would continue to promote the importance of having in place economic target reference points for this fishery. They requested SPC's Oceanic Fishery Programme to consider developing a report on stock contraction so that management advice can be further formulated for WCPFC10 to consider addressing this long standing

issue. Notwithstanding these points, these CCMs were supportive of maintaining the skipjack stock status description and management advice of SC8.

158. PNA asked for an explanation regarding the problems experienced by IATTC using alternative methods to assess the status of skipjack tuna, and what could be learned from the experience.

159. SPC responded by stating that pole-and-line data in the EPO were not available.

#### 4.1.3.2 Provision of scientific information

**a. Status and trends**

160. **SC9 noted that no stock assessment was conducted for WCPO skipjack tuna in 2013. Therefore, the stock status description from SC8 is still current**

**b. Management advice and implications**

161. **SC9 noted that no management advice has been provided since SC8. Therefore, the advice from SC8 should be maintained, pending a new assessment or other new information.**

162. **SC9 noted that the total skipjack catch in 2012 was 1,664,309 mt, which was a significant (9%) increase over 2011 but the same as the average over 2007–2011.**

### 4.1.4 South Pacific albacore tuna

#### 4.1.4.1 Review of research and information

163. SC9 was informed that there is no new information to add to the stock assessment for South Pacific albacore apart from what was presented in the indicator analysis paper (SC9-SA-WP-06). The discussion of South Pacific albacore tuna that resulted from SC9-SA-WP-06 is provided below.

164. Some CCMs noted that the highest catch of South Pacific albacore was taken in 2012, a 24% increase over 2011 and a 22% increase over the 2007–2011 average. They also noted that the longline catch had increased 25% over 2011 and 22% over 2007–2011 as a result of a significant increase in longline CPUE of the major longline fleets of Korea, China and Chinese Taipei in 2012 relative to 2011 and 2007–2011. However, there was a decrease in mean weight of longline caught fish. These CCMs viewed with caution these ongoing trends and in particular, the possible implications of a significant ramp up in effort and, therefore, catch of South Pacific albacore. Pacific Island domestic fleets, which are dependent on albacore, continue to experience diminishing CPUE, thereby affecting profitability and, in many cases, survival.

165. Some CCMs' primary concern was with the current albacore CMM not being able to control the rapid increase in catch and effort. In particular, projection analyses based on 2010 conditions show falling long-term CPUEs and reduced biomass in the South Pacific albacore fishery. FFA members and New Caledonia were also concerned with any increases in catch or effort that would lead to declines in catch rates in Pacific Island waters. This is particularly important relative to high and increasing longline catches of adult albacore, which will have associated impacts on vessel profitability of domestic longline fishing fleets of small island developing States (SIDS) and territories.

166. Some CCMs supported ongoing research on this species and the regional bio-economic analysis. Outcomes from this type of work would help determine how much of a reduction there should be in

fishing mortality in order for South Pacific albacore to achieve economically viable catch rates. Considering the indicator trends in the fishery, these CCMs supported SC9 strengthening SC8's advice to WCPFC to more effectively control South Pacific albacore catches.

167. While there were concerns over the increasing catches of South Pacific albacore, some CCMs recognized the potential for oceanography and climate change to influence South Pacific albacore stocks and fishery catchability. These CCMs supported further analytical work in this direction, and making available the latest developments in the finer-scale modeling of South Pacific albacore using the spatial ecosystem and population dynamics model (SEAPODYM). They also supported research to explore models with separate subpopulations by region and reviewing finer-scale spatial and temporal information, and the inclusion of additional fleets and consideration of the troll fishery.

168. SPC indicated that it would continue to improve and extend SEAPODYM for this purpose.

#### 4.1.4.2 Provision of scientific information

**a. Status and trends**

169. **SC9 noted that no stock assessment was conducted for South Pacific albacore tuna in 2013. Therefore, the stock status description from SC8 is still current.**

**b. Management advice and implications**

170. **SC9 noted that no management advice had been provided since SC8.**

171. **The total South Pacific albacore catch in 2012 (89,258 mt) was a 24% increase over 2011 and a 22% increase over 2007–2011. Longline catches (86,064 mt) increased 25% from 2011 and 22% from 2007–2011. Troll and other catches (3,158 mt) were down 8% on 2011, but up 15% on 2007–2011.**

172. **It should be emphasized that increasing catch and effort on South Pacific albacore has occurred from 2009 to 2012, which is a concern. The current CMM 2010-05 appears not to be effective in constraining effort in the subtropics (south of 20°S). Given the recent expansion of the fishery and recent declines in exploitable biomass available to longline fisheries in SIDS and territories, and the importance of maintaining catch rates, particularly for the domestic fleets that are highly dependent on this resource, SC9 recommended that longline fishing mortality and longline catch be reduced if the Commission wishes to maintain economically viable catch rates.**

### 4.2. Northern stocks

173. Annex I of the Commission's Rules of Procedure defines northern stocks to be northern Pacific bluefin, northern albacore and the northern stock of swordfish. According to the memorandum of understanding (MOU) between WCPFC and ISC, ISC's scientific information and advice was presented at the SC's annual meeting and SC9-GN-IP-02 (Report of the 13th Meeting of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean) is posted on WCPFC's website.

174. G. DiNardo (ISC chair) presented highlights of the ISC13 plenary meeting.

a) The 13th ISC plenary, held in Busan, Republic of Korea from 17–22 July 2013, was attended by members from Canada, Chinese Taipei, Japan, Korea, Mexico and the USA as well as WCPFC. The plenary reviewed results and conclusions, which were based on new data and updated analyses, of the billfish, shark and Pacific bluefin tuna working groups. The plenary

endorsed the findings that the Pacific blue marlin and North Pacific blue shark stocks are not overfished nor experiencing overfishing, but reiterated that Pacific bluefin tuna are overfished and experiencing overfishing. It provided projections for managers to consider when crafting management measures for North Pacific albacore tuna, swordfish, and striped marlin, and updated the conservation advice from ISC12 based on these projections.

b) The plenary reviewed the progress of the working groups and endorsed their work plans. The ISC work plan for 2013–2014 includes completing a new stock assessment for albacore tuna and swordfish, and an updated Pacific bluefin tuna assessment in time for ISC14, completing a shortfin mako shark stock assessment in 2014, enhancing database and website management, and a tuna ageing workshop scheduled for November 2014 in Shimizu, Japan. A special seminar on Pacific Ocean ecosystem and tuna dynamics was held. Plenary discussed formalizing ISC's structure and administration and began researching means of doing both. Plenary also noted the strides that working groups had made in incorporating best available scientific information into stock assessment work, enhanced stock assessment reports and the increased transparency in working group efforts. Observers from the Pew Charitable Trust, ISSF and WWF attended. The plenary re-elected G. DiNardo for a second term as ISC chair and elected Z. Suzuki as the new Pacific Bluefin Tuna Working Group (PBFWG) chair. The next plenary will be held in Chinese Taipei in July 2014.

c) Collaborations between Pacific regional fishery management organizations (RFMOs), regional fishery organizations (RFOs), and other scientific organizations are essential to advance the science in the region and provide timely scientific advice to decision-makers. In doing so, we must be cognizant of agreements, as well as operating rules and procedures within organizations. In particular, rules covering data sharing and the use of proprietary data. Within the ISC, proprietary data should be made available to contributors and members of ISC working groups for use in the work of working groups only. They are not to be retained or shared with non-members of the working groups. There was a violation of the proprietary data sharing agreement within the ISC Shark Working Group (SHARKWG), which has far-reaching implications within ISC and its collaborators. To advance the science in the region, adhering to standing agreements and policies is paramount.

**Discussion**

175. The ISC chair commented that the SHARKWG chair would extend an invitation to other CCMs with shark-ageing specialists to participate in the upcoming Second ISC Shark Age and Growth Workshop.

176. It was suggested that SC recommend reference points for Pacific bluefin tuna to the Northern Committee (NC) because there are currently no reference points established by WCPFC for Pacific bluefin tuna. The ISC chair commented that in response to a request from NC, the ISC PBFWG provided a suite of candidate references points, and now WCPFC and ISC are waiting to hear back from NC regarding specific reference points for Pacific bluefin tuna.

### 4.2.1 North Pacific albacore tuna

#### 4.2.1.1 Review of research and information

177. There were no presentations specifically addressing this agenda item.

#### 4.2.1.2 Provision of scientific information

178. One CCM asked about the review of the stock assessment for North Pacific albacore. ISC informed SC9 that the independent review of the stock assessment will occur after SC9.

**a. Status and trends**

179. **SC9 noted that no stock assessment was conducted for North Pacific albacore in 2013. Therefore, the stock status description from SC8 is still current.**

**b. Management advice and implications**

180. **SC9 noted that no management advice has been provided since SC8. Therefore, the advice from SC8 should be maintained, pending a new assessment or other new information.**

### 4.2.2 Pacific bluefin tuna

#### 4.2.2.1 Review of research and information

181. Y. Takeuchi (Japan) presented the 2012 Pacific bluefin tuna stock assessment conducted by ISC (SC9-SA-WP-10), and information that became available after the 2012 stock assessment.

182. Results of the 2012 stock assessment are summarized below.
The Pacific bluefin tuna stock is currently near a historical low level of biomass. Based on the suite of biological reference points, the stock is overfished and overfishing is occurring. ISC considered the effects of the management measure by WCPFC and IATTC under historical average recruitment level and found that spawning stock biomass (SSB) is expected to increase with $F_{2002\text{-}2004}$, which is the level of F recommended by ISC and the catch limit on purse-seine fisheries in both the western Pacific Ocean (WPO) and the EPO. In July 2013, ISC conducted the future projection under low recruitment. ISC discussed Kobe plots for this stock and a fishery impact analysis. The fishery impact analysis clearly indicated a vast major fishery impact from the fishery exploiting juvenile Pacific bluefin tuna. Regarding future projection under low recruitment, the stock has an increased risk of SSB falling below the historical lowest SSB in the immediate future. In light of this information, ISC revised conservation advice for Pacific bluefin tuna, requiring further reduction of fishing mortality, especially for juvenile fish as well as strengthening the monitoring of recruitment.

183. T. Gedamke (Pew Charitable Trusts) presented working paper SC9-SA-WP-15 (Preliminary analyses of the potential impacts of minimum weight regulations for Pacific bluefin tuna). The presenter prefaced his presentation by saying that this is only one of many potential management ideas that could be considered for Pacific bluefin tuna.

a) The method employed for Atlantic bluefin tuna by ICCAT (SCRS/2006/091) was used as a starting point to estimate the first-order effects on yield, total biomass, and SSB for five minimum weight restrictions on the Pacific bluefin tuna fishery. Projections included five levels of tolerated catch below the minimum size limit for a total of 25 different management scenario evaluations. Data from the 2012 Pacific bluefin tuna assessment were used to populate the simulations and the most recent five-year averages for fishing mortality-at-age and numbers-at-age were used as the starting point and reference period for the projections.
b) The results should be viewed as best-case scenarios and represent what might happen given the assumptions of the model with perfect implementation and no transfer of effort. In all scenarios explored, substantial long-term increases in biomass and yield were predicted. The simulations suggest that the maximum yield per recruit occurs at a minimum weight of around 20 kg and a doubling of yield and an order of magnitude increase in SSB are

theoretically possible. Short-term losses in yield are evident for one to three years following implementation depending on the scenario. Further work is needed to determine an optimal management strategy whereby minimum size can be increased gradually as biomass rebuilds to minimize short-term losses in yield.

**Discussion on SC9-SA-WP-10**

184. Given the extremely poor condition of the stock, some CCMs jointly recommended that candidate reference points be advanced that are consistent with those adopted by the Commission for other species.

185. A CCM asked about the sensitivities conducted to address biological uncertainties. The PBFWG chair indicated that the 20 runs highlighted in the report were chosen by the working group as the ones that addressed the greatest uncertainties in the assessment but that other runs were conducted.

186. Several members indicated that it would be good to see the sensitivities using lower steepness values for the spawner-recruitment relationship (below 0.999) because the results showing current catch at roughly one-third of SSB seems astonishing given the high catch of young fish, and it is unlikely that the steepness is 1. The PBFWG chair stated that the data cannot explain lower steepness values.

187. The PBFWG chair explained that ISC is concerned about the increased risk of SSB falling to the historically lowest level and the possibility of a reduction in recruitment when SSB is reduced to a low level not previously experienced.

188. SPC suggested some additional outputs for future assessments, including showing the plots for spawners and recruits together for each model run, and a plot of the depletion level over time. SPC also noted that the Kobe plots show that the stock was heavily depleted at the start of the assessment time period and asked whether there is any historical catch information that may help evaluate the depletion level at the start of the time period. The PBFWG chair responded that $B_0$ for Pacific bluefin tuna is uncertain, and there is less information to determine the appropriate level of $B_0$ in contrast to tropical tunas that are supposed to be close to $B_0$ at the start of the stock assessment period. Good information on the reproductive potential of older age animals is also lacking, adding to the uncertainty.

189. Some CCMs collectively indicated that the interactive CIE review of the SPC bigeye tuna assessment had been very useful, and suggested that the same process be undertaken for ISC assessments rather than having desktop reviews. They also asked that the Pacific bluefin assessment review, like the bigeye assessment review, be presented to SC for comment.

190. The ISC chair clarified how the CIE review of the Pacific bluefin tuna stock assessment was conducted. It was also clarified that they will be posted on the US National Oceanic and Atmospheric Administration's website with responses to the reviews if necessary. The PBFWG is working on responding to the reviews as well to revising its work plan and improving its next stock assessment.

191. It was suggested that projections are run with alternative recruitment assumptions e.g. (high vs. low recruitment) within the F bounds chosen. The PBFWG chair pointed out that future projections with the alternative low recruitment scenario were already conducted by ISC, and the results were presented.

**Discussion on SC9-SA-WP-15**

192. Members were interested in the analyses and potential for stock rebuilding by implementing a minimum weight catch policy. Discussion of some option for the next steps included evaluation of the

impact of each of the 14 fisheries and determining which fisheries would be most affected and would, therefore, need to reduce catches.

193. It was suggested that comparing the economic yield of the fisheries under a minimum size catch policy would be interesting since larger fish are much more valuable than small fish.

#### 4.2.2.2 Provision of scientific information

**a. Status and trends**

194. **SC9 noted that the PBTWG provided the following conclusions on the stock status of Pacific bluefin tuna.**

**Based on the reference point ratios, overfishing is occurring and the stock is heavily overfished. Model estimates of the 2010 SSB are at or near their lowest level and SSB has been declining for over a decade; however, the 2012 stock assessment, which used data through the first half of 2011, did not find evidence of reduced recruitment. Recently implemented WCPFC (CMM 2010-04, entered into force in 2011) and IATTC (Resolution C-12-09, entered into force in 2012) CMMs, combined with additional Japanese voluntary domestic regulations aimed at reducing mortality, if properly implemented and enforced, are expected to contribute to the recovery of the stock assuming historical average recruitment conditions.**

**Fishery impact analysis suggests that historically, the Japanese coastal fishery group has had the greatest impact (i.e. expected SSB) on the Pacific bluefin tuna stock, but since about 1999 the impact of the WPO purse-seine fleet has increased, and the effect of this fleet is currently greater than any of the other fishery groups. The impact of the EPO fishery was significant before the mid-1980s, but decreased after the 1990s. The WPO longline fleet has had a limited effect on the stock throughout the analysis period.**

**Based on newly available fishery data, concerns about stock status were reinforced. The potential risk of decline of SSB may be higher than previously thought. When recruitment is low, the risk of SSB falling below the historically lowest SSB level will increase under $F_{2007–2009}$ harvesting conditions while the risk under $F_{2002–2004}$ conditions will remain small in the long term, although some short-term risk remains.**

**b. Management advice and implications**

195. **SC9 noted the following conservation advice from ISC.**

**The current (2010) Pacific bluefin tuna biomass level is near historically low levels and experiencing high exploitation rates above all biological reference points (BRPs) commonly used by fisheries managers. Based on projection results, extending the status quo (2007–2009) fishing levels is unlikely to improve stock status. Continued monitoring of abundance indices is recommended to track SSB.**

**Preliminary WPO data indicate an unusually low catch of age-0 Pacific bluefin tuna in 2012; this may imply low recruitment, which would adversely affect projected stock rebuilding and increase the risk of SSB falling below its historical lowest level observed. Further reduction of fishing mortality, especially for juvenile fish, is needed to reduce the risk of SSB falling below its historically lowest level.**

**Strengthening the monitoring of recruitment is highly recommended to comprehend the trend of recruitment in a timely manner.**

196. **SC9 could not reach consensus on management advice to the Commission. In lieu of this the following two statements are provided:**

**Majority view:**

**Noting the current very low level of SSB (4% $B_0$), which is far below the common reference levels, and the low levels of recruitment observed in 2012, SC9 recommended that the fishing mortality on Pacific bluefin tuna be immediately reduced, especially on juveniles, in order to reduce the risk of recruitment collapse and allow the spawning stock to rebuild. SC9 recommended that candidate limit and target reference points be advanced for Pacific bluefin tuna that are consistent with the Commission's adopted or default reference points.**

**Minority view:**

**SC9 endorsed the conservation advice put forward by ISC13, calling for further reductions in fishing mortality, especially for juvenile fish, to reduce the risk of further declines in SSB and strengthening the monitoring of recruitment to comprehend the trend of recruitment in a timely manner.**

**Discussion**

197. During SC9, some CCMs worked to develop agreeable management advice for Pacific bluefin tuna. However, SC9 could not reach consensus and some CCMs expressed their disappointment and CCMs made the following statements.

198. Japan made the following statement:

Japan did not support the "Majority view" not because it has objections over the competence of SC. Japan fully supports its functions as described in Article 12 of the Convention. That said, Japan believes that the special circumstances starting from the establishment of NC should be taken into account when discussing the northern stocks. Given that the current framework of management of the northern stocks, namely that NC formulates the draft CMM based on the conservation advice from ISC, is working quite well, the recommendations from ISC should be sufficient for the work of the Commission; it is not necessary for SC to revise nor restate conservation advice made by ISC. This is why Japan supports the advice that states SC endorsed the conservation advice put forward by ISC.

199. New Zealand made the following statement:

New Zealand is particularly disappointed with the outcome of discussions on management advice, particularly because the statements are so similar, but differ in some important areas. However New Zealand hopes that these two statements will provide managers at the Commission with the leverage they require to develop effective management measures for this stock.

200. Australia made the following statement:

Australia regards this as a disappointing outcome after it worked to arrive at a consensus recommendation for Pacific bluefin tuna. This is a stock where Australia has clear conclusions with respect to status (depletion to 4% of unfished levels, high juvenile fishing mortality and an extremely high exploitation rate). On this, Australia is in agreement. The science, it believes, is clear and the role of SC (consistent with the Convention and its

objective) is to provide scientific advice in respect of Pacific bluefin tuna. Australia's position is that scientific advice for all WCPFC stocks comes from SC. For Pacific bluefin tuna, a clear recommendation from SC to the Commission for management action is required. That we have not been able to come to consensus on that advice for this concerning situation is disappointing.

201. PNG, Palau and Cook Islands supported the sentiments of Australia and New Zealand, particularly that SC does not exist to simply endorse the work of another group.

### 4.2.3 North Pacific swordfish

#### 4.2.3.1 Review of research and information

202. North Pacific swordfish projections considered by the ISC Billfish Working Group (BILLWG) were presented (Appendix 4 in SC9-SA-IP-13; all symbols, Table and Figure numbers in this sections refer to those in Appendix 4).

a) This work addressed a request by NC to BILLWG to conduct stock projections for the WCPO swordfish stock. The requested projections included information on expected yields and their variability under alternative harvest rates and BRPs.
b) Updated catch information for WCPO swordfish through 2012 was gathered from ISC members and all other available sources. The potential limit reference points (LRPs) to set the harvest rate scenarios for NC's request included three scenarios: i) the most recent three-year average harvest rate (scenario 1); ii) the harvest rate set at fractions of the harvest rate that produces MSY ($H_{MSY}$) ranging from 0.5–1.5 in multiples of 0.25 (scenarios 2.1 to 2.5); and iii) the harvest rate set at the maximum historic harvest rate during 1951–2012 (scenario 3). Parameters of the WCPO production model were re-evaluated using the updated catch data during 2007–2012 (Fig. 1.1). Revised estimates of BRPs were virtually identical to those from the 2009 stock assessment: MSY = 14,400 mt, $B_{MSY}$ = 57,300 mt, and $H_{MSY}$ = 0.26. Estimates of the exploitable biomass of WCPO swordfish showed the same trends as in the 2010 stock assessment (Fig. 1.2). Exploitable biomass in 2012 was estimated to be 80,800 mt (±26.4), or 41% above $B_{MSY}$. Similarly, estimates of the harvest rate of WCPO swordfish also exhibited the same trends as in the 2010 stock assessment (Fig. 1.3). The harvest rate in 2012 was estimated to be 12% (±5%), or about 54% below $H_{MSY}$.
c) Overall, the updated stock status information indicated that the WCPO swordfish stock was not overfished nor experiencing overfishing in 2012 relative to MSY-based reference points. Projection results indicated that expected WCPO yields would increase under most of the alternative harvest rate scenarios and that expected WCPO biomass would be reduced to below $B_{MSY}$ in 2017 (Table 3 and Fig. 2.2) under some of the harvest rate scenarios. Projection results for the probabilities of breaching biomass depletion reference points indicated that the there was a high probability that exploited biomass would be reduced to below $B_{MSY}$ in 2017 for some of the higher harvest rate scenarios.

**Discussion**

203. There were no comments regarding the projections for the western and central North Pacific swordfish.

#### 4.2.3.2 Provision of scientific information

**a. Status and trends**

204. **SC9 noted that no stock assessment was conducted for North Pacific swordfish in 2013. Therefore, the stock status description from SC6 is still current. SC9 noted that stock projections based on western and central North Pacific Ocean swordfish catches through 2012 indicate that the stock is currently not likely to be overfished and is not likely to be experiencing overfishing.**

**b. Management advice and implications**

205. **SC9 noted that no management advice has been provided since SC6. Therefore, the advice from SC6 should be maintained, pending a new assessment or other new information.**

**4.3 WCPO sharks**

**4.3.1 Oceanic whitetip shark**

**4.3.1.1 Review of research and information**

206. SC9 noted that no stock assessment was conducted in 2013. No new information was presented.

207. Some CCMs requested that an analysis of 2013 data on fishery interactions with oceanic whitetip sharks be presented to SC10.

**4.3.1.2 Provision of scientific information**

**a. Status and trends**

208. **SC9 noted that no stock assessment was conducted for WCPO oceanic whitetip shark in 2013. Therefore, the stock status description from SC8 is still current.**

**b. Management advice and implications**

209. **SC9 noted that no management advice has been provided since SC8. Therefore, the advice from SC8 should be maintained, pending a new assessment or other new information.**

**4.3.2 Silky shark**

**4.3.2.1 Review of research and information**

210. SPC presented SC9-SA-WP-03 (Updated stock assessment of silky sharks in the western and central Pacific Ocean). Excerpts from the Executive Summary of this paper are provided below as are several figures and tables regarding stock status that reflect reference case and sensitivities presented to SC9. The model runs based on the non-target longline CPUE were selected by SC for determining current stock status and providing management advice; these are shown in Figure FAL5 and Table FAL2.

211. This paper presents an update from the first stock assessment of silky shark in the WCPO that was submitted to SC8 in August 2012.

a) The main changes are the inclusion of a greater number of CPUE and catch time series in the analysis. The assessment uses the stock assessment model and computer software known as Stock Synthesis (version 3.21B at http://nft.nefsc.noaa.gov/Download.html). The silky shark model is an age-structured (36 years), spatially aggregated (one region) and two-sex model. The catch, effort, and size composition of catch are grouped into four fisheries, all of which cover the time period from 1995 through 2009.

b) Silky sharks are most often caught as bycatch in Pacific tuna fisheries, although some directed mixed species fisheries (sharks, tunas and billfish) do exist. Commercial reporting of landings has been minimal, as has information regarding the targeting and fate of sharks encountered in the fisheries. Useful data on catch and effort is mostly limited to observer data held by SPC, but observer data also suffer from poor coverage. Therefore, multiple data gaps had to be overcome through the use of integrated stock assessment techniques and the inclusion of alternate data that reflected different states of nature.

c) Multiple models with different combinations of the input datasets and structural model hypotheses were run to assess the plausible range of inputs and the resulting estimates of stock status. These models were each given a "weight" based on the *a priori* plausibility of the assumptions and data used in each model. The reference case presented here was the highest weighted run. This reference case model is used as an example for presenting model results (Figs. FAL1 and FAL2, Table FAL1 ), but the most appropriate model run on which to base management advice determined by SC is the median of grid based on the non-target longline (Table FAL2). The sensitivity of the reference model to key assumptions (i.e. regarding the stock recruitment relationship, CPUE time series, the purse-seine catch and size data, the growth model) were explored via sensitivity analyses (Figs. FAL3 and FAL4).

d) SPC has reported stock status in relation to MSY-based reference points, but the actual reference points to be used to manage this stock have not yet been determined by the Commission.

e) As requested by SC9, SPC presented key model results for the presented reference case, the one-change sensitivities to the reference case (Table FAL1), and the SPC bycatch by longline (excluding Hawaii data) Table FAL2. The main results presented in the following bullet points regarding stock status are based on the median of the weighted grid for only the non-target longline (Fig. FAL5, Table FAL2), as requested by SC9.

f) This is an update to the first stock assessment for silky sharks in the WCPO. The key conclusions are as follows.

- The results of the model can be split into two categories that are mutually exclusive with respect to estimates of stock status. These two categories are characterized by the CPUE input. All runs that included the target longline CPUE trend estimated a current total biomass in excess of 150,000,000 mt. This is more than 18 times greater than the combined 2010 estimate of bigeye, South Pacific albacore, skipjack and yellowfin tuna total biomass combined. Therefore, these runs are not considered plausible.
- Notwithstanding the difficulties inherent in the input data, the size composition data shows consistent declines over the period of the model (1995–2009), which is coupled with increasing fishing mortality and a recently declining CPUE trend.
- This is a low productivity species, as reflected in the low estimated value for $F_{MSY}$ (0.08) and a high estimated value for $SB_{MSY}/SB_0$ (0.39). These directly impact on conclusions about overfishing and the overfished status of the stock.
- Based on the reference case, the estimated SSB, total biomass and recruitment all decline consistently throughout the period of the model. The biomass declines are driven by the CPUE series, and the recruitment decline is driven through the tight assumed relationship between SSB and recruitment.
- Estimated fishing mortality has increased to levels far in excess of $F_{MSY}$ ($F_{current}/F_{MSY}$ = 4.32) and across nearly all plausible model runs undertaken, estimated F values were much higher than $F_{MSY}$ (the 5$^{th}$ and 95$^{th}$ quantiles are 2.49 and 7.45, respectively). Based on these results, it was concluded that overfishing is occurring.
- Estimated SSB has declined to levels below $SB_{MSY}$ ($SB_{current}/SB_{MSY}$ = 0.72) and for the majority of the model runs undertaken, $SB_{current}$ is less than $SB_{MSY}$ (the 5$^{th}$ and 95$^{th}$

quantiles are 0.51 and 1.02, respectively). Based on the distribution of these results, it was concluded that it is highly likely that the stock is in an overfished state.

- Notwithstanding the point above, that estimates of $SB_0$ and $SB_{MSY}$ are uncertain as the model domain begins in 1995, so it is also useful to compare current stock size to that at the start of the model. Estimated SSB has declined over the model period to 81% of the 1995 value for the reference case, and across the majority of the model runs $SB_{current}/SB_{1995}$ has declined (the 5$^{th}$ and 95$^{th}$ quantiles are 44% decline and a 30% increase).
- Current catches are higher than MSY (7,123 mt vs. 2,937 mt), additional catches at current levels of fishing mortality would continue to deplete the stock below $SB_{MSY}$. Current (2005–2008 average) and latest (2009) catches are significantly greater than the forecast catch in 2010 under $F_{MSY}$ conditions (approximately 600 mt).
- The greatest impact on the stock is attributed to bycatch from the longline fishery, but there are also significant impacts from the associated purse-seine fishery, which catches predominantly juvenile individuals.
- Given the bycatch nature of fishery impacts, mitigation measures provide the best opportunity to improve the status of the silky shark population. Existing observer data may provide some information on which measures would be the most effective.

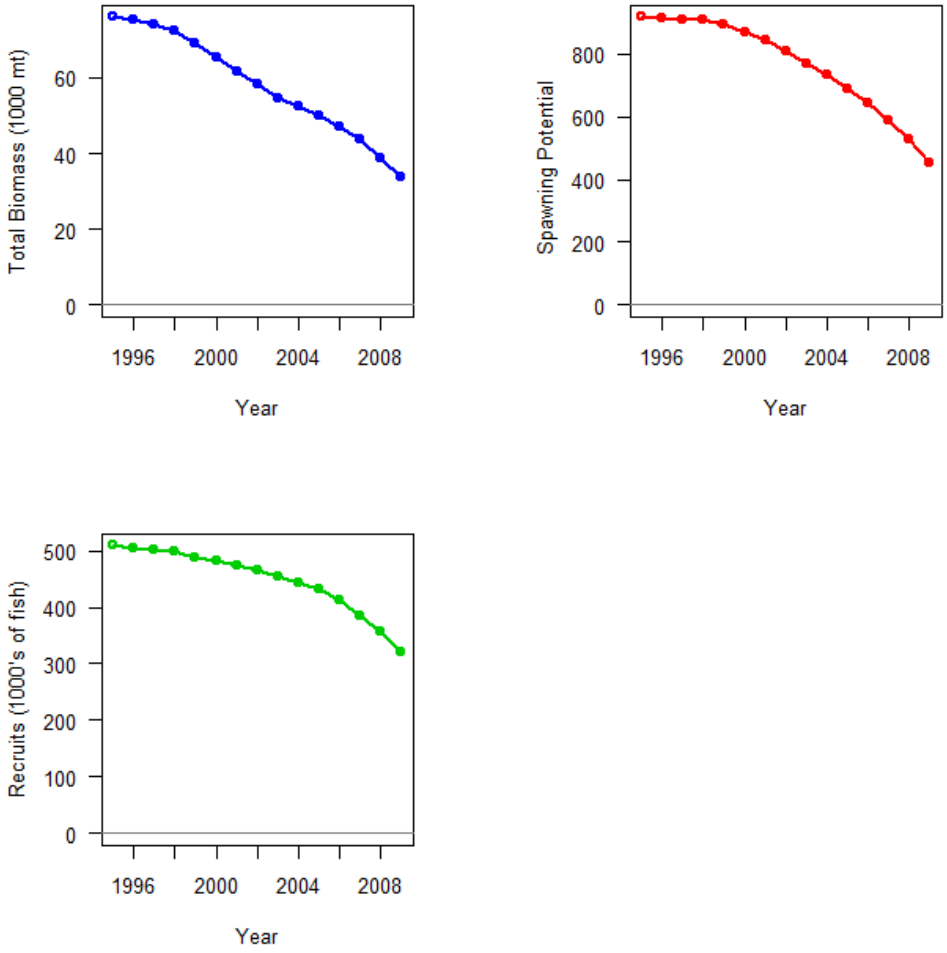


**Figure FAL1:** Estimated total biomass (top left), estimated SSB (top right), and estimated annual recruitment in the WCPO for the reference case.

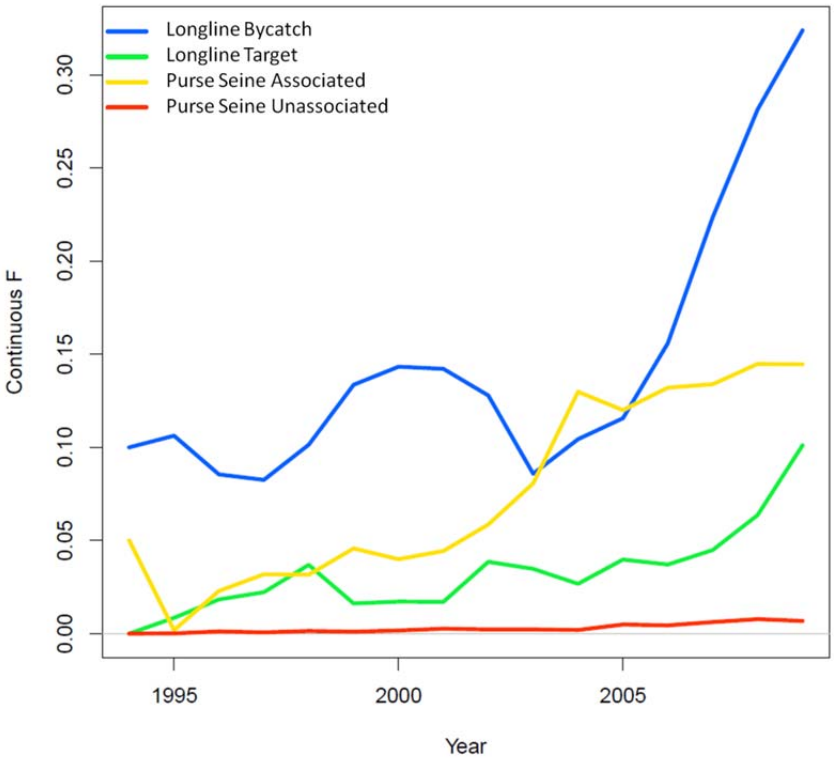


**Figure FAL2:** Estimated fishing mortality through time by fleet for the reference case.

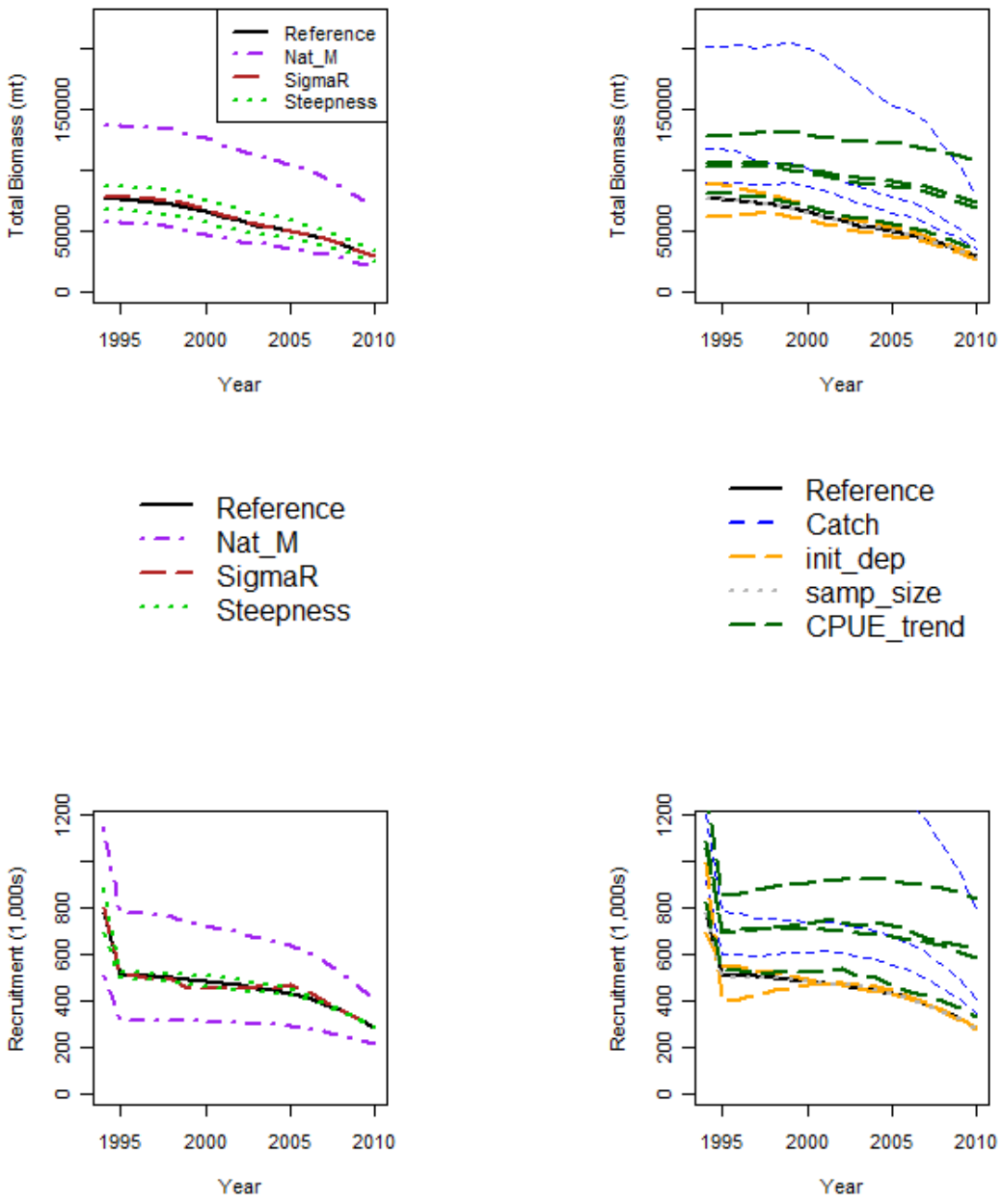


**Figure FAL3:** Sensitivity of total biomass (top) and recruitment (bottom) to alternative values of input variables. The figures on the left show the effects of alternative values for natural mortality, SigmaR (the s.d. on the recruitment devs.), and steepness. The figures on the right show the effects of alternative assumptions for catch inputs, initial depletion, and sample size weighting. Note that in the right-hand side panels, the sensitivity CPUE_trend is off the scale.

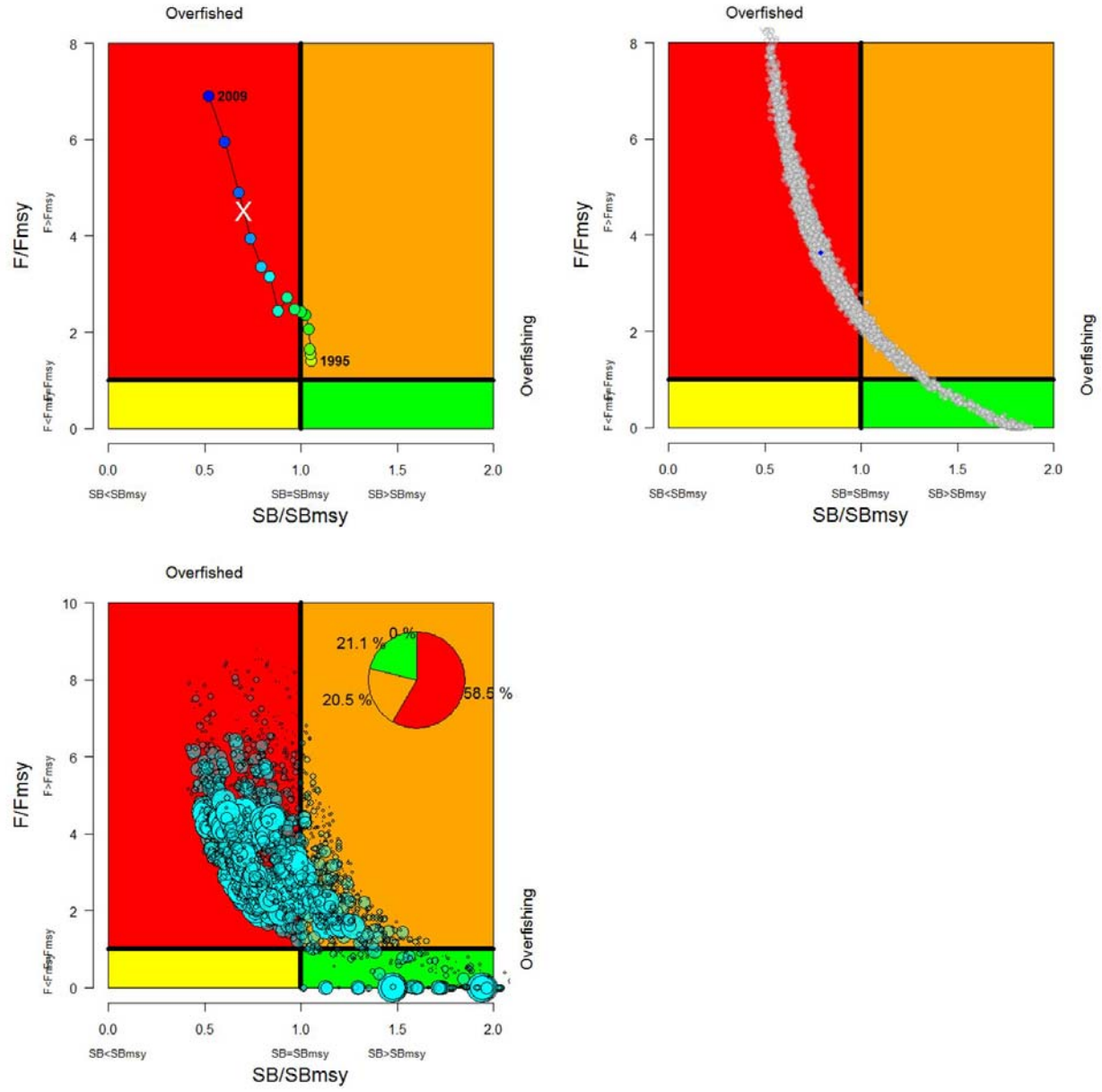


**Figure FAL4:** Kobe plots indicating annual stock status, relative to $SB_{MSY}$ (x-axis) and $F_{MSY}$ (y-axis). These present the reference points for the reference model for the period 1995–2009, with the current (average 2005–2008) depicted by the white "X" (top left panel); statistical uncertainty for the current (average 2005–2008) conditions based on a Markov Chain Monte Carlo analysis (top right panel, blue dot indicates the posterior current estimate). The bottom panel depicts estimates based on all (2,592) runs. The pie chart in the top right quadrant of the bottom panel summarizes the proportion of model results in each quadrant of the Kobe plot. In the bottom plot the size of the circle is proportional to the weight (plausibility) of the run.

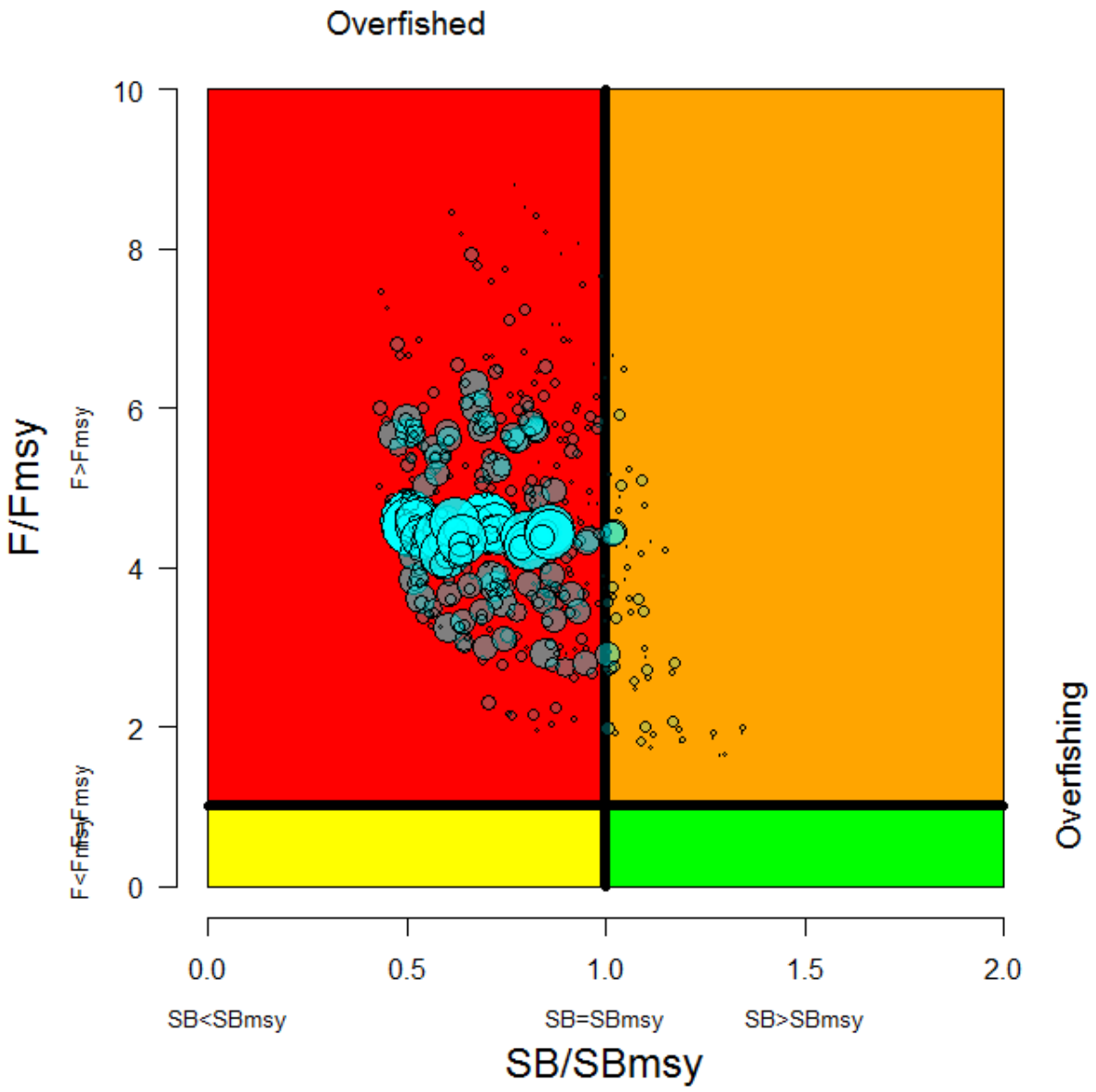


**Figure FAL5:** Kobe plot from the grid based only on the non-target longline CPUE, which SC9 selected to represent the uncertainty in the silky shark assessment.

**Table FAL1:** Estimates of management quantities for the reference case and the runs selected by SC to represent the uncertainty in the model.

| | Units | Reference | Catch_2 | Catch_4 | Catch_5 | CPUE_3 | CPUE_4 | CPUE_5 | CPUE_6 | CPUE_7 |
|---|---|---|---|---|---|---|---|---|---|---|
| C_latest | t | 6,090 | 12,264 | 9,567 | 25,513 | 6,523 | 7,227 | 6,556 | 6,264 | 6,669 |
| C_cur | t per annum | 5,331 | 8,328 | 6,562 | 16,020 | 5,564 | 5,981 | 5,539 | 5,376 | 5,629 |
| Y_MSY | t per annum | 1,994 | 3,134 | 2,389 | 5,401 | 2,665 | 6,092,720 | 2,751 | 2,096 | 3,328 |
| B_zero | t | 149,368 | 229,893 | 175,221 | 395,969 | 201,352 | 467,638,000 | 207,899 | 157,469 | 252,219 |
| B_msy | t | 57,660 | 88,556 | 67,494 | 152,523 | 77,785 | 180,878,468 | 80,314 | 60,804 | 97,459 |
| B_cur | t | 44,988 | 70,520 | 58,407 | 140,462 | 82,887 | 364,973,250 | 87,142 | 51,144 | 118,832 |
| SB_zero | | 2,257 | 3,473 | 2,647 | 5,982 | 3,042 | 7,065,070 | 3,141 | 2,379 | 3,811 |
| SB_msy | | 871 | 1,338 | 1,020 | 2,304 | 1,175 | 2,732,710 | 1,213 | 919 | 1,472 |
| SB_cur | | 613 | 966 | 817 | 1,978 | 1,154 | 5,318,520 | 1,207 | 692 | 1,671 |
| B_cur/B_zero | | 0.301 | 0.307 | 0.333 | 0.355 | 0.412 | 0.78 | 0.419 | 0.325 | 0.471 |
| B_cur/B_msy | | 0.78 | 0.796 | 0.865 | 0.921 | 1.066 | 2.018 | 1.085 | 0.841 | 1.219 |
| SB_cur/SB_zero | | 0.272 | 0.278 | 0.309 | 0.331 | 0.379 | 0.753 | 0.384 | 0.291 | 0.438 |
| SB_cur/SB_msy | | 0.704 | 0.722 | 0.801 | 0.858 | 0.982 | 1.946 | 0.995 | 0.753 | 1.135 |
| SB_cur/SB_1995 | | 0.667 | 0.682 | 0.757 | 0.811 | 0.931 | 1.847 | 0.943 | 0.713 | 1.076 |
| B_msy/ B_zero | | 0.386 | 0.385 | 0.385 | 0.385 | 0.386 | 0.387 | 0.386 | 0.386 | 0.386 |
| SB_msy/SB_zero | | 0.386 | 0.385 | 0.385 | 0.385 | 0.386 | 0.387 | 0.386 | 0.386 | 0.386 |
| F_cur | | 0.374 | 0.369 | 0.353 | 0.359 | 0.198 | 0 | 0.183 | 0.323 | 0.139 |
| F_msy | | 0.084 | 0.078 | 0.078 | 0.078 | 0.086 | 0.089 | 0.086 | 0.084 | 0.086 |
| F_cur/F_msy | | 4.476 | 4.726 | 4.522 | 4.599 | 2.316 | 0.001 | 2.141 | 3.828 | 1.613 |

| | Units | Nat_M_1 | Nat_M_3 | Steep_1 | Steep_3 | Init_F_1 | Init_F_3 | SampSz_2 | SigmaR_2 |
|---|---|---|---|---|---|---|---|---|---|
| C_latest | t | 7,619 | 5,261 | 6,315 | 5,859 | 6,140 | 5,999 | 6,100 | 5,983 |
| C_cur | t per annum | 6,620 | 4,603 | 5,477 | 5,179 | 5,387 | 5,205 | 5,324 | 5,248 |
| Y_MSY | t per annum | 2,276 | 1,826 | 1,662 | 2,265 | 1,762 | 2,537 | 1,989 | 2,060 |
| B_zero | t | 325,676 | 97,063 | 169,891 | 132,028 | 132,110 | 189,649 | 149,021 | 153,894 |
| B_msy | t | 128,486 | 36,742 | 70,886 | 46,477 | 51,002 | 73,197 | 57,527 | 59,392 |
| B_cur | t | 96,458 | 32,041 | 52,086 | 39,068 | 47,281 | 41,523 | 44,713 | 44,999 |
| SB_zero | | 5,630 | 1,116 | 2,567 | 1,995 | 1,996 | 2,865 | 2,251 | 2,325 |
| SB_msy | | 2,221 | 422 | 1,071 | 702 | 771 | 1,106 | 869 | 897 |
| SB_cur | | 1,614 | 302 | 741 | 507 | 647 | 564 | 607 | 623 |
| B_cur/B_zero | | 0.296 | 0.33 | 0.307 | 0.296 | 0.358 | 0.219 | 0.3 | 0.292 |
| B_cur/B_msy | | 0.751 | 0.872 | 0.735 | 0.841 | 0.927 | 0.567 | 0.777 | 0.758 |
| SB_cur/SB_zero | | 0.287 | 0.27 | 0.289 | 0.254 | 0.324 | 0.197 | 0.27 | 0.268 |
| SB_cur/SB_msy | | 0.727 | 0.714 | 0.692 | 0.722 | 0.839 | 0.51 | 0.698 | 0.694 |
| SB_cur/SB_1995 | | 0.756 | 0.629 | 0.708 | 0.624 | 0.543 | 1.015 | 0.662 | 0.657 |
| B_msy/ B_zero | | 0.395 | 0.379 | 0.417 | 0.352 | 0.386 | 0.386 | 0.386 | 0.386 |
| SB_msy/SB_zero | | 0.395 | 0.379 | 0.417 | 0.352 | 0.386 | 0.386 | 0.386 | 0.386 |
| F_cur | | 0.44 | 0.287 | 0.446 | 0.347 | 0.354 | 0.337 | 0.336 | 0.386 |
| F_msy | | 0.08 | 0.087 | 0.061 | 0.109 | 0.084 | 0.083 | 0.084 | 0.083 |
| F_cur/F_msy | | 5.508 | 3.28 | 7.33 | 3.19 | 4.219 | 4.058 | 4.015 | 4.653 |

**Table FAL2:** Management quantities for the reference and grid based only on non-target longline CPUE.

| | Reference | Grid_Median | Grid_5% | Grid_95% |
|---|---|---|---|---|
| C_latest | 6090 | 10759 | 5434 | 30042 |
| C_cur | 5331 | 7123 | 4690 | 19062 |
| Y_MSY | 1994 | 2937 | 1754 | 6970 |
| B_zero | 149368 | 237839 | 113353 | 781495 |
| B_msy | 57660 | 91580 | 42131 | 302873 |
| B_cur | 44988 | 70416 | 36633 | 239129 |
| SB_zero | 2257 | 3433 | 1303 | 13509 |
| SB_msy | 871 | 1338 | 491 | 5235 |
| SB_cur | 613 | 937 | 349 | 4006 |
| B_cur/B_zero | 0.30 | 0.31 | 0.21 | 0.43 |
| B_cur/B_msy | 0.78 | 0.79 | 0.51 | 1.15 |
| SB_cur/SB_zero | 0.27 | 0.28 | 0.19 | 0.39 |
| SB_cur/SB_msy | 0.70 | 0.72 | 0.51 | 1.02 |
| SB_cur/SB_1995 | 0.67 | 0.81 | 0.56 | 1.30 |
| B_msy/ B_zero | 0.39 | 0.39 | 0.34 | 0.42 |
| SB_msy/SB_zero | 0.39 | 0.39 | 0.34 | 0.42 |
| F_cur | 0.37 | 0.35 | 0.22 | 0.52 |
| F_msy | 0.08 | 0.08 | 0.06 | 0.11 |
| F_cur/F_msy | 4.48 | 4.32 | 2.49 | 8.45 |

**Discussion**

212. CCMs were pleased to note the increase in the number of inputs to the assessment model as suggested by SC8, and the sensitivity analysis pertaining to those inputs (Fig. FAL3).

213. There was consensus among FFA members that this presentation of a more robust and comprehensive stock assessment for silky shark clearly demonstrates that catch and mortality of this species must urgently be reduced. It was noted that bycatch in the longline fishery is the main source of mortality of silky sharks, although there is also significant mortality in the associated purse-seine fishery, which predominantly catches juvenile individuals. They pointed out that the most recent work by SPC on shark bycatch mitigation has suggested that the implementation of measures such as restrictions on the targeting of shark, and bans on the use of shark lines and shark bait, are effective in reducing shark bycatch. In addition, preliminary work suggested that removing the use of wire traces would result in a 50% reduction in the catch of silky shark by longline vessels. These measures should also prove effective in reducing the mortality of other at-risk shark species such as oceanic whitetip shark.

214. FFA members recommended the development of a more comprehensive CMM to reduce shark bycatch that utilises the current research outcomes on effective bycatch mitigation measures or other catch reduction mechanisms.

215. One CCM noted that in working paper ISC/13/SHARKWG-2/02 it was stated that the reporting of blue sharks on these longline vessels had been mandatory between 2000 and 2010, and if so, why had not all sharks been reported? Japan stated that these longline vessels had been discarding and not reporting all sharks since 2000 and that this had created problems for estimating the catch.

216. Another CCM noted working paper SC7-EB-WP-02 where the data from Japanese research and training vessels had been filtered and considered reliable for constructing CPUE series for sharks.

217. China stated that it had good observer data on blue and silky sharks and offered to work with SPC to improve data issues.

218. The Pre-Assessment Workshop decided that CPUE of Hawaii longline silky shark shows a totally different trend from other fleets operating in the North Pacific because vessels from Hawaii rarely fish south of 10°N where silky sharks are located. Data from that fishery should not, therefore, be used in the WCPO silky shark assessment.

219. Japan noted that because released and discarded catches have not been sufficiently recorded by research and training vessels from 2000 to 2010, catch rates would be underestimated and not reliable during this period. Japan further noted that these vessels have recently been strongly requested to record these data. Collection of catch data has improved in recent years.

220. One CCM noted that analyses of the Japanese training vessel data had been undertaken and that some vessels provide reliable estimates, and appropriate characterisation and vessel selection prior to CPUE analysis can overcome these difficulties. Analyses undertaken using this approach have been employed to verify catch and effort data from the Japanese commercial fleet.

221. SPC pointed out that there has been no examination of observed distributions of silky shark in the EPO and WCPO.

222. IATTC informed the Committee that the catch distribution of silky sharks in IATTC areas is from coastal waters to well offshore but information on the possible linkages between WCPO and IATTC Convention Area sharks is limited. Average observed size in the coastal waters of the EPO is smaller than in the WCPO, and further investigation, in collaboration with Mexico and Ecuador, is required.

223. SC9 noted that the coverage of the collected catch, size and sex data of Japanese research and training vessels in the 1990s is very good but catch data since 2000 is poor. Filtering of the data to allow for the difference has occurred, and the fact that observer data cover the whole period is part of the solution, but more work is required.

224. SPC advised that the target longline series was created because some vessels clearly have higher catches than others and it was important to separate these from the bycatch data. There was a targeted shark fishery in and around PNG and the Solomon Islands for a few years, but SPC does not recommend using the resulting observer data because the area covered is very small area, the entire population is not indexed, and the coverage through time is incomplete.

225. SC9 noted that although the longevity of the silky shark is 36 years, is it possible to conduct the assessment using the data with a duration less than longevity (15 years) to estimate trends in abundance.

226. FFA members reiterated the need for species-specific shark reporting and for compliance with the 5% observer coverage standard to be improved, to support the development of a more comprehensive and effective shark bycatch CMM that reduces the impact of WCPO fisheries on all shark species.

227. The SC9 consensus was to use the non-target longline series and estimate the grid with alternative catch, steepness, natural mortality, effective sample size weighting, initial depletion and standard deviation of recruitment deviates.

#### 4.3.2.2 Provision of scientific information

**a. Status and trends**

228. **Silky shark is a low productivity species and this low productivity is reflected in the low estimated value for $F_{MSY}$ ($F_{MSY}$ = 0.08) and high estimated value for $SB_{MSY}/SB_0$ = 0.39. These directly impact on conclusions about overfishing and the overfished status of the stock. Estimated fishing mortality has increased to levels far in excess of $F_{MSY}$ ($F_{current}/F_{MSY}$ = 4.32) and across nearly all plausible model runs undertaken, estimated F values were much higher than $F_{MSY}$ (the 5th and 95th quantiles are 2.49 and 7.45, respectively). Based on these results, SC9 concluded that overfishing is occurring. Estimated SSB has declined to levels below $SB_{MSY}$ ($SB_{current}/SB_{MSY}$ = 0.72) and for the majority of the model runs undertaken, $SB_{current}$ is less than $SB_{MSY}$ (the 5th and 95th quantiles are 0.51 and 1.02, respectively). Based on the distribution of the relative current SSB, SC9 concluded that it is highly likely that the stock is in an overfished state.**

**b. Management advice and implications**

229. **Current catches are higher than MSY (7,123 mt vs. MSY = 2,937 mt), further catches at current levels of fishing mortality would continue to deplete the stock below $SB_{MSY}$. Current (2005–2008 average) and latest (2009) catches are significantly greater than the forecast catch in 2010 under $F_{MSY}$ conditions (approximately 600 mt).**

230. **The greatest impact on the stock is attributed to bycatch from the longline fishery in the tropical and subtropical areas, but there are also significant impacts from the associated purse-seine fishery that catches predominantly juvenile sharks. The Commission should consider measures directed at bycatch mitigation as well as measures directed at targeted catch, such as from shark lines (Attachment F), to improve the status of the silky shark population. Existing observer data may provide some information on which measures would be the most effective.**

### 4.3.3. South Pacific blue shark

#### 4.3.3.1 Review of research and information

231. J. Rice (SPC) presented working paper SC9-SA-WP-04 (Potential catch and CPUE series to support a stock assessment of blue shark in the South Pacific Ocean), which responds to the Pre-Assessment Workshop recommendation regarding blue shark data. He noted that at SC8, SPC was requested to conduct assessments for blue shark in the North and South Pacific Oceans. In developing the critical catch and CPUE inputs for the South Pacific assessment, it became apparent to SPC that data to support the development of catch estimates varied greatly in their quality and coverage, and constructing catch estimates that could be easily understood and accepted by SC was going to be challenging. This conclusion was supported by the Pre-Assessment Workshop.

a) The paper presented the nature and extent of data available for the construction of CPUE and catch series for a South Pacific blue shark assessment, and highlighted some of the critical gaps in the data and provides some potential catch and CPUE series. SPC asked SC to i) determine if it has sufficient confidence in the available data to request SPC to complete the stock assessment; and 2) provide guidance on which CPUE and catch series should be included in the assessment, if one goes ahead.
b) The paper presented the estimated catches and standardized CPUE series for blue sharks in the southwestern central Pacific from longline vessels based on observer, logsheet and aggregate data held by SPC for the years 1990–2011. The datasets all share the same characteristics of poor coverage with respect to space, time, or species identification or all

three. The analysis was conducted based on five regions for both catch and CPUE, although the fleet-specific CPUE trends correspond only approximately to catch regions. A further nine CPUE trends for eight individual fleets were estimated for five regions. Purse-seine data was not considered due to the extremely low observed catch rates.

c) Catch estimates in the early years are all quite uncertain and there is a large variation in the catch estimates throughout the 1990s. By the end of the model period, total catch estimates from five of the six approaches used were in the 90,000–180,000 mt range. While this is a nearly 100% difference between the lowest and highest (of these lowest five models) they appear to be more consistent than the logsheet raised restricted estimate which is over 500,000 mt in the last four years of the series. The recommendation is to use the standardized observer-based catch estimates in a future stock assessment.
d) Because catch at length data show region-specific differences, it is important to bound the uncertainty in the catch by including alternative trends in any future assessment. The catch trends derived from aggregated reported data and the logsheet standardized data should also be included as sensitivities to capture the differences in the magnitude and trend of the region-specific catch estimates.
e) Overall CPUE trends are quite different between the individual fleets, and in any assessment multiple runs should be undertaken based on groupings of similar CPUE trends because it is generally considered to be incorrect to include both increasing and decreasing trends in the same model run.
f) The fleet-specific standardized CPUE trends presented at SC9 reflected the underlying nominal data in many of the models, indicating that the standardization may have had little effect over the entirety of the time series. SPC recommended that Fleet 7 should be the index to use in an assessment associated with catch Region 4, a refined estimate from Fleet 8 should be used for Region 5, along with Fleets 1 and 2 for Regions 1 and 3. Due to the difference in the standardized CPUE trend based on observer data for Fleet 2 and the standardized CPUE trend resulting from catch estimation for Region 2, SPC suggested that both trends be included in any future assessment. SPC advised that additional standardization work for the logsheet-derived CPUE trend could improve the index; this is because time series trends from the generalized additive model (GAM) that include splines on the year effect are usually over-fit with respect to the intra-year variability.

**Discussion**

232. One CCM stated support for using the standardized observer CPUE data but noted that instead of using the median of the effects level, the weighted average for each year should be used. It was asked what percentage of the data was used in the series based on those fleets that had reported blue shark five times within five years. SPC explained techniques that were used to get the best value from the data, but did not have information on hand to provide an estimate of the percentage of effort that was filtered out from different datasets as a result of these techniques.

233. It was noted that the method described in SC9-SA-IP-10 may offer an alternative way of using the observer data to raise the logbook catch.

234. Japan noted that a recent review of its porbeagle shark data had uncovered a number of additional datasets that might be useful in the South Pacific blue shark and shortfin mako shark assessments, such as the pelagic driftnet surveys of 1992–1990. SC9 appreciated Japan's offer and SPC's willingness to analyze these data.

235. USA asked if the catch discard information recorded by observers was included in datasets because this would be important for fleets where catches are mostly discarded. SPC pointed out that

logbook data from some regions do not distinguish between captured and retained. It was noted that there are problems with gathering these data, and SPC is aware of the implications and will take these into account.

236. Some CCMs recognized that the delay in the completion of the South Pacific blue shark stock assessment was necessary in order to ensure sufficient scrutiny of the available data. These CCMs felt that the presentation demonstrated a recurrent theme in the shark assessment agenda items; that is, the challenge to assessment and management resulting from the lack of robust data. While recognizing that uncertainty is unavoidable when dealing with non-target species with limited data coverage, these CCMs felt that, given the further work done in analyzing the available data, there was now a sufficient basis for SPC to progress the stock assessment of this species, and the results of the stock assessment should be presented to SC10.

#### 4.3.3.2 Provision of scientific information

**a. Status and trends**

237. **SC9 noted that no stock assessment was conducted for South Pacific blue shark in 2013.**

**b. Management advice and implications**

238. **There was no stock assessment for this species; therefore SC9 was unable to provide management advice on this stock.**

### 4.3.4. North Pacific blue shark

239. ISC advised that an assessment had been completed for North Pacific blue shark and that a second draft will be reviewed by ISC in January 2014. Within the ISC SHARKWG, ISC used a simpler model, a Bayesian Production Modeling platform, and the second, a more detailed approach led by SPC and IATTC uses Stock Synthesis 3 (SS3) as the modeling platform. The completed ISC assessment was conducted collaboratively under the umbrella of ISC and published as an ISC SHARKWG working paper at ISC plenary in July 2013 (SC9-SA-WP-02 and SC9-SA-WP-11).

#### 4.3.4.1. Review of research information

*SC9-SA-WP-11 (ISC Shark Working Group: Stock assessment and future projections of blue shark in the North Pacific, plus reports from the associated ISC Shark WG Workshops)*

240. S. Kohin (chair of the ISC SHARKWG) presented the recently completed North Pacific blue shark stock assessment (BS1), which was completed in April 2013 using fishery data through 2011.

a) Stock biomass and fishing mortality levels were estimated using a state-space Bayesian surplus production model (BSP2) that fits estimated catch to standardized CPUE data compiled by the SHARKWG from 1971–2011. Annual catch estimates were derived for a variety of fisheries by nation and compiled into a single catch time series for input into the BSP2 model. The SHARKWG developed annual estimates of standardized CPUE for several fisheries and used criteria to select representative indices for the assessment.
b) Standardized CPUE from the Japanese shallow longline fleet that operates out of Hokkaido and Tohoku ports for the periods 1976–1993 and 1994–2010 were used as measures of relative population abundance in the base case assessment (Fig. BS1-1). A Fletcher-Schaefer production model was fit in a likelihood-based statistical framework with priors assigned to several parameters, including the intrinsic rate of population increase (r) and the ratio of

initial biomass to carrying capacity ($B_{init}/K$). Bayesian posteriors of model parameters and derived outputs from the base case model were used to characterize stock status.

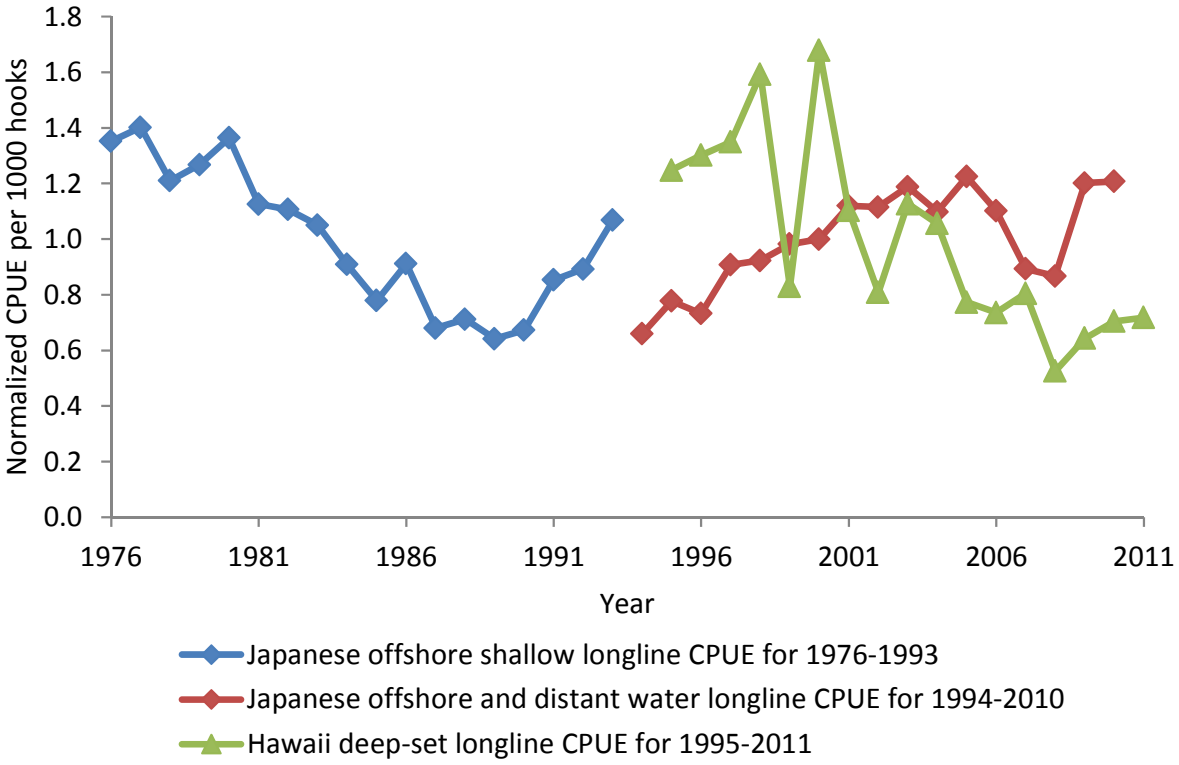


**Figure BS1-1:** BS1-standardized CPUEs used as abundance indices in the blue shark (*Prionace glauca*) stock assessment. The base case model was fitted to the Japanese longline early (1976–1993), and late indices (1994–2010). A sensitivity run was fitted to the Hawaii deep-set longline index (1995–2011) and the Japanese longline early index to examine the effect of an alternative index for the late period.

c) The SHARKWG recognized uncertainties in the procedures used to estimate catch and standardized CPUE series, and in the selection of input parameters and priors. The influence of these uncertainties on biomass trends and the 2011 fishing mortality level was assessed by constructing 21 sensitivity scenarios, which were designed to capture the maximum range of uncertainty in the input information, using alternative data and/or parameterizations.

d) Stock projections of biomass and catch of blue shark in the North Pacific from 2012 to 2031 were conducted, assuming 21 alternative harvest scenarios and starting biomass levels. Status quo catch and F were based on the average over the recent five years (2006–2010). The estimated catch from 2011 was not used for projections due to the impact of the March 2011 Great East Japan Earthquake on Japanese fishing effort. A simulation model was used for annual projections, and included uncertainty in the population size at the starting year of stock projection, fishing mortality and productivity parameters.

e) Based on the trajectory of the base case model, median stock biomass of blue shark in 2011 ($B_{2011}$) was estimated to be 456,000 mt (Fig. BS1-2). Median annual fishing mortality in 2011 ($F_{2011}$) was 7.14% of $B_{2011}$. Catch in 2011 ($C_{2011}$) was estimated to be 75% of replacement yield (REPY). Stock status is reported in relation to MSY. Stock biomass in 2011 was approximately 60% higher than $B_{MSY}$, and $F_{2011}$ was estimated to be well below $F_{MSY}$. (Table BS1-1).

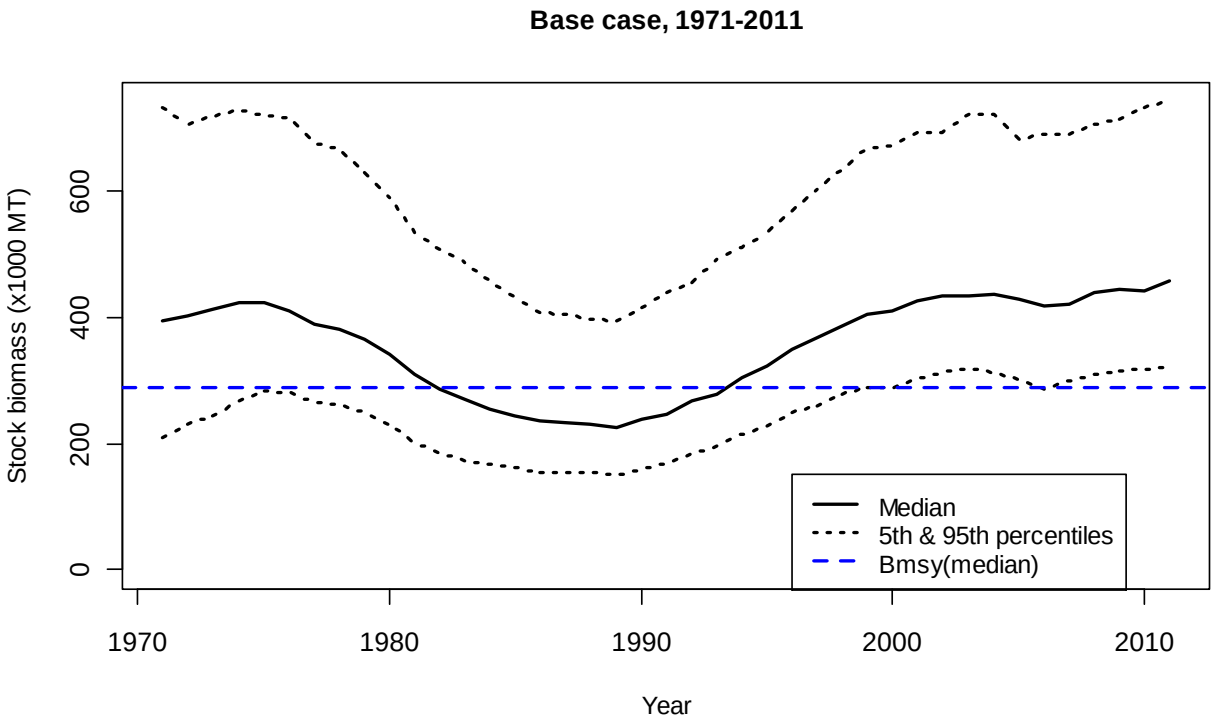


**Figure BS1-2:** Median and 90% confidence intervals for the estimated historical stock dynamics of North Pacific blue shark (*Prionace glauca*).

**Table BS1-1:** Base case model results of blue shark (*Prionace glauca*) assessment — median and 90% confidence intervals of important biological parameters and reference points. REPY and $C_{2011}$ indicates replacement yield and catch in 2011, respectively.

| Variable | 5th percentile | Median | 95th percentile |
|---|---|---|---|
| *r* | 0.25 | 0.40 | 0.58 |
| K (‘000 t) | 432 | 613 | 961 |
| MSY (‘000 t) | 52 | 58 | 65 |
| $B_{MSY}$ (‘000 t) | 203 | 288 | 452 |
| $B_{1971}$ (‘000 t) | 208 | 393 | 732 |
| $B_{2011}$ (‘000 t) | 323 | 456 | 741 |
| $B_{2011}/B_{MSY}$ | 1.30 | 1.59 | 1.88 |
| $B_{2011}/B_{1971}$ | 0.81 | 1.17 | 1.94 |
| $B_{2011}/K$ | 0.65 | 0.80 | 0.94 |
| $F_{MSY}$ (%) | 12.6 | 20.0 | 29.0 |
| $F_{2011}$ (%) | 4.4 | 7.1 | 10.0 |
| $F_{2011}/F_{MSY}$ | 0.28 | 0.35 | 0.48 |
| *REPY* (‘000 t) | 28 | 43 | 53 |
| $C_{2011}/REPY$ | 0.59 | 0.75 | 1.08 |

f) While the results varied depending on the input assumptions, there was general agreement in nearly all scenarios in terms of the key model results: stock biomass was near a time-series high in 1971, fell to its lowest level in the late 1980s, and subsequently increased gradually,

and has levelled off at a biomass similar to that at the beginning of the time series (Fig. BS1-3) A scenario using CPUE data for the Hawaii-based deep longline fleet for 1995–2011 in place of the Japanese shallow longline index for 1994–2010, showed a continual decline in stock biomass from 1971 to 2011. However, the Hawaii index was not considered to be representative of the stock due to the relatively small amount of catch and spatial coverage and the potential impact of regulatory changes in the fishery.

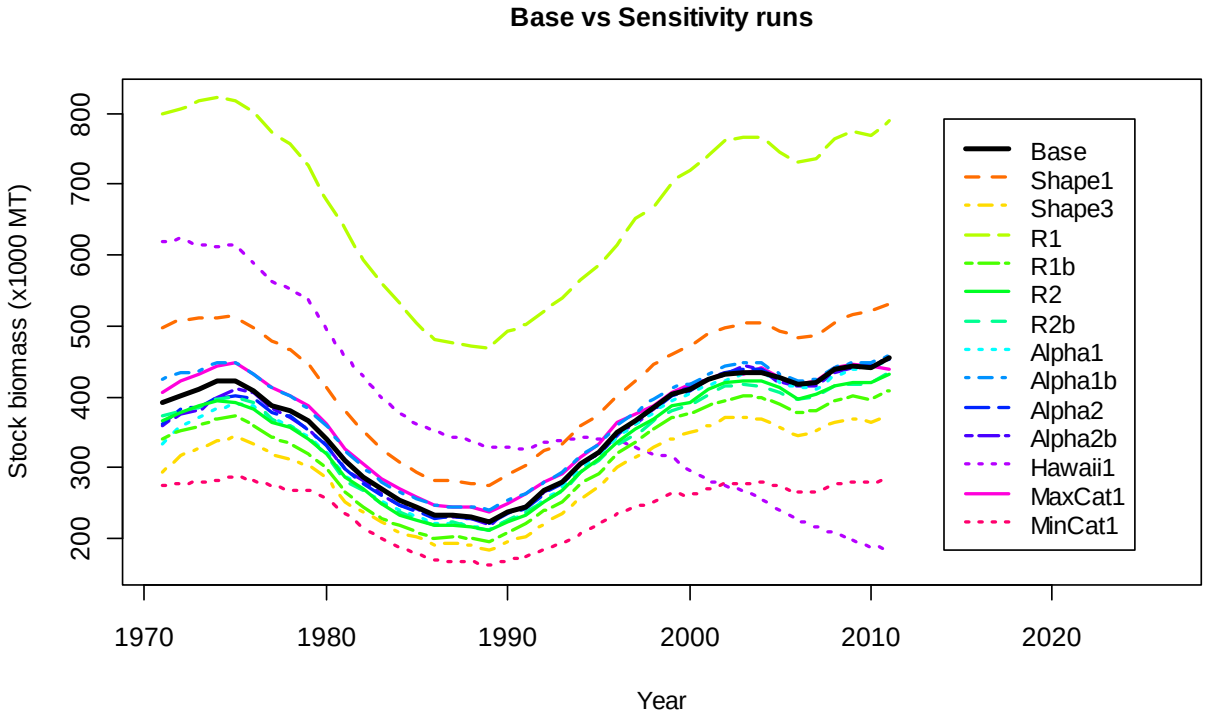


**Figure BS1-3:** Comparison of trajectories of median stock biomass between the base case and sensitivity runs. See ISC blue shark (*Prionace glauca*) assessment report (SC9-SA-WP-11) for run identifiers and detailed descriptions of the sensitivity runs.

g) Future projections of the base case model show that median blue shark biomass in the North Pacific will remain above $B_{MSY}$ under the catch harvest policies examined (status quo, +20%, -20%). Similarly, future projections under different fishing mortality (F) harvest policies (status quo, +20%, -20%) show that median blue shark biomass in the North Pacific will remain above $B_{MSY}$ (Table BS1-2).

**Table BS1-2:** Decision table based on results of future projections for the base case blue shark (*Prionace glauca*) assessment. Catch harvest control policies examined include status quo catch (calculated as the average for 2006–2010) and ± 20% change from status quo catch. F harvest control policies examined included status quo F (calculated as the average for 2006–2010), ± 20% change from status quo F, and $F_{MSY}$.

| Harvest Policy | | Current | | | | 5-Year Projection | | | | | 20-Year Projection | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total $C_{2011}$ | $B_{2011}$ / $B_{msy}$ | $F_{2011}$ / $F_{msy}$ | $C_{2011}$ / REPY | Total $C_{2016}$ | $B_{2016}$ / $B_{msy}$ | P($B_{2016}$ > $B_{msy}$) | $F_{2016}$ / $F_{msy}$ | $C_{2016}$ / REPY | Total $C_{2031}$ | $B_{2031}$ / $B_{msy}$ | P($B_{2031}$ > $B_{msy}$) | $F_{2031}$ / $F_{msy}$ | $C_{2031}$ / REPY |
| Catch | Status Quo | 32.54 | 1.59 | 0.35 | 0.75 | 40.64 | 1.55 | 1.00 | 0.45 | 0.93 | 40.64 | 1.58 | 0.99 | 0.44 | 0.95 |
| | + 20% | 32.54 | 1.59 | 0.35 | 0.75 | 48.77 | 1.45 | 0.99 | 0.58 | 1.05 | 48.77 | 1.42 | 0.95 | 0.60 | 0.99 |
| | - 20% | 32.54 | 1.59 | 0.35 | 0.75 | 32.51 | 1.65 | 1.00 | 0.34 | 0.79 | 32.51 | 1.72 | 1.00 | 0.33 | 0.83 |
| F | Status Quo | 32.54 | 1.59 | 0.46 | 0.75 | 38.45 | 1.55 | 1.00 | 0.46 | 0.91 | 42.92 | 1.55 | 0.99 | 0.46 | 1.37 |
| | + 20% | 32.54 | 1.59 | 0.56 | 0.75 | 43.99 | 1.46 | 0.99 | 0.56 | 0.96 | 48.45 | 1.44 | 0.96 | 0.56 | 1.28 |
| | - 20% | 32.54 | 1.59 | 0.37 | 0.75 | 32.24 | 1.63 | 1.00 | 0.37 | 0.85 | 36.42 | 1.65 | 1.00 | 0.37 | 1.54 |
| | $F_{msy}$ | 32.54 | 1.59 | 0.35 | 0.75 | 66.38 | 1.12 | NA | 1.03 | 1.17 | 57.97 | 1.00 | NA | 1.00 | 1.00 |

h) Projections under different catch and fishing mortality policies were also conducted for the maximum and minimum catch model scenarios. In all cases, patterns of trajectories were essentially the same as for the base case, and the projected stock biomass remained above $B_{MSY}$. Projected stock biomass was lower for runs with either catch or F 20% above current, as expected, but remained above $B_{MSY}$.

i) Model inputs for this assessment have been improved since the previous assessment and provide the best available scientific information. However, there are uncertainties in the time series for estimated catch and abundance indices for blue shark in the North Pacific, as well as for many life history parameters used to estimate stock productivity. Available catch composition information demonstrates evidence of spatial and temporal stratification by size and sex. The use of other modeling approaches, if sufficient data are available, may provide additional insights into stock dynamics.

j) Based on the base case and plausible model scenarios, the blue shark biomass level in 2011 in the North Pacific is estimated to be near the highest levels seen in the time series, and the current fishing mortality rates and catch levels are below those expected to produce MSY. Stock status in relation to MSY demonstrates that the stock is not overfished and overfishing is not occurring (Fig. BS1-4).

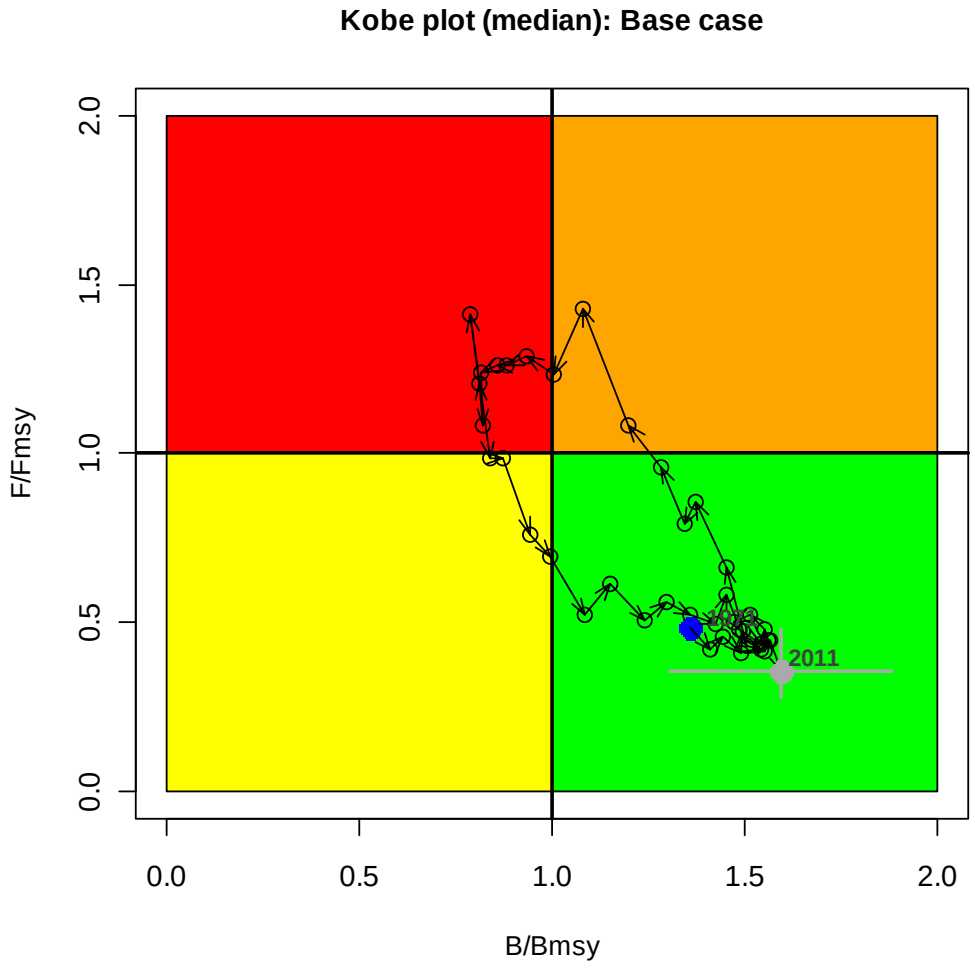


**Figure BS1-4:** Kobe plot for the base case in the North Pacific blue shark (*Prionace glauca*) stock assessment. Kobe plot illustrates relative stock depletion (horizontal axis) and fishing mortality (vertical axis) levels. Colors represent the magnitude of risk of stock collapse green (safe) to red (high risk). The solid blue circle indicates the median estimate in 1971 (the start year of stock assessment calculation). The solid gray circle and its horizontal and vertical solid gray lines indicate the median and 90% confidence limits in 2011, respectively. The open black circles and connected solid black arrows are the medians in years between 1971 and 2011 and historical directions of stock status.

k) A single scenario using CPUE data for the Hawaii-based deep longline fleet for 1995–2011 in place of the Japanese shallow longline index for 1994–2010, showed a continual decline in stock biomass from 1971 to 2011, which could lead to a different conclusion regarding stock status. The Hawaii index was not considered to be representative of the Pacific-wide stock due to the relatively small amount of catch and spatial coverage and the potential impact of regulatory changes in the fishery.

l) Based on the base case and plausible model scenarios, the North Pacific blue shark stock is not overfished and overfishing is not occurring. Due to data uncertainties, improvements in the monitoring of blue shark catches and discards, as well as continued research into the biology and ecology of blue shark in the North Pacific are recommended.

m) Future projections of the base case model show that median blue shark biomass in the North Pacific will remain above $B_{MSY}$ under the catch harvest policies examined (status quo, +20%, -20%). Similarly, future projections under different fishing mortality (F) harvest policies

(status quo, +20%, -20%) show that median blue shark biomass in the North Pacific will remain above $B_{MSY}$ (Table BS1-2).

n) The analyses indicate that the stock is in a healthy condition and current levels of F are sustainable in the short and long term.

*SC9-SA-WP-02 (Stock assessment of blue sharks in the North Pacific Ocean using Stock Synthesis)*

241. J. Rice (SPC) presented SC9-SA-WP-02 (BS2). The excerpts from the Executive Summary of this paper are provided below as are several figures and tables regarding stock status that reflect the model runs selected by SC for determining current stock status and providing management advice.

a) This paper presents an age-based statistical catch-at-length stock assessment of blue shark in the North Pacific Ocean (NPO). The assessment uses the stock assessment model and computer software known as Stock Synthesis (version 3.24F at http://nft.nefsc.noaa.gov/Download.html).

b) This is one of the two stock assessment approaches being applied to blue sharks in the NPO. The ISC SHARKWG has agreed to use a Bayesian Surplus Production (BSP) model for the main stock assessment and the age-based statistical catch-at-length length stock assessment presented here to help support results from the BSP model. This paper should be read with the full assessment report of the ISC SHARKWG, which provides greater details of the data sources and how they were derived as well as pertinent summaries of biological knowledge.

c) The primary reason to use Stock Synthesis was to take advantage of the low fecundity spawner recruitment relationship (LFSR) functionality. In the assessment we examined many alternative parameterisations of this relationship which provided similar productivity assumptions to the BSP (i.e. $B_{MSY}/B_0 \sim 0.5$). Also we were able to incorporate the strong sex-specific patterns that are seen in many of the datasets.

d) This is an integrated stock assessment using estimated catch, standardized catch per unit of effort time series, observed catch at length, and published life history information. The blue shark model is an age (30 years) structured, spatially aggregated (1 region), and two-sex model. The catch, effort, and size composition of catch are grouped into 18 fisheries covering the time period 1976 through 2011.

e) Blue sharks are often caught as bycatch in the Pacific tuna fisheries, though significant directed and mixed species (sharks, and tunas/billfish) fisheries do exist. Commercial reporting of blue shark landings has been minimal, and information regarding the targeting, and fate of sharks encountered in the fisheries is limited. Observer data on catch and effort are mostly confined to areas near the Hawaii Islands (US jurisdiction) and the island states north of the equator. Although the observer data suffer from poor coverage in key areas such as the eastern Pacific Ocean and northwest Pacific, logbook and other fishery dependent data exists.

f) Due to gaps in the data and varied estimates of life history parameters, multiple models that reflected different assumptions were run with alternative data and/or parameters. These multiple models with different combinations of the input datasets and structural model hypotheses were used to assess the plausible range of stock status for blue shark. The reference case presented here was chosen based on input from ISC and attempts to approximate the overall productivity assumptions used in the BSP. It represents the set of LFSR parameters that gave the best fit given other assumptions decided for the reference case. The reference case model is used as an example for presenting model diagnostics. The most appropriate model run(s) on which to base management advice will be determined by SC, considering the recommendations from the ISC plenary.

g) The reference case model and alternative model assumptions are provided in Table BS2-1 below. A full factorial grid of all options was run (giving a total of 192 model runs), and full results for any run are available on request.

**Table BS2-1:** Reference case model and alternative model assumptions.

| Axis of uncertainty | Reference case assumption | Alternative assumptions |
|---|---|---|
| CPUE series | Japanese early and late CPUE series | Japanese early and Hawaii deep set<br>Japanese early and Japan research and training vessel |
| Age-specific natural mortality approach | Chen and Watanabe (high) | Peterson and Wroblewski (low) |
| Sample size for length-frequency data | Scalar of 0.2 | Scalar of 0.5 (upweight) |
| Sfrac of the LFSR | 0.35 | 0.05, 0.13, 0.2 |
| Beta of the LFSR | 2 | 1,3,4 |

LFSR = low fecundity spawner recruitment relationship

h) We recognize that there are other sources of model and data uncertainty that could be examined, but believe we have captured the major sources of uncertainty here relative to the BSP model.

i) We have reported stock status in relation to MSY-based reference points, but note that WCPFC has not yet made decisions regarding limit (or target) reference points for sharks.

j) The key conclusions of the Stock Synthesis stock assessment for blue sharks in the NPO are as follows:

- For the reference case model current catches are two thirds of the MSY level (MSY = 50,330 mt), current biomass is 84.6% of $B_{MSY}$ (Table BS2-2) and 90% in the last year of the model, and fishing mortality is 77.6% of $F_{MSY}$ level. The stock could be said to be in an overfished state, but the stock is rebuilding under current catches as fishing mortality is declining (Figs. BS2-1, BS2-2 and BS2-3**)**. However, there is considerable uncertainty around the estimates of current depletion and fishing mortality from the model. The 95% confidence limits for spawning depletion in the final year are 17.5–152.0% of $B_{MSY}$ and fishing mortality at 20–136% of $F_{MSY}$.

**Table BS2-2:** Estimates of management quantities for the reference, median, 5th, and 95th quantiles of the uncertainty grid based on the reference case CPUE.

| | Reference | Median | 5% | 95% |
|---|---|---|---|---|
| C_latest | 33,744 | 33,744 | 33,744 | 33,744 |
| C2011_msy | 0.670 | 0.645 | 0.194 | Inf |
| Y_MSY | 50,330 | 52,301 | - | 191,406 |
| equil_pt | 0.469 | 0.504 | 0.441 | 1.000 |
| Recr_Virgin | 22983 | 59562 | 17692 | 246989 |
| B_zero | 2,791,650 | 4,278,960 | 1,488,526 | 12,391,320 |
| B_msy | 1,310,478 | 2,311,458 | 689,223 | 8,124,070 |
| B_cur | 1,108,347 | 2,073,334 | 517,697 | 10,359,893 |
| SB_zero | 321,845 | 493,315 | 173,347 | 1,436,836 |
| SB_msy | 151,083 | 269,182 | 80,264 | 936,613 |
| SB_cur | 127,780 | 240,235 | 59,782 | 1,194,380 |
| B_cur_F0 | 2,820,515 | 4,347,210 | 1,388,742 | 11,999,712 |
| SB_cur_F0 | 325,173 | 503,734 | 161,727 | 1,395,345 |
| B_cur/B_zero | 0.397 | 0.476 | 0.324 | 1.028 |
| B_cur/B_msy | 0.846 | 0.939 | 0.682 | 2.104 |
| B_cur/B_cur_F0 | 0.393 | 0.463 | 0.332 | 0.994 |
| Bratio_1976 | 0.290 | 0.371 | 0.247 | 0.668 |
| Bratio_2011 | 0.425 | 0.500 | 0.363 | 0.992 |
| Bratio_cur | 0.397 | 0.476 | 0.324 | 1.028 |
| B_msy/ B_zero | 0.469 | 0.504 | 0.441 | 1.000 |
| SB_cur/SB_zero | 0.397 | 0.476 | 0.324 | 1.028 |
| SB_cur/SB_msy | 0.846 | 0.939 | 0.682 | 2.104 |
| SB_cur/SB_cur_F0 | 0.393 | 0.463 | 0.332 | 0.994 |
| SB_msy/SB_zero | 0.469 | 0.504 | 0.441 | 1.000 |
| SB_cur_init | 1.368 | 1.285 | 1.031 | 1.552 |
| Fcur | 0.229 | 0.128 | 0.039 | 0.306 |
| F_msy | 0.226 | 0.176 | 0.051 | 0.322 |
| F_2011_msy | 0.776 | 0.691 | 0.160 | 1.357 |
| F_cur_msy | 1.012 | 0.850 | 0.173 | 1.801 |

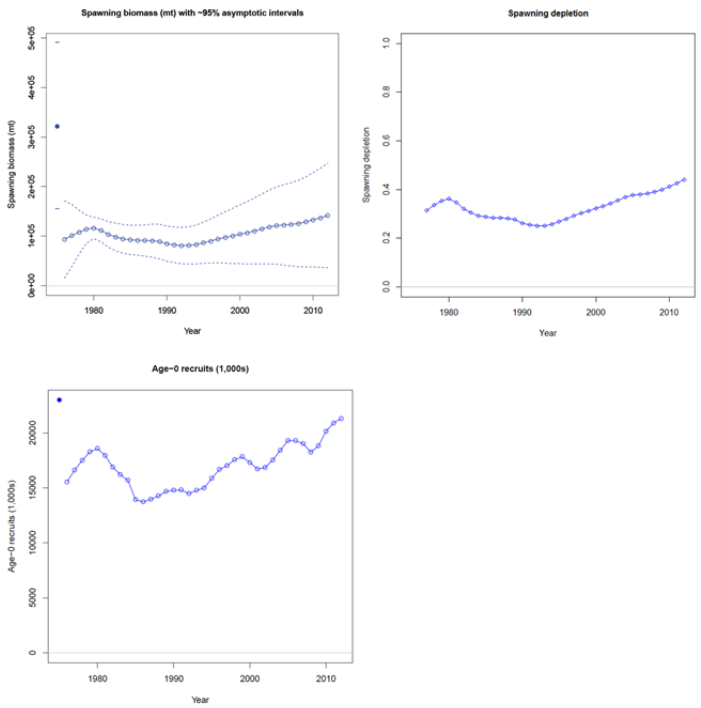


**Figure BS2-1:** Estimated SSB (top left), estimated SSB depletion (top right) and estimated annual recruitment (1000's of fish) in the North Pacific for the reference case.

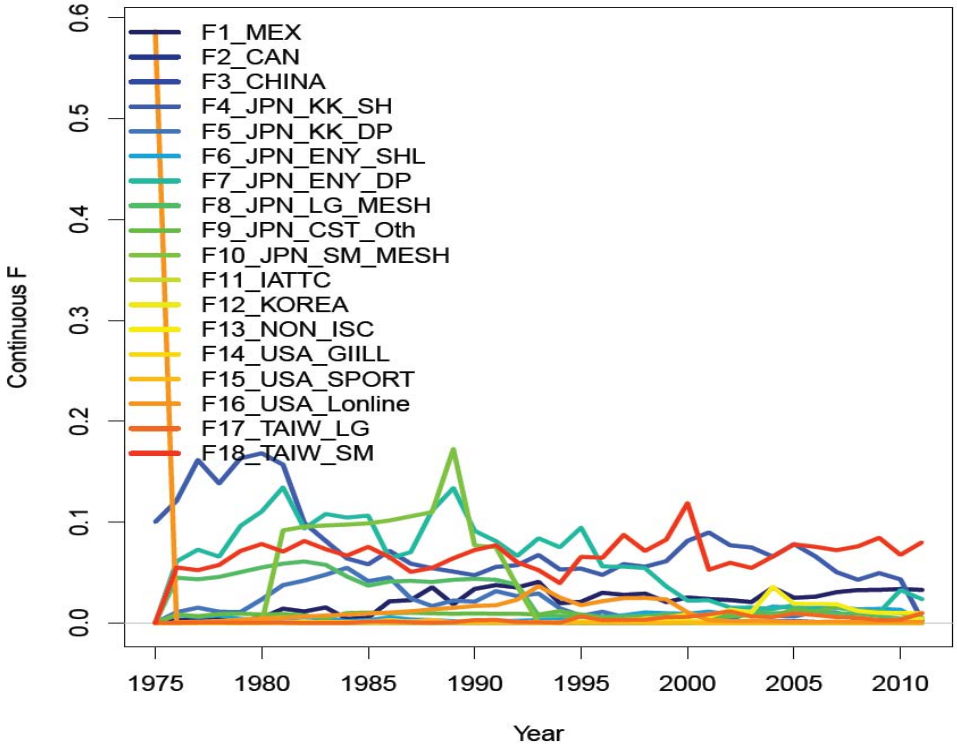


**Figure BS2-2:** Estimated fishing mortality by fleet for the reference case over the model period.

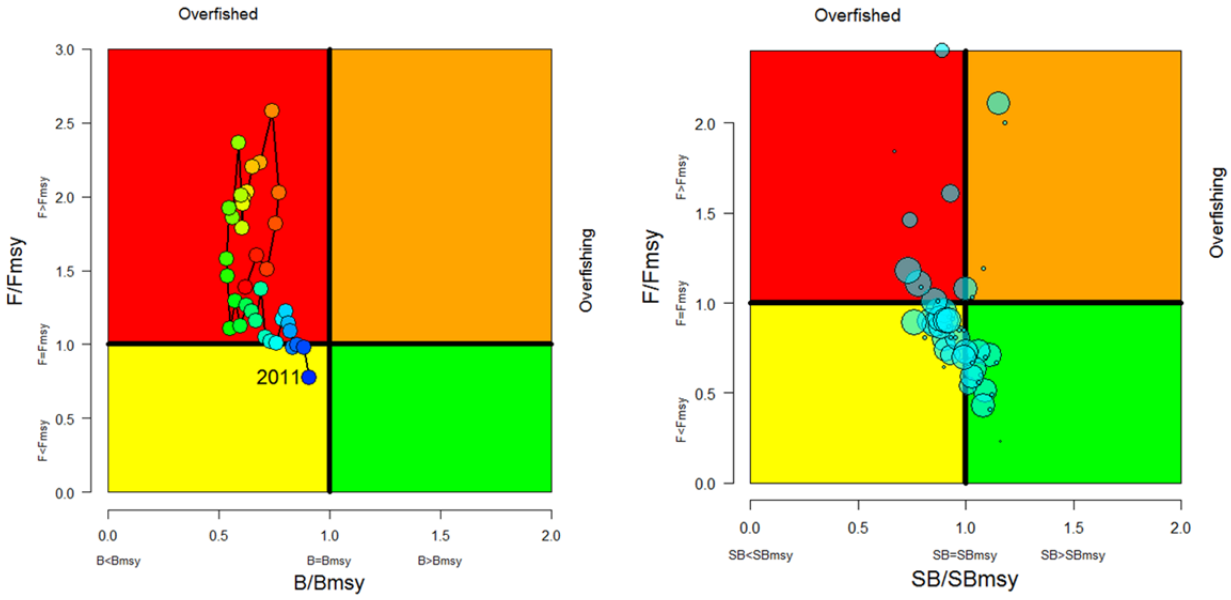


**Figure BS2-3:** Kobe plots indicating annual stock status, relative to $SB_{MSY}$ (x-axis) and $F_{MSY}$ (y-axis) reference points. These present the reference model for the period 1976–2011 (left panel) and are based on current (average of 2008–2010) estimates for all models using the reference case CPUE (Japanese early and late). In the right-hand side panel, the size of the circle is proportional to the inverse of the total likelihood value, with larger circles representing a more plausible model run. Note that the y-axes' range differ in the plots.

- We found many significant sex-specific differences in selectivity and catchability which emphasises the importance of including these processes in the assessment.
- Looking at the key sources of uncertainty, one-off changes from the reference case lead to the following conclusions:
  i) The alternative late CPUE series had the greatest influence on the assessment conclusions. Under the Hawaii deepset series, the biomass was continually declining over the modeling period, MSY was lower, depletion was much greater with the stock 60% below the $B_{MSY}$ level, and fishing mortality was well above $F_{MSY}$. Under the Japan research and training vessel series, the model often failed to converge – mostly due to the population crashing. Model runs that did converge suggested even worse conditions than the Hawaii deepset series (Table BS2-3).

**Table BS2-3:** Estimates of key management quantities for the reference case model and all one-change sensitivity analyses. Models with "NA" did not successfully converge. Latest = 2011, and cur = the mean over the period 2007–2010. Note: CPUE 1 is the run with the Japanese early and Hawaii deepset series, and CPUE 3 is the run with the Japanese early and research and training vessel series (this did not converge).

| | Units | Reference | CPUE 1 | CPUE 3 | SampSize 0.5 | M at Age HI | Sfrac 0.05 &Beta 1 | Sfrac 0.05 &Beta 2 | Sfrac 0.05 &Beta 3 | Sfrac 0.05 &Beta4 | Sfrac 0.13 &Beta 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C_latest | T | 33,744 | 33,744 | NA | 33,744 | 33,744 | 33,744 | 33,744 | 33,744 | NA | 33,744 |
| C2011_msy | | 0.670 | 0.793 | NA | 0.673 | 0.674 | 1.832 | 0.768 | 0.505 | NA | 0.945 |
| Y_MSY | T | 50,330 | 42,574 | NA | 50,151 | 50,035 | 18,415 | 43,912 | 66,859 | NA | 35,722 |
| equil_pt | | 0.469 | 0.469 | NA | 0.469 | 0.490 | 0.496 | 0.514 | 0.529 | NA | 0.488 |
| Recr_Virgi | T | 22983 | 18972 | NA | 23066 | 69890 | 77567 | 74130 | 93913 | NA | 54908 |
| B_zero | T | 2,791,650 | 2,304,460 | NA | 2,801,770 | 3,016,320 | 9,421,780 | 9,004,300 | 11,407,200 | NA | 6,669,390 |
| B_msy | T | 1,310,478 | 1,081,607 | NA | 1,314,623 | 1,476,933 | 4,668,657 | 4,631,547 | 6,035,983 | NA | 3,256,669 |
| B_cur | T | 1,108,347 | 427,490 | NA | 1,242,140 | 1,294,646 | 4,154,800 | 4,120,460 | 6,118,423 | NA | 2,410,571 |
| SB_zero | T | 321,845 | 265,678 | NA | 323,012 | 351,267 | 1,086,220 | 1,038,090 | 1,315,120 | NA | 768,905 |
| SB_msy | T | 151,083 | 124,697 | NA | 151,561 | 171,997 | 538,241 | 533,963 | 695,880 | NA | 375,457 |
| SB_cur | T | 127,780 | 49,285 | NA | 143,205 | 150,769 | 479,002 | 475,042 | 705,386 | NA | 277,912 |
| B_cur_F0 | T | 2,820,515 | 2,239,417 | NA | 2,844,292 | 3,152,243 | 10,255,105 | 9,657,120 | 11,911,239 | NA | 7,267,157 |
| SB_cur_F0 | T | 325,173 | 258,179 | NA | 327,914 | 367,096 | 1,182,293 | 1,113,353 | 1,373,230 | NA | 837,821 |
| B_cur/B_zero | | 0.397 | 0.186 | NA | 0.443 | 0.429 | 0.441 | 0.458 | 0.536 | NA | 0.361 |
| B_cur/B_msy | | 0.846 | 0.395 | NA | 0.945 | 0.877 | 0.890 | 0.890 | 1.014 | NA | 0.740 |
| B_cur/B_cur_F0 | | 0.393 | 0.191 | NA | 0.437 | 0.411 | 0.405 | 0.427 | 0.514 | NA | 0.332 |
| Bratio_1976 | | 0.290 | 0.403 | NA | 0.298 | 0.337 | 0.443 | 0.449 | 0.450 | NA | 0.328 |
| Bratio_2011 | | 0.425 | 0.159 | NA | 0.479 | 0.447 | 0.442 | 0.460 | 0.541 | NA | 0.366 |
| Bratio_cur | | 0.397 | 0.186 | NA | 0.443 | 0.429 | 0.441 | 0.458 | 0.536 | NA | 0.361 |
| B_msy/ B_zero | | 0.469 | 0.469 | NA | 0.469 | 0.490 | 0.496 | 0.514 | 0.529 | NA | 0.488 |
| SB_cur/SB_zero | | 0.397 | 0.186 | NA | 0.443 | 0.429 | 0.441 | 0.458 | 0.536 | NA | 0.361 |
| SB_cur/SB_msy | | 0.846 | 0.395 | NA | 0.945 | 0.877 | 0.890 | 0.890 | 1.014 | NA | 0.740 |
| SB_cur/SB_cur_F0 | | 0.393 | 0.191 | NA | 0.437 | 0.411 | 0.405 | 0.427 | 0.514 | NA | 0.332 |
| SB_msy/SB_zero | | 0.469 | 0.469 | NA | 0.469 | 0.490 | 0.496 | 0.514 | 0.529 | NA | 0.488 |
| SB_cur_init | | 1.368 | 0.460 | NA | 1.489 | 1.274 | 0.995 | 1.020 | 1.191 | NA | 1.101 |
| Fcur | | 0.229 | 0.676 | NA | 0.205 | 0.160 | 0.062 | 0.065 | 0.059 | NA | 0.100 |
| F_msy | | 0.226 | 0.225 | NA | 0.226 | 0.176 | 0.026 | 0.069 | 0.109 | NA | 0.069 |
| F_2011_msy | | 0.776 | 2.889 | NA | 0.716 | 0.735 | 1.712 | 0.699 | 0.454 | NA | 1.038 |
| F_cur_msy | | 1.012 | 3.004 | NA | 0.911 | 0.913 | 2.395 | 0.950 | 0.540 | NA | 1.460 |

| | Units | Sfrac 0.13 &Beta 2 | Sfrac 0.13 &Beta 3 | Sfrac 0.13 &Beta4 | Sfrac 0.2 &Beta 1 | Sfrac 0.2 &Beta 2 | Sfrac 0.2 &Beta 3 | Sfrac 0.2 &Beta4 | Sfrac 0.35 &Beta 1 | Sfrac 0.35 &Beta 3 | Sfrac 0.35 &Beta4 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C_latest | T | 33,744 | 33,744 | 33,744 | 33,744 | 33,744 | 33,744 | 33,744 | 33,744 | 33,744 | 33,744 |
| C2011_msy | | 0.632 | 0.595 | 0.580 | 0.718 | 0.643 | 0.625 | 0.633 | 0.605 | 0.636 | 0.603 |
| Y_MSY | T | 53,420 | 56,709 | 58,166 | 46,967 | 52,461 | 54,028 | 53,313 | 55,819 | 53,022 | 55,963 |
| equil_pt | | 0.506 | 0.523 | 0.537 | 0.479 | 0.495 | 0.514 | 0.531 | 0.460 | 0.494 | 0.516 |
| Recr_Virgi | T | 57378 | 50471 | 47136 | 54213 | 40807 | 36188 | 33086 | 33343 | 21377 | 21141 |
| B_zero | T | 6,969,460 | 6,130,450 | 5,725,430 | 6,585,060 | 4,956,700 | 4,395,540 | 4,018,810 | 4,050,040 | 2,596,560 | 2,567,850 |
| B_msy | T | 3,525,536 | 3,206,956 | 3,073,564 | 3,151,575 | 2,453,668 | 2,261,150 | 2,133,077 | 1,861,756 | 1,283,396 | 1,325,330 |
| B_cur | T | 3,156,968 | 2,916,499 | 2,855,389 | 2,733,630 | 2,047,441 | 1,912,066 | 1,874,004 | 1,405,749 | 1,006,040 | 968,834 |
| SB_zero | T | 803,499 | 706,772 | 660,077 | 759,183 | 571,451 | 506,756 | 463,324 | 466,923 | 299,354 | 296,043 |
| SB_msy | T | 406,454 | 369,726 | 354,347 | 363,341 | 282,880 | 260,685 | 245,920 | 214,639 | 147,961 | 152,795 |
| SB_cur | T | 363,962 | 336,240 | 329,194 | 315,156 | 236,046 | 220,440 | 216,052 | 162,067 | 115,985 | 111,696 |
| B_cur_F0 | T | 7,304,352 | 6,438,026 | 5,997,016 | 6,878,534 | 5,183,771 | 4,561,786 | 4,116,686 | 4,201,432 | 2,541,687 | 2,430,366 |
| SB_cur_F0 | T | 842,108 | 742,232 | 691,388 | 793,017 | 597,630 | 525,922 | 474,608 | 484,377 | 293,028 | 280,193 |
| B_cur/B_zero | | 0.453 | 0.476 | 0.499 | 0.415 | 0.413 | 0.435 | 0.466 | 0.347 | 0.387 | 0.377 |
| B_cur/B_msy | | 0.895 | 0.909 | 0.929 | 0.867 | 0.834 | 0.846 | 0.879 | 0.755 | 0.784 | 0.731 |
| B_cur/B_cur_F0 | | 0.432 | 0.453 | 0.476 | 0.397 | 0.395 | 0.419 | 0.455 | 0.335 | 0.396 | 0.399 |
| Bratio_1976 | | 0.352 | 0.368 | 0.381 | 0.308 | 0.307 | 0.324 | 0.345 | 0.241 | 0.292 | 0.286 |
| Bratio_2011 | | 0.462 | 0.487 | 0.512 | 0.424 | 0.427 | 0.453 | 0.487 | 0.364 | 0.420 | 0.411 |
| Bratio_cur | | 0.453 | 0.476 | 0.499 | 0.415 | 0.413 | 0.435 | 0.466 | 0.347 | 0.387 | 0.377 |
| B_msy/ B_zero | | 0.506 | 0.523 | 0.537 | 0.479 | 0.495 | 0.514 | 0.531 | 0.460 | 0.494 | 0.516 |
| SB_cur/SB_zero | | 0.453 | 0.476 | 0.499 | 0.415 | 0.413 | 0.435 | 0.466 | 0.347 | 0.387 | 0.377 |
| SB_cur/SB_msy | | 0.895 | 0.909 | 0.929 | 0.867 | 0.834 | 0.846 | 0.879 | 0.755 | 0.784 | 0.731 |
| SB_cur/SB_cur_F0 | | 0.432 | 0.453 | 0.476 | 0.397 | 0.395 | 0.419 | 0.455 | 0.335 | 0.396 | 0.399 |
| SB_msy/SB_zero | | 0.506 | 0.523 | 0.537 | 0.479 | 0.495 | 0.514 | 0.531 | 0.460 | 0.494 | 0.516 |
| SB_cur_init | | 1.287 | 1.294 | 1.310 | 1.346 | 1.346 | 1.344 | 1.351 | 1.438 | 1.328 | 1.320 |
| Fcur | | 0.105 | 0.112 | 0.113 | 0.119 | 0.149 | 0.156 | 0.157 | 0.198 | 0.241 | 0.246 |
| F_msy | | 0.131 | 0.151 | 0.161 | 0.124 | 0.166 | 0.177 | 0.180 | 0.224 | 0.217 | 0.208 |
| F_2011_msy | | 0.663 | 0.608 | 0.579 | 0.790 | 0.727 | 0.705 | 0.696 | 0.702 | 0.835 | 0.881 |
| F_cur_msy | | 0.803 | 0.740 | 0.707 | 0.959 | 0.899 | 0.880 | 0.873 | 0.885 | 1.111 | 1.182 |

ii) The upweighting of the length–frequency data made the assessment more optimistic in terms of higher $B/B_{MSY}$ and lower $F/F_{MSY}$ but the stock was still estimated to be in an overfished state (but recovering). Continuing to increase the weight to these data will give further improved stock status, but as this is at the cost of fitting the CPUE series, this does not seem to be a good practice given what we know about the size data (i.e. that they are not expected to be particularly informative on trends in abundance).
iii) The higher natural mortality had similar impacts to the higher sample size in terms of optimism, but fit both CPUE series noticeably worse at the expense of a better fit to the size data. While the decision to use the lower mortality rates for the reference case was relatively arbitrary, they do fit the CPUE series much better and provide a better overall model fit.
iv) The response to changes is the LFSR was quite complex:
    - For low Sfrac,[3] MSY and $F_{MSY}$ (and overall stock condition) increased dramatically with increases of beta from 1 to 3, but the fit to the Japanese late series was extremely poor (e.g. it did not predict the strong increase).
    - Under high Sfrac, the model results were relatively consistent across the range of values of beta.

- There are some concerns over all three late CPUE series used in this assessment in terms of whether the trend accurately changes in relative abundance over the extent of the stock. Given this and the extent of uncertainty, even within the reference case model, it is our conclusion that the possibility that the abundance is not increasing or possibly declining in recent years should be a factor in any management advice from the assessment.
- We suggest that depending on the nature of any management action, an updated assessment should be conducted in the next two to three years. This assessment should consider:
    - Alternative approaches to account for targeting in the Japanese fleet.
    - Examination of the potential to include some fisheries with asymptotic selectivity curves (this will likely involve examination of asymptotic length from the growth curve).
    - Determine if there are plausible alternative catch series; in particular, ones with different trends through time (this should include detailed analysis of observer reports to estimate discards).
    - Continued development of alternative CPUE series
    - Detailed consideration of how the biology of blue sharks can be modelled within the Stock Synthesis framework (including LFSR).

**Discussion on ISC North Pacific blue shark paper**

242. One CCM noted that the CPUE series are highly influential on the model results and it was queried why the CPUE series being used was based on logbook data rather than on the higher quality observer data. It was suggested that the two main CPUE series could be considered as bounding the range of uncertainty in the data used in the model. The presenter acknowledged that the sensitivities explored in the model were only related to the biological input parameters rather than the uncertainties in the input

[3] Sfrac = survival fraction. It is one of three parameters in a low fecundity spawner–recruit relationship that controls the degree of "dome-ness", similar to a ricker curve.

data, and stated that while the Hawaii series was well standardized it was not used due to its limited spatial extent.

243. In response, the CCM again reiterated the need to fully recognize the limitation in both CPUE series, and expressed concern that the model had only explored one possible state of nature. It was recommended that future analyses explore the full range of uncertainties.

244. Another CCM supported these comments, stating that the model results were biased without full consideration of the uncertainties in the data inputs. They noted that the Hawaii index may provide an index of the adult population and that the CPUE based on the Japanese data is influenced by the increase in the targeting of blue shark over the past decade.

245. Japan noted that the targeting effect had been removed through the method used to standardize these data. Another CCM noted, however, that the results shown in working paper ISC/13/SHARKWG-2/02 indicated that the targeting factor used in this model had resulted in no change to the index and, therefore, the model had not been able to account for the increase in targeting. It was also noted that the model had not incorporated other factors such as the number of hooks per float.

**Discussion on SPC North Pacific blue shark paper**

246. One CCM noted that the estimated biomass in model BS2 at the start of the assessment period (1976) was low, and stated that according to interviews with Japanese fishermen, blue shark had not been targeted before this period. The presenter stated that the initial depletion is high at beginning likely due to the length-frequency composition data.

247. When asked why MSY reference points had been used, the presenter responded that appropriate reference points for sharks have not yet been developed by SC, so they used the commonly used reference points.

248. In response to a query as to why a value of 0.2 was used in the BS2 assessment to weight the length–frequency data the presenter noted that they had used a couple of different values. The age-structured production model analyses suggested that this weighting may be too high. The strategy was to downweight the length data so that catch and CPUE were driving the scale of the assessment results.

249. FFA members thanked the presenter and noted that the assessment clearly demonstrates a lack of data and difficulty in understanding stock status. They noted that reporting has improved and collaboration is important, and requested that ISC and SPC work together to ensure that best quality assessments are produced.

250. The USA noted that the catch data in both assessments have been much improved and that the greatest uncertainty was due to CPUE during the latter part of the time series. It supported the use of the shallow set longline CPUE as being the most representative. The USA noted that the Hawaii index has been well standardized and could represent a real trend in the corresponding smaller area of distribution.

**General discussion on both North Pacific blue shark papers**

251. SC9 noted that the BS1 assessment model assumes a large well-mixed stock and the model indicates that the stock is in a healthy condition based on MSY, but the quality of the data and the sensitivity of the model to particular inputs are questionable.

252. Some CCMs recognize that there remain practical challenges in ensuring scientific collaboration on a regional basis, and strongly believe that a collaborative approach to the production of transparent and accountable science is a necessary foundation to cooperative management of these shared stocks.

253. Some CCMs requested that all CCMs continue to ensure that the reporting of shark species is improved across the fleets so that there is more robust basis on which to assess and manage all shark species.

254. Some CCMs recognize that there remain practical challenges in ensuring scientific collaboration on a regional basis. FFA members requested that SPC and ISC continue to work together on species of shared interest to ensure that the best quality science is produced. Some CCMs could not support the conclusion of the BS1 assessment that the stock is relatively healthy.

255. SC9 noted that catch data in both assessments have been much improved. The greatest uncertainty is due to CPUE in the latter part of time series.

256. FFA members raised some concerns with the assessment (BS1) for North Pacific blue shark. In reviewing the stock assessments undertaken, FFA members raised the following issues with the methodology, which contains inconsistencies in the process used by the ISC SHARKWG for accepting and rejecting different data series as inputs, and subsequently used limited alternative CPUE series in the assessment. Further to that, FFA members are concerned with the limited range of uncertainty in the model runs predicted and the contradictory nature of the runs shown. The highly influential shallow-set Japanese longline CPUE analysis does not sufficiently consider the onset of targeting in the Japanese fleet, despite targeting behavior having been demonstrated in a 2011 analysis undertaken by Clarke, and a 2013 report by Hiraoka. FFA members lack confidence in the outputs of the assessments and consider the subsequent conclusions with regards to the status of the stock as overly optimistic. Given that the ISC assessment fails to explore an appropriate range of sensitivities, FFA members asked SC to reject the ISC assessment and requested that an updated assessment that takes into account these concerns be presented at SC10.

257. The USA responded that there is evidence of spatial structure in the North Pacific blue shark. The USA believes that a sex- and age-structured model may better represent the stock dynamics if the data are rich enough. The USA suggested that the SHARKWG devote time to reviewing the SPC/IATTC assessment, and to work collaboratively to further develop a fully integrated model for North Pacific blue shark. The USA agreed with ISC's conservation advice for North Pacific blue shark based on the BSP base case model. The stock condition appears to have improved since the closure of the high seas, drift gill net fishery and is now likely in a healthy condition. Because of the uncertainties previously mentioned, the USA advocated completion of another North Pacific blue shark assessment within two years. Furthermore, given uncertainties not only in the indices and spatial dynamics, the USA recommended improvements in the monitoring of blue shark catches and discards, and the continued biological and stock assessment research.

258. One FFA member reinforced the position that it does not believe that the ISC assessment (BS1) encapsulates the full range of the appropriate CPUE series and, therefore, provides only a very biased view of the stock status. The model relies heavily on the recent Japanese longline CPUE index. The standardization of this index had little effect and as a result is overly influenced by the effects of targeting. This FFA member, therefore, believes that the model fails the plausibility test that CPUE is an index of abundance and given the model is driven by CPUE, the CCM cannot agree that ISC's advice represents appropriate advice to the Commission. Further work on these assessments is warranted.

#### 4.3.4.2 Provision of scientific information

**a. Status and trends**

259. **SC9 noted that two stock assessments for North Pacific blue shark were undertaken by ISC using different modeling frameworks. The conclusions and resulting stock status and management advice depend heavily on the CPUE series assumed to describe stock abundance.**

260. **Based on the CPUE series selected by the ISC SHARKWG for inclusion in the base case models, both assessment models predict that biomass is increasing and fishing mortality has been decreasing in recent years. The models show similar trajectories but differ in terms of their estimated status with respect to $B_{MSY}$. One model estimated that the stock has been overfished since the 1970s, but is rebuilding; the other model estimated that biomass has been greater than $B_{MSY}$ since the 1990s. However, using an alternative CPUE series for a sensitivity run, both modeling frameworks estimated the stock to be in an overfished state with overfishing occurring.**

**b. Management advice and implications**

261. **SC9 could not reach consensus on which CPUE series best reflected changes in the relative abundance and, therefore, recommended that a revised assessment be presented to SC10.**

262. **In the interim, SC9 recommended that the Commission consider this uncertainty and adopt a precautionary approach when considering any potential management measures for blue shark in the North Pacific.**

### 4.4 WCPO billfish

### 4.4.1 South Pacific swordfish

#### 4.4.1.1 Review of research and information

**a. Review of 2013 stock assessment**

263. G. Pilling (SPC) presented the 2013 stock assessment for swordfish (*Xiphias gladius*) in the southwest Pacific (SC9-SA-WP-05). CCMs were referred to SC9-SA-IP-03, SC8-SA-IP-13 and SC9-SA-IP-01, which describe the CPUE standardization used in the southwest Pacific swordfish stock assessment.

264. The assessment is supported by other analyses, which are documented separately, but should be considered when reviewing this assessment as they underpin many of the fundamental inputs to the models. These include standardized CPUE analyses of aggregate Japanese and Chinese Taipei longline catch and effort data (Hoyle et al. 2013); and standardized CPUE analyses of operational catch and effort data for longline fisheries in Australia (Campbell 2012), New Zealand (OFP 2013), and Spain (i.e. the EU) (OFP 2012). The assessment included a new "reference case4" model (Ref.case), and then a series of "one-off" sensitivity models that represented a single change from the Ref.case model run. The key model runs were taken as representing a set of plausible model runs, and these were included in a structural uncertainty analysis (grid) for consideration in developing management advice.

[4] While the Ref.case model run is designated as the "reference case" model for the purpose of structuring the modeling analyses, the most appropriate model run(s) on which to base management advice will be determined by SC.

265. The main developments for modeling structural assumptions were to: i) assume two model regions, biologically connected, based on the results of recent electronic tagging programmes, and relaxing assumptions such as the relative recruitment to each region; ii) fixing steepness at 0.8; and iii) estimating spline and non-decreasing selectivities for the main longline fisheries. A new statistical assumption was to include time-variant precision in fitting the model to standardized CPUE indices. A summary of these and the alternative assumptions for the Ref.case and the other key model runs as agreed on at the 2013 SPC Oceanic Fisheries Programme Pre-Assessment Workshop are provided in Table SWO1.

**Table SWO1:** Reference case (Ref.case) model assumptions and sensitivity analyses as recommended by the 2013 Pre-Assessment Workshop, making up the 16 key model runs for the swordfish assessment.

| Assumption | Ref. case | Sensitivities | |
|---|---|---|---|
| Steepness | 0.8 | 0.65; 0.95 | |
| Movement (diffusion rate) | 0.11 | 0.0; 0.05; 0.25 | |
| Growth rate, maturity, and mortality schedule | GHMHS | GHMH | GAMHS |
| | | GHML | GAMH |
| | | GHMLS | GAML |
| | | | GAMLS |
| CPUE series | Region 1: DW_1C, AU_1<br>Region 2: DW_2C; EU_2 | Region 1: DW_1C, AU_1<br>Region 2 options:<br>1. DW_2C only<br>2. DW_2C, NZ_2 | |
| Size data relative weighting | AU, NZ = nsamp/40;<br>Other = nsamp/100 | AU, NZ = nsamp/80;<br>Other = nsamp/200 | |

266. The main conclusions of the assessment are below.

a) The relatively steep decline in biomass over the period 1997–2011 over all key model runs, with no concurrent temporal change in recruitment, is a notable feature of the current assessment. It is concurrent with large increases in catch particularly in Region 2, and declines in CPUE and median fish sizes in the main fisheries. The recent increase in the AU_1 CPUE index is best described by the Ref.case model for which the faster Hawaii schedule is made, whereas no increase is predicted when the slower Australian schedule is assumed.

b) Estimates of absolute biomass and equilibrium yield were sensitive to including the NZ_2 standardized CPUE time series in the model fit (key model run cpopt_TW_NZ). The recent declines in the Ref.case model indices for Region 2 appear to be consistent with declines in median size over the same period, whereas the NZ_2 index is in conflict with this trend, and is derived from a limited spatial distribution. On this basis, the cpopt_TW_NZ model is considered unreliable, or at least highly uncertain, and this model estimate is excluded from the ranges of the key model runs provided in this section below.

c) The key source of uncertainty in this assessment is the assumed growth-, maturity-, and mortality-at-age schedule. Estimates of stock status are highly uncertain with respect to this assumption. Across the full uncertainty grid, where the Hawaii schedule was assumed, the probability of $F_{current}/F_{MSY}$ being greater than 1 was less than 2%, while where the slower Australian schedule was assumed, this increased to 51%.

d) Total biomass and SSB are estimated to have declined most notably since the late 1990s, with more gradual declines before that time. Current levels of total biomass $B_{current}/B_0$ = 44–

68% and spawning biomass $SB_{current}/SB_0$ = 27–55% (range of key model runs) (Fig. SWO1).

e) 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, for the current period, spawning potential is at 26–60% (range of key model runs) of the level predicted to exist in the absence of fishing while assuming the historical estimated annual recruitments (Fig. SWO2).

f) Recent catches are between 82% of the MSY level and 102% above the MSY level of between 5,299 mt and 12,730 mt (range of key model runs). Within this range:
   - assuming the Hawaii schedule produces estimates between 82% of the MSY level and 24% above the MSY level, while,
   - assuming the Australian schedule produces estimates that are between 53% and 102% above the MSY level.

   Based on these results, it was concluded that under the Hawaii schedule, current catches are around the MSY level, while under the Australian schedule, current levels of catch are above the MSY level.

g) Fishing mortality for adult and juvenile swordfish is estimated to have increased sharply in the mid-1990s following significant increases in catches at that time (Fig. SWO3). $F_{current}/F_{MSY}$ was estimated to be between 0.33 and 1.77 (range of key model runs). Within this range:
   - assuming the Hawaii schedule produces estimates between 0.40 to 0.70, while,
   - assuming the Australian schedule produces estimates that are between 1.06 to 1.77.

   Based on these results, we conclude that under the Hawaii schedule, overfishing is not occurring, while under the Australian schedule, overfishing is occurring.

h) Current stock status compared to the $B_{MSY}$-related reference points indicates that the current total biomass and SSB are: $\frac{B_{current}}{B_{MSY}}$ from 1.15 to 1.85 and $\frac{SB_{current}}{SB_{MSY}}$ from 1.15 to 3.53, (range of key model runs). Within this range:
   - assuming the Hawaii schedule produces estimates between 1.51 to 1.58, and 1.86 to 2.54, respectively, while,
   - assuming the Australian schedule produces estimates between 1.15 to 1.37, and 1.15 to 1.80, respectively.

   Under either the growth, maturity, and mortality schedule, current stock status is predicted to be above the level supporting MSY. Based on these results, we conclude that the stock is not in an overfished state.

i) Based on the results above, and the recent trend in fishing mortality, it was concluded that under the Hawaii schedule overfishing is not occurring, but under the Australian schedule, overfishing is occurring, the stock is not in an overfished state.

j) Other assumptions tested in the key model runs that notably affected the estimates of stock status included: lower steepness equating to higher $F_{current}/F_{MSY}$ and lower $SB_{current}/SB_{MSY}$, and higher steepness producing the opposite effect; and where no movement was assumed, more optimistic estimates of stock status were obtained.

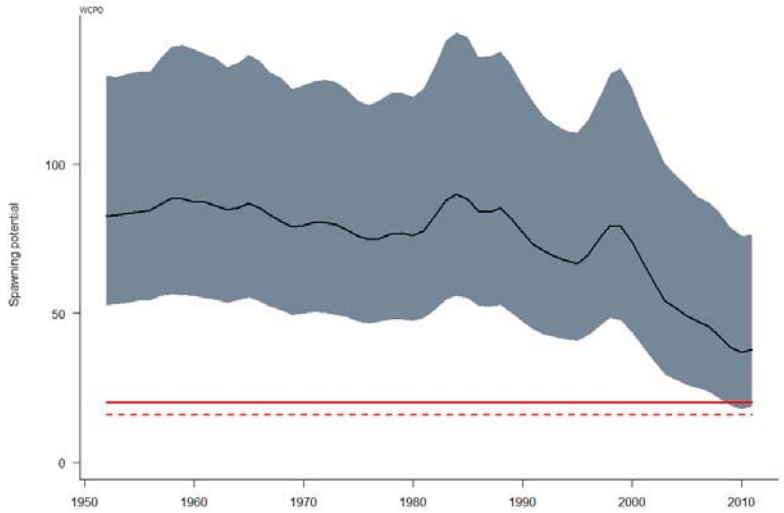


**Figure SWO1:** Estimated average annual average spawning potential for the southwest Pacific Ocean swordfish obtained from the Ref.case model (black line). The solid red line indicates the respective MSY levels, and the dashed red line indicates the 20% current period SSB under zero fishing mortality ($SB_{current\ F=0}$).

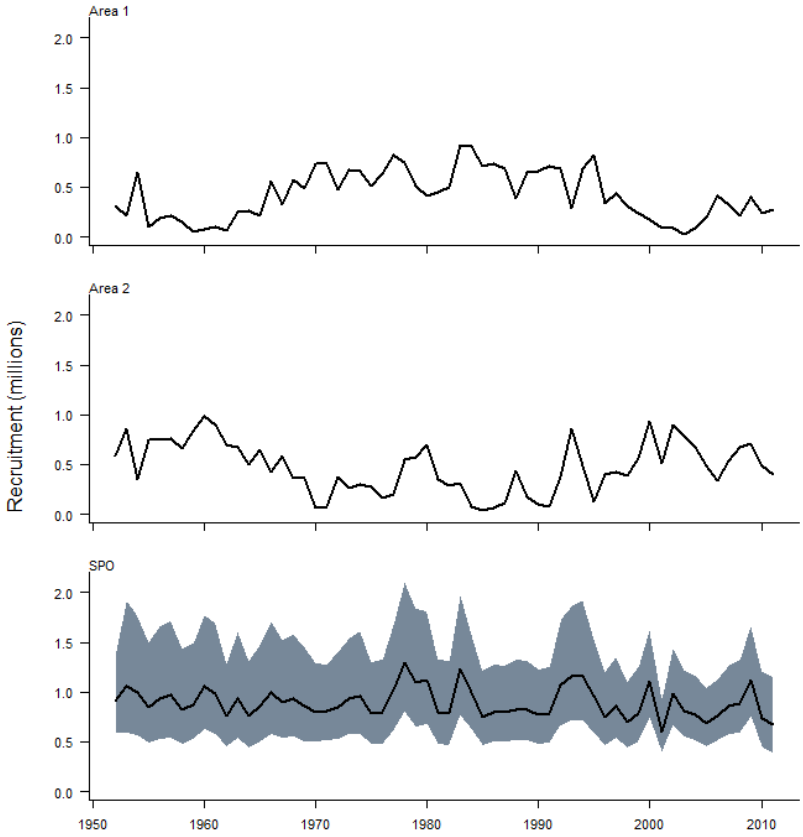


**Figure SWO2:** Annual recruitment estimates (number of fish) of swordfish in each of the model regions, and the combined model region. The shaded area in the combined model region figure indicates the approximate 95% confidence intervals. Model estimates are from the Ref.case model.

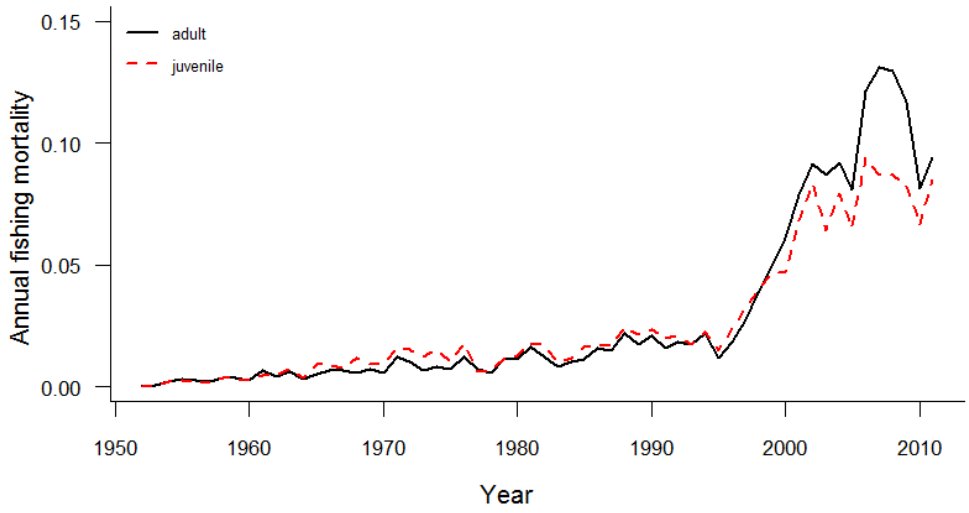


**Figure SWO3:** Estimated annual average juvenile and adult fishing mortality for the southwest Pacific Ocean swordfish obtained from the Ref.case model.

**Discussion**

267. FFA members noted that the improvements to this year's assessment are largely due to improvements in the provision of operational catch and effort and size composition data, recent tagging work, and information on CPUE indices from different fleets. These inputs have helped to reduce some of the uncertainties from previous assessments, improving this year's assessment outputs, whereby we finally have plausible assessment results that include the south-central Pacific.

268. Several CCMs noted the uncertainties due to sexual dimorphism that are likely occur in South Pacific swordfish. In the Atlantic, only females make long-distance feeding migrations and they grow faster and to larger sizes. In the South Pacific, there are some catch records that show the catch of large females in southern areas during a particular season that may also indicate sex-specific movement patterns. The catch sex ratio data and some tagging data further support sex-specific movements. If sex-specific data collection is improved, it is possible that moving to a sex-based model may reduce uncertainty in the assessment.

269. SPC stated that Region 2 has more larger female fish, and Australia noted that the model is not sexually explicit, which may explain why large fish could not be fitted to southern data

270. Several CCMs raised the issue of uncertainty regarding the different growth and maturity estimates used in the assessment. The assessment uses the Hawaii (faster) growth model in the reference case assessment and the Australian growth model in sensitivity runs. It seems counterintuitive for the assessment to use the Hawaii growth model, despite the assessment region and data coming from the same area as the fish sampled for the Australian growth model. Some work has been done to compare the results of the Australian and Hawaii growth models. Cross reading of otoliths has shown that consistent age determination across readers is achieved if readers follow region-specific guidelines. Thus, the ageing issue is still uncertain and the decision to use the Hawaii growth curve in the reference case was recommended at the SPC annual stock assessment planning workshop. The Australian growth curve is

also supported by a limited number of tag recaptures from the eastern Australia area. Regarding the difference in the maturity ogives, a re-evaluation of the maturity studies and a preliminary analysis suggest that the Australian ogive developed for swordfish overestimated the age at 50% maturity, which may actually be closer to six years. There are some rapid changes seen in the CPUE indices that seem inconsistent with the slower growth model, which is also one of the reasons the Hawaii model was chosen for the reference case model.

271. One CCM stated that although the new model included tagging data, there were very few deployments in the eastern extent of the WCPO area, thus, it is not possible to rule out mixing with EPO swordfish.

272. It was recommended and supported by a second CCM that SC use the median of the outputs of the uncertainty grid assessment models that did not include the New Zealand CPUE series to develop management recommendations. Another CCM advised that there was clear evidence of size-dependent distribution and movement from tag data and sex ratio distribution. Deployment of tags in the eastern part of the assessment area is negligible (160°W max), and there is a possibility of mixing with EPO swordfish. A major area of uncertainty is in growth. Hawaii growth is unusually fast, but is plausible, especially given the recent research on Australian growth. Hawaii data fits the model better than the Australian data. In conclusion, the CCM suggested using the median of the uncertainty grid (Table 5 in SC9-SA-WP-02), which suggests that overfishing is not occurring.

273. FFA members, agreed with the comments above that the main concern in this assessment is the uncertainty in growth estimates, making the choice of a single model on which to base advice impossible. The consequence of choosing one growth schedule over the other without proper evidence to determine which of the two is more representative of swordfish growth in the South Pacific, has significant management implications. FFA members believed that SC9's advice to the Commission should include the full range of results produced for the most plausible runs, as indicated in the paper, noting that none of these indicate the stock as overfished, but runs for slow growth assumptions indicate the stock is subject to overfishing. The advice should recommend no increases in catch over recent levels and should note that the potential maximum catch under CMM 2009-03 is well in excess of the MSY estimates in this assessment.

274. FFA members supported recommending the management of this stock as a level 3 stock with a limit reference point for spawning stock biomass of 20% $SB_0$, given the uncertainties in the life history characteristics of this species.

275. FFA members also noted that given the effect that the differences in the growth estimates have on assessment outputs, SC should encourage the collection of biological samples for swordfish throughout the WCPO, and include growth, age and particularly validation studies in the SC research work plan as a high priority.

276. Several CCMs agreed that there should not be an increase in fishing mortality, and they would support additional work on swordfish and that the SC work plan for 2016 should include a swordfish assessment.

**Recommendations**

277. **Noting the inconsistencies in the Australian and Hawaii growth schedules, SC9 recommended that additional work on age, growth and age validation be undertaken.**

#### 4.4.1.2 Provision of scientific information

**a. Status and trends**

278. **The South Pacific swordfish assessment was highly sensitive to growth assumptions. Two different growth models, one from Australia (GA) and the other from Hawaii (GH), were included in alternative model runs. SC could not decide which of these two assumptions was more reliable. Assessment runs using the GA growth data indicated that overfishing was occurring but that the stock was not in an overfished state. Assessment runs using the GH growth data indicate that no overfishing is occurring and that the stock is not in an overfished state.**

279. **Although the median of the uncertainty grid indicates that overfishing ($F_{current}/F_{MSY}$ = 0.74) was not occurring, those sensitivity runs that used the GA growth and maturity schedule indicate that overfishing may be occurring (grid range 5th–95th percentiles: 0.51–2.02). Recent preliminary findings from tagging data indicate that this alternative growth schedule (GA) warrants further consideration. Estimates of stock status are highly uncertain with respect to this assumption. The equivalent grid range of $F_{current}/F_{MSY}$ for the Hawaii schedule (GH) is 0.25–0.97. Across the uncertainty grid of 378 runs, where the Hawaii schedule was assumed, the probability of $F_{current}/F_{MSY}$ being greater than 1.0 was less than 3%, while when the slower Australian schedule was assumed, 54% of runs estimated the stock to be experiencing overfishing (Table SWO2, Fig. SWO4)**.

**Table SWO2:** Estimates of management quantities from the median of the selected uncertainty grid (excluding runs with the New Zealand CPUE time series), from the 2013 stock assessment. For the purpose of this assessment, "current" is the average over the period 2007–2010 and "latest" is 2011.

| | Median of the selected grid runs | Range | |
|---|---|---|---|
| | | 5%ile | 95%ile |
| $C_{current}$ | 10,456 | 10,041 | 11,368 |
| $C_{latest}$ | 10,020 | 9,636 | 10,549 |
| $MSY$ | 8,175 | 5,100 | 14,006 |
| $C_{current}/MSY$ | 1.29 | 0.74 | 2.11 |
| $C_{lastest}/MSY$ | 1.23 | 0.72 | 1.99 |
| $F_{mult}$ | 1.36 | 0.56 | 3.39 |
| $F_{current}/F_{MSY}$ | 0.74 | 0.30 | 1.77 |
| $SB_0$ | 90,535 | 70,849 | 122,190 |
| $SB_{MSY}/SB_0$ | 0.23 | 0.12 | 0.30 |
| $SB_{current}/SB_0$ | 0.47 | 0.32 | 0.59 |
| $SB_{current}/SB_{MSY}$ | 2.07 | 1.18 | 4.50 |
| $SB_{latest}/SB_{MSY}$ | 1.70 | 0.89 | 3.75 |
| $SB_{curr}/SB_{currF=0}$ | 0.49 | 0.32 | 0.60 |
| $SB_{latest}/SB_{latestF=0}$ | 0.43 | 0.23 | 0.56 |

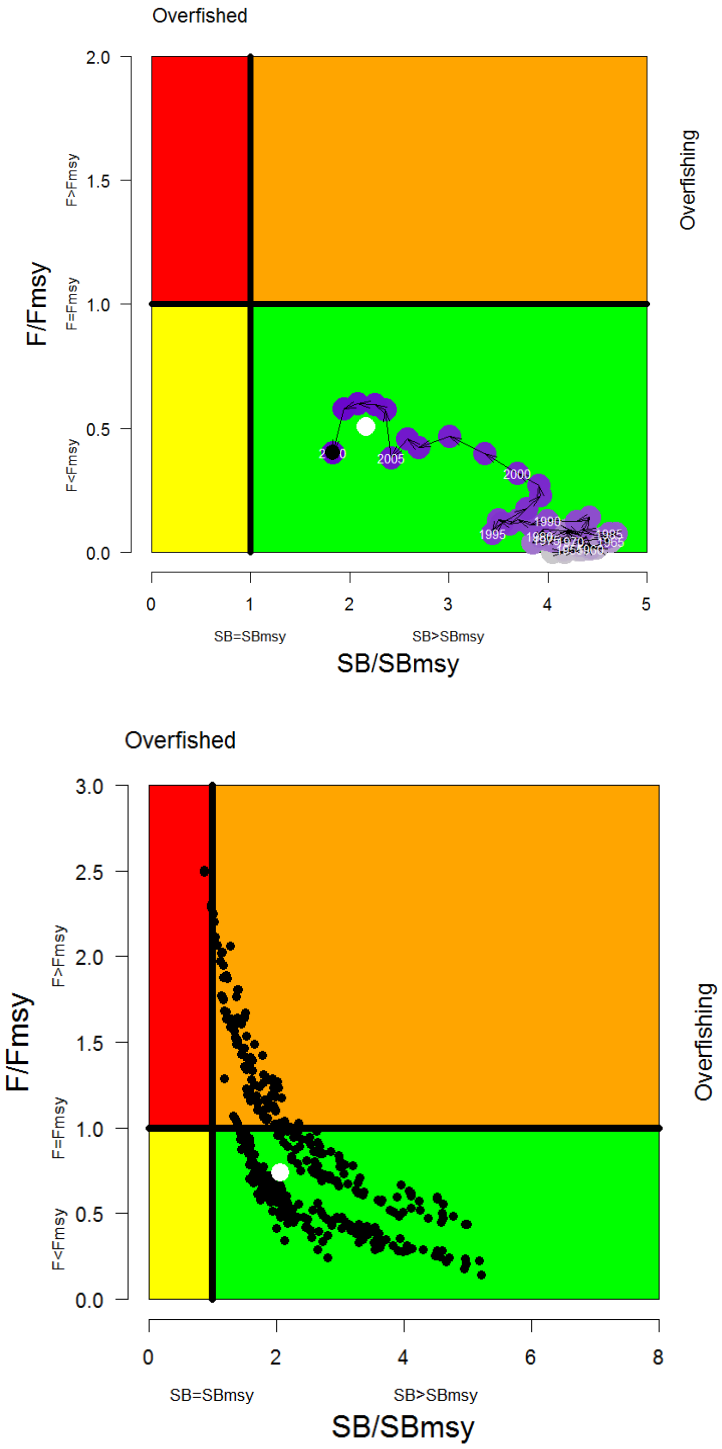


**Figure SWO4:** Temporal trend in annual stock status, relative to $SB_{MSY}$ (x-axis) and $F_{MSY}$ (y-axis) reference points for the Ref.case (top); and $F_{current}/F_{MSY}$ and $SB_{current}/SB_{MSY}$ for the median of the selected uncertainty grid (white circle) and the individual uncertainty grid runs (excluding runs where the New Zealand CPUE series was used; bottom).

**b. Management advice and implications**

280. **SC9 recommended that given the current uncertainty in the assessment, the Commission should adopt a precautionary approach when considering future management arrangements. Given this, SC9 recommended that there be no increase in fishing mortality over current (2007–2010) levels.**

281. **Noting that recent catches between the equator and 20ºS now represent the largest component of the catch in Region 2 (equator to 50°S, 165°E to 130°W), SC9 recommended that the Commission consider developing appropriate management measures for this region, which is not covered by CMM 2009-03.**

### 4.4.2. Southwest Pacific striped marlin

#### 4.4.2.1 Review of research and information

282. SPC presented paper SC9-SA-WP-07, which addressed a request from SC8 for an analysis of areas of concentration of catches of striped marlin in the southwest Pacific Ocean. The distribution of longline effort and striped marlin catches was based on raised aggregate data and available operational catch and effort data, noting that the aggregate data represents the authoritative data due to gaps in the coverage of operational data. Overall, the waters of Australia and the adjacent high seas represent a consistent hotspot for catches across the datasets and time windows; the waters of New Caledonia, Vanuatu, New Zealand, French Polynesia, and their adjacent high seas are also important.

**Discussion**

283. Some CCMs noted that the SPC presentation demonstrates that increasing catch and effort for southwest Pacific striped marlin is occurring in waters north of 15°S. As noted at SC8, this stock is fully exploited and may be overfished, and measures need to be developed to reduce the overall catch of this stock throughout its range. FFA members, therefore, recommended that the current southwest Pacific striped marlin CMM be extended to waters north of 15°S, noting that a revised CMM 2006-04 should maintain the current exemption from the vessel number limits for SIDS and territories domestic fleets.

284. Some CCMs thought that CMM 2006-04 should be extended to north of 15°S, adding that FFA members consider that extending the measure across the full range of the fishery will prove more effective than management measures targeted at areas of high concentration, as suggested by SC8.

285. One CCM noted that because most striped marlin are caught as bycatch, an effective measure might include requirements for live release.

286. Some CCMs queried whether there were any identified linkages between hotspots. In response, attention was drawn to information paper SC9-SA-IP-09, which provides details of the movements of striped marlin according to pop-up satellite archival tags. SPC noted that there is tagging information, which indicates some striped marlin connectivity between New Zealand and French Polynesia.

#### 4.4.2.2 Provision of scientific information

**a. Status and trends**

287. **SC9 noted that no stock assessment was conducted for southwest Pacific striped marlin in 2013. Therefore, the stock status description from SC8 is still current.**

**b. Management advice and implications**

288. **SC9 noted that no management advice was provided since SC8. Therefore, the advice from SC8 should be maintained, pending a new assessment or other new information.**

### 4.4.3. North Pacific striped marlin

#### 4.4.3.1 Review of research and information

289. J. Brodziak gave a brief presentation on North Pacific striped marlin (SC9-SA-IP-13), providing a historic overview of the fishery.

a) Female SSB is currently low, averaging roughly 1,518 mt during 2007–2009 (56% of $SB_{MSY}$, the female SSB to produce MSY).
b) Fishing mortality on the stock (average F on ages 3 and older) is currently high, averaging roughly F = 0.76 during 2007–2009 (24% above $F_{MSY}$).
c) Recruitment averaged about 328,000 recruits during 1994–2008, which was roughly 30% below the 1975–2010 average.
d) Compared with MSY-based reference points, the current (average during 2007–2009) SSB is 44% below $SB_{MSY}$ and the current fishing mortality exceeds $F_{MSY}$ by 24%.
e) Therefore, overfishing is currently occurring relative to MSY and the stock is overfished.

290. Additional information includes the following.

a) In 2012, the catch biomass of the western and central North Pacific Ocean striped marlin by Japanese fleets totalled 1,407 mt, a decline of 86 mt from the 2011 catch of 1,493 mt (-6%).
b) A reduction in fishing mortality would likely increase SSB and would improve the chances of higher recruitment.
c) The ISC 13 plenary had noted that current management measures to reduce catch put forward by WCPFC in 2010 were based on the outdated 2007 stock assessment.
d) Based on new projection results, fishing at $F_{MSY}$ would lead to a SSB decrease of about 8% in 2017 under recent average recruitment. In contrast, if recruitment improves the medium or long-term average pattern, increases of roughly 45–73% may occur.

**Discussion**

291. The ISC chair noted that future projections on the latest assessment were presented at WCPFC9, as requested, and described these along with the advice ISC13 had provided on the fishery.

292. Some CCMs thanked the presenter for the work on the North Pacific striped marlin stock and recent work on projections that were undertaken in response to a request from SC8. This stock is currently overfished and overfishing is occurring.

293. Some CCMs noted that, given that this stock is considered one of the most overfished of any assessed WCPO stock, an amendment to the current North Pacific striped marlin CMM to implement far

more stringent arrangements such as catch reductions should be implemented to reduce fishing mortality to levels that will allow SSB levels to increase.

294. Some CCMs also encouraged flag States whose vessels are catching this species to achieve the catch reduction through the development of technical measures or spatial management so as to avoid yield loss in target species. These CCMs further noted that this is a WCPO stock, and not a northern stock, and recommended that the next stock assessment due in 2017 be undertaken by WCPFC's scientific services provider (i.e. SPC).

295. Japan noted that the length-frequency data for its longline fishery in 2012 shows an increase in the ratio of small fish caught, well above recent averages, that may indicate a stronger age class with higher recruitment, or a decrease in large fish.

#### 4.4.3.1 Provision of scientific information

**a. Status and trends**

296. **SC9 noted that no stock assessment was conducted for North Pacific striped marlin in 2013. Therefore, the stock status description from SC8 is still current.**

**b. Management advice and implications**

297. **SC9 noted that no management advice had been provided since SC8. Therefore, the advice from SC8 should be maintained, pending a new assessment or other new information.**

### 4.4.4. Other billfishes

#### 4.4.4.1 Pacific blue marlin

##### 4.4.4.1.1 Review of research and information

298. J. Brodziak (USA) presented the stock assessment of Pacific blue marlin to SC9 (SC9-SA-WP-09: Report of the billfish working group workshop – Assessment of the Pacific blue marlin stock in 2013). The presentation included the results of the current assessment of blue marlin using new life history information and updated data using a sex-specific, size-based, age-structured, integrated (fitted to many different types of data) statistical stock assessment model. The stock assessment was conducted from 20–28 May 2013 in Shimizu, Japan (ISC BILLWG 2013b), and stock projections were developed from 14–15 July 2013 at Busan, Korea. The objectives of this assessment are to i) understand the dynamics of Pacific blue marlin by estimating population parameters such as time series of recruitment, biomass and fishing mortality; ii) determine stock status by summarizing results relative to MSY-based limit reference points; and iii) formulate scientific information on conservation needs for fisheries managers based on projections using constant fishing mortality scenarios.

299. A summary of the presentation follows.

a) The Pacific blue marlin (*Makaira nigricans*) stock range includes all waters of the Pacific Ocean and all available fishery data from this area were used for the stock assessment. For the purpose of modeling observations of CPUE and size composition data, it was assumed that there was an instantaneous mixing of fish throughout the stock area on a quarterly basis.
b) Pacific blue marlin catches exhibited an increasing trend from the 1950s to the 1980s and then fluctuated without trend. In the 1990s, the catch by Japanese fleets decreased while the catch by Taiwanese fleets, and WCPFC and some IATTC members increased (Fig. PBM2).

Overall, longline gear has accounted for the vast majority of Pacific blue marlin catches since the 1950s (Fig. PBM3).

c) Catch and size composition data were compiled from ISC countries (Japan, Taiwan, and USA), some IATTC member countries, and the WCPFC (Table PBM1). Standardized CPUE data used to measure trends in relative abundance were provided by Japan, USA, and Chinese Taipei. The Pacific blue marlin stock was assessed using an age-, length-, and sex-structured assessment Stock Synthesis 3 model fit to time series of standardized CPUE and size composition data. Sex-specific growth curves and natural mortality were used because of the known sexual dimorphism of adult blue marlin. The value for steepness of the stock and recruitment relationship was h = 0.87. The assessment model was fitted to relative abundance indices and size composition data in a likelihood-based statistical framework. Maximum likelihood estimates of model parameters, derived outputs, and their variances were used to characterize stock status and to develop stock projections. The ISC BILLWG also conducted several sensitivity analyses to evaluate the effects of changes in model parameters, including the data series used in the analyses, the natural mortality rate, the stock-recruitment steepness, growth curve parameters, and the female age at 50% maturity.

d) Estimates of total stock biomass show a long-term decline. Population biomass (age-1 and older) averaged roughly 123,523 mt over 1971–1975, the first five years of the assessment time frame, but then declined by approximately 40% to an average of 78,663 mt in 2011 (Fig. PBM4). Female SSB was estimated to be 24,990 mt in 2011. Fishing mortality on the stock (average F, ages 2 and older) averaged roughly F = 0.26 during 2009–2011. The predicted value of the spawning potential ratio (SPR, the predicted spawning output at current F as a fraction of unfished spawning output) is currently $SPR_{2009–2011}$ = 23%. The annual average in 2007–2011 was about 823×103 recruits, and there was no apparent long-term recruitment trend. Overall trends in SSB and recruitment indicate a long-term decline in SSB and suggest a fluctuating pattern without a trend for recruitment (Fig. PBM4). Kobe plots depict the stock status in relation to MSY-based reference points (see below) from the base case Stock Synthesis model (Fig. PBM5). Kobe plots indicate that the Pacific blue marlin SSB decreased to the MSY level in the mid-2000s, and since then has increased slightly. The base case assessment model indicates that the Pacific blue marlin stock is currently not overfished and is not subject to overfishing relative to MSY-based reference points.

e) The population biomass of Pacific blue marlin was also estimated for three alternative stock assessment models (Fig. PBM6). An age-structured, pooled-sexes model (AS) and an age-, length-, and sex-structured Stock Synthesis model were fitted to catch data from 1952 through 2011 and both models indicated that relative biomass declined by about 50% during the first 10 years of the time series. A hybrid production model indicated that relative biomass exhibited a more moderate decline throughout the 60-year period. Results from each of the alternative models were similar at the end of the assessment time series, which demonstrated the robustness of the assessment results. Overall, the results of the alternative assessment models were consistent and showed that Pacific blue marlin biomass has declined but that the stock is not overfished and is not experiencing overfishing in recent years.

f) Deterministic stock projections were conducted in Stock Synthesis to evaluate the impact of various levels of fishing intensity on future female spawning stock biomass and yield for blue marlin in the Pacific Ocean. The future recruitment was based on the stock recruitment curve. These calculations used all the multi-fleet, multi-season, size- and age-selectivity, and complexity in the assessment model to produce consistent results. Projections started in 2012 and continued through 2020 under four levels of fishing mortality (F30% corresponds to the fishing mortality that produces 30% of the spawning potential ratio): i) constant fishing mortality equal to the 2003–2005 average (F(2003–2005)=F(16%)); ii) constant fishing mortality equal to $F_{MSY}$ = F(18%); iii) constant fishing mortality equal to the 2009–2011 average defined as current (F(23%)); and iv) constant fishing mortality equal to F(30%).

Results showed projected female SSB and the catch for each of the four harvest scenarios (Table PBM2 and Fig. PBM7).

g) Biological reference points were computed with the Stock Synthesis base case model (Table 3). The point estimate of maximum sustainable yield was MSY = 19,459 mt. The point estimate of the SSB to produce MSY (adult female biomass) was $SSB_{MSY}$ = 19,437 mt. The point estimate of $F_{MSY}$, the fishing mortality rate to produce MSY (average fishing mortality on ages 2 and older) was $F_{MSY}$ = 0.32 and the corresponding equilibrium value of spawning potential ratio at MSY was $SPR_{MSY}$ = 18%. The point estimate of $F_{20\%}$ was 0.29 and the corresponding estimate of $SSB_{20\%}$ was 26,324 mt.

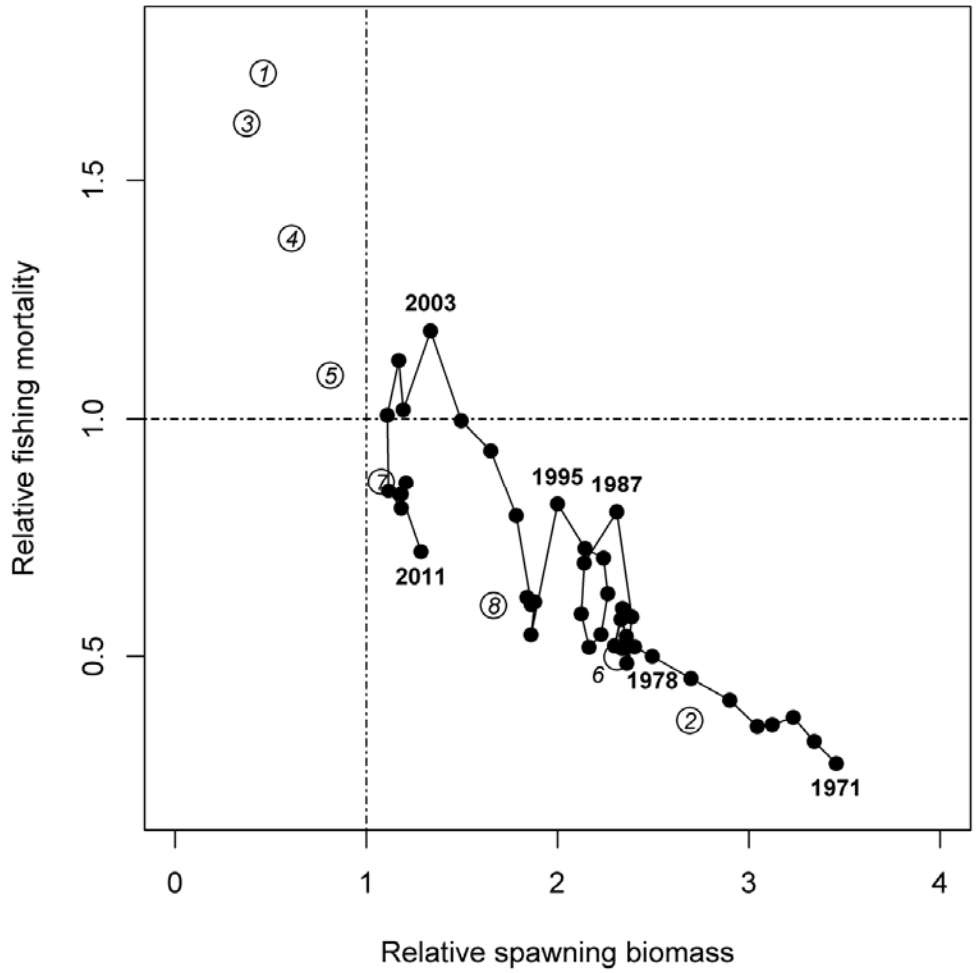


**Figure PBM1:** Relative fishing mortality (average of age-2+) is expressed as ($F/F_{MSY}$) so that values below 1 indicated fishing mortality less than that associated with MSY. Relative SSB is expressed as ($SSB/SSB_{MSY}$) so that values greater than 1 indicate biomass is above that associated with MSY. The open circles with numbers are the location of the 2011 ratios for the eight sensitivity models, where model 1 is the model run fitted to Hawaii longline CPUE, model 2 is the high M model, model 3 is the low M model, mode 4–6 is the model with h=0.65, 0.75, 0.95, respectively, model 7 is the model with larger fish growth curve and model 8 is the model with smaller fish growth curve.

h) Based on the results of the stock assessment, the stock is not currently overfished and is not experiencing overfishing. The stock is nearly fully exploited. Stock biomass has declined since the 1970s and has been stable since the mid-2000s with a slight recent increase. Because blue marlin is mostly caught as bycatch, the direct control of catch amounts is difficult. The working group recommend that fishing mortality not be increased from the current level in order to avoid overfishing.
i) The working group noted that the lack of sex-specific size data and the simplified treatment of the spatial structure of Pacific blue marlin population dynamics were important sources of uncertainty.

**Discussion**

300. Some CCMs thanked ISC for the stock assessment work on Pacific blue marlin. FFA members noted that based on the reference points shown in Table 9.8 on page 33 and the Kobe plots (Fig. 9.9) on page 34 in SC9-SA-WP-09, the Pacific blue marlin stock is not currently overfished and the stock is not currently experiencing overfishing.

301. These CCMs noted that given the spatial distribution of Pacific blue marlin, which is found between 48°N and 48°S and that the annual commercial catches of blue marlin usually exceed those of swordfish and other istiophorid billfishes combined, that it is appropriate for the Pacific blue marlin to be included as part of the work of the Commission's scientific services provider.

302. Some CCMs expressed concern that the work carried out by ISC tends to exclude developing States and as such is not sufficiently transparent to those who are not ISC members, and that this concern would be alleviated if WCPFC's scientific services provider were tasked with undertaking the assessment in collaboration with ISC.

303. A CCM suggested that it would be useful to present outputs from sensitivity runs to encapsulate uncertainty in order to enable SC to evaluate results; however, given the short time, the following sensitivity runs will be included: 3 levels of steepness; the Hawaii longline CPUE series; and high and low natural mortality rate.

304. In response to the request to provide additional information on the relative levels of F and SSB with respect to MSY, the ISC BILLWG lead modelers produced a Kobe plot showing the trajectory of base case and terminal year estimates for the key sensitivity runs (see Fig. PBM1).

305. Other CCMs asked for more details about the misidentification of blue marlin mentioned in the assessment report and whether that added uncertainty to the catch time series. Japan indicated that prior to 1971, marlin species were reported in aggregate, mostly blue and black marlin combined. Once species-specific reporting was required on the logsheets, two reporting patterns were noted: one from captains that routinely showed a separation of blue and black marlin, and the second that showed all marlin catches as blue marlin. For the latter logsheets, species compositions were corrected based on the catch ratios from the logsheets provided by captains that reported both species routinely. It was suggested that perhaps another catch time series could be developed to account for any species misidentification uncertainty.

306. A CCM referred to the previous Pacific blue marlin assessment, which showed a decline of roughly 50% from 1952 to 1971 and a further decline of roughly 50% from 1971–1996. The current assessment time series started in 1971 but also included some sensitivities with data back to 1952. The ISC BILLWG chair was asked to comment on the impact of starting the time series at a time when depletion was already quite high. It was clarified that the primary reason for starting the time series in 1971 was that the data were not considered very reliable prior to 1971 and there were no size data prior to

1971. The ISC BILLWG did conduct a run with a reconstructed catch time series back to 1952, but the relative biomass trend from 1971 forward was essentially the same.

307. A CCM explained that the large difference of levels of standardized CPUE series of Japanese longline between early and later periods was because standardizations were made by delta lognormal GLM modeling for early period, and by habitat based standardization model for later periods.

**Table PBM1:** Reported catch (mt), population biomass (age-1 and older, mt), female spawning biomass (mt), relative female spawning biomass ($SSB/SSB_{MSY}$), recruitment (thousands of age-0 fish), fishing mortality (average F, age-2 and older), relative fishing mortality ($F/F_{MSY}$), and spawning potential ratio of Pacific blue marlin.

| Year | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | Mean[1] | Min[1] | Max[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| Reported catch | 23,962 | 21,100 | 18,554 | 17,709 | 18,147 | 19,388 | 17,430 | 17,792 | 9,160 | 25,510 |
| Population biomass | 73,812 | 70,945 | 72,102 | 72,453 | 70,694 | 76,089 | 78,663 | 99,151 | 70,694 | 128,228 |
| Spawning biomass | 22,730 | 21,574 | 21,701 | 23,003 | 23,486 | 22,988 | 24,990 | 40,723 | 21,574 | 67,224 |
| Relative spawning biomass | 1.17 | 1.11 | 1.12 | 1.18 | 1.21 | 1.18 | 1.29 | 2.10 | 1.11 | 3.46 |
| Recruitment (age-0) | 914 | 889 | 718 | 689 | 1177 | 705 | 825 | 879 | 508 | 1177 |
| Fishing mortality | 0.36 | 0.32 | 0.27 | 0.26 | 0.28 | 0.27 | 0.23 | 0.21 | 0.09 | 0.38 |
| Relative fishing mortality | 1.12 | 1.01 | 0.85 | 0.81 | 0.87 | 0.84 | 0.72 | 0.66 | 0.28 | 1.18 |
| Spawning potential ratio | 15% | 18% | 21% | 23% | 22% | 22% | 25% | 31% | 15% | 56% |

[1] During 1971–2011

**Table PBM2:** Projected values of Pacific blue marlin spawning stock biomass (mt) and catch (mt) under alternative harvest rate scenarios during 2012–2020.

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| **Scenario 1: constant $F = F_{2003-2005}$** | | | | | | | | | |
| Spawning biomass | 25,269 | 23,193 | 21,518 | 20,263 | 19,354 | 18,689 | 18,195 | 17,823 | 17,540 |
| Catch | 25,374 | 23,546 | 22,353 | 21,548 | 20,985 | 20,576 | 20,272 | 20,042 | 19,865 |
| **Scenario 2: constant $F = F_{MSY}$** | | | | | | | | | |
| Spawning biomass | 25,490 | 24,142 | 22,996 | 22,106 | 21,452 | 20,968 | 20,605 | 20,331 | 20,121 |
| Catch | 23,296 | 22,173 | 21,412 | 20,887 | 20,519 | 20,252 | 20,055 | 19,906 | 19,793 |
| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
| **Scenario 3: constant $F = F_{2009-2011}$** | | | | | | | | | |
| Spawning biomass | 25,924 | 26,112 | 26,169 | 26,177 | 26,188 | 26,200 | 26,212 | 26,221 | 26,229 |
| Catch | 19,235 | 19,154 | 19,106 | 19,078 | 19,066 | 19,061 | 19,060 | 19,061 | 19,062 |
| **Scenario 4: constant $F = F_{30\%}$** | | | | | | | | | |
| Spawning biomass | 26,368 | 28,264 | 29,845 | 31,139 | 32,207 | 33,078 | 33,782 | 34,347 | 34,799 |
| Catch | 14,900 | 15,542 | 16,048 | 16,442 | 16,749 | 16,988 | 17,174 | 17,318 | 17,430 |

**Table PBM3:** Estimated biological reference points derived from the Stock Synthesis base case model where "MSY" indicates maximum sustainable yield-based reference points, "20%" indicates reference points corresponding to a spawning potential ratio of 20%, F is the instantaneous annual fishing mortality rate, SPR is the annual spawning potential ratio, and SSB is female spawning stock biomass.

| Reference point | Estimate |
|---|---|
| $F_{2009–2011}$ (age-2+) | 0.26 |
| $SPR_{2009-2011}$ | 23% |
| $F_{MSY}$ (age-2+) | 0.32 |
| $F_{20\%}$ (age-2+) | 0.29 |
| $SPR_{MSY}$ | 18% |
| $SSB_{2011}$ | 24,990 mt |
| $SSB_{MSY}$ | 19,437 mt |
| $SSB_{20\%}$ | 26,324 mt |
| MSY | 19,459 mt |

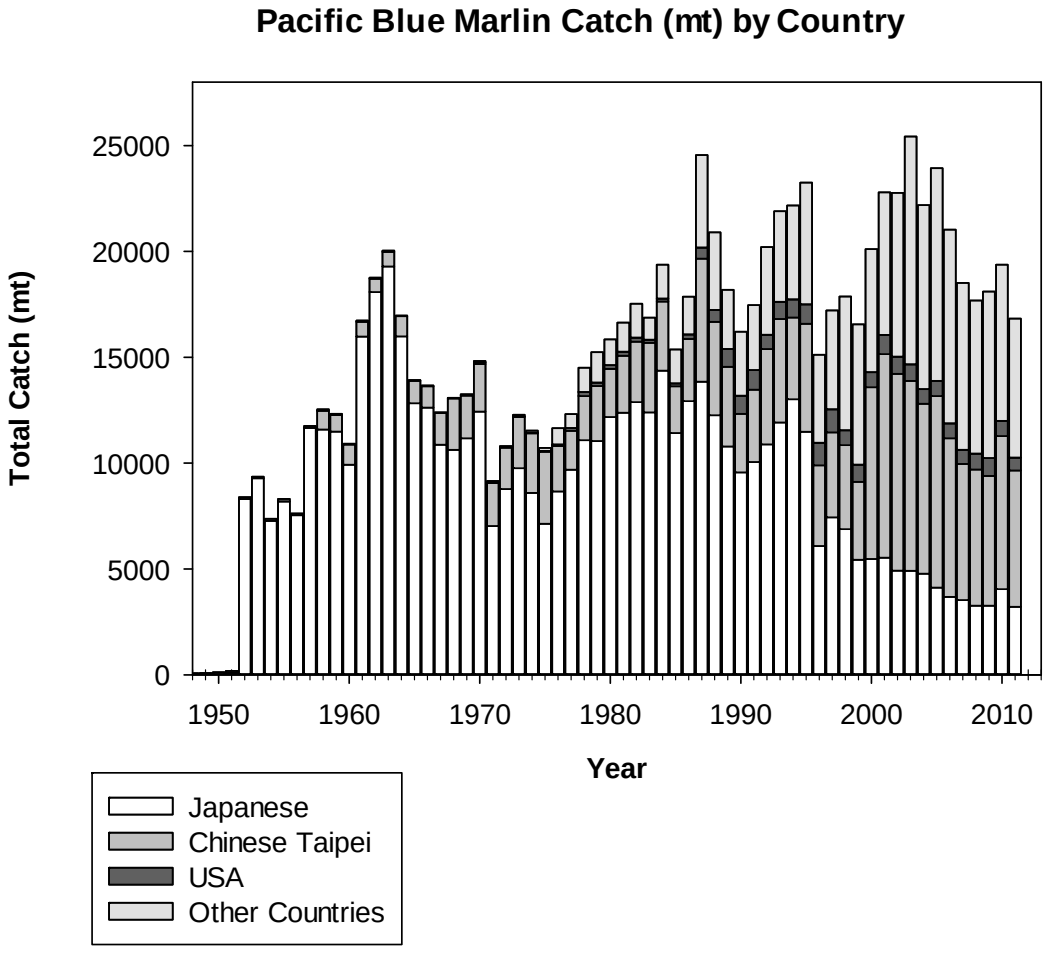


**Figure PBM2:** Pacific blue marlin (*Makaira nigricans*) catches (mt) in the Pacific Ocean by country for Japan, Chinese Taipei, the USA, and other countries.

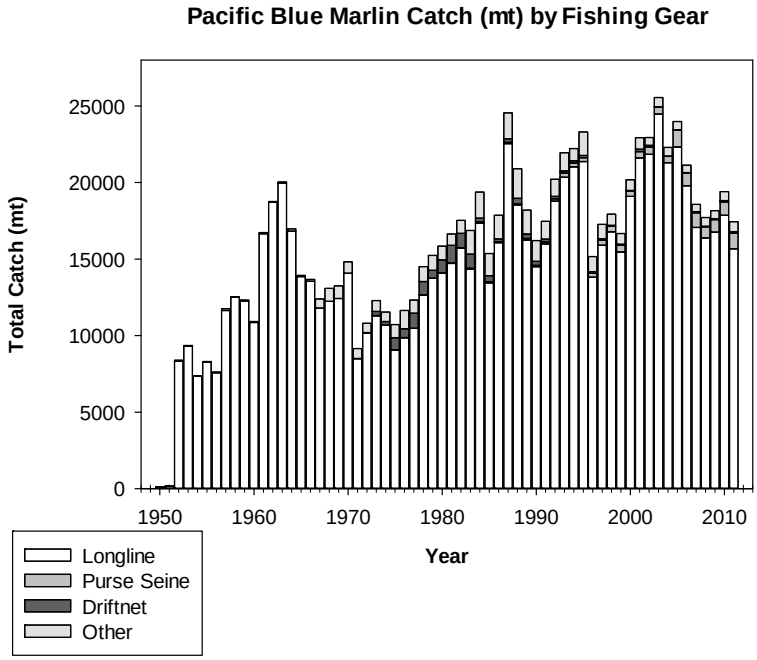


**Figure PBM3:** Blue marlin (*Makaira nigricans*) catch data (mt) by fishing gear from 1952–2011 used in the base case Stock Synthesis model.

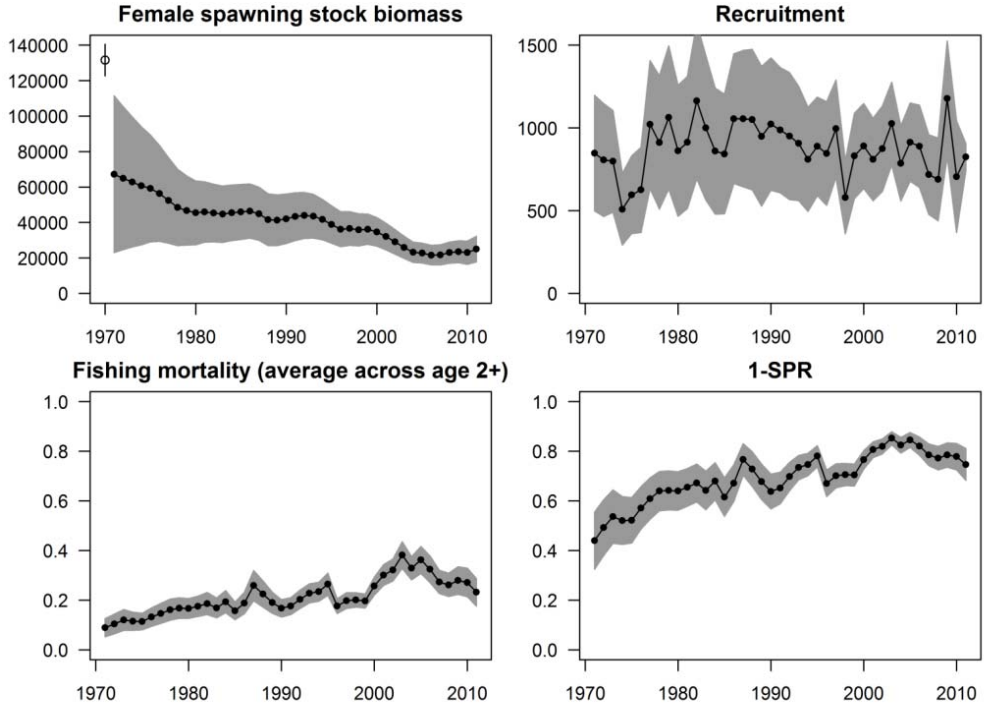


**Figure PBM4:** Estimates of female SSB (top left panel), recruitment (top right panel), fishing mortality (bottom left panel), and fishing intensity (bottom right panel) from the Stock Synthesis base case model (point estimate, solid circle) with +/- 1.96 standard deviation shown (shaded area).

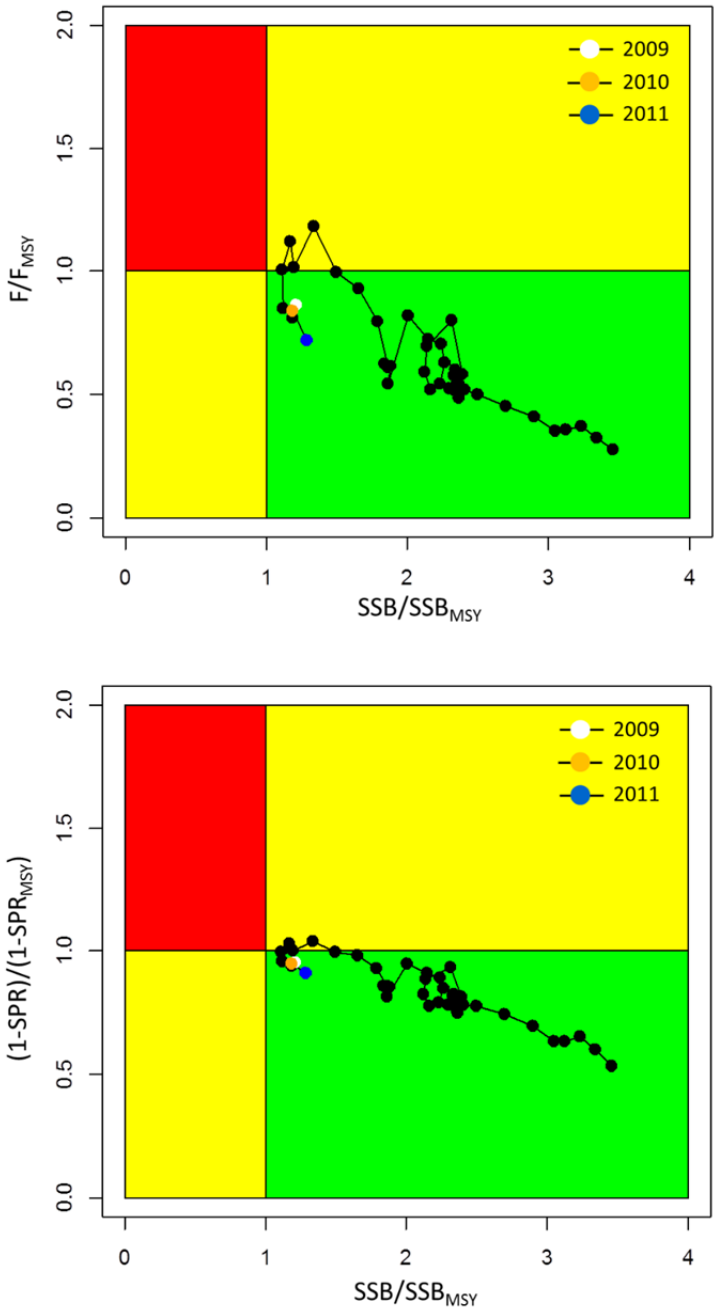


**Figure PBM5:** Kobe plots showing Pacific blue marlin stock status in relation to MSY-based reference points for the Stock Synthesis base case model with respect to relative fishing mortality (top panel) and relative SPR-based fishing intensity (bottom panel).

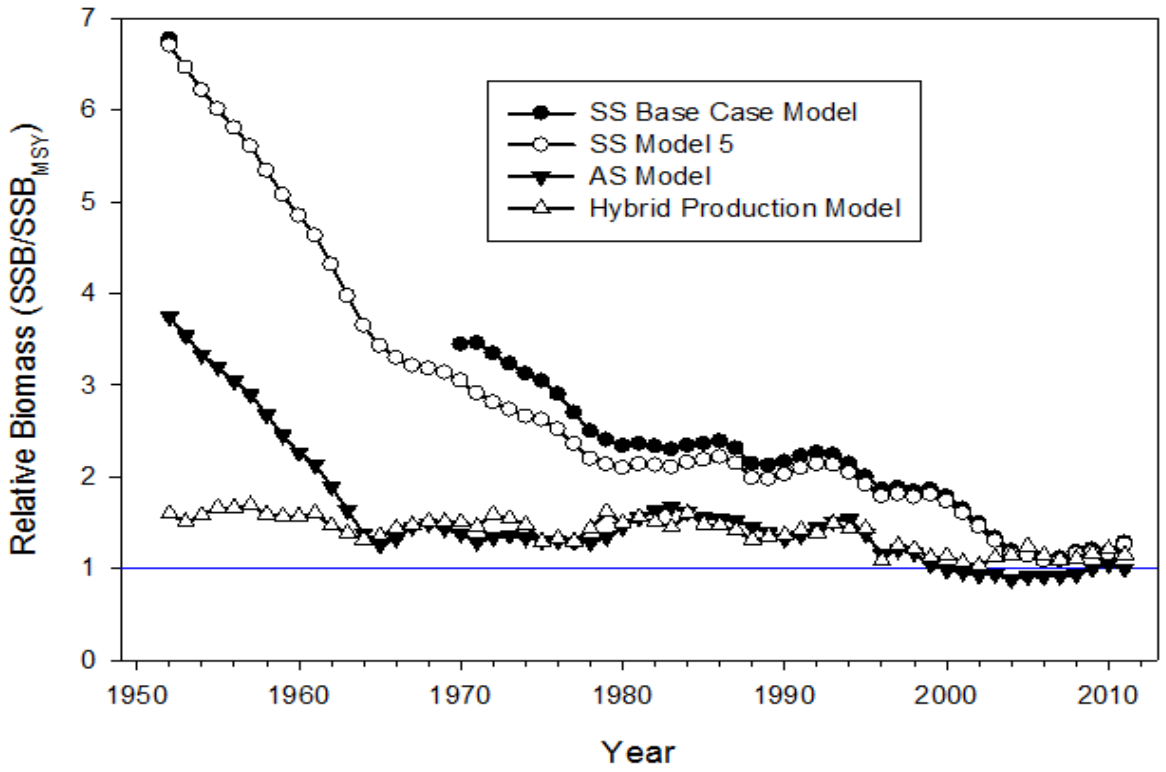


**Figure PBM6:** Comparison of estimates of relative SSB trends ($SSB/SSB_{MSY}$) of Pacific blue marlin *Makaira nigricans* from the Stock Synthesis (SS) Base Case Model, the SS Model 5 using 1952–2011 catch data, the Age-Structured (AS) Model, and the Hybrid Production Model.

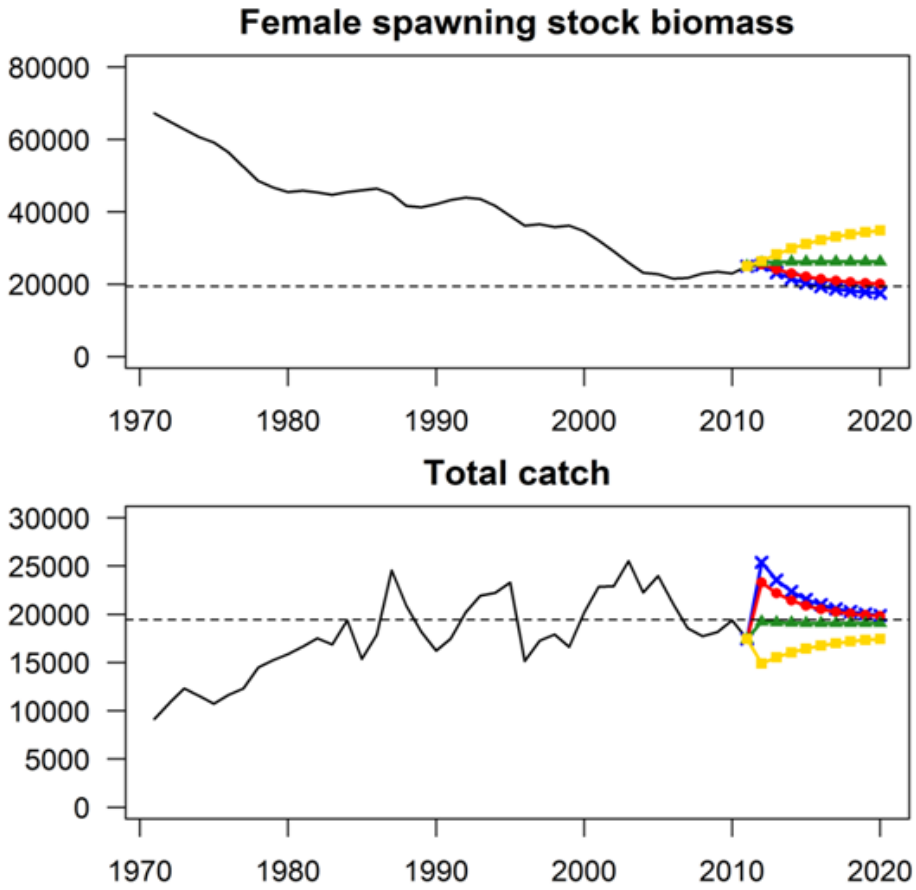


**Figure PBM7:** Historic and projected trajectories of female SSB and total catch from the Pacific blue marlin base case model. The solid black line shows female SSB estimates (top panel) and the catch biomass (bottom panel), and the projected estimates after 2012 show the predicted values if fishing intensity ($F_{X\%}$) were to continue at: i) average fishing intensity during 2003–2005 ($F_{2003\text{-}2005} = F_{16\%}$) indicated by the blue line with cross symbols; ii) fishing intensity at MSY ($F_{MSY} = F_{18\%}$) indicated by the red line with circles; iii) average fishing intensity during 2009–2011 ($F_{2009\text{-}2011} = F_{23\%}$) indicated by the green line with triangles; and iv) fishing intensity at $F_{30\%}$ indicated by the yellow line with squares. The dashed horizontal lines show the associated MSY levels of female SSB and catch biomass.

#### 4.4.3.1 Provision of scientific information

**a. Status and trends**

308. **Based on the finding of the ISC blue marlin stock assessment, the following information on stock status and trends is provided:**

- **Estimates of total stock biomass show a long-term decline.**
- **Current fishing mortality on the stock (average F, age-2 and older) averaged F = 0.26 during 2009–2011 and was below $F_{MSY}$ ($F_{MSY}$ [age-2+] = 0.32).**
- **The predicted value of the spawning potential ratio (SPR, the predicted spawning output at current F as a fraction of unfished spawning output) is currently $SPR_{2009–2011}$ = 23%.**
- **The overall trends in SSB and recruitment indicate a long-term decline in SSB and suggest a fluctuating pattern without trend for recruitment.**
- **Pacific blue marlin SSB decreased to the MSY level in the mid-2000s, and since then has increased slightly.**
- **The base case assessment model indicates that the Pacific blue marlin stock is currently not overfished and is not subject to overfishing relative to MSY-based reference points.**

**b. Management advice and implications**

309. **SC9 noted ISC's conservation advice for the Commission's consideration as follows:**

**Based on the results of the stock assessment, the stock is not currently overfished and is not experiencing overfishing. The stock is nearly fully exploited. Stock biomass has declined since the 1970s and has been stable since the mid-2000s with a slight recent increase. The fishing mortality rate should not be increased from the 2009–2011 level to avoid overfishing.**

## AGENDA ITEM 5 — MANAGEMENT ISSUES THEME

310. The Management Issues Theme was convened by R. Campbell (Australia). The rapporteurs for this theme were P. Maru (FFA), S. Bishop (New Zealand), T. Beeching (WCPFC), C. Reid (FFA), A. Cook (WWF), G. Langdon (Cook Islands) V. Chan (USA), and A. McDonald (FFA). The convener informed the meeting that seven working papers would be presented during this session and that a further three information papers had been prepared.

### 5.1 Limit reference points

311. The convener reminded SC that the Commission has adopted the hierarchical approach to identifying key limit reference points (LRPs), where levels are based on the biological knowledge available for the stock in question. It was further noted that SC8 and the Commission had recommended that the scientific services provider undertake work to identify:

- the appropriate period (or time window) for estimating the average recruitment for each species in the LRP $20\%SB_{recent,F=0}$, and
- the appropriate values of X for each species in the LRP $F_{x\%SPR_0}$.

**Time window**

312. A. Berger (SPC) presented working paper SC9-MI-WP-02 (Determination of appropriate time windows for calculation of depletion-based limit reference points), which addresses the request to develop an appropriate time window ($t_1$-$t_2$) over which to calculate the average unfished reference level ($SB_{F=0, t1-t2}$) for SC9. The time window should cover a time period thought to best represent current and likely future average environmental and stock productivity conditions.

313. Several approaches to selecting an appropriate time period were examined, including those based on environmental conditions (large-scale climatic cycles), species generation times (one and two generations), and indicative trends in recruitment and unfished SSB collated from recent stock assessments used for providing management advice to the Commission. Assessment models were rerun to account for stock recruitment bias-corrections (recent update to MFCL) and to explore two options for calculating unfished biomass levels. Unfished biomass levels were calculated using: i) absolute recruitment levels taken directly from the estimation model (ABS), or by ii) scaling absolute estimated recruitment levels upwards according to the stock recruitment relationship (SRR).

314. Analyses indicated that reference levels of unfished SSB and the resulting depletion-based reference point ($SB_{current}/SB_{F=0, t1-t2}$) were generally insensitive to the time period selected across species examined, regardless of the approach used to estimate unfished biomass levels. However, one approach (ABS) consistently led to a less conservative estimate of stock status relative to the LRP compared with the SRR approach. The value of $20\%SB_{F=0,t1-t2}$ and the perceived risk of falling below that value will depend on the specified approach for calculating unfished biomass levels, so this will be an important consideration for defining LRPs. The assumed value of steepness and the deviates around the stock recruitment relationship (magnitude and temporal trends) will also influence the LRP.

315. The paper highlights key considerations for selecting an appropriate time window and protocols for the review of the calculation time period in the future. Based on the analyses presented, the use of a 10-year fixed time window for WCPFC species might be adequate. Over longer time scales (i.e. 10 or more years), it will be important to periodically revisit the reference time window ($t_1$-$t_2$) to ensure that: i) the selected time period remains indicative of plausible future conditions, and ii) there is no confusing a biomass-driven decline as a general environmental change, as might be the case if steepness is lower than assumed.

**Discussion**

316. The convener clarified that three decisions needed to be made:
   a) define the length of the time window;
   b) determine whether to use a static or dynamic time window; and
   c) determine what approach to use to calculate unfished levels of SSB.

317. Some CCMs indicated a preference for using a 10-year time period to capture recent recruitment trends and large-scale environmental and climatic events that may influence species distribution. It was suggested that this should be the most recent 10-year period used in the latest assessment (i.e. 2000–2009 for assessments made in 2011). It was noted that the use of this time period should be subject to review in order to ensure that this approach appropriately represents future conditions for individual stocks.

318. One CCM questioned the 10-year time window as not being long enough to include a two-generation period for bigeye of 9 years. The presenter clarified that generation times of 50% maturity were used based on the Beverton paper mentioned in SC9-MI-WP-02. This resulted in a two-generation bigeye period of 9 years.

319. Some CCMs advised that they preferred to base estimates of the levels of unfished biomass on SRR, based on their understanding that this option is generally more conservative than using an absolute estimate of recruitment.

320. Another CCM noted its preference for a 10-year time window; and that the 10-year time window should either shift in reference to the stock assessment, or should be determined through a consultative process. The preferred option is that the time window automatically shift with the stock assessment periods, being the previous 10 years to the assessment year.

321. The convener noted that it has been normal practice in past assessments to not use the most recent year in these calculations. SPC confirmed that the process would require exclusion of the most recent 2-year period to the year of the assessment, but include the 10 years prior to that 2-year period.

322. One CCM queried whether the time period used to calculate the reference points and the final year of the assessment would differ. The convener confirmed that this would be the case, and that the terminal year used in the stock assessment would be 2012, while the 10-year period used for the calculation of reference points would be 2002–2011.

323. The convener noted that estimating unfished levels of spawning stock biomass ($SB_{F=0}$) requires including levels of recruitment associated with the levels of the unfished biomass (SRR). The ABS approach uses the recruitment estimated by the assessment but is based on a fished stock. However he noted that the results in the paper using these two approaches were currently similar.

324. One CCM noted that reliable estimates of $B_0$ are required; therefore, using the SRR approach has disadvantages that introduce uncertainties in the analyses, given the uncertainties in estimating steepness and the assumption that SRR is well defined (which is not the case).

325. The presenter stated that $B_0$ estimates depend on the carrying capacity or $R_0$ and the scaling up of these. When approaching low stock levels, using the ABS approach, determining whether recruitment is influenced by environmental conditions or the stock level is difficult. On the other hand, the steepness of the stock-recruitment relation is an important factor as to how recruitment will be raised in the SRR approach. The results between the ABS and SRR approaches do not show that much difference, however one approach needs to be chosen for consistency relative to reference points.

326. The ISSF feels that it is important to maintain consistency with the indicators used to determine stock status relative to the benchmarks used for advice. Noting that if SRR is used for MSY reference points by which stock status is determined, then it would be desirable to also use this approach to determine LRPs for consistency. The convener agreed that consistency was important.

327. One CCM noted the issues with estimating steepness and asked how sensitive the analysis was to this, given the little difference between results in the ABS vs. SRR outputs. The presenter noted that sensitivities of steepness in the analyses were not examined and so could not comment at this time.

328. In summary, the convener noted that there was general consensus that the appropriate "recent" time window to use for estimating the average recruitment for the LRP $20\%SB_{F=0,t1\text{-}t2}$ is the most recent 10 years, and that the SRR approach be used.

329. One CCM sought clarification on whether this time window applied to all key species, noting that the Commission has only allocated the management of three stocks at level 2 using an LRP of $20\%SB_{F=0,t1\text{-}t2}$. The convener clarified that the time window would apply to the key tuna and billfish

species, and confirmed that only three species (bigeye, yellowfin and South Pacific albacore) are designated for level 2 management. However, he further clarified that the application of $20\%SB_{F=0,t1-t2}$ applies at both level 2 and level 3.

**Appropriate values of X in $F_{X\%SPR0}$**

330. A. Berger (SPC) also presented SC9-MI-WP-03 (Proposed F-based LRPs for bigeye, yellowfin and South Pacific albacore tunas), which responds to SC8's request for the development of fishing mortality LRPs (F LRP) based on spawning potential per recruit ($F_{x\%SPR0}$). These are requested for "Level 2" species (bigeye, yellowfin, and South Pacific albacore tunas) under the "tiered" approach for LRPs adopted by WCPFC.

331. A summary of the presentation follows.

a) The method adopted for this analysis used the most recent stock assessments — updated with relevant methodological changes — and stochastic projections to find levels of fishing mortality that reduced the stocks down below the SSB LRP ($20\%SB_{F=0,2001–2010}$) with a probability of either 5% or 10%. We then translated this fishing mortality to give the depletion level "x" in $F_{x\%SPR0}$ and thus found the F-based LRP that matched the SSB LRP.
b) For each stock we repeated this analysis across a range of existing alternative assessment model runs, particularly those with different productivity assumptions (e.g. steepness or growth). We also examined two approaches for defining SSB LRP as described in SC9-MI-WP-02.
c) While results for both 5% and 10% risk are provided in the paper, we primarily focus on the 5% results here for simplicity (Table FX1). It can be noted that for a higher risk (e.g. 10%), a higher level of fishing mortality is permissible and the stock is reduced to a lower level on average.
d) We found that the SSB LRP varied across species, among assessment model runs examined for each species, and by the method applied to calculate SSB LRP. Assuming the absolute method (ABS) for determining the SSB LRP, the SSB LRP relative to $SB_{MSY}$ ranged from 0.45–0.70 for yellowfin tuna; from 0.63–0.91 for South Pacific albacore; and 0.62–1.18 for bigeye tuna. Some of the differences could be attributed to recent recruitment deviates, which were mostly negative for yellowfin and South Pacific albacore tuna, but other differences require further examination to identify the cause.
e) In general, the "x" in $F_{x\%SPR0}$ ranged from 0.2–0.3 across the three species (yellowfin ranging from 0.19–0.28 with a mean of 0.23; South Pacific albacore ranging from 0.23–0.31 with a mean of 0.26; and bigeye ranging from 0.25–0.36 with a mean of 0.29). Lower values were often associated with higher assumed steepness values. Overall, $F_{x\%SPR0}$ ranged from $0.83F_{MSY}$ (a bigeye run) to $2.30F_{MSY}$ (an albacore run), but most were in excess of $F_{MSY}$.

**Table FX1:** Range of key indicator values across selected model runs for each species, tuned to have a 5% risk level of falling below the biomass-based LRP $20\%SB_{F=0,\ 2001\text{-}2010}$ at the end of the projection period. Unfished levels of spawning biomass were calculated using the ABS or SRR approach. Refer to working paper SC9-MI-WP-03 for more information.

| **5% Risk** SB LRP calculation: | **%SPR$_0$ (range)** | | **$F/F_{MSY}$ (range)** | | **$SB/SB_{MSY}$ (range)** | |
|---|---|---|---|---|---|---|
| | **ABS** | **SRR** | **ABS** | **SRR** | **ABS** | **SRR** |
| Bigeye | 0.26–0.36 | 0.29–0.41 | 0.83–1.24 | 0.82–1.09 | 0.76–1.58 | 0.95–1.60 |
| South Pacific albacore | 0.23–0.31 | 0.23–0.36 | 0.83–2.30 | 0.62–2.14 | 0.76–1.12 | 0.78–1.29 |
| Yellowfin | 0.19–0.28 | 0.19–0.31 | 1.16–1.44 | 1.08–1.33 | 0.64–0.90 | 0.71–0.91 |

f) Alternatively, when the SRR approach was used to determine the SB LRP, the SB LRP was much closer to $SB_{MSY}$ for bigeye and South Pacific albacore, but still well below $SB_{MSY}$ for yellowfin tuna (range of 0.54–0.71). The $F_{x\%SPR0}$ levels were higher than when using the ABS method, indicating lower levels of fishing mortality for the LRP, with many more model runs giving estimates in the range 0.25–0.35.

g) In some cases, simply avoiding an LRP with a high probability can result in average biomass levels that might be suitable target reference points. However, given the levels of uncertainty included in the projections, avoiding the SB LRP with 95% probability gave expected biomass levels (across model runs) of $0.74SB_{MSY}$ for yellowfin to $1.14SB_{MSY}$ for bigeye tuna, which is likely to be lower than practical target reference points that may not meet specified management objectives.

h) There are several important issues for SC to consider in terms of these results. The first point to note is that we did not calculate an F-based LRP that "should be avoided with high probability", rather we calculated the level of fishing mortality that would result in an "acceptable" risk of breaching the SB LRP. The second point to note is that resulting high levels of fishing mortality are unlikely to be breached until the stock is close to breaching the SB LRP, so they are unlikely to act as an early warning system against overcapacity (e.g. it would allow for levels of catch well in excess of MSY at stock levels only slightly above $SB_{MSY}$). However, this needs to be tested thoroughly within a management strategy evaluation framework with the inclusion of harvest control rules which may themselves limit fishing mortality, but it is possible that there are alternative ways to develop F-based LRPs depending on management goals (e.g. to complement the SB LRP or to act as an early warning of potential overcapacity).

i) The variation in the $F_{x\%SPR0}$ LRP level across species and among models for each species is significant, and there is value in a better understanding of what might be responsible for this. It could relate to variation in current levels of recruitment relative to spawner recruitment predictions (after SC9-MI-WP-02).

j) Finally, we note that the actual levels of allowable risk will be determined by the Commission.

**Discussion**

332. The convener thanked SPC for the presentation and opened the floor for comments on the matching approach. He noted that the work to estimate X used the reference case and a range of sensitivities from the stock assessment and queried whether recalculations of X would be done based on the most recent suite of stock assessment models. The presenter explained that the analysis provides a range of F values based on recent information, so would not envisage doing this at each assessment but to

provide a range of what F may be. Further, it was stated that the iterative tuning (over 150,000 projections) is a very time consuming process.

333. One CCM asked what the difference (if any) was between the SRR steepness of 0.8 (as used from the reference case in the stock assessment for bigeye and yellowfin) and the estimates of SSR in this analysis noting that large differences may be problematic if there was no consistency between this analysis and the stock assessment itself. The presenter confirmed that a steepness of 0.8, which is not that different from a value of 1, was used in the analysis and looked at sensitivities using two values of steepness (h=0.65 and h=0.95). If the true steepness was less than the assumed value, then declines in recruitment would not be correctly attributed to the impact of reductions in SSB. The resulting biomass LRP would be too low. For South Pacific albacore, striped marlin and yellowfin, SPC informed SC9 that steepnesses estimated in the model were much lower than 0.8.

334. One CCM queried whether it was run 21 that had a longer time series that had more data points feeding in to the recruitment estimates compared with the reference case. SPC clarified that this was the opposite and that run 21 used the most recent 10-year period.

335. The convener noted that recruitment levels were estimated to be much higher in the 2000s compared to the 1990s, requiring the need for this sensitivity run, assuming this high level of recruitment continues in future.

336. In relation to the acceptable level of risk falling below the LRP, one CCM noted that the risk levels of 5% and of 10% is a decision for managers, and that scientists should provide analyses with additional risk levels for managers to determine which risk level to apply. This CCM also suggested it was not necessary to link $20\%SB_{F=0,t1-t2}$ and F reference points, and suggested that they be treated independently, and that an examination of other risk probabilities of falling below $20\%SB_{F=0,t1-t2}$ (e.g. 10%, 30%, or 40%) be undertaken.

337. The convener agreed that any decision on the acceptable level of risk is the role of managers. However, he noted that SC8 had generally recommended a 10% risk level to the Commission, and that the Commission had adopted 20% as the depletion level associated with the $SB_{F=0}$ reference point. He reminded SC that they were tasked with determining what level of X achieves the 5% and 10% risk levels.

338. Some CCMs welcomed the Commission's adoption of the SC recommendation for further work on F-based LRPs based on spawning potential per recruit, and thanked SPC for this work. These CCMs noted the value of the "matching" approach to determining F-based LRPs that are equivalent to the SSB LRPs. It was interpreted that this would provide a set of reference points on the Kobe plot that fulfill a similar role to the MSY-based reference points, but in this case for limits. Noting the simplicity of this approach, these CCMs noted their concerns that such an approach may not be sufficiently precautionary and could open up the prospect of outcomes that would not contribute to avoiding overcapacity.

339. Some CCMs registered their interest in learning more about the application of an early warning type approach for fishing mortality LRPs, noting the need for a better understanding of how this would work within the framework of harvest control rules that include arrangements to adjust fishing mortality, especially as the SSB LRP is approached. Furthermore, these CCMs support the proposal in the paper for further work on both approaches within the framework of harvest control rules.

340. One CCM suggested that SC recommend periodic review of this approach in light of new information and methods.

341. The convener noted that precautionary trigger reference points could be predefined and included within harvest control rules. The convener also suggested that the evaluation of reference points within a management strategy evaluation framework would be best practice in adopting reference points and suggested that this could occur as part of the management objectives workshop process.
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342. One CCM noted the differences between $20\%SB_{F=0,t1-t2}$ and $F_{X\%SPR0}$ reference points, and that they should be considered separately because stocks assigned with level 3 management use $20\%SB_{F=0,t1-t2}$. Therefore, $F_{X\%SPR}$ can be used independently of $20\%SB_{F=0,t1-t2}$.

343. The convener reminded SC that the Commission asked for values of F-based LRPs that are commensurate with $20\%SB_{F=0,t1-t2}$.

344. The USA provided comments on two issues. First, it advocated the use of $F_{MSY}$ as the F-based LRP, reiterating its position at SC8, noting that this differs from what the Commission has adopted. It was noted that $F_{MSY}$ is a good choice because the optimal level of F can be determined and controlled, and that $B_{MSY}$ is less attractive and less reliable. The USA further noted that the calculation of $20\%SB_{F=0,t1-t2}$ using the ABS approach includes the time window. SPC investigated a two-generation time period, noting that this was an *ad hoc* choice, and did not know if environmental influences were captured within a two generation time period. The SRR approach, however, is more consistent with the approach in the model, and the USA preferred this approach.

345. Some CCMs supported the proposal in SC9-MI-WP-03 for further work on fishing mortality LRPs within the framework of potential harvest control rules, noting the importance of delivering clear advice before a particular recommendation is made to the Commission. These CCMs noted that they were not currently in a position to make that decision without further analysis along the lines proposed in the working paper.

346. The convener noted that some CCMs wanted management strategy evaluation and harvest control rule development along with LRPs. However, asked whether SC could agree on the approach as outlined in the paper to identify values of X that will be adopted by the Commission, he further noted that once the Commission advises SC on what levels of risk they are willing to accept, then calculations can be done to determine the resulting values of X (in $F_{x\%SPR0}$).

347. Some CCMs noted the complexities associated with the papers presented under this agenda item, and that it is difficult in the busy regional and national fishery agendas to find the time needed to do justice to this important area. As such, the CCM suggested that more emphasis be placed in the annual stock assessment workshops on reference points and harvest control rules.

348. One CCM noted the implications of differences in using the ABS and SRR approaches from historical periods through to projected periods.

349. The presenter responded, noting that the SRR approach was used to determine unfished levels historically and continued in the projected periods. There was no difference in the calculation of unfished levels with the SRR approach between this paper and SC9-MI-WP-02.

350. One CCM noted that this approach was almost the same as using $B_0$, assuming $R_0$ would not be much different from SRR and, therefore, no difference between using $B_0$.

351. The presenter responded, noting that the difference would be in that $SB_0$ would be the virgin population, and that results may show changes in the unfished population due to environmental changes; therefore, he advocated using the recent period to reflect recent changes.

352. One CCM commented that SRR might take into account environmental effects; however, there are examples that show recent recruitment deviates are distributed around the mean recruitment level, as the SRR level in recent years.

353. Some CCMs welcome the adoption of SSB LRPs for bigeye, yellowfin, skipjack and albacore by the Commission at WCPFC9, and agreed that further work on assessing potential F-based LRPs for albacore, bigeye and yellowfin was needed to complement SSB LRPs. These CCMs suggested that it is time to move away from the practice of relating all reference points back to MSY. SC and Commission have made the explicit decision to move away from MSY-based reference points because the assumptions that drive them (particularly steepness) are too uncertain, and this should be reflected in SC practice.

354. The convener summarized discussions, noting the general acceptance of the method used for deriving the value of X in F-based LRPs. This value will depend on the risk level (%) but will depend on the model used. If this is acceptable, the Commission at its next meeting can advise SC on what they consider to be an acceptable risk level, noting that there will be new assessments next year. This would enable the scientists to show what F-based LRPs would be derived from the assessment as the basis for this work.

355. The USA agreed with the method used for deriving the value of X in F-based LRPs as set out in the paper, and that it was the role of managers to choose the acceptable level (5% or 10%). The USA noted that B-based LRPs are intrinsically linked with F-based values, and that there was no need for both, and again reiterated its preference for F-based LRPs over B-based LRPs or a combination of a B-based LRP and an F-based target reference point (TRP).

356. It was proposed that SC adopt this approach and recommend that the Commission make decisions on the risk level so that the new stock assessments next year can re-do calculations and get corresponding values of X.

**Recommendations**

**357. SC9 noted the hierarchical approach and the associated key LRPs for the key target species in WCPFC adopted by the Commission and the request made by WCPFC9 for SC9 to identify: i) the appropriate time window ($t_1$-$t_2$) for estimating the average unfished biomass in the LRP $20\%SB_{F=0,t1-t2}$, and ii) the appropriate values of X for each species in the LRP $F_{X\%SPR0}$.**

**358. SC9 noted the work described in working paper SC9-MI-WP-02 and recommended that the time window to be used in the LRP $20\%SB_{F=0,t1-t2}$ satisfy the following criteria:**

- **have a length of 10 years;**
- **be based on the years $t_1=y_{last}-10$ to $t_2=y_{last}-1$ where $y_{last}$ is the last year used in the assessment; and**
- **the approach used for calculating the unfished biomass levels be based on scaled estimates of recruitment according to the stock recruitment relationship.**

**359. SC9 also recommended that the selection of this time window be subject to periodic review to ensure that this approach is appropriately representing future conditions for individual stocks.**

**360. SC9 noted the work described in working paper SC9-MI-WP-03 and recommended that the identification of the appropriate values of X for each species in the LRP $F_{X\%SPR0}$ be based on an iterative search to "match" $F_{X\%SPR0}$ with $20\%SB_{F=0,t1-t2}$ as described in this working paper.**

**361. SC9 also noted that working paper SC9-MI-WP-03 had considered two levels of risk (5% and 10%) associated with breaching the LRP. Further noting that the identification of acceptable risk is a management issue, SC9 recommended that WCPFC10 identify what level of acceptable risk should be applied to breaching an LRP. Once this level of risk has been identified, SC9 recommended that the appropriate values of X for each species in the LRP $F_{X\%SPR0}$ be calculated using the updated assessments to be presented to SC10.**

**362. For stocks for which the Commission has adopted LRPs, SC9 recommended that future assessment summaries (e.g. tables, Kobe-like plots) include stock status relative to those LRPs.**

**363. SC9 also recommended that SC10 and the Commission give consideration for the need to identify associated early warning or trigger reference points that would alert the Commission that a stock may be approaching an LRP and that appropriate management action may be required. When possible, future consideration should also be given to testing the fishing mortality LRPs within the framework of potential harvest control rules.**

### 5.2 Development of WCPFC management objectives

364. I. Cartwright (independent consultant) presented SC9-MI-WP-05 (Report of the Expert Working Group Management objectives, performance indicators and reference points). Following a direction from WCPFC7 that an informal workshop on management objectives be held, WCPFC8 subsequently agreed to the terms of reference and suggested that a workshop be convened immediately before WCPFC9. In response, the WCPFC Secretariat convened the first Management Objectives Workshop (MOW1) in Manila from 28–29 November 2012, using an independent expert panel and input from CCMs and observers. The workshop sought to:

- increase the understanding of the purpose and implications of management objectives in terms of biological, economic and social outcomes;
- increase the understanding of the role of reference points and indicators in measuring the achievement of management objectives; and
- develop a list of recommended management objectives.

365. Given the time available and the number of participants, MOW1 was primarily an awareness raising exercise, with an opportunity to exchange views on a wide range of issues associated with developing management frameworks, including objectives, reference points and performance indicators. There was preliminary discussion of the current management frameworks, as represented by CMM 2010-05 (South Pacific albacore) and draft CMM 2012-01 (bigeye and yellowfin tunas). A candidate list of management objectives, broken down by ecosystem, biological, economic and social objectives, was developed using feedback from participants provided by questionnaires.

366. WCPFC9, in considering the outcomes of MOW1, agreed to use the same expert group that provided input into that workshop to develop a "straw man" consisting of a candidate list of management objectives, performance indicators, and target reference points for each major fishery, including tropical longline, southern longline, purse-seine, Pacific bluefin tuna, and North Pacific albacore.

367. It is noted that the above list includes both species and fisheries. The WCPF Convention and the Fish Stocks Agreement both focus on stock- and/or species-based approaches to management. In some fisheries, where mixed species are taken either unavoidably due to the selectivity of the gear, or for operational or economic viability reasons, it may be more appropriate to look at fishery-based objectives and reference points. For example, the purse-seine fishery takes mixed-species catches (yellowfin and

skipjack), so a maximum economic yield objective for the fishery as a whole may be more appropriate than objectives for each single species. While a fishery-wide objective may replace the objectives for individual species, there would still be a need for LRPs for each species in order to avoid overfishing.

368. The "straw man" was to be provided to all Commission members for review prior to being sent to SC9 and NC9 for comment and suggestions for improvement. These comments and suggestions were required to be provided to MOW2, which will be held immediately before WCPFC10.

369. This paper seeks to provide an increased understanding of the interests and motivations of the major participants in particular fisheries and the range of objectives. For some species and fisheries it is likely to be difficult to envisage a process whereby CCMs will be able to agree on Commission objectives per se, particularly where large proportions of particular stocks or fisheries exist in the waters, or are under the effective control, of one or more coastal states.

**Discussion**

370. Some CCMs thanked the WCPFC Secretariat and the Expert Working Group for the work they had undertaken so far in the Management Objectives process, noting that they felt that the 1st workshop in Manila was a success, and at WCPFC9, they supported the continuation of the process. These CCMS also welcomed the "straw man" paper, and the approaches on which it is based, including the attention paid to the major fisheries and individual stocks, noting that they think the paper clearly states the range of objectives of different Commission members and other stakeholders, and the special requirements and aspirations of SIDS and territories. They further noted that they looked forward to the further development of the paper, particularly the proposals for target reference points, and MOW2, and understand that the paper will be revised after receiving comments from SC, and distributed to Commission members for comment.

371. One CCM noted that it would be helpful if more information could be provided about the process for developing the paper before the 2nd workshop session prior to WCPFC10, particularly on the timing of work related to TRPs. The WCPFC Secretariat noted that the Expert Working Group's report would be presented to SC, NC and TCC and comments from these groups would be compiled and presented, along with the report, to MOW2. MOW would then develop a paper for consideration at WCPFC10.

372. Another CCM asked for a clarification on the difference between TRPs for fisheries and TRPs for species. The presenter noted that in a single-species fishery, it was easier because the TRP for the species could be managed to that TRP, whereas in a multi-species fishery, it was not always possible to manage the fishery in such a way as to ensure that the TRP for the different species was achieved and, therefore, it was often necessary to manage the fishery to achieve an overall TRP, while ensuring that no LRPs were breached, and this may not necessarily result in an individual species TRP being achieved.

373. A CCM referred to Figure 2 on page 11 of SC9-MI-WP-05 and suggested that a buffer around the TRP be included in a similar manner on the revised Kobe plot used to present stock assessment results. SPC agreed that the form of this plot had merit and noted that it would appreciate feedback on how easy the modified Kobe plot was to understand.

374. The convener noted that the Informal Small Group (ISG7) would be convening to discuss the report of the Expert Working Group further and help formulate comments and feedback from SC to the Commission on this important topic. He encouraged all CCMs to either attend this meeting or discuss this issue directly with the presenter in the margins of the meeting. A summary of these comments are provided in Attachment G.

**Recommendations**

375. **SC9 noted the report by the Expert Working Group on management objectives, performance indicators and reference points for WCPFC (SC9-MI-WP-05) and recommended that MOW2, which will be held in November 2013, take note of the comments made on this report by SC9 (Attachment G).**

## 5.3 Reference points and the characterization of uncertainty

*Approaches to describe uncertainty*

376. A. Berger (SPC) presented SC9-MI-WP-04 (Approaches to describe uncertainty in current and future stock status), which responds to SC8's request for further development of a common approach to describe uncertainty in current and future stock status. In particular, consideration was given to defining a consistent approach that could be used to evaluate management risks (e.g. the risk of falling below LRPs). It is acknowledged that there are unavoidable trade-offs between the degree of analytical rigor, computational demand, and time constraints that must be considered when choosing an approach that is practical, yet informative.

377. A summary of the presentation follows.

a) The relative advantages and challenges associated with common approaches to incorporate uncertainty into fisheries management decision-making are highlighted. Recommendations are provided for describing uncertainty, options for selecting a representative subset of assessment model runs, and discussions on the use of model plausibility weights. Key considerations for this work are also discussed.
b) Ultimately, the approach used to describe uncertainty will influence perceptions of management risks and the selection of a management strategy (including reference points and harvest control rules) to meet management objectives. In particular, this is critical for measuring the risk of exceeding LRPs. The validity of using a single model to characterize uncertainty in stock status is questionable. An approach to incorporate uncertainty that takes into account model error (integrating across multiple assessment models) in addition to process and estimation error would be the most sensible while balancing the impracticalities associated with computing and resource time.
c) With this in mind, the following are recommended guidelines for describing uncertainty in current and future stock status for the provision of management advice to the Commission:
    - The use of a hierarchical approach towards uncertainty estimation, which involves: i) selecting a representative subset of models from the structural uncertainty grid to capture the extent of model uncertainty and ii) using stochastic projections on the chosen subset of models (~5–10 models) from the grid to provide management advice that captures key sources of process uncertainty.
    - Incorporating uncertainty in recruitment as a minimum in stochastic projections, but preferably also with respect to catchability (effort deviates) and the age structure in the first year of the projection period as well.
    - The use of expert opinion by SC to determine a representative subset of models from the grid (perhaps done by individual stock assessment working groups or at pre-assessment workshops) for describing model uncertainty, guided by the assessment document provided by stock assessment scientists.
    - SC to determine plausibility weights for each model in the subset on a case-by-case basis (perhaps by the stock assessment working group or at pre-assessment workshops), guided

by the assessment document provided by the stock assessment scientists (the default being that all assessment model runs have equal weight).

d) The hierarchical approach described above is consistent with that discussed at the pre-assessment workshop held in Noumea from 8–12 April 2013. These guidelines for describing uncertainty were developed as a common approach for evaluating risks associated with candidate management strategies (e.g. risk of falling below the LRP). However, it is acknowledged that other approaches for handling uncertainty may be more suitable for particular analyses.

**Discussion**

378. FFA members supported the technical approach proposed in SC9-MI-WP-04, which is based on selecting a representative subset of models from the structural uncertainty grid to capture the extent of model uncertainty, and using projections on the chosen subset of models to provide management advice that captures key sources of process uncertainty. These CCMs also have some views on the process for applying this approach. It is very important to FFA members that they participate in this process. For this reason, FFA members do not support the option for this work to be done during the Pre-Assessment Workshop. If it was done during the Pre-Assessment Workshop, participation would have to be expanded. FFA members believe that would change the nature of the Pre-Assessment Workshop in ways that might reduce its strength for its core business of guiding the assessment work. Instead, members propose that this work be undertaken by assessment scientists and included in assessment reports, in the same way that assessment scientists now select reference cases, sensitivity runs, and the uncertainty grid. This work would then be reviewed by SC when it reviews the assessment reports in the normal way, possibly in a working group at SC in which SIDS' and territories' scientific and technical personnel could participate.

379. The convener noted that the proposed approach is similar to what has been used in past. An example of the current process was used in the assessment of silky sharks presented during the Stock-Assessment Theme. This approach is not new and has been adopted over the past few years.

380. One CCM noted that recruitment variability could be incorporated into the model in a way that does not include the whole time series and particular recruitment levels. The presenter responded that there have been some updates in a MULTIFAN-CL paper used for tunas, which provides options to use subsets to look at recruitment periods to address concern that deviates are skewed from the predicted relationship.

381. There was an overall general support across the floor for using the approach proposed in the paper. The convener mentioned the need to put plausibility criteria on the elements of the subset, which will require more work.

382. The convener thanked SPC for the presentation, and encouraged CCMs to complete the questionnaire (Expert Opinion Poll, Appendix 1 in SC9-MI-WP-04).

*Cost-earnings study of the American Samoa Longline Fishery*

383. K. Bigelow (USA) presented SC9-MI-WP-06 (Cost-earnings study of the American Samoa longline fishery based on vessel operations in 2009). The purpose of this study was to update the cost-earnings information for the longline fishing fleet based in American Samoa, and to examine the economic health of the fleet. An in-person survey was conducted in 2010 to collect cost information from the fleet, focusing on the 2009 operating year. This cost-earnings analysis uses both primary and secondary sources of data to provide baseline information needed to support fishery management. This study found that in 2009, the majority of boats suffered net losses from longline operations. Rising fuel

costs, which accounted for approximately 27% of total expenditures, coupled with relatively low revenues (due to lower CPUE), were the major factors leading to poor economic performance. Due to the use of foreign nationals (as opposed to USA nationals) as crew members, overall crew compensation was relatively low and accounted for 11% of total expenditures. Compared with unprofitable vessels, profitable vessels were found to generate significantly higher annual revenues while expending less on variable inputs but more on fixed inputs. Results were also compared with the previous (2001) cost-earnings study of the same fleet, although results may not be directly comparable based on different sampling methodologies and assumptions.

**Discussion**

384. SC9 was informed that the profit-per-vessel returns to the fishery (~ USD 6,400 using USD 1.00/lb but ~USD 53,000 using the higher Thailand price of USD 1.20/lb) were highly dependent on the price received for fish. The presenter noted though that while there remained some uncertainty in the price received during the study period, that even under the higher price scenario not all vessels in the fishery would have made a net positive return.

**Recommendations**

385. **SC9 considered working paper SC9-MI-WP-04 on approaches to describe uncertainty in current and future stock status. SC9 recommended that the following hierarchical approach to describe uncertainty:**

- **Select a representative subset (5–10) from the structural uncertainty grid of assessment model runs to capture the extent of model uncertainty.**
- **Apply stochastic projections across the chosen subset of models required to integrate across the key uncertainties.**
- **Undertake the selection of the representative subset by SC after reviewing the associated stock assessment.**

386. **SC9 also recommended that:**

- **SC10 give further consideration to the need to assign plausibility weights for each model run, and if needed, how these weights may be developed to further assist in reducing uncertainty in the description of stock status.**
- **The work to describe uncertainty described above should be undertaken to the extent possible by the assessment scientists, included in the assessment reports, and reviewed by SC.**

## 5.4 Implementation of CMM 2012-01

*Request to review alternative reduction of FAD sets*

387. A short summary of CMM 2012-01 and the alternative option for FAD management was provided by the convener. The paper provided by the Secretariat, SC9-MI-IP-03 (Summary of reporting received by WCPFC in accordance with CMM 2012-01), was noted and it was highlighted that only three CCMs are reported as having taken up the alternative FAD option specified in Appendix B of CMM 2012-01.

*Relationship between bigeye tuna catch and school type*

388. H. Okamoto (National Research Institute of Far Seas Fisheries) presented SC9-MI-WP-07 (Updating analyses for relationship between bigeye tuna catch and school type of the Japanese purse-seine fishery). As part of approaches to reduce bycatch of bigeye tuna by Japanese purse-seine vessels on FADs, the relationship between bigeye tuna catch and school type was investigated. The survey corresponds to paras. 25 and 26 of CMM 2008-01 (Juvenile tuna catch mitigation research).

389. This updates the analysis for a previous study in SC8, incorporating the effect of oceanographic conditions. Catch information was collected from logbook and market receipt (fish unloading data). The vessels targeted both free schools and associated schools from the beginning, and the proportion of sets on free schools had been about 40% with annual fluctuations from 2002–2009. The proportion of free school sets increased suddenly in 2010 and reached around 80%. At the same time, the catch of small tunas (bigeye, yellowfin and skipjack) and large bigeye tunas decreased. GAM was applied for investigating the relationship between catch (bigeye, yellowfin and skipjack), school type, purse-seine mesh size, and oceanographic conditions (sea temperature, mixing layer depth, eddy kinetic energy, and standard deviation of horizontal current velocity). GAM analysis accounted for 48–57% and 22–37% of the variance in catch per set for small and large tuna (bigeye, yellowfin and skipjack), respectively. In this analysis, oceanographic conditions were applied to confirm that the differences in catch per set for small tuna species are derived from school type rather than environmental factors. After including the effect of oceanographic factors in the model, school type (ratio of log-associated set per cruise) still showed a strong effect on it.

**Discussion**

390. SC9 noted that in the Japanese analyses, the school type had a large effect on the proportion of small bigeye in the catch.

391. SPC noted that because the data were aggregated over the whole trip, it was not surprising that effects such as latitude, longitude and oceanographic variables were not found to be significant. SPC asked whether there was sufficient confidence in the catch data such that the analysis could be undertaken at a set level, and whether there had been a change in the depth of the net as well as a change in mesh size. The presenter advised that a more detailed analysis could be undertaken using logsheet data, however the data were not as robust, and that to his knowledge — based on past analyses — there had not been any remarkable change in net depth in this decade.

392. One CCM thanked Japan for this presentation, stating that it was very useful.

*SC9-MI-WP-01 (Analysis of the implementation and effectiveness of key management measures for tropical tunas)*

393. G. Pilling (SPC) presented SC9-MI-WP-01 (Analysis of the implementation and effectiveness of key management measures for tropical tunas). He reviewed the implementation and effectiveness of key management measures for tropical tunas, using the most current data and stock assessments available. For the most part, these measures related to CMM 2008-01 and its successors. The working paper examined the key components of the measures — purse-seine effort, FAD closure, high seas pockets closure, longline catches and catches by other fisheries. It also reviewed the results of previous stock projections undertaken using the reference case models for each key tropical tuna stock to assess the implications of status quo conditions, and identify changes within the fisheries required to remove overfishing on the WCPO bigeye stock. The results of a series of new projections specifically for the bigeye tuna stock under a range of future of purse-seine-associated set effort and longline fishery bigeye catch level

combinations were also presented. Using this set of projections, conditions in these fisheries that removed 50% and 100% of overfishing in bigeye tuna in the WCPO by 2018 were identified.

**Discussion**

394. One CCM asked if the drop in bigeye CPUE of the tropical longline fishery was due to a drop in biomass, a change in targeting, or the development of another longline fishery targeting fish other than bigeye. The presenter advised that the best assumption is that the CPUE trend, when standardized, are our best knowledge of abundance. He also noted that without operational data there is limited ability to analyze the change in targeting although they had attempted to remove this effect by limiting the latitudinal range of the data analyzed.

395. The same CCM requested an overlay of the bigeye catch and CPUE with that of yellowfin and albacore, and asked for the analysis to be limited to 20°N and 10°S in order to know if any shift of effort has occurred towards targeting albacore or yellowfin. The presenter noted that it may be possible to present this later during the meeting.

396. One CCM commented on the 2012 purse-seine effort and whether the present estimate may be an underestimation. The presenter noted that there had been a shift in the reporting of days, with a decrease in the number of search days and an increase in the proportion of transit days inside the zone. Further investigations are underway.

397. One CCM noted that the comment on longline bigeye catch over the last three years was not consistent with their understanding of catch trends based on the Japanese, Korean and Chinese fleets. They therefore requested that SPC provide a breakdown of catch and effort by fleet so that SC could review the contribution of fleets to bigeye catch trends over the past few years. SPC advised that it would attempt to prepare the tables of contribution by fleet for SC9's consideration. These tables will also be made available for the Tokyo Working Group meeting and the SPC Tuna Yearbook.

398. The same CCM sought advice on the magnitude of catch revisions by CCMs. SPC advised that it had received at least two revisions since the April submission deadline, and that revisions to initial estimates are regularly received when complete information is received by CCMs.

399. In response to a request as to whether an analysis of effort shifts by vessel size could be provided, SPC advised that the data may not enable this level of analysis, but it will report back to SC. SPC also advised that amendment of the three-vessel rule would allow CCMs to undertake the analyses requested for the consideration of this matter using public domain data.

400. Some CCMs thanked SPC for the paper and presentation. These CCMs found the paper very useful and requested that it be forwarded to the CMM Working Group. These CCMs noted that the outlook presented is similar to the information reviewed at SC7 and SC8, but most indicators suggest continuing increases in fishing mortality and further declines in stocks for the major tropical tunas. Therefore, SC's advice on this issue should be carried forward from last year and strengthened. Key elements in this advice would be that overfishing of bigeye is projected to continue at around the same levels, that the number of FAD sets is high despite the FAD closure and increased control is needed to reduce FAD use, and that reductions in longline catches appear to be largely a result of falling catch rates with little effective reduction in fishing mortality. Overall, the information in the paper reinforces SC8's advice that additional management measures are needed to reduce fishing mortality in the purse-seine and longline fisheries, and in other fisheries.

401. Some CCMs noted that the information in this presentation and other SC papers indicates that the situation with respect to bigeye, skipjack and yellowfin tunas is no better, and in most respects worse, than what was reported to SC7 and SC8. It is now clear that the encouraging results in 2010 were a one-off result, and the tropical tuna CMMs have systematically failed to achieve the objective of removing bigeye overfishing. Commission members have now agreed that the new CMM will include measures relating to management of skipjack and yellowfin. These CCMs believe that the updated information and broadening of the scope of the new CMM require more comprehensive limits and reductions across all fisheries. This year, SC's advice should clearly address the need for reductions in effort and capacity in both the purse-seine and longline fisheries to remove bigeye overfishing, and maintain sustainable fisheries for tropical tunas.

402. Some CCMs noted that the paper includes two new elements this year that need to be reflected in SC9's advice on the effectiveness of the tropical tuna CMMs. The first is the set of projected conditions in Table 3 of the working paper that remove bigeye overfishing. These CCMs propose that SC recommend that the tropical tuna CMM working group use the information in this table as a starting point for the design of a package of measures to remove bigeye overfishing. The second is the information in Figures 9a and 9b of the working paper, which shows increases since 2010 in longline effort in the core area of the tropical longline fishery, and associated declines in bigeye CPUE. These trends are a serious concern to SIDS and territories, and SC needs to draw this information to the attention of the working group and the Commission, and include references in SC's advice to the need to control fishing effort in the tropical longline fisheries. These CCMs also requested that SPC provide more detailed data by flag State on these trends to the working group and the Commission.

403. Some CCMs noted that the paper, at several points, compares purse-seine effort to 2004 levels, which tends to give the misleading impression that CMM 2008-01 was meant to limit effort to 2004 levels, without being sufficiently clear about the exemption for domestic vessels and the provision for existing commitments to provide access to foreign fleets. These CCMs wanted to clarify certain points about the initial measure for tropical tunas, CMM 2008-01. First, the use of 2004 base year data in CMM 2008-01 was a stopgap decision taken initially in 2005 to address bigeye bycatches before the FAD closure was developed. Because it was a bigeye bycatch measure and not a skipjack measure, CMM 2008-01 allowed for purse-seine growth in two ways: i) It did not apply to the domestic fleets of SIDS, and allowed for SIDS and territories to develop their purse-seine fisheries for skipjack; and ii) At the request of the EU in 2005, it allowed for obligations for access that had been entered into in 2005 but not taken up at that time, provided these were documented in agreements registered with the Commission. The registered agreements included provision for future access for fleets from the EU, Korea, New Zealand and USA. Therefore, CMM 2005-01 and its successor, CMM 2008-01, allowed for growth in purse-seine fleets in these two ways. Second, now, CMM 2012-01 is different from the previous two CMMs: it is a skipjack measure as well as a bigeye measure, and includes an effort limit for PNA that is based on the 2010 effort level without the previous exemptions. These CCMs hoped this clarified that CMMs 2005-01 and 2008-01 did not limit purse-seine effort in PNA waters to 2004 levels, because in fact, they left scope for the growth for SIDS' domestic fleets and for SIDS and Territories to meet obligations for access by foreign fishing fleets that had already been entered into. These CCMs hoped that this is taken account in the next review of CMM 2008-01.

404. A request was made that SPC update the projections in Tables 3 and 4 of the working paper to include the 2001–2004 average or 2004 as the reference level. SPC noted that while this could be undertaken for an update of this paper for TCC it was not known if these results could be provided during SC9. The CCM requested that the update should also be made to the Tokyo Working Group meeting.

405. Some CCMs reiterated their concerns about the growth in longline effort in the tropics. These CCMs are very dependent on the southern albacore longline fishery. There is already a serious problem in

this fishery because of increasing effort, and these CCMs to whom this fishery is important are very concerned that the increasing effort in the tropical longline fishery will be transferred south as bigeye catch rates fall in tropical areas and bigeye catch limits are tightened. These CCMs strongly support including a reference to reducing effort and capacity in the WCPO longline fishery in SC's advice.

406. Some CCMs are increasingly concerned at the apparent growth in capacity and effort in the tropical longline fishery, in spite of the longline catch limits. Longline catches of bigeye are only 9% lower in the provisional data for 2012 than they were in 2008 and growing, and the 2012 catch is only 15% lower than the 2001–2004 average, which is far short of the 30% target. In addition, tropical longline effort appears to have increased by more than 30% since 2010. This is a clear signal that catch reductions do not actually reflect a reduction in fishing mortality, but in the availability of fish, and that tropical longline effort needs to be reduced and not shifted to other species or areas, particularly to the south. This supports the point raised that the advice from SC8 must focus on management measures being applied to all sectors of the fishery.

407. A request was made to keep this agenda item open until after the additional catch and effort data by fleet are made available to SC. The convener advised that this matter would be re-visited, conditional on the ability of SPC to respond to the data requests.

**Recommendations**

408. **SC9 recommended that the WCPFC Working Group on Tropical Tunas (to be held in Tokyo in late August 2013), TCC and the Commission note the following conclusions based on analyses presented in working paper SC8-MI-WP-01 when reviewing the effectiveness of past management measure CMM 2008-01 (and its extension under CMM 2011-01) and in consideration of any revision of CMM 2012-01.**

- **a) The limits placed on purse-seine operations have not adequately constrained total purse-seine effort with total effort (excluding domestic Indonesian and Philippines) in 2011 being a record high and estimated to be 10% higher compared with effort in 2010. Effort in 2012 was similar to 2011 and was 8% higher than in 2010.**
- **b) Stock assessment results indicate that the effectiveness of purse-seine effort has typically increased on top of the increase in total effort (i.e. effort creep is occurring).**
- **c) A comparison of effort between logsheet fishing days and sets and VMS sources also suggest that for some fleets there has been a change in how days are reported; specifically, days that would have previously been reported as days searching (which are counted as fishing days) are now reported as days in transit (which are considered as non-fishing days), which is inconsistent with effort reported in previous years.**
- **d) Reported activity related to the use of drifting FADs during the FAD closures was considerably lower in the period 2010–2012 (5.6%, 9.6% and 3.2%, respectively) compared with 2009 (19.2%). The observed incidence of vessels drifting at night with fish aggregation lights on increased from 2.4% in 2009 to 4.7% in 2010 but was 2.3% in 2011 and 1.2% in 2012.**
- **e) Despite the FAD closure, the total estimated number of FAD sets made in 2011 was a record high, largely due to the increased purse-seine effort overall, with a slight decline in 2012. Nevertheless, several fleets (notably Japan, Philippines, New Zealand) have substantially changed their fishing operations, focusing more on unassociated set fishing in 2010–2012 than they had in the past, while other fleets (e.g. Kiribati, Korea) show notable declines in the 2012 data available.**
- **f) Skipjack, yellowfin and total catches were slightly below average during the 2009 and 2010 closures. Sustained high total catches (particularly skipjack and bigeye) occurred between the 2010 and 2011 closures; however total (and skipjack) catches during the**

**2011 closure were almost half those seen during the previous closure months. Catches recovered somewhat following the 2011 closure, but did not reach the levels experienced earlier in that year, primarily due to continued relatively low skipjack catches. Catches of skipjack and overall catch levels recovered in 2012, and catches during the closure period were similar to those seen during 2009 and 2010 closures.**

**g) Bigeye tuna catches were significantly reduced during closure periods compared with other months of those years.**

**h) The total average bigeye longline catch for 2001–2004 was 83,923 mt. In recent years, total bigeye longline catch has increased slightly from 66,441 mt in 2010 to 67,557 mt in 2011, to 71,148 mt in 2012 (79%, 81% and 85% of the average catch for 2001–2004, respectively) while some CCMs achieved 30% reduction from the 2001–2004 level. However, in the core area of the tropical longline fishery (130$^{o}$E to 150$^{o}$W, 20$^{o}$N to 10$^{0}$S), the reduced catches have been paralleled by a decline in nominal CPUE (and a ~30% increase in longline effort from the low in 2010 to 2012). These declines in nominal CPUE require further investigation and SC10 will review analyses that provide standardized CPUE (relative abundance) estimates for bigeye tuna that remove effects due to: latitude, longitude, targeting (e.g. yellowfin, albacore), fleet and vessel.**

**i) For yellowfin tuna, the longline catch in 2001–2004 averaged 75,712 mt. In 2010 and 2011, catches were 75,582 mt and 75,393 mt, respectively, and fell below the 2001–2004 average level in 2012 to 65,582 mt.**

**j) Stock projections undertaken using the reference case models for the 2011 assessments for bigeye tuna and effort levels observed in the fishery in 2011 results in $F/F_{MSY}$ stabilizing around 1.29 in 2021. However, for the scenario best approximating the reported catch and effort in the fishery in 2010, $F/F_{MSY}$ declines and is at a projected level of 0.96 in 2021. This is driven by several factors: lower than usual FAD use in 2010, lower longline catches, and a large (30%) reduction in reported catches from the domestic fisheries of Indonesia and the Philippines. The difference between 2010 and 2011 fishery outcomes is mainly due to the return to higher levels of FAD-based purse-seine effort in 2011.**

**k) A series of projections, specifically for the bigeye tuna stock under a range of future of purse-seine-associated set effort and longline fishery bigeye catch level combinations, would be beneficial to identify the conditions in these fisheries that remove 50% and 100% of overfishing in bigeye tuna in the WCPO by 2018.**

**l) Use the information provided in Tables 3 and 4 of working paper SC9-MI-WP-01 to help design an appropriate package of measures to remove bigeye overfishing.**

409. **Based on the above observations and analyses, and noting that previous CMMs have failed to reduce the fishing mortality for bigeye to the level intended, SC9 supported the need for additional or alternative targeted measures to reduce the fishing mortality on bigeye. In this regard, SC9 reaffirms the recommendations made by SC8 (para. 351 of SC8 Summary Report) when considering revisions to the current CMM for bigeye, yellowfin and skipjack tuna stocks and recommended that the WCPFC Working Group on Tropical Tunas and the Commission take these into consideration.**

## AGENDA ITEM 6 – ECOSYSTEM AND BYCATCH MITIGATION THEME

### 6.1 Ecosystem effects of fishing

#### 6.1.1 Review of research and information

**Kobe III Bycatch Specialist Working Group**

410. S. Harley (SPC) presented SC9-EB-WP-04 (Progress on Kobe III Bycatch Technical Working Group), which describes progress on the Kobe III Bycatch Specialist Working Group.

**Discussion**

411. SC9 noted a call to support the bycatch mitigation information system (BMIS) through the harmonization of data collection across tuna RFMOs. It was noted that there is a lack of resources relating to a variety of bycatch taxa, including seabirds, and CCMs were encouraged to recognize the utility of harmonization and collaboration of resources.

**SEAPODYM**

412. SC9-EB-WP-03 (Project 62: SEAPODYM applications in WCPO), which describes a multi-agency collaboration that will improve knowledge on the influence of environmental drivers on tuna fisheries to reduce the uncertainty in short, medium and longer term projections of tuna catches. The project is developing and applying the SEAPODYM model to better forecast seasonal and decadal trends and the influence of this variability on tuna fisheries. The presentation outlined the three classes of optimisations that have been developed. The first allows decadal variability to be assessed at the ocean basin scale, the second allows fishery impacts and CMM evaluation, and the third simulations of the potential impacts of climate variability and change. The application of the optimisations have direct relevance for the WCPFC work programme, which should enhance national and international policy advice and technical support for sustainable tuna fisheries in the WCPO. The paper outlines a work plan for the next 12 months, which includes the full incorporation of the Pacific Tuna Tagging Programme data into relevant SEAPODYM optimizations.

**Discussion**

413. SC9 acknowledged SPC for the progress report on SEAPODYM as the information provides for better understanding of ecosystem effects of fishing. SC9 also noted the utility of ecosystem modeling and encouraged more work in this field, including assessment of climate variability.

414. Some CCMs noted that no update was provided on Project 46 (Ecosystem modeling) on western Pacific Ocean ecosystem indicator trends or the newly endorsed project on progressing adaptation to climate change variability and change in the WCPO tuna fisheries. These CCMs asked that updated papers on this ecosystem modeling work be made available at future meetings.

415. FFA members supported ongoing development of SEAPODYM and its application, as this allows improved understanding of the combined effects of fishing and non-fishing activities. They welcomed the utility of the model to investigate specific questions, including climate variability, range contraction issues, and application to Pacific tuna and billfish populations and fisheries.

416. SPC indicated that SEAPODYM is not able to provide insights into bigeye recruitment trends seen in the stock assessment at this stage due to the length of physical forcing currently required by the model, which limits the time frames available.

417. Some CCMs noted that understanding the impact of oceanography and climate change is useful for effective management of the South Pacific albacore fishery.

418. Some CCMs recognized the utility of a peer review of the model as it would also be useful in developing standards for SEAPODYM applications.

**Recommendations**

419. **SC9 recommended that:**

**a) WCPFC support BMIS by working to harmonize data collection across tuna RFMOs;**
**b) the Commission support the ongoing work and development of SEAPODYM;**
**c) members support the SEAPODYM work through the provision of fine-scale data; and**
**d) the Commission consider an external review of the SEAPODYM model.**

## 6.2 Sharks

### 6.2.1 Shark Research Plan

420. S. Harley (SPC) presented a summary (SC9-EB-WP-06) of the progress made against the Shark Research Plan (SRP). A progress report on the SRP, in particular the achievements since the last meeting of SC in August 2012.

421. At WCPFC9, the Commission made four significant decisions relating to sharks and the SRP:

- approving the extension of funding of the SRP for an additional three years;
- designating the whale shark as a key shark species;
- adopting a CMM for whale sharks; and
- approving co-financing for the Global Environment Facility project, Areas Beyond National Jurisdiction, which includes work on bycatch, including sharks.

422. The paper highlighted several important areas of progress that had been made under the SRP since SC8, including:

a) a stock assessment for blue shark in the North Pacific conducted through the ISC process;
b) development of potential catch and CPUE series for blue shark in the South Pacific (noting that SC9 should provide guidance on the sufficiency of these available datasets to conduct a full stock assessment for SC10);
c) analysis of potential mitigation options for silky and oceanic whitetip sharks for WCPFC9 and SC9;
d) a revised silky shark assessment, incorporating a broader range of data inputs;
e) an analysis of the spatial and temporal distribution of whale sharks in the WCPO; and
f) distribution of 400 shark identification guides to longline vessels operating from the ports of several SIDS.

423. The paper on the SRP provides a summary of each of the outcomes described above, and also includes:

a) estimates of coverage of shark catch (both aggregate and species-specific estimates) and effort data from logsheets, observer data, and aggregate catch and effort data;

b) a summary of coverage and shark condition data from SPC observer data holdings; and
c) an outline of anticipated work in 2013/2014 under the SRP and other potential activities for the consideration of SC9.

424. The following recommendations were made in this paper for the consideration of SC9:
a) that the stock assessment for blue shark in the South Pacific Ocean be conducted for SC10;
b) that SPC focus on the calculation of catch and CPUE series for mako shark in the South Pacific and then determine whether it progresses the assessment for SC10 based on feedback from the 2014 Pre-Assessment Workshop;
c) that SC9 consider the value of assigning SPC resources to stock assessments for shark populations in the Northern Hemisphere given the interest of ISC. When participating in such assessments SPC does not get access to the raw data used to generate model inputs; and SPC does not have sufficient resources to attend multiple ISC meetings, in particular meetings that finalize the assessments are typically held from mid- to late-July, which is around the SC paper submission deadline.
d) noting c) above, that SC9 determine the desired level of SPC involvement with other ISC members on a stock assessment for mako shark in the North Pacific. This could also include a recommendation on the form of the assessment (e.g. will it be an integrated age-structured model or production model);
e) that the stock assessments for the thresher shark complex be delayed, due to the low likelihood of success and the higher priority activities that are being undertaken;
f) that WCPFC members provide available observer, research and training data that have not been previously provided to SPC or WCPFC to support the SRP assessment work, and/or provide cost-effective means for collaborative research efforts; and
g) consider the following additional pieces of work related to the objectives of the SRP, noting that additional funding may be required in some instances:
    i. a desktop review of relevant policy and legal documents that would inform the consideration of TRPs and LRPs for shark species taken predominantly as bycatch;
    ii. conducting a standardized CPUE analysis for whale sharks using observer data from the tropical purse-seine fishery;
    iii. indicator analyses for key shark species for which assessments are not undertaken;
    iv. application of "key shark species" criteria to existing species on the list (for priority setting) and to other sharks and rays taken in WCPO tuna fisheries;
    v. contributing to a stock assessment for porbeagle shark with Commission for the Conservation of Southern Bluefin Tuna (if this proceeds);
    vi. updating and enhancing the shark tagging database STAGIS (shark tagging information system);
    vii. expanding the distribution of shark identification (ID) guides to other longline fleets;
    viii. developing a shark ID poster that could be distributed to longline vessels as this could have a greater impact than ID guides;
    ix. developing an ID guide to allow the identification of sharks in various processed states;
    x. conducting biological studies to reduce uncertainty in important life history parameters of key shark species;
    xi. conducting electronic tagging studies to estimate post-release mortality for key shark species; and
    xii. undertaking a review of the SRP for the development of a revised plan.

**Discussion**

425. FFA members supported the recommendations above, and noted the importance of continuing the research on shark bycatch mitigation, and data collection requirements for most shark species.

426. FFA members highlighted the urgent need for undertaking a desktop review, as above, to provide guidance for developing reference points for all targeted shark species

### 6.2.2 Review of CMM for sharks

427. M. Hutchinson (ISSF) presented document SC9-EB-WP-12 (Fishery interactions and post-release survival rates of silky sharks caught in purse-seine fishing gear). The study estimated the mortality of juvenile silky sharks at different stages of the capture and loading process during FAD sets by a commercial tuna purse seine vessel, through the use of a combination of blood chemistry analysis and pop-up satellite archival transmitting tags, during the ISSF Bycatch Project cruise in 2012.

a) Animals were sampled during every stage of the fishing operations, including animals that were captured while they were still free swimming inside the net, and on FADs that were not encircled by the purse seine to identify the point in the fishing operations when sharks sustain injuries that result in death.
b) The assessment results indicate that lactate is the best predictor of mortality, and that survival is compromised once the silky sharks have been confined in "the sack" towards the end of the net haul.
c) Blood chemistry analysis revealed total mortality of silky sharks captured in purse-seine gear exceeds 84%.
d) ISSF scientists found that post-release survival estimates can be predicted by the stage of the fishing operation in which the animals are landed, and by the condition in which they are released. It was observed that mortality rates are not explained by the size of the catch due to silky shark behavior in the net at the end of the net hauling process.
e) Satellite tag data revealed that juvenile silky sharks occupy the upper 100 m of the water column in the mixed layer, thereby remaining within the vertical range of the average purse-seine net of 150–200 m.
f) Additionally, a comparison of shark catches recorded by the vessel and observers were significantly lower than the numbers recorded by the scientific crew.
g) This silky shark catch analysis revealed a high overall total mortality rate of 84.3% under current fishing practices. Post-release survival was dependent on which stage in the fishing process the shark was landed.
h) The study also highlighted that simply encircling the animals in a purse seine does not cause mortality. The results indicate that early release (of entangled sharks, or through an escape panel) could significantly reduce the impact FAD-based, purse-seine fishing has on silky shark populations. This is particularly true because all of the sharks encountered during this cruise were juveniles and a demographic study conducted by IATTC showed that juvenile survival (age-0–5) had the greatest impact on silky shark population growth (Marlon Roman Verdesoto, IATTC, pers. comm.).
i) The study documented a significant difference in the estimates made by vessel crew, and the observer and the scientific party, of the number of sharks captured in the fishing operation. It was suggested that these discrepancies could be factored into future assessments of silky shark populations across the region.

**Discussion**

428. In response to a question on the appropriate time for assessing fishing-related mortality, the presenter indicated that mortality within 10 days of the fishing event is assumed to be fishing related. Mortality is assumed if the fish sank.

429. SC9 noted the inability of fishers and observers to accurately assess shark bycatch in the purse-seine fishery. The presenter pointed out that this was because observers have a heavy workload and the speed at which brails are loaded makes it difficult for them to see all specimens. It was further noted that an additional observer on board would be helpful in order to spread workload and allow better estimates of shark bycatch; an alternative could be e-monitoring if cameras were strategically placed.

430. On the question of the survival of free-swimming individuals, the presenter explained that all of the free-swimming sharks that were released subsequently survived but most sharks in the brail died.

431. The meeting also noted that lactate levels that result in mortality were species-specific and that the tags were set to pop off after 10 days to avoid tag induced mortality for fish with prolonged tag deployments.

432. FFA members supported the need for research of this type, including ways to improve estimates of the number of sharks caught.

**a. CMM 2010-07 (CMM for sharks)**

433. S. Clarke (USA) presented a paper examining three existing WCPFC shark measures in terms of their implementation and effectiveness (SC9-EB-WP-08: Towards an integrated shark conservation and management measure for the western and central Pacific Ocean).

434. Current implementation of CMM requirements appears to be at best ~60%, and in several cases considerably lower. This is partially due to ambiguities in interpreting CMMs. Only limited effectiveness can be confirmed, in part because of extremely low regional observer programme coverage (<2%) in the longline fishery, which catches over 10 times as many of the key shark species as the purse-seine fishery does. It appears that the Commission's finning controls provide only a negligible benefit to shark survival. Lack of consistent recording of shark discards and releases will similarly impede a future assessment of the effectiveness of the oceanic whitetip and whale shark measures. It was therefore concluded that although WCPO shark stock assessments have demonstrated the need for shark mortality reductions, these are not yet being delivered by WCPFC CMMs. By using shark fishing mortality as a single "currency", common ground between WCPFC and a variety of national measures can be found and used to avoid decision-making stalemates arising from one-size-fits-all gear modification proposals. An approach similar to that used for tropical tunas was proposed, whereby a fishing mortality management goal is set based on assessment results, and a package of mitigation measures designed to reach the goal is negotiated and implemented on an interim basis.

**Discussion**

435. Some CCMs acknowledged that CMM 2010-07 has limited effectiveness due to unclear definitions of key components, and recognized that the definitions of the form of the fins and the form of the carcass should be clearly specified. CMM 2010-07 was originally endorsed to allow for the industry to retain shark fins and for inspectors to check the corresponding number of shark carcasses onboard, and is based on a 5% fin-to-body ratio.

436. Some CMMs noted that without clear definitions of the form of the fins (i.e. whether frozen or dried), and the form of the body (such as whole weight, dressed or partially dressed carcass), compliance standards would be unenforceable.

437. Some CCMs also noted that the most recent work undertaken by SPC has shown that measures such as restrictions on the targeting of sharks, and bans on the use of shark lines and shark bait, are

effective in reducing shark bycatch. In addition to previously addressed studies, preliminary work (WCPFC9-2012-IP-14) suggests that the removal of wire traces would result in a 50% reduction silky shark catches by longline vessels.

438. Some CCMs discussed substantial amendments to this CMM for consideration at WCPFC10, based on the examination of technical mitigation measures to reduce shark capture. They reiterated the widely-expressed views that more comprehensive arrangements that reduce fishing mortalities to all shark species are preferable to species-specific mitigation measures.

439. Given the current growing public concern over global shark overexploitation, most CCMs consider that there is a need for WCPFC to adopt more robust and enforceable measures for sharks to reduce mortality in both the longline and purse-seine fisheries.

440. One CCM noted that rather than bringing sharks on board, it was better to cut sharks off the hook to reduce mortality although the CCM recognized that this makes it more difficult to accurately identify species.

441. SC9 requested guidance on how to effectively release live sharks and clarification on definitions of release and discards. It was stressed that CMMs need to be based on stock assessments and focus on shark species with sustainability concerns.

442. SPC clarified that the expanded regional longline logsheet (available in several languages) enables entry of information on retained and discarded key shark species, and therefore encouraged all CCMs to use the logsheets.

443. One CCM noted that its country has a "fins attached" policy and uses wire traces on the longline snood to target oilfish, and believed that a ban on wire traces would threaten that fishery.

444. Another CCM noted that the shark CMMs were all relatively new and it would take time to detect a management response from stocks. Members noted that shark identification and handling guidelines would be useful. SPC referred CCMs to the shark identification guide, and noted that 400 guides have been distributed to the fleets of SIDS.

445. China stated that it has prepared key shark species posters for its longline vessels, and this makes it easy for Chinese fishers to identify shark species.

446. A representative of the Convention on Migratory Species encouraged collaboration on shark bycatch mitigation through the global memorandum of understanding for sharks, currently under development by the Convention on Migratory Species.

**b. CMM 2011-04 (CMM for oceanic whitetip shark)**

447. J. Rice (SPC) presented SC9-EB-WP-02 (Analyses of the potential influence of four gear factors [leader type, hook type, "shark" lines and bait type] on shark catch rates in WCPO tuna longline fisheries). Excerpts from the Executive Summary of this paper are provided below as are several figures and tables regarding the results.:

a) In reviewing the stock assessments conducted in 2012 for silky and oceanic whitetip sharks, SC8 noted i) concerns over the status of the stocks, and ii) the large impact that non-target longline fisheries are estimated to have. For these reasons, SC8 recommended consideration of mitigation measures as providing the best opportunity to improve their stock status.

b) A number of factors related to longline fishing methods, such as leader type, hook type, shark lines and bait (among others) may influence shark catch rates and offer potential for developing mitigation options. This paper represents an extension of work presented in a preliminary analysis of wire trace effects on oceanic whitetip and silky shark provided to WCPFC9 in 2012. The key differences are that this paper reviews regional observer data and determines if there is sufficient homogeneity and contrast throughout fishery, area and time strata in the key factors of interest to support integrated regional level analysis of leader, hook, shark line and bait effects. It also identifies strata within the observer database where data are relatively more concentrated and contain relatively high contrast (heterogeneity) in one or more of these factors through time and space. Finally, it describes subregional models to assess the relative effect of wire trace, hook type, shark lines and bait categories (along with other environmental and fishing method) factors on catches of oceanic whitetip and silky sharks in fisheries within the WCPO.

c) Key findings include the following.
   - A significant relationship between shark line use and increased catch of both shark species was identified in the tuna fisheries of the Marshall Islands, FSM and Fiji.
   - A wire trace was also estimated to have a positive relationship with silky shark catches in Fiji's fishery, but not in the fisheries of Hawaii or the Marshall Islands.
   - Shark bait was not, on its own, estimated to be related to shark catches (although it is uncertain to what degree it may be confounded in models with shark line use).
   - Hook type (interacting with leader type) was assessed in the Hawaii-based fishery but no substantial difference in effects on catch of either shark species was estimated. However, model diagnostics were particularly poor for this fishery, and there is uncertainty over whether some sets in fact constituted "mixed" hook-type sets; further work on the models may be required.

d) This information may, in combination with information on shark condition (see working paper SC9-EB-WP-06) and wire trace usage (WCPFC9-2012-IP-14) assist with the development of models to predict changes in oceanic whitetip and silky shark catch and mortality levels under different potential mitigation scenarios. To address some specific issues that involve interactions between factors, higher levels of observer coverage plus heterogeneity in fleet practices will be necessary, otherwise it might be necessary to undertake specific experiments. Discontinuing the use of shark lines would reduce the catch rate of silky and oceanic whitetip sharks.

**Discussion**

448. SC9 acknowledged that the lack of data hindered the analysis of shark species.

449. CCMs sought clarification on whether it would be possible to gauge which fleets require more observer data to achieve a more comprehensive outcome from this research. The presenter indicated that overall information from all fleets would be helpful, but increased coverage in the main tuna longline fleets in the tropics would be particularly helpful, and that increased logbook reporting by species should be encouraged.

450. One CCM noted that a properly designed experiment would be the best way to assess the impacts of various measures. The presenter agreed with this but noted that a properly designed mitigation experiment would be expensive and logistically difficult.

451. One CCM noted that it would like to see reductions in fishing mortality quantified by SC for silky and oceanic whitetip sharks, and would like SC to make recommendations on how these reductions can be achieved.

452. SC9 noted that this analysis did not include data on shark lines in the time series used, but noted that the removal of a shark line would be an immediate and effective way to reduce the mortality of silky and oceanic whitetip sharks. Most CCMs reiterated their view that this research showed the value that a comprehensive CMM on shark bycatch mitigation would have for reducing catches of overexploited and vulnerable shark species.

**c. CMM 2012-04 (Protection of whale sharks from purse-seine fishing)**

453. S Harley (SPC) presented working paper SC9-EB-WP-01 (Spatial and temporal distribution of whale sharks in the western and central Pacific Ocean based on observer data and other data sources) on the preliminary study to establish the spatial and temporal distribution of whale sharks across the WCPO using observer data and related data sources.

454. The study estimated a decline in the occurrence of whale shark interactions from free-school sets of around half over the past 10 years. It is not clear if this reflects an increase in identifying whale sharks before the set is made (i.e. more are reported as whale shark sets), a real decline in the abundance of whale sharks, biases in the available data prior to 2010, or simply a result of some other factors that would warrant the inclusion in a standardized analysis of these data. Given the nature of this trend it is strongly recommended that WCPFC consider a standardized analysis of whale shark records to determine if this may reflect a trend in abundance.

455. It was observed that the areas with the highest numbers of whale shark records were generally the areas of highest observed fishing effort; the occurrence rate was high in only a few small areas. Therefore, it is not known if whale sharks are generally quite uniformly distributed across the western equatorial Pacific Ocean, or if instead, whale sharks are aggregated in the areas of highest fishing effort. The question is likely to be critical to any further directed management of purse-seine and whale shark interactions, and electronic tagging offers the best way to determine the distribution of whale sharks independent to the fishery.

456. The paper highlighted the need for further work on this research on the spatial and temporal distribution of whale sharks. The paper also examined the possibility of establishing an index of abundance, and suggested that if future work is undertaken, WCPFC should consider the following.

- Detailed statistical modeling of whale shark records from the tropical purse-seine fishery using environmental data as a predictor (after Sequeira et al. 2012). Such an analysis could lead to the development of some form of relative index of abundance.
- Incorporating any records from other purse-seine datasets not currently available to SPC or WCPFC (e.g. from the Japanese coastal fisheries).
- Electronic tagging of whale sharks to determine the nature and extent of movement within the WCPO.
- Observers obtaining more representative size data of these animals.

**Discussion**

457. One CCM noted that it prohibited the catch of whale sharks.

458. It was acknowledged that this work could lead to the development of a juvenile index of abundance for whale sharks using free-school set data. CCMs were encouraged to provide any records

from purse-seine or other datasets not currently available to SPC or WCPFC to progress this work. Electronic tagging of whale sharks to determine the nature and extent of whale shark movement within the WCPO was also encouraged.

459. SPC noted it was not aware of any data on successive purse-seine sets on individual sharks.

460. PNA members noted that they were pleased with the whale shark CMM, and applauded Chinese Taipei's ban on whale sharks catches. PNA members expressed their continued support of the SRP, and requested that particular priority be placed on whale sharks.

**d. Guidelines for the safe release of encircled animals**

461. An informal small group (ISG-2) met in the margins of SC9 to consider the issue of draft guidelines for the safe release of encircled animals, including whale sharks. Guidelines were further discussed, and are included as Attachment H. This draft will be forwarded to TCC9 for further consideration.

### 6.2.3 International cooperation on shark issues

462. The ISC chair briefed SC9 on the activities of ISC SHARKWG.

463. SC9 noted that an important part of the SRP is the collaboration with other agencies to maximize the efficiency of the resources available for shark mitigation research and stock assessments. Four main collaborations have been established from 2011 to 2013, which included ISC, IATTC, CSIRO, and the US National Marine Fisheries Service.

464. As a member of ISC, SPC has attempted to participate in meetings of the ISC SHARKWG, only when funding, resources and WCPFC commitment allows. During the discussion it was noted that due to the recent inclusion of another five shark species into CITES Appendix II, SC9 should consider the listing implication, especially as this would be pertinent for future scientific activities of the Commission.

**Recommendations**

465. **SC9 recommended the following.**

- **a) The Commission develop reference points for key shark species.**
- **b) The development of safe release guidelines to maximize shark survival for species of concern, such as for oceanic whitetip and silky sharks for longline and purse-seine fisheries. Draft guidelines for whale sharks in the purse-seine fishery should be updated in light of any new information.**
- **c) CCMs be reminded that it is a requirement (CMM 2010-07) to report retained and discarded[5] shark catches by key shark species. CCMs are encouraged to implement a consistent logsheet to estimate retained and discarded key shark species. SC recommended that this item be prioritized by TCC.**
- **d) The development of an integrated and comprehensive shark CMM to reduce the catch of overexploited shark species.**
- **e) The Commission consider measures directed at bycatch mitigation as well as measures for targeted shark catch (such as shark lines), if it wishes to reduce mortality on overfished sharks (e.g. silky and oceanic whitetip).**

[5] Discards include live and dead releases.

## 6.3 Seabirds

### Seabird bycatch

466. W. Papworth (ACAP) presented two papers.

a) SC9- EB-WP-05 (Progress on the development of a seabird identification guide)

At the first meeting of the Joint Tuna RFMO Technical Working Group on Bycatch in July 2011, ACAP offered to develop a standardized seabird identification guide to assist with the harmonization of data collection across RFMOs. ACAP has been working with the Japanese National Research Institute of Far Seas Fisheries to produce a draft photo identification guide for seabird bycatch for use by observers at sea. The draft guide primarily uses head and bill characteristics and includes photos of dead seabirds caught as bycatch in longline fisheries to facilitate fast and accurate identification.

b) SC9- EB-WP-09 (Electronic monitoring of seabird bycatch)

This paper outlined the potential benefits of e-monitoring in meeting the requirements of para. 8 of CMM 2012-07, which requires the IWG-ROP to take into account the need to obtain detailed information on seabird interactions to allow analysis of the effects of fisheries on seabirds and evaluation of the effectiveness of bycatch mitigation measures. Electronic monitoring is the use of fixed cameras on fishing vessels to record data on fishing activity, linked to other data on fishing operations that is collected electronically and stored on a computer hard drive on the vessel for later analysis.

### Discussion

467. SC9 noted that the use of pictures in the identification guide was a useful approach. It was further noted that the proposal to include a guide to collect genetic samples would assist in distinguishing albatross species and sub-populations.

468. SC9 noted the benefits of electronic monitoring, but also the technological challenges. One CCM suggested that electronic monitoring could be used for compliance. Further development of software is required to enable the system to be able to distinguish seabird at the species level.

469. It was reported that Australia is introducing 100% electronic monitoring in their longline fishery. It was noted that electronic monitoring is used in addition to at-sea observers, not as a replacement for them.

*SC9-EB-WP-14 (Overlap between WCPFC longline fishing effort and albatross distribution in the North Pacific)*

470. K. Baird (Birdlife International) presented SC9-EB-WP-14, and the summary follows.

a) The purpose of the study was to investigate the areas used by the three species of albatross that occur in the North Pacific, and how this overlaps with longline fishing effort, as few bycatch data are being reported.
b) Three species of albatrosses — short-tailed albatross (*Phoebastria albatrus*), Laysan albatross (*Phoebastria immutabilis*) and black-footed albatross (*Phoebastria nigripes*) — occur in the North Pacific. Remote tracking data from BirdLife International's tracking database are available for all three species although not for all colonies or breeding states. Using longline

fishing data available on WCPFC's website calculated as the average number of hooks set per 5 x 5 degree grid square per quarter year, this paper estimated spatial and temporal overlap between the distribution of the North Pacific albatrosses and longline fishing effort.

c) The analysis shows high overlap between the three albatross species, with fishing effort in the North Pacific with black-footed albatross overlap being the highest. For Laysan and black-footed albatrosses, overlap is mostly in the high seas area. Given high overlap between these North Pacific albatrosses and fishing effort, consideration should be given to the scarcity of data available on bycatch rates in the North Pacific and to the current exemption provided to small vessels.

**Discussion**

471. FFA members noted the importance of collecting quality data that will help to better understand the fisheries that FFA is required to manage. Data collection that improves understanding of these fisheries as a whole is more useful than species-specific efforts. FFA members believe that data collection should focus on accurately collecting gear attributes (fishing and mitigation) and the associated catch data that can then be linked back to which gear catches target species and which gear attributes do not catch bycatch species, including unwanted teleosts, sharks, sea turtles and seabirds. This type of information will allow more robust analyses in the future and provide a clearer direction when considering mitigation analyses.

472. Chinese Taipei noted that its small vessels operate west of 150$^{o}$E and it is assumed that they do not interact with albatrosses within its EEZ.

473. FFA members thanked ACAP and others for the updated papers on seabird mitigations. These papers provided useful additional information and recommendations to further improving seabird mitigation

474. FFA members noted at least three main mitigation measures in the current seabird CMM: weighted branch lines, night setting, and tori lines. They continue to hold the view in support of a combination of these three measures as the most appropriate seabird mitigation measures to be applied in high-risk areas. Equally, FFA members encourage consideration of other factors such as safety, practicality, fishery characteristics, and the use of safe mitigation techniques.

475. FFA members welcome suggestions for improving mitigation measures expressed in the papers, and supported further development and spatial trialing of these suggestions and findings to be considered in future meetings. FFA members are particularly interested in exploring further the need, with practical implications if any, for better data attributes and additional data fields associated with different gear types.

476. The importance of collecting quality data to better understand fishery impacts on seabirds was emphasized when assessing the efficacy of mitigation measures currently in use.

477. Samoa supported the views expressed by other FFA members, and the delegation underscores the importance of collecting quality data to better understand fishery impacts on seabirds, and assessing the efficacy of the mitigation measures currently in use. Samoa is particularly pleased to see that work on the seabird identification guide has advanced, and noted that the pocket and photo identification guides would be very helpful to observers. Samoa also supported the promotion of electronic monitoring, recognizing cost factor and possible need for further trials and a cost–benefit analysis.

*SC9-EB-WP-11 (At-sea experiment to evaluate the effectiveness of multiple mitigation measures on pelagic longline operation in western north Pacific)*

478. D. Ochi (Japan) presented SC9-EB-WP-11, which is summarized below.

a) Japan presented the results of an experiment to evaluate tori lines, weighted branchlines and a combination of both on chartered longline vessels in the western North Pacific. The experiment confirmed that both the sole use of tori lines and a combination of toriline and weighted branchline were effective in reducing attack by, and bycatch of, albatrosses and that the use of weighted branchlines was also effective although the effect was less than that of tori line.

b) Regarding the issue of entanglement of branchlines and the catch rate of target fish, the presenter suggested that it is not necessary to deploy a combination of tori lines and weighted branchlines from pelagic longline vessels in the North Pacific.

**Discussion**

479. One CCM remarked that the results of SC9-EB-WP-11 suggest that a single seabird mitigation measure may suffice in mitigating the mortality of seabirds. Some CCMs noted that bycatch rates were very high for albatrosses during the experimental period and questioned if this is how a usual commercial vessel would fish.

480. SC9 noted that in the conclusion of SC9-EB-WP-11, the use of a tori line and weighted branchline results in lower bycatch rates. The presenter explained that this experimental voyage was designed to assess the difference between seabird bycatch mitigation methods, and was focused in an area where seabirds were abundant, but far from the main fishing grounds of commercial tuna longline fisheries. Therefore, the results could not be extrapolated to any commercial fleet.

481. Some CCMs noted that this experiment was undertaken in the areas north of 23°N and that the seabird CMM does not apply to vessels less than 24 m. Given the results of this work, it was not clear what the scientific evidence exists to support this exemption. Noting that nearly 60% of vessels north of 24°N are less than 24 m, it was requested that Northern Hemisphere members share their data on how seabird interaction rates change with vessel size. The work highlights a potential gap in the protection of albatrosses and other seabirds in the North Pacific.

482. One CCM noted that this work demonstrates the strong need for a uniform approach to seabird mitigation both north of 23°N and south of 30°S, rather than exemptions for different areas.

483. Some CCMs noted that as per the current CMM, mitigation measures are not limited to a single strategy due to the diversity of fleet and seabird assemblages and that the use of multiple measures used in combination are likely to be the most effective. One CCM noted that in the areas north of 23°N, the CMM does not seem to apply to vessels less than 24 m. It is unclear as to why this exemption is in place and it is requested that Northern Hemisphere members share their information on interaction rates.

**Implications of the North Pacific small vessel exemption on seabird interaction rates**

484. An informal small group (ISG-6 on seabird mortality) was convened in the margins of SC9 to examine the following three issues:

- the implications of the North Pacific small vessel exemption on seabird interaction rates;
- new information from CCMs' research or any monitoring programmes on seabirds; and

- review and use of information provided by CCMs in Part 1 of their Annual Reports on interactions to estimate seabird mortality in all fisheries in the WCPFC area.

485. CMM 2012-07 requires the use of at least two mitigation methods for all vessels fishing south of 30°S and for vessels ≥ 24 m in length for vessels fishing north of 23°N. Three CCMs — Japan, Chinese Taipei, and the USA — were identified as the main CCMs with longline vessels fishing north of 23°N. Information provided from these CCMs and the WCPFC record of fishing vessels was used to examine the number of vessels to which the small vessel exemption covered.

**Table NPV1:** Vessels less than 24 m and equal to and greater than 24 m in length.

| CCM | No. of vessels < 24 m | No. of vessels ≥ 24 m | Total no. of vessels |
|---|---|---|---|
| Japan | 305* | 323* | 628* |
| Chinese Taipei | 324 | 179 | 503 |
| USA | 98 | 30 | 128 |

* These numbers were derived from the WCPFC Record of Fishing Vessels.

486. Table NPV1 shows that longline vessels less than 24 m in length account for approximately 58% of total longline vessels fishing in the WCPFC area north of 23°N.

487. Information was unavailable on the difference between seabird interaction rates of vessels less than 24 m and vessels equal to and greater than 24 m. The USA noted that it requires its longline vessels to use mitigation methods regardless of vessel size, and the smallest vessel in its fleet fishing in the North Pacific was approximately 16 m in length.

488. Based on information on vessel number and size for longline vessels operating in the North Pacific, the ISG found that the small vessel exemption applies to over half the vessels operating north of 23°N.

**Recommendations**

489. **SC9 recommended the following.**

a) **In order to address the impacts of vessels less than 24 m that are fishing in the North Pacific (north of 23°N) without seabird mitigation, seabird bycatch rates for vessels less than 24 m, and equal to or greater than 24 m fishing with longline gear need to be investigated. The investigation is required due to the high overlap between the longline fishery in the North Pacific (north of 23°N) and North Pacific albatrosses, and the paucity of bycatch data; and that nearly 60% of longline vessels in the North Pacific are less than 24 m in length.**
b) **ACAP forward the seabird identification guide to the WCPFC Secretariat for circulation to all relevant national and regional observer programmes for their advice and input.**
c) **A pilot project assessing the utility of electronic monitoring be undertaken in the WCPFC longline fishery.**

### 6.5 Sea turtles

490. No papers were tabled on sea turtles and there was no discussion.

### 6.5 Other species and issues

*SC9-EB-WP-10 (Physical and psychological deterrence strategies to mitigate odontocete bycatch and depredation in pelagic longline fisheries:* Progress report)

491. D. Hamer (Australian Marine Mammal Centre) presented SC9-EB-WP-10 on mitigating depredation by, and bycatch of, toothed whales on longline fisheries in the South Pacific. The aim was to: i) develop two devices that physically or psychologically deterred depredating whales by simulating gear tangles (several fisher reports indicate these are avoided), and ii) assess their effectiveness under rigorous experimental conditions in an operational environment.

a) Many of the outcomes of this study were positive and provided encouragement for ongoing research, although further funding is required. Some companies have expressed a desire to implement the gear in a commercialized context, suggesting that elements of refinement and costing need to be explored and resolved before large-scale manufacture would be possible.
b) The final report for this project should become available on the Australian Antarctic Division website towards the end of 2013, with at least two publications following soon after in peer reviewed journals.

**Discussion**

492. One CCM noted that in the mid-1970s, a Japanese paper showed a range of losses through depredation of 5–15%. The presenter indicated that while publication on this issue had increased over time, a global review of depredation was not able to determine if depredation rates have increased. The presenter noted that the issue was also a concern within the fishing industry.

493. SC9 noted that a cost–benefit analysis is planned by project coordinators that will assist vessels in making decisions regarding future use of the devices.

*SC9-EB-WP-13 (Depth distribution for both target species and bycatches of longline fisheries in Solomon Islands: A case study based on an observation programme)*

494. W. Zhenhua presented SC9-EB-WP-13; a summary follows.

a) The work was undertaken to understand the depth distribution of longline fishing gear and pelagic fishes.
b) Time-depth recorders were deployed during a longline observer trip from 24 July to 20 November 2012 in the waters of eastern Solomon Islands (06°50'–18°00'S, 160°48'–173°08'E). The hook number for the most commonly captured species was recorded and their distribution was analyzed. Change in depth for longline gear was also recorded. The information in this report improves an understanding of longline sinking and vertical distribution of pelagic species in this area.

**Discussion**

495. CCMs encouraged China to continue this work as they have many vessels in the fishery.

496. The presenter elaborated that 71 sharks belonging to 6 species were recorded by observers (silky, oceanic whitetip, tiger, blue shark, thresher and mako), and some shark species are landed depending upon the conservation status of the shark.

### 6.5.1 FAD bycatch and mitigation

*SC9-EB-WP-07 (Summary of research activities and results of the International Seafood Sustainability Foundation's second bycatch project cruise WCPO-2 in the Western and Central Pacific Ocean)*

497. J. Muir (ISSF) presented a summary (SC9-EB-WP-07) of the second WCPO research cruise conducted on a US purse-seine vessel as part of the ISSF bycatch project that facilitates industry collaboration in the development and scientific testing of technical options to minimize undesirable catch in tuna fisheries

a) Observations of sharks and other species in the net were made on most sets to determine whether the spatial distribution of these animals was consistent with the previous cruise.
b) Overall, there was a lower occurrence of silky sharks observed and caught (average of 2.3 sharks/set) as compared with the 2012 cruise (average of 10.7 sharks/set). Silky sharks were not observed consistently in the vicinity of the original 2012 release panel location, but due to the relatively low numbers of sharks observed per set, it is hard to draw conclusions based on these observations. There were several ancillary projects, including data collection on net depth and FAD design, and genetic, isotope, and oral bacteria sampling on some or all of the following species: skipjack, yellowfin and bigeye tunas, and silky shark, oceanic triggerfish, and rainbow runner.
c) Further testing of the release panel mechanism is planned on future ISSF cruises, perhaps in more western regions of the WCPO, and/or in the Atlantic and Indian oceans. Further exploration of bigeye mitigation techniques is also planned by ISSF.

**Discussion**

498. A CCM suggested that because of an observer's workload in addition to larger sets, the observer may not be able to observe all sharks to species level. The presenter confirmed that the discrepancy between the number of sharks seen by the observer and the scientists occurred with bigger sets. The CCM, therefore, recommended that this should be investigated using the data from all ISSF research cruises, and a retrospective correction factor based on set size could be applied to shark estimates.

499. SC9 was informed that future ISSF research will focus on i) reducing the catch of small bigeye tuna in associated sets; ii) tagging and tracking large animals that are released in order to estimate their fate; and iii) avoidance of exposing sharks to the brailing process given the very low post-release survival after brailing.

500. SC9 also noted that while there continue to be gaps in the understanding of bycatch in purse-seine operations, there is currently sufficient knowledge to adopt certain mitigation practices. These include avoiding some non-target species, selective removal from the net, avoiding the brailing of sharks, using electronic tags to verify post-release survival for other species, and developing practices that maximize condition at release. Future work should include feedback from the industry about the practicality of these practices.

501. A CCM asked for clarification about the variables used to measure the condition of skipjack tuna in free schools and in associated sets. The presenter explained that these are simple indicators of health of an organism, often used in humans and other animals, and that preliminary analyses of the condition data collected during the cruise does not support the so-called "ecological trap hypothesis".

**Recommendations**

502. **SC9 supports the research objectives of the ISSF bycatch research cruises, and encourages further work by ISSF and all CCMs to develop and test purse-seine mitigation. Priority should be given to work that investigates: i) mitigation of small bigeye and yellowfin tunas; ii) avoidance or selective release of bycatch species from the net to maximize the chances of survival of released animals; and iii) investigations that scientifically verify the post-release condition of bycatch species using pop-up archival tags and other technology.**

### 6.5.2 Food security issues with bycatch

503. SPC's Oceanic Fisheries Programme tabled information paper SC9-EB-IP-02 (Estimation of catches and condition of edible bycatch species taken in the equatorial purse-seine fishery) but there was no discussion on this agenda item.

## AGENDA ITEM 7 — OTHER RESEARCH PROJECTS

### 7.1 West Pacific East Asia Oceanic Fisheries Management Project

504. The Secretariat noted that convening the WPEA OFM Project Steering Committee is not required this year because the project was completed in March 2013. Furthermore, it was impossible to convene the meeting without the delegations from Indonesia and Vietnam, which were absent from SC9.

505. The Secretariat presented a progress report and future work plan of the WPEA Project. The second phase of the WPEA Project, called "Sustainable Management of Highly Migratory Fish Stocks in the West Pacific and East Asian Seas", has been prepared by the Secretariat in collaboration with the United Nations Development Programme, and there is positive progress. Core activities such as data collection from port sampling and catch estimates workshop will continue in Indonesia, Philippines and Vietnam until the new project commences.

### 7.2. Pacific Tuna Tagging Project

506. T. Usu (PNG) gave a brief report on the seventh meeting of the Pacific Tuna Tagging Project Steering Committee, which was held on Saturday, 10 August 2013 in the margins of SC9. The Steering Committee report is contained in paper SC9-RP-PTTP-02.

## AGENDA ITEM 8 — COOPERATION WITH OTHER ORGANIZATIONS

507. SC9 noted information paper SC9-GN-IP-01. The Chair invited SEAFDEC's Secretary General to introduce the work of SEAFDEC and its intention to cooperation with WCPFC. SEAFDEC's statement is in Attachment I.

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

508. The Assistant Science Manager, T. Beeching, who administers the Japan Trust Fund (JTF), took the opportunity to welcome Y. Akatsuka as the new JTF coordinator, replacing S. Nakatsuka, and went on to detail the composition of the steering committee, including the nomination of K. Sisior (Palau) as the island representative. Approximately USD 400,000 was available this year, which fully funded five projects and supplemented the funding of a sixth in 2013. These projects were presented along with three others carried over from earlier funding periods. He explained how JTF Steering Committee provides a

forum to assist and offer advice where there are problems with project delivery. After comments from the floor, he closed by urging participants to be ready for the call for next year's funding, which would likely have a closing date of 31 December.

509. On behalf of FFA members, Cook Islands thanked Japan for its generosity in relation to the JTF, which has enabled developing coastal States such as FFA SIDS to enhance their capacity building related to fisheries statistical data collection, regulations and enforcement. Cook Islands also acknowledged contributions made by CCMs that have contributed to the Special Requirement Fund (SRF), which has also enabled some FFA SIDS to implement projects that were funded under this scheme. They also encouraged those CCMs that have yet to contribute to the Commission's SRF to comply with their obligations as stipulated in Article 30 of the Convention to support SIDS and territories to implement activities in the following key areas:

a) Scientific research and improved technological capacity in countries that would contribute to the implementation of national priorities;
b) Increased and efficient human resources to help building capacity in countries, in both technical (including science; monitoring, control and surveillance; management; policy; and legal fields) and administrative roles;
c) The development of new initiatives based on best practice; and
d) Improved and expanded collection and analysis of data in countries, as well as additional monitoring and evaluation strategies.

## AGENDA ITEM 10 — FUTURE WORK PROGRAMME AND BUDGET

### 10.1 Review of the 2013 SC work programme

510. The Secretariat updated the Record of SC Work Programme since SC8 (SC9-GN-WP-05, Attachment J). The ISG-4 facilitator (S. Brouwer) presented the outputs of ISG-4. SC9 considered and endorsed the following recommendations on database improvements:

a) Where necessary, research the history of SC projects that have been implemented to fill any missing fields, including missing information in Delivering Agency and Outputs.
b) All project deliverables should be listed, if any additional, in addition to project papers.
c) Separate fields for "Projected Outputs" and "Delivered Outputs" should be included.
d) "Relevant CCMs" and "Links to other Projects" are useful fields and need to be entered.
e) Criteria for designating High, Medium and Low priority need to be developed.
f) Include a column for the allocated budget to be entered if known.
g) The numbering should include a start year as part of the number to avoid duplication.
h) The database should include "End Year" — the last year of funding for the project (the year can be extended if further funding is approved).

511. In order to select high priority projects for funding support using 2013 unobligated budget, ISG-5 provided the following scored projects. Subject to SPC's proposal on Project 60, the first three projects will be advertised to seek research proposals.

| Title | Score |
|---|---|
| 1) Desktop analysis to develop reference points for elasmobranchs and other bycatch species | 4 |
| 2) Development of a best practice approach to standardize CPUE indices for use in stock assessments | 3.8 |
| 3) Review of Project 60 update — desktop analysis for carrying forward Project 60 | 3.5 |
| 4) Electronic tagging of whale sharks released from purse-seine nets (to examine survival) | 3.1 |
| 5) Development of a Library of Commission Documents | 3.1 |
| 6) Project 19 — Regional Observer Programme (ROP) data fields. Identification and description of operational characteristics of the major WCPO fleets and identification of important technical parameters for data collection | 3 |
| 7) Project 68 — Seabird interaction and bycatch mortality | 3 |

512. SC9 reviewed draft revisions on the "Guidelines outlining the process for formulating the work programme and budget of the Scientific Committee" (Attachment P, SC5 Summary Report) and endorsed the revision (Attachment K).

### 10.2 Development of the 2014 work programme and budget, and projection of 2015–2016 provisional work programme and indicative budget

513. SC9 adopted the work programme and budget for 2014 and indicative budget for 2015–2016 as shown in Table WP1. The scientific services provider will conduct stock assessment for bigeye tuna, yellowfin tuna and skipjack tuna in 2014 under the current service agreement for scientific services. SC9 also requested the scientific services provider to conduct shark analysis as follows for presentation at SC10 (assuming a stock assessment for blue shark in the South Pacific in 2015):

- A stock assessment for blue shark in the North Pacific conducted through the ISC process; and
- Analysis of potential mitigation options for silky and oceanic whitetip sharks.

**Table WP1:** SC work programme and budget for 2014–2016.

| List of Scientific Committee work programme titles and budget for 2014, and indicative budget for 2015–2016, which require funding from the Commission's core budget (in USD). | | | |
|---|---|---|---|
| **Research activity / Project with priority** | **2014** | **2015** | **2016** |
| Project 14. WPEA Project | 25,000 | 25,000 | 25,000 |
| Project 35. Refinement of bigeye parameters | 75,000 | 75,000 | - |
| Project 42. Pacific-wide tagging project | 10,000 | 10,000 | 10,000 |
| Project 57. Limit reference points | 30,000 | - | - |
| Project 66. Target reference points | - | - | - |
| Project 63. Harvest control rules | - | - | - |
| Project 60. Purse-seine species composition | - | - | - |
| Additional resourcing SPC | 160,000 | 160,000 | - |
| UNOBLIGATED BUDGET | 83,000 | 83,000 | 83,000 |
| SPC OCEANIC FISHERIES PROGRAMME BUDGET | 871,200 | 871,200 | 871,200 |
| **GRAND TOTAL** | **1,254,200** | **1,224,200** | **989,200** |

## AGENDA ITEM 11 — ADMINISTRATIVE MATTERS

### 11.1 Rules of Procedure

514. No proposals were received, and SC9 had no comments on this agenda item.

### 11.2 Peer review of stock assessments

515. No comments were received.

### 11.3. Future operation of SC

#### 11.3.1 Future structure of SC

516. FSM made the following statement:

> FFA members note efforts to rationalize meetings by reducing and streamlining meeting agendas. We see no need to re-introduce the Fishing Technology, Biology, and Methods themes for SC10. As far as possible, we encourage new developments to be considered such as stock assessment preparatory workshops. Where there are significant new developments that require SC's decision, they can be incorporated in one of the existing themes, or as a GN paper. In relation to the pre-assessment workshop, FFA members understand the value of this workshop to SPC and the Commission, and request that the Commission provide a budget to enable SIDS and Territories to fully participate in this process.

#### 11.3.2 Review of scientific aspects of the Commission's Independent Performance Review

517. As requested by the Commission (para. 429 of WCPFC9 Summary Report), SC9 reviewed recommendations from the Performance Review and responded (Attachment L).

#### 11.3.3 Resolution 2012-01

518. There were no comments on this resolution.

### 11.4 Election of SC officers

519. There were no nominations for the position of SC Vice-Chair.

### 11.5 Next meeting

520. The Marshall Islands kindly offered to host SC10 in Majuro, Marshall Islands, which is provisionally scheduled for 6–14 August 2014. FSM confirmed that it would host SC11.

## AGENDA ITEM 12 — OTHER MATTERS

521. There were no other matters raised for discussion.

## AGENDA ITEM 13 — ADOPTION OF SC9 SUMMARY REPORT

522. The SC9 Summary Report was adopted.

## AGENDA ITEM 12 — CLOSE OF THE MEETING

523. Closing statements of appreciation were made by FSM and Fiji, and the Chair responded by thanking everyone for a successful meeting.

524. SC9 closed at 18:00 on 14 August 2013.

**Attachment A**

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

**Scientific Committee**
**Ninth Regular Session**

**Pohnpei, Federated States of Micronesia**
**6-14 August 2013**

## WELCOME SPEECH
## by Scientific Committee Chair, Mr Ludwig Kumoru

Very good morning and welcome delegates of the WCPFC, both members, Cooperating Non-members, Participating Territories and Observers to the Ninth Regular Session of the Scientific Committee.

SC9 will deliberate on four themes, which are: Data and Statistics, Stock Assessment, Management Issues and Ecosystem and Bycatch mitigation. The most critical issue to be addressed, in my opinion, is the issue on Data collection and data gaps. Without good data, you can't have good stock assessment and thus provide good management advice. The issue on data and data gaps especially the provision of operational catch and effort data is not new. It has been an issue for the last several Science meetings. I am afraid; this issue will not come to an end if we carry on business as usual. I think we should take a different approach to addressing this issue. Why can't the Science Committee bring this matter to the Technical Compliance Committee to deal with the fleets which are failing to comply with their obligation to provide data to WCPFC. Having said that, I also note the big improvement in data provision as reported in some of the papers submitted to this year's Science committee meeting. A lot of this improvement is no doubt due to your hard work.

Thank you.

**Attachment B**

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

**Scientific Committee**
**Ninth Regular Session**

**Pohnpei, Federated States of Micronesia**
**6-14 August 2013**

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**Attachment C**

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

**Scientific Committee**
**Ninth Regular Session**

**Pohnpei, Federated States of Micronesia**
**6-14 August 2013**

# AGENDA

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**Attachment D**

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

**Scientific Committee**
**Ninth Regular Session**

**Pohnpei, Federated States of Micronesia**
**6-14 August 2013**

## ABBREVIATIONS AND ACRONYMS USED BY WCPFC

| | |
|---|---|
| ACAP | Agreement for the Conservation of Albatross and Petrels |
| ALB | albacore (*Thunnus alalunga*) |
| $B_{current}$ | average biomass over the period 2006–2009 |
| BET | bigeye tuna (*Thunnus obesus*) |
| BFAR | Bureau of Fisheries and Aquatic Resources (Philippines) |
| $B_{MSY}$ | biomass that will support the maximum sustainable yield |
| CCAMLR | Commission for the Conservation of Antarctic Marine Living Resources |
| CCM | Members, Cooperating Non-members and participating Territories |
| CCSBT | Commission for the Conservation of Bluefin Tuna |
| CMM | Conservation and management measure |
| the Convention | The Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean |
| CPUE | catch per unit effort |
| CSIRO | Commonwealth Scientific and Industrial Research Organization (Australia) |
| DFLL | deep frozen tuna longline |
| EB-theme | Ecosystem and Bycatch Mitigation theme |
| EEZ | exclusive economic zone |
| ENSO | El Niño-Southern Oscillation |
| EPO | eastern Pacific Ocean |
| ERA | ecological risk assessment |
| ETBF | Eastern Tuna and Billfish Fishery (Australia) |
| EU | European Union |
| F | fishing mortality rate |
| FAD | fish aggregating/aggregation device |
| FAO | Food and Agriculture Organization of the United Nations |
| $F_{current}$ | average fishing mortality rate over the period xxxx–xxxx |
| FFA | Pacific Islands Forum Fisheries Agency |
| $F_{MSY}$ | fishing mortality that will support the maximum sustainable yield |
| FSM | Federated States of Micronesia |
| $F_{SSB\text{-}ATHL}$ | fishing mortality that maintains spawning stock biomass (SSB) above the average level of its ten historically lowest points (ATHL) |
| GAM | generalized additive model |
| GEF | Global Environment Facility |
| GLM | general linear model |
| GT | gross registered tonnage |

| | |
|---|---|
| IATTC | Inter-American Tropical Tuna Commission |
| ICCAT | International Commission for the Conservation of Atlantic Tunas |
| IFLL | ice fresh (tuna) longline |
| IOTC | Indian Ocean Tuna Commission |
| ISC | International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean |
| ISG | Informal Small Group |
| ISSF | International Sustainable Seafood Foundation |
| IWG | Intersessional working group |
| JPY | Japanese yen |
| JTF | Japan Trust Fund |
| LL | longline |
| LRP | limit reference point |
| m | meters |
| MCMC | Markov chain Monte Carlo (a random sampling method) |
| MFCL | MULTIFAN-CL (a stock assessment modeling approach) |
| $M_{FMT}$ | maximum fishing mortality threshold |
| MOU | memorandum of understanding |
| MSE | management strategy evaluation |
| $M_{SST}$ | minimum stock size threshold |
| MSY | maximum sustainable yield |
| mt | metric tonnes |
| NPAFC | North Pacific Anadromous Fisheries Commission |
| PFRP | Pelagic Fisheries Research Program (Hawaii, USA) |
| PNA | Parties to the Nauru Agreement |
| PNG | Papua New Guinea |
| PTTP | Pacific Tuna Tagging Programme |
| ROP | Regional Observer Programme |
| RFMO | regional fisheries management organization |
| RMI | Republic of the Marshall Islands |
| SB | spawning biomass |
| SC | Scientific Committee of the WCPFC |
| SEAFDEC | Southeast Asian Fisheries Development Center |
| SEAPODYM | spatial ecosystem and population dynamics model |
| SIDS | small island developing state |
| SKJ | skipjack tuna (*Katsuwonus pelamis*) |
| SPC-OFP | Secretariat of the Pacific Community- Oceanic Fisheries Programme |
| SPR | spawning potential per recruit |
| SSB | spawning stock biomass |
| TCC | Technical and Compliance Committee of the WCPFC |
| TOR | terms of reference |
| USA | United States of America |
| USD | US dollars |
| WCPFC | Western and Central Pacific Fisheries Commission |
| WCPFC Convention Area | The area of competence of the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean |
| WCPFC Statistical Area | The WCPFC Statistical Area is defined in para. 8 of the document "Scientific data to be provided to the Commission" |
| WCPO | western and central Pacific Ocean |

| | |
|---|---|
| WG | working group |
| WPEAOFM | Western Pacific East Asia Oceanic Fisheries Management Project |

**Attachment E**

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

**Scientific Committee**
**Ninth Regular Session**

**Pohnpei, Federated States of Micronesia**
**6-14 August 2013**

## LIST OF DOCUMENTS

### MEETING INFORMATION

| | |
|---|---|
| **WCPFC-SC9-2013-01** | Meeting notice and information |
| **WCPFC-SC9-2013-02** | Provisional agenda (Rev. 2) 01 Aug 2013 |
| **WCPFC-SC9-2013-03** | Provisional annotated agenda (Rev. 2) 01 Aug 2013 |
| **WCPFC-SC9-2013-04** | Indicative schedule (Rev. 1) 05 August 2013 |
| **WCPFC-SC9-2013-05** | Registration form |
| **WCPFC-SC9-2013-06** | Guidelines for submitting meeting papers |
| **WCPFC-SC9-2013-07** | List of Documents (Rev.4) 4 August 2013 |
| **WCPFC-SC9-2013-08** | Provisional agenda for head of delegation (HOD) meeting (1600-1700) (Rev.3) 05 August 2013/Informal Small Groups (ISG) |
| **WCPFC-SC9-2013-09** | Provisional Agenda of the JTF Steering Committee Meeting |
| **WCPFC-SC9-2013-10** | Provisional Agenda of the PTTP Steering Committee Meeting |
| **WCPFC-SC9-2013-11** | Provisional Agenda of the WPEA OFM Project Steering Committee |

### GENERAL PAPERS

| ***GENERAL PAPERS – Working Papers*** | |
|---|---|
| **GN-WP-01** | Williams, P and P. Terawasi. . Overview of tuna fisheries in the western and central Pacific Ocean, including economic conditions – 2012. |
| **GN-WP-02** | IATTC. Summary of the fishery and assessments of the major stocks of tuna exploited in the eastern Pacific Ocean. |
| **GN-WP-03** | Secretariat. Issues arising from the Commission |
| **GN-WP-04** | Secretariat. Intersessional activities of the Scientific Committee |
| **GN-WP-05** | Secretariat. List of Work Programme of the Scientific Committee |
| **GN-WP-06** | Secretariat. Recommendations from the Review of the WCPFC. (Rev.1) 07 Aug 2013) |
| ***GENERAL PAPERS – Information Papers*** | |
| **GN-IP-01** | Secretariat. Cooperation with other organizations |
| **GN-IP-02** | ISC (Chair). Report of the 13th Meeting of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean. |
| **GN-IP-03** | Robert Gillett. WPEA OFM Project – Independent Evaluation Report (January, 2013) |
| **GN-IP-04** | Secretariat. SP albacore fishery |
| **GN-IP-04a** | Excel: SPA vessel number latitude flag |
| **GN-IP-04b** | Excel: SPA catch proportion latitude flag |

| | |
|---|---|
| **GN-IP-05** | SEAFDEC Statement |

**SCIENCE-RELATED DOCUMENTS PRESENTED AT WCPFC9**

| | |
|---|---|
| **SC9-WCPFC9-01** | Report from the Management Objectives Workshop (WCPFC9-2012-14) |
| **SC9-WCPFC9-02** | Secretariat. South Pacific Albacore Fishery (WCPFC9-2012-IP-07) |
| **SC9-WCPFC9-03** | Resolution on the Best Available Science (Resolution 2012-01) |
| **SC9-WCPFC9-04** | SPC-OFP Update of progress towards a stock assessment for swordfish in the southern WCPO (WCPFC9-2012-IP-10) |
| **SC9-WCPFC9-05** | SPC-OFP Addendum to WCPFC9-2012-IP-10 (WCPFC9-2012-IP-10A) |
| **SC9-WCPFC9-06** | SPC-OFP. Projection analysis of alternative management options for south Pacific albacore (WCPFC9-2012-IP-11) |
| **SC9-WCPFC9-07** | SPC-OFP. Information Paper Supplement to WCPFC-2012-IP-11 (WCPFC9-2012-IP-12) |
| **SC9-WCPFC9-08** | SPC-OFP. Progress on the updated silky shark stock assessment in the WCPO (WCPFC9-2012-IP-13) |
| **SC9-WCPFC9-09** | SPC-OFP. Preliminary analysis of potential impacts of wire traces on shark catches in WCPO tuna longline fisheries (WCPFC9-2012-IP-14) |
| **SC9-WCPFC9-10** | SPC-OFP. An assessment of the Chairman's draft CMM for tropical tunas (Rev 1) (WCPFC0-2012-IP-15 (Rev1)). |
| **SC9-WCPFC9-11** | ISC. Future Projections of the Western and Central North Pacific Striped Marlin Stock (WCPFC9-2012-IP-18) |
| **SC9-WCPFC9-12** | Secretariat. Draft Strategic Plan (WCPFC9-2012-FAC6-07) |

**DATA AND STATISTICS THEME**

| ***ST THEME – Working Papers*** | |
|---|---|
| **ST-WP-01** | Williams, P. Scientific data available to the Western and Central Pacific Fisheries Commission. |
| **ST-WP-02** | Lawson, T. and F. Lasi. Report for the WCPFC Consultancy on the Collection and Evaluation of Purse-Seine Species Composition Data, February 2013 — July 2013. |
| **ST-WP-03** | Lawson, T. Estimation of the species composition of the catch by purse seiners in the Western and Central Pacific Ocean – a response to recent independent reviews |
| **ST-WP-04** | Ramiscal, R. V. et al. Analysis of Purse Seine/Ring Net Fishing Operations in Philippine EEZ |
| **ST-WP-05** | Ramiscal, R. V. et al. Status of Philippine Group Seine Operations in High Seas Pocket 1-Special Management Area (HSP1-SMA) |
| **ST-WP-06** | Harley, S and P. Williams. Consideration of data to use in the 2014 stock assessments for bigeye, yellowfin, and skipjack tunas |
| ***THEME – Information Papers*** | |
| **ST-IP-01** | SPC-OFP. Estimates of annual catches in the WCPFC Statistical Area. (Rev. 1) 19 July 2013) |
| **ST-IP-02** | Cordue, P. L. Project 60 review paper: Review of species and size composition estimation for the western and central Pacific purse seine fishery |
| **ST-IP-03** | Powers, J. E. Project 60 review paper: Review of SPC Estimation of Species and Size Composition of the Western and Central Pacific Purse Seine Fishery from Observer-based Sampling of the Catch |
| **ST-IP-04** | McArdle, B. Project 60 review paper: To improve the estimation of species and size composition of the western and central Pacific purse seine fishery from observer based |

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| | sampling of the catch. |
| **ST-IP-05** | Williams, P., C. Cole and C. Falasi. Status of Observer Data Management |
| **ST-IP-06** | Williams, P. and E Schneiter E-Reporting Trials Conducted by SPC |
| **ST-IP-07** | L. Baje et al. The Use Of Electronic Data Forms In The PNG Purse Seine Port Sampling Program |

**STOCK ASSESSMENT THEME**

| ***SA THEME – Working Papers*** | |
|---|---|
| **SA-WP-01** | Nicol, S. and C.Sanchez1: Project 35: Bigeye tuna age and reproductive biology progress report (Rev 1) 24 July |
| **SA-WP-02** | Rice, J. Stock et al. Stock assessment of blue shark in the north Pacific Ocean using Stock Synthesis. |
| **SA-WP-03** | Rice, J. and S. Harley. Stock assessment of silky shark in the western and central Pacific Ocean |
| **SA-WP-04** | Rice, J. and S. Harley. Potential catch and CPUE series to support a stock assessment of blue shark in the south Pacific Ocean |
| **SA-WP-05** | Davies, N. et al. Stock assessment of swordfish in the southwest Pacific Ocean |
| **SA-WP-06** | Harley, S. and P. Williams. A compendium of fisheries indicators for bigeye, skipjack, yellowfin, and south Pacific albacore tunas |
| **SA-WP-07** | Harley, S. and P. Williams. Distribution of longline catches for southwest Pacific striped marlin |
| **SA-WP-08** | Harley, S. Overview of the implementation of the recommendations from the Independent Review of the 2011 bigeye tuna stock assessment |
| **SA-WP-09** | ISC Billfish Working Group: Stock Assessment of Blue Marlin in the Pacific Ocean in 2013 (Replacement Document 31 July 2013) |
| **SA-WP-10** | ISC Pacific bluefin tuna Working Group: Stock assessment of Pacific bluefin tuna in 2012 (Rev. 1) 30 July 2013 |
| **SA-WP-11** | ISC Shark Working Group: Stock Assessment And Future Projections Of Blue Shark In The North Pacific, Plus Reports From The Associated ISC Shark WG Workshops. |
| **SA-WP-12** | Lee S. I., Z. G. Kim, M. K. Lee, J. E. Ku, S. C. Yoon and D. W. Lee. Updated CPUE standardization for yellowfin tuna caught by Korean tuna longline fisheries in the WCPO |
| **SA-WP-13** | Okamoto, H., H. Kiyofuji, Y. Horii, A. Hoshikawa and H. Ashida. Comparison of CPUE trends for skipjack tuna between two troll fisheries around Hachijo-Island and south off Wakayama prefecture. |
| **SA-WP-14** | Kiyofuji, H. and H. Okamoto. Decadal and spatial analysis of Japanese pole and line fisheries for improving catch per unit effort of skipjack in the WCPO. |
| **SA-WP-15** | Gedanke, T. Preliminary Analyses of the Potential Impacts of Minimum Weight Regulations for Pacific Bluefin Tuna. |
| ***SA THEME – Information Papers*** | |
| **SA-IP-01** | SPC. Report from the SPC pre-assessment workshop, Noumea, April 2013 |
| **SA-IP-02** | Rice, J. Catch and catch per unit effort of silky sharks in the Western and Central Pacific Ocean |
| **SA-IP-03** | Hoyle, S., N. Davies and Shui-Kai Chang. Analysis of swordfish catch per unit effort data for Japanese and Chinese Taipei longline fleets in the southwest Pacific Ocean |
| **SA-IP-04** | Hoyle, S. and H. Okamoto. An investigation of targeting changes in the tropical longline fishery - implications for CPUE series |
| **SA-IP-05** | Mckechnie, S., S, Hoyle and S. Harley. Longline CPUE series that account for changes |

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| | in the spatial extent of fisheries |
| **SA-IP-06** | Hoyle, S., D. S. Kolody and S. Nicol. An analysis of mixing rates for bigeye and yellowfin tuna – implications for model structure |
| **SA-IP-07** | Davies, N. et al. Recent developments in the MULTIFAN-CL stock assessment software |
| **SA-IP-08** | McKechnie, S. and S. Hoyle, Swordfish CPUE for the Japanese charter fleet fishing off the west coast of the South Island of New Zealand |
| **SA-IP-09** | Chambers, M. et al. The spatial distribution of striped marlin in the SW Pacific Ocean: Estimates from PSAT Tagging Data |
| **SA-IP-10** | Campbell, R. Summary of logbook and observer data pertaining to the catch of blue sharks off eastern Australia |
| **SA-IP-11** | Kolody, D. and S. Hoyle. Evaluation of Tag Mixing Assumptions for Skipjack, Yellowfin and Bigeye Tuna Stock Assessments in the Western Pacific and Indian Oceans |
| **SA-IP-12** | Lee, M. K., S. I. Lee, Z. G. Kim, J. E. Ku, S. C. Yoon and D. W. Lee. The fishing characteristics of Korean tuna purse seine fishery in the Western and Central Pacific Ocean |
| **SA-IP-13** | ISC Billfish Working Group: Report Of The Billfish Working Group Workshop May 2013 |

**MANAGEMENT ISSUES THEME**

| ***MI THEME – Working Papers*** | |
|---|---|
| **MI-WP-01** | Pilling, G. et al. et al. Analysis of the implementation and effectiveness of key management measures for tropical tunas Rev 1 (14 August) |
| **MI-WP-02** | Berger, A. et al. Determination of appropriate time-windows for calculation of depletion-based limit reference points |
| **MI-WP-03** | Berger, A. et al. Proposed F-based limit reference points for bigeye, yellowfin, and south Pacific albacore tuna |
| **MI-WP-04** | Berger, A. et al. Approaches to describe uncertainty in current and future stock status |
| **MI-WP-05** | Cartwright, I., J. Ianelli and R. Allen. Report of the Expert Working Group Management objectives, performance indicators and reference points retitled |
| **MI-WP-06** | Arita, S. and M. Pan. Cost-Earnings Study of the American Samoa Longline Fishery Based on Vessel Operations in 2009 |
| **MI-WP-07** | Satoh K., H. Okamoto and M. Ogura. Updating analyses for relationship between bigeye tuna catch and school type of Japanese purse seine fishery. (new document) |
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| **MI-IP-01** | ISSF. Report of the 2013 ISSF Stock Assessment Workshop: Harvest Control Rules and Reference Points for Tuna RFMOs, San Diego, California, USA, March 6-8, 2013 |
| **MI-IP-02** | Withdrawn |
| **MI-IP-03** | Secretariat. Summary of CCM's reporting on CMM 2012-01 for bigeye catch and FAD additional reduction |
| **MI-IP-04** | NRIFS: Report of 2013 NRIFSF Workshop on Biological Reference Points for Fisheries Management under Environmental Changes |

**ECOSYSTEM AND BYCATCH MITIGATION THEME**

| ***EB THEME – Working Papers*** | |
|---|---|
| **EB-WP-01** | Harley, S., P. Williams, and J. Rice. Spatial and temporal distribution of whale sharks in the WCPO based on observer data and other data sources |

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| **EB-WP-02** | Bromhead D., J. Rice and S. Harley. Analyses of the potential influence of four gear factors (leader type, hook type, "shark" lines and bait type) on shark catch rates in WCPO tuna longline fisheries. (Rev. 1) 22 July 2013 |
| **EB-WP-03** | Lehodey, P. et al. SEAPODYM applications in WCPO – progress report. (Rev. 1) 8 August 2013 |
| **EB-WP-04** | Nicol, S., S. Bunce and L. Fitzsimmons. Progress on Kobe III bycatch Technical Working Group |
| **EB-WP-05** | Beck, N., Y. Inoue and W. Papworth. Progress Report on the Development of a Seabird Identification Guide for use by tRFMOs. |
| **EB-WB-06** | Harley, S., J. Rice, and P. Williams. A progress report on the shark research plan |
| **EB-WP-07** | Muir, J. et al. Results of the International Seafood Sustainability Foundation's WCPO-2 research cruise |
| **EB-WP-08** | Clarke, S. Towards an Integrated Shark Conservation and Management Measure for the Western and Central Pacific Ocean (retitled) |
| **EB-WP-09** | Papworth, W. Electronic Monitoring of Seabird Bycatch |
| **EB-WP-10** | Hamer, D. and S. J. Childerhouse. Physical and psychological deterrence strategies to mitigate odontocete by-catch and depredation in pelagic longline fisheries: progress report |
| **EB-WP-11** | Ochi, D. et al. At-sea experiment to evaluate the effectiveness of multiple mitigation measures on pelagic longline operations in western north Pacific. (Rev. 1) 1 August 2013 |
| **EB-WP-12** | Hutchinson, M. et al. Post-release mortality rates of silky sharks caught in purse seine fishing gear |
| **EB-WP-13** | Wang Zhenhua, et al. Depth distribution for both target species and bycatches of longline fisheries in Solomon Islands: A case study based on an observation program. |
| **EB-WP-14** | Anderson, D. et al. Overlap between WCPFC longline fishing effort and albatross distribution in the North Pacific |
| ***EB THEME – Information Papers*** | |
| **EB-IP-01** | Secretariat: Summary of Catch discard reporting received by WCPFC under CMM 2009-02 |
| **EB-IP-02** | Pilling, G. et al. Estimation of catches and condition of edible bycatch species taken in the equatorial purse seine fishery |
| **EB-IP-03** | Fitzsimmons, L. Bycatch Mitigation Information System |
| **EB-IP-04** | Wang Xuefang et al. Preliminary Results on Fishery Biology for Rainbow Runner Elagatis bipinnulata Associated with Drifting Fish Aggregation Devices in the Western and Central Pacific Ocean |
| **EB-IP-05** | Polovina, J. and P. Woodworth-Jefcoats. Fishery-induced changes in the subtropical Pacific pelagic ecosystem size structure: observations and theory. Pacific Islands Fisheries Science Center, NOAA Fisheries, Honolulu, Hawaii, United States of America |
| **EB-IP-06** | Small C. Methods/minimum elements to review the effectiveness of seabird bycatch mitigation regulations in tuna RFMOs |

**RESEARCH PROJECTS**

| | |
|---|---|
| ***JAPAN TRUST FUND*** | |
| **RP-JTF-01** | Secretariat. Japan Trust Fund Status Report (2013) |
| **RP-JTF-02** | Secretariat. Japan Trust Fund Steering Committee Report |
| ***PACIFIC TUNA TAGGING PROJECT*** | |
| **RP-PTTP-01** | Hampton, J. et al. PTTP progress report and work plan for 2012-2013 |

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| | (Rev. 1) 8 August 2013 |
| **RP-PTTP-02** | PTTP-SC. Report of the PTTP Steering Committee |
| **RP-PTTP-03** | Scutt-Phillips, J. et al Species specific vertical habitat utilisation by tunas in the tropical WCPO. |
| ***WEST PACIFIC EAST ASIA PROJECT*** | |
| **RP-WPEA-01** | Secretariat. Steering Committee of the WPEA Project |
| **RP-WPEA-02** | Secretariat. Summary Report on 2012-2013 WPEA Project Activities |
| **RP-WPEA-03** | Secretariat. Financial Statement of the WPEA Project |
| **RP-WPEA-04** | Indonesia. WPEA Project: Progress Report – Indonesia |
| **RP-WPEA-05** | Philippines. WPEA Project: Progress Report – Philippines |
| **RP-WPEA-06** | Vietnam. WPEA Project: Progress Report – Vietnam |
| **RP-WPEA-07** | Secretariat. Steering Committee Report of the WPEA Project (meeting cancelled) |

**ANNUAL REPORT – PART 1**

| Symbol | CCMs |
|---|---|
| AR-CCM-01 | Australia |
| AR-CCM-02 | Canada |
| AR-CCM-03 | China |
| AR-CCM-04 | Cook Islands |
| AR-CCM-05 | European Union |
| AR-CCM-06 | Federated States of Micronesia |
| AR-CCM-07 | Fiji |
| *Covered by its territories* | *France* |
| AR-CCM-08 | French Polynesia |
| AR-CCM-09 | Japan |
| AR-CCM-10 | Kiribati |
| AR-CCM-11 | Korea |
| AR-CCM-12 | Marshall Islands |
| AR-CCM-13 | Nauru |
| AR-CCM-14 | New Caledonia |
| AR-CCM-15 | New Zealand |
| AR-CCM-16 | Niue |
| AR-CCM-17 | Palau |
| AR-CCM-18 | Papua New Guinea |
| AR-CCM-19 | Philippines |
| AR-CCM-20 | Samoa |
| AR-CCM-21 | Solomon Islands |
| AR-CCM-22 | Chinese Taipei |
| AR-CCM-23 | Tokelau |
| AR-CCM-24 | Tonga Rev 1 (26 July 2013) |
| AR-CCM-25 | Tuvalu |
| AR-CCM-26 | United States of America |
| AR-CCM-27 | Vanuatu Rev 1 (2 August 2013) |

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| AR-CCM-28 | Wallis and Futuna |
| *Covered by USA Annual Report* | *American Samoa* |
| | *Guam* |
| | *Northern Mariana Islands* |
| AR-CNM-29 | Belize |
| AR-CNM-30 | Democratic People's Republic of Korea |
| AR-CNM-31 | Ecuador |
| AR-CNM-32 | El Salvador Rev 1 (7 July 2013) |
| AR-CNM-33 | Indonesia |
| AR-CNM-34 | Mexico |
| AR-CNM-35 | Panama |
| AR-CNM-36 | St. Kitts and Nevis |
| AR-CNM-37 | Senegal |
| AR-CNM-38 | Thailand |
| AR-CNM-39 | Vietnam Rev 1 (16 July 2013) |

**Non-governmental organisations and others**

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| WWF SC9 Position Paper |
| PEW Statement to SC9 |
| Greenpeace Briefing for SC9 |

**Attachment F**

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

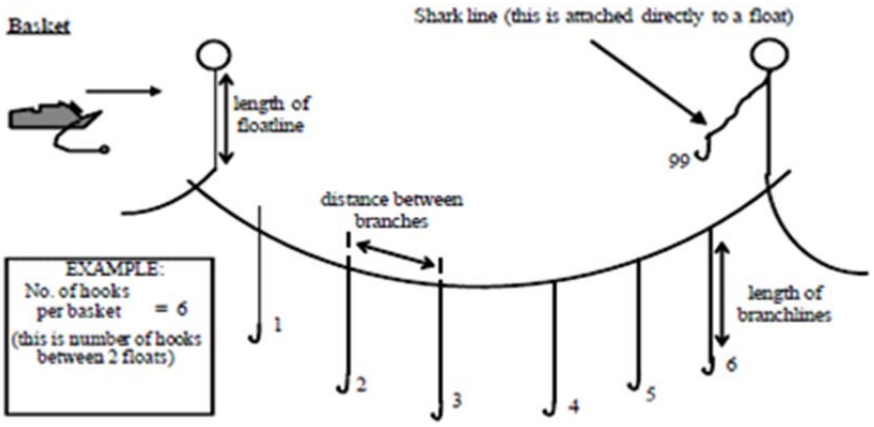
**Scientific Committee**
**Ninth Regular Session**

**Pohnpei, Federated States of Micronesia**
**6-14 August 2013**

## DEFINITION OF SHARK LINES

"Shark lines on floats (Hook No. 99s): If vessel has special lines tied directly to the floats to catch extra sharks, count the total number used in the set. What is their usual length (m)?

N.B. Do not count a shark line on a float as one of the 'hooks per basket' (see diagram)."
http://www.spc.int/oceanfish/en/publications/doc_download/991-obs-ll-workbook



**Attachment G**

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

**Scientific Committee**
**Ninth Regular Session**

**Pohnpei, Federated States of Micronesia**
**6-14 August 2013**

## SUMMARY OF SCIENTIFIC COMMITTEE'S INPUT TO THE MANAGEMENT OBJECTIVES PROCESS

1. The Commission (WCPFC9) directed the Management Objectives Working Group to obtain comments and suggestions from SC and NC on the draft report of candidate management objectives, performance indicators and reference points. It has also been proposed that the paper be considered by TCC.

2. The draft SC record contains the following advice:
   - the paper lays out well the range of objectives of different Commission members and other stakeholders and the special requirements and aspirations of SIDS;
   - support for the process to continue and the further development of the paper, particularly the proposals for target reference points, and the 2nd session of the Management objectives Workshop;
   - further clarification of the difference between TRPs for fisheries and TRPs for species; and
   - preference for use of a modified Kobe plot to illustrate the use of a "buffer" around the TRP.

3. A small working group was convened and added the following suggestions to assist with progressing the report of the working group and the MOW2 workshop, which is to be held before WCPFC 10 in Cairns, Australia.
   - Include a brief introductory session to ensure participants are aware of the process and key concepts, given the likely changes that will occur within delegations.
   - It would helpful to explore the implications of ranges of TRPs for some species as a means of illustrating how objectives, PIs and reference points interact in a management framework.
   - Support exploring ranges of TRPs for skipjack and southern albacore, and possibly Pacific bluefin, noting that in the case of Pacific bluefin, an approach based on an interim rebuilding target would be appropriate.
   - MEY-based approaches require a range of economic data; this data is not available for a number of fisheries, and even where some data exists, there are considerable gaps, particularly with respect to operating costs and the relative values of access.
   - Definitions of MEY will vary between CCMs and fleets depending on objectives e.g. maximising profits or employment, and whether or not just the harvesting sector or other sectors (e.g. processing) are included.
   - To assist in the development of MEY-based approaches it would be helpful to identify current data holdings, where gaps exist and a strategy for collecting priority missing data.

- Current stock assessment models are based on spatial delineation and may not be suitable for considering the analysis of options for management strategies that take account of economic outcomes.

4. On the issue of the format of MOW2, the small working group suggested:
   - a focus on options and ranges of values for TRPs for skipjack and southern albacore, and possibly Pacific Bluefin.

**Attachment H**

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

**Scientific Committee**
**Ninth Regular Session**

**Pohnpei, Federated States of Micronesia**
**6-14 August 2013**

# GUIDELINES FOR THE SAFE RELEASE OF ENCIRCLED ANIMALS, INCLUDING WHALE SHARKS


**Summary**

An Informal Small Group 2 (ISG2) meeting was held during the WCPFC SC9 in Pohnpei, FSM on 7 August 2013. Seven SC9 participants took part in the meeting and discussed the development of guideline for the safe release of encircles animals, including whale sharks, followed by the discussion in the WCPFC SC8, 2012. Discussion made by the ISG in 2012 was forwarded to the TCC8 2012, however, there was no discussion at the TCC8. WCPFC9 noted the need to continue development of science-based guidelines through discussions at SC and TCC, including establishing field tests to assess handling, post-release mortality, practicality and effectiveness (WCPFC9 Summary Report, 2012).


## (a) Additional information for the guideline

There was no new additional information regarding safe release methodology of encircled animals after WCPFC SC8 ISG3 discussion. Therefore, ISG2 recommended guideline for the safe release adheres fundamentally to the Attachment G in the Summary Report of WCPFC SC8 in 2012. In addition to this, the ISG2 considered following items in general principles of the guideline in case CCMs develop new methods for the safe release of encircled animals, including whale sharks.

- In case CCMs develop new methods for the safe release of encircled animals, including whale sharks under its analysis used by their purse-seine vessels, these methods will be reported and considered to be added as possible release methods in this guideline at WCPFC SC.

## (b) Research recommendation

The following items should be considered in order to investigate the post-release mortality of encircled animals after release. Developing a concrete plan for final research goals, schedule, achievability and budget are absolutely imperative. Research should be conducted by each nation's responsibility or within the Regional Observer Programme. To conduct such research, the intentional setting of a net around whale sharks should not be done.

## (c) Items for investigating post-release mortality of encircled animals

- Observe swimming behavior of encircled animals to find alternative release methods during purse-seine operation.

- Record swimming behavior and conditions before and after release.
- Record detailed release method, whale shark size, and conditions during release.
- Develop techniques for attaching satellite tags to whale sharks.
- Develop analytical methods for estimating the viability of whale sharks after release based on satellite tag data.

ISG2 discussed the need to collect information on methods for attaching tags to whale sharks as there are no established methods for attaching satellite tags to whale sharks during purse-seine operations. ISG participants were requested to investigate reliable methods for attaching satellite tags to whale sharks during purse-seine operations, and to report on any developments at SC10.

**Attachment I**

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

**Scientific Committee**
**Ninth Regular Session**

**Pohnpei, Federated States of Micronesia**
**6–14 August 2013**

## STATEMENT OF THE SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER

**Presented by Dr Chumnarn Pongsri, Secretary General,**
**Southeast Asian Fisheries Development Center**

The Chairperson,
Members of the WCPFC Scientific Committee,
Ladies and gentlemen,

On behalf of the Southeast Asian Fisheries Development Center or SEAFDEC, I would like to express our deep appreciation for the invitation extended to SEAFDEC to attend in this Ninth Session of the Scientific Committee of WCPFC, and to observe the initiatives and technical and scientific findings that are closely aligned with part of our activities that also aim to enhance sustainable utilization of tuna resources in the Southeast Asian region.

SEAFDEC has been established since 1967 to promote fisheries development in Southeast Asia, and the organization aims specifically to develop fishery potentials in the region through training, research and information services in order to improve the food supply by the rational utilization of fisheries resource in the region. For over 45 years, SEAFDEC has forged an on-going initiatives and activities in response to the declination of fishery resources through a wide range of activities. Recently, the scope of work of SEAFDEC has been extended from a wholly technical-oriented, to also address policy-related issues in order to safeguard the interest of our Member Countries (which includes ten ASEAN Members plus Japan) from impacts that could be anticipated from emerging challenges including relevant international-related issues. The current works of SEAFDEC therefore cover both specific technical issues that are of priority for countries in the region, which falls within the broad concepts of the Codes of Conduct for Responsible Fisheries, to address fish trade and environment-related issues, as well as other fisheries management and policy-related subjects.

Tunas have been very important resources for several countries in Southeast Asia in view of its contribution to economies and improving livelihoods of fishers in the region. From the regional perspective, it was commonly agreed that tuna fisheries in the Southeast Asian waters should be placed under the guidance and management of respective tuna RFMOs. However, since there is no clear data and information on stock structure of tunas distributed in the Southeast Asian region, development of appropriate tuna management at the national and sub-regional levels could be difficult. The lack of data and information in this region would also hamper the efforts of concerned RFMOs in carrying out effective regional stock assessment.

Confronting with this scenario, SEAFDEC with funding support from the Government of Japan through Japanese Trust Fund carried out the project on "Information Collection of Highly Migratory Species in the Southeast Asian Waters" from 2008 to 2012, to monitor the trend of tuna exploitation in the Southeast Asian waters. With specific objectives of clarifying and assessing the status of tuna exploitation in the Southeast Asian waters through various methods of information gathering, the project was conducted in collaboration with major tuna producing countries in the region, namely: Indonesia, Philippines, Thailand, Vietnam, and Malaysia. Under this project, analysis of the tuna exploitation had been focused on both oceanic and neritic tunas that are exploited in the EEZs of the Southeast Asian countries.

SEAFDEC is also planning to conduct a three-year collaborative research survey on tuna resources in the Sulu-Sulawesi Sea, starting from 2013, in collaboration with the Philippines, Indonesia and Malaysia; and the first project meeting would be conducted by the end of this month in Kuala Lumpur, Malaysia, to finalize the project work plan. And with this opportunity, and as guided by SEAFDEC Council during its 45$^{th}$ Meeting early this year, SEAFDEC plans to also develop the Plan of Action on tuna management through the regional cooperation among SEAFDEC Member Countries. And as mentioned earlier that it was agreed that management of tuna should be under the respective RFMOs, it is expected that the POA on conservation and management of tunas in the Southeast Asian region would initially focus on neritic tunas, which are caught mostly within the EEZs of the respective countries, as well as on the establishment of the fish *refugia* to protect spawning and nursery grounds which also include closed season for conservation and management.

In this regard, SEAFDEC do hope that the Members of Scientific Committee and WCPFC would share experiences and technical supports to SEAFDEC and our Member Countries, in order that this could be used in the development of tuna management plan of the region as mentioned earlier.

Finally, I hope that the objectives of the Ninth Session of the Scientific Committee would be accomplished, and this would finally lead to the sustainability of tuna fisheries in the Western Central Pacific Area, which would be the ultimate goal of WCPFC as well as the relevant countries of SEAFDEC.

Thank you.

## ANNEX 1

## Promoting Sustainable Tuna Fisheries Management in Southeast Asian Waters through Regional Cooperation

### I. Introduction

Statistics have shown that in the Western Central Pacific Area (WCPA), the trend of skipjack tuna production had been increasing from 200,000 metric tons (mt) in 1970 to 1,300,000 mt in 2005, while stocks of bluefin tuna in the southern oceans decreased from 65,000 mt in 1970 to only 15,000 mt in 2005 (FAO, 2006). It has always been suggested that from the regional perspective, tuna fisheries in the Southeast Asian waters as a sub-regional area, should be placed under the guidance and management of tuna RFMOs such as the Western Central Pacific Fisheries Commission (WCPFC) and Indian Ocean Tuna Commission (IOTC). However, since the stock structure of tunas distributed in the Southeast Asian region is presently obscure and vague, it would be difficult to develop appropriate tuna management at the national and sub-regional levels, hampering the efforts of concerned RFMOs in carrying out effective regional stock assessment.

Confronted with a similar scenario, SEAFDEC with funding support from the Government of Japan Trust Fund carried out the project on "Information Collection of Highly Migratory Species in the Southeast Asian Waters" from 2008 to 2011, to examine the trend of tuna exploitation in the Southeast Asian waters. With specific objectives of clarifying and assessing the status of tuna exploitation in the Southeast Asian waters through various methods of information gathering, the project was conducted in collaboration with major tuna producing countries in the region, namely: Indonesia, Philippines, Thailand, Vietnam, and Malaysia. Analysis of the tuna exploitation focused on oceanic and neritic tunas that are exploited in the EEZs of the Southeast Asian countries. The data and information used for the analysis were sourced from national fishery statistics data, data samplings at selected landing sites, and results of consultations with national tuna focal points. Origin and species composition of tunas were examined and analyzed to warrant the status of tuna exploitation in specific sea areas, such as in the South China Sea, Sulu Sea, Celebes Sea, Andaman, Sea, Eastern Indian Ocean, Western Pacific Ocean, Banda Sea, and Gulf of Thailand. Nevertheless, since oceanic tunas are highly migratory while most of the neritic tuna stocks are shared among the Southeast Asian countries, therefore, management of tunas under the jurisdiction of a single country would not be sufficient.

In an effort to address such concern, the SEAFDEC Council at its 44$^{th}$ Meeting in April 2012 and the Fisheries Consultative Group of the ASEAN-SEAFDEC Strategic Partnership (FCG/ASSP) at its 15$^{th}$ Meeting in November 2012, requested SEAFDEC to develop a concept for regional cooperation to promote the sustainable management of tuna fisheries in the Southeast Asian region. However, before proceeding with the establishment of such Regional Cooperation, it is important that the countries should develop their respective policies that would support any concerted effort for the sustainable exploitation of the oceanic and neritic tuna resources in the sub-regional and/ or regional areas of the Southeast Asian waters. Moreover, the development of such Regional Cooperation would also take into consideration relevant provisions in the ASEAN-SEAFDEC Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020 which were adopted in 2011, while the 2009 SEAFDEC Programme Framework would be used as guide for the ASEAN-SEAFDEC countries in the promotion of sustainable tuna fisheries in the Southeast Asian waters. The outcomes of the Regional Cooperation would be beneficial not only to the countries in the region but also to relevant tuna RFMOs.

## II. Status of Tuna Exploitation in Waters of Southeast Asia

The trend of tuna exploitation in the Southeast Asian countries has been well documented, especially in Indonesia and the Philippines, although this is not well organized in other countries such as Thailand, Vietnam, Malaysia, Myanmar, Brunei Darussalam, and Cambodia. As shown in the fishery statistical data, the total tuna production from Southeast Asian waters was about 1.94 million mt in 2008 increasing from 0.87 million mt in 2001 (Fig. 1). During its peak in 2008, the total marine capture production in the region was 13.8 million mt (SEAFDEC, 2010), and tuna represented about 14% of the total production from marine capture fisheries of the region. Comparing the catch among the Southeast Asian countries in 2010, about 56% and 36% of the total tuna production from the region were provided by Indonesia and Philippines, respectively. Subsequently, it can be gleaned that Indonesia was the biggest supplier of fresh and frozen tuna to the U.S.A. contributing about 36% (or about 9,000 mt) of the total U.S. fresh and frozen tuna imports in 2007 (Globefish, 2008), followed by the Philippines at 23%. As the number one supplier of principally yellowfin and bigeye tunas to sashimi markets in Japan, Indonesia air-ships about 15,000 mt of sashimi- grade tuna per year (Infofish, 2007). Nevertheless, the total tuna production from the region had slightly declined from 1.94 million mt in 2008 to 1.60 million mt in 2010 due to the declining trend of tuna exploitation especially by Indonesia and the Philippines while those of the other countries such as Malaysia and Vietnam also indicated certain fluctuations. However, the total tuna catch landing in Vietnam is estimated only for oceanic tuna but not including neritic tuna due to insufficient statistical data by species.

The composition of tuna stocks in the Southeast Asian waters depends on the sea areas and sub-regional areas (SEAFDEC, 2012). However, an overview of the tuna resources in the region indicated that skipjack is a dominant species representing 36% of all tuna exploitations followed by frigate tuna, yellowfin, eastern little tuna, and longtail tuna representing 18%, 17%, 14% and 9%, respectively. The other tuna species such as bigeye, bullet tuna, albacore, and southern bluefin tuna account for less than 7% of the total exploitation. Although tuna fisheries in the region could be grouped according to species, the catch composition could also be classified from the type of main fishing gears used for both oceanic and neritic tunas such as purse-seine (including ring nets) associated with fish aggregating devices (FADs) called *payao* in the Philippines or *rumpons* in Indonesia, longline, vertical hand-line, and gillnet. In the Philippines, the major catch from purse-seine and ring net vessels is composed of skipjack tuna, roundscads, yellowfin tuna and frigate tuna. Other catches include small volumes of bigeye tuna, eastern little tuna and bigeye scad. For tuna handline, majority of the catch comprises adult yellowfin tuna, blue marlin and swordfish. Adult bigeye and yellowfin are also popularly caught in nearby FADs by vertical handline, a method of which has been recently applied in Sabah State of Malaysia. This led to increased total landings of oceanic tuna especially yellowfin and bigeye in Sabah State. The yellowfin, bigeye, albacore, and southern bluefin tuna taken from the Western Pacific within the EEZs of the Philippines and Indonesia and in some sea areas such as Banda Sea and South China Sea, are also caught by longlines. Pole-and-line fishery for skipjack is also being operated in the Sulawesi Sea by the Indonesian fishers.

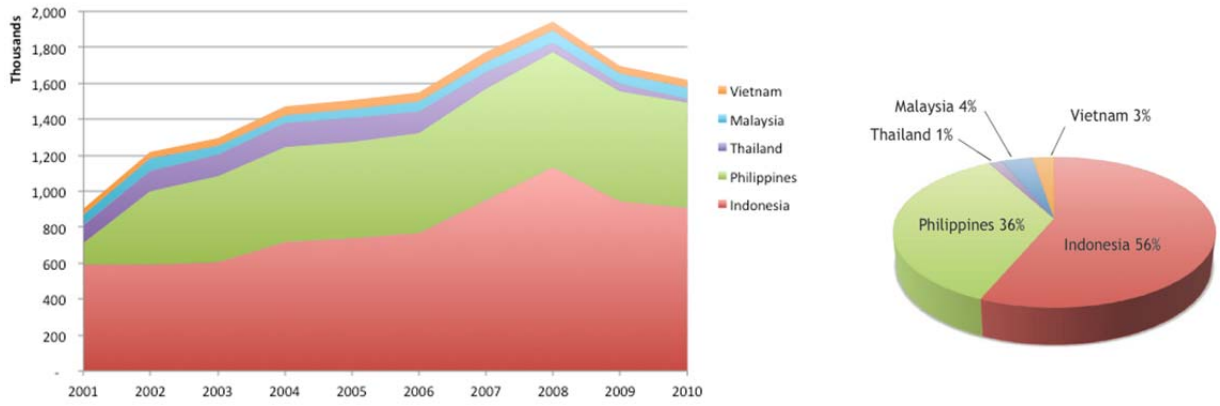



Figure 1. Total exploitation of tunas during 2001–2010 in the Southeast Asian waters (left) and percentage of catch by country in 2010 (right).

Results based on this study indicated that important tuna fishing grounds which could provide yields higher than 200,000 mt are in Maluku-Papua, North Sulawesi, Mindanao Sea, and Sulu Sea as shown in Figure 2. As the figure clearly shows, tuna resources are very important and shared by two or three countries especially in the Sulu-Sulawesi sub-regional area (Sulu Sea and Celebes Sea). Meanwhile, the South China Sea and Andaman Sea are also other areas where tuna resources are shared. The said study also indicated that aside from oceanic tunas (i.e. bigeye and yellowfin tunas), neritic tunas (i.e. frigate tuna, longtail tuna and eastern little tuna) are also abundant and important resources in the aforementioned sub-regional sea areas.

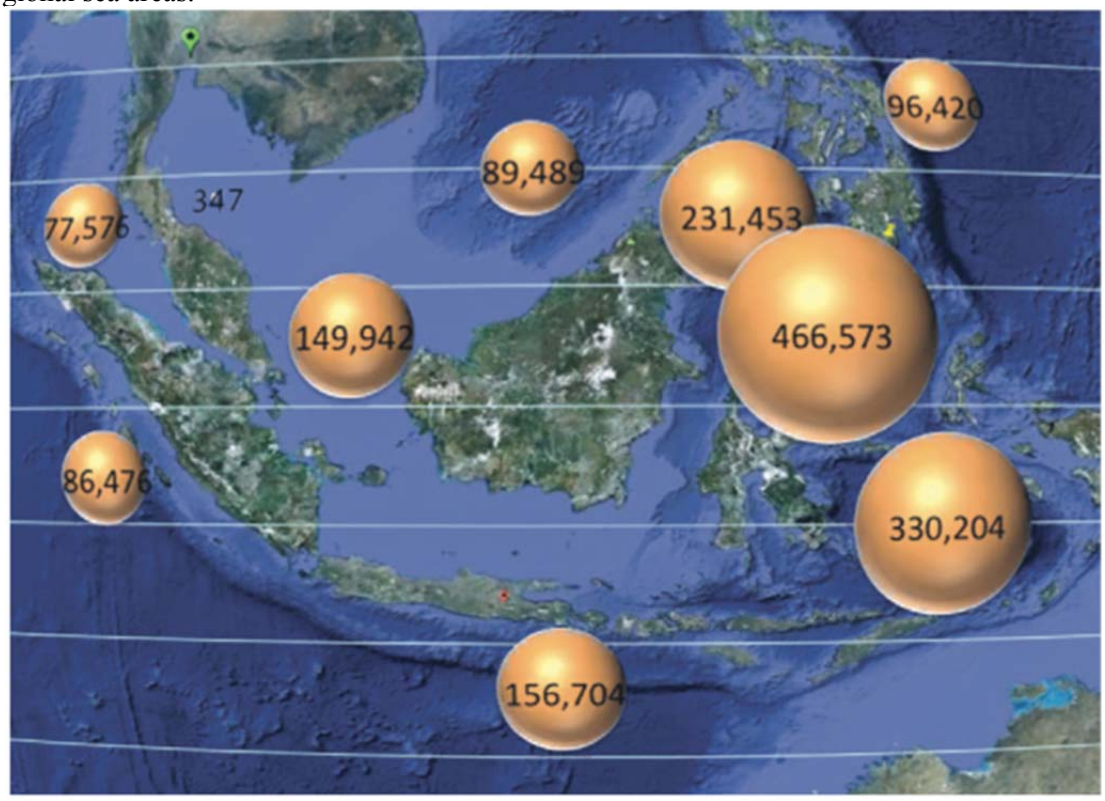



Figure 2. Relative abundance of tuna resources in different sub-regional areas of the Southeast Asian region.

## III. Regional Assessment of Tuna Stocks

In principle, tuna resources in the Southeast Asian region are managed under the framework of relevant tuna RFMOs such as the WCPFC and IOTC, which also support the regular conduct of tuna stock assessment in the WCPA and the Indian Ocean, respectively. However, stock assessment conducted by these tuna RFMOs focuses mainly on oceanic tuna species such as skipjack, yellowfin, bigeye, albacore, and bluefin tunas based on an assessment model that requires time series data inputs and other relevant parameters/data. Taking into account the geographic feature of the Southeast Asian region as part of WCPA, any stock assessment that mainly uses time series data from developed countries' fishing activities in the high seas and in some EEZs of the Pacific Island countries may not reflect the real status of the tuna stocks in the waters of Southeast Asia. This is because of the complex data at the sub-regional areas such as those in the South China Sea, Sulu Sea, Celebes Sea, and Banda Sea. Furthermore, the tuna stock assessments conducted by such tuna RFMOs do not cover the neritic tuna species.

Many Southeast Asian countries have attempted to assess the tuna stocks in their respective EEZs and national waters with support from regional/international organizations such as SEAFDEC, FAO, RFMOs, among others. However, Chee (1995) pointed out that the inadequate information in most countries on the distribution and migration of the several tuna species as well as on stock structure even though biological information be collected independently by many countries, does not merit proper assessment of the tuna stocks. Many countries in the region are known to have also conducted several workshops with the objective of assessing the stocks of tuna, for example the workshop in Indonesia (SFP, 2009) which aimed to determine the stocks of tunas in its waters. The workshop indicated that insufficient and inaccurate statistical data (that meet the data requirements for scientific stock assessments) still prevail up to now, therefore satisfactory results of scientific stock assessments relating to tunas are not available in many countries of the region. Nonetheless, tuna experts at the workshop agreed that although reasonable stock size of Indonesian tunas could not be estimated to date, indicators should be established to predict the condition of Indonesian tuna fisheries, instead of coming up with the actual estimation of the tuna stock size *per se*.

## IV. Requirements for Tuna Fisheries Policy and Management

Exploitation of tuna at particular time, age, and size by one country will definitely affect the catch of other neighboring countries since tunas are migratory stocks. In order to address this concern, a concerted effort of all parties involved in tuna fisheries in the Southeast Asian region is deemed necessary. Specifically, a coordinated regional approach is necessary in order to gather the appropriate data and carry out analyses and interpretations that could lead to effective management. The important geographic features and large marine ecosystems in the region include spawning grounds of important tuna species as could be gleaned from the total tuna production of the Southeast Asian region and in the RFMO areas.

In this connection, development of sustainable management for tuna fisheries in the Southeast Asian waters should be considered at national and regional levels although this should not be isolated from that of the RFMOs, in fact, such regional management schemes should be complementary. However, since relevant data are still not sufficient for effective tuna stock assessment at national, sub-regional and regional levels, therefore a regional working group should be established to focus on the stock assessment of each tuna species. Results of the stock assessment would be used to support the development of fisheries policies and effective management for sustainable tuna fisheries in the Southeast Asian region.

Box 1. Key issues to be addressed under the proposed regional cooperation for sustainable tuna fisheries management in the Southeast Asian waters.

1) **Stock Assessment at National and Sub-regional Areas**
   - ❖ Establishment of working group(s) on tuna stock assessment under the SEAFDEC Regional Advisory Committee (RAC) framework
   - ❖ Improvement of national data collection systems
     - ✓ Support routine biological and resources surveys
     - ✓ Separate high seas production from domestic tuna production
   - ❖ Promote collaborative/joint research surveys in the EEZs and sub-regional areas
2) **Impacts on Environment, Biodiversity and Tuna Stock**
   - ❖ Fishing Gear Selectivity
     - ✓ Reduction of the by-catch of endangered aquatic species such as marine turtles, dolphin, sharks and rays, etc. from long-line fisheries
     - ✓ Reduction of juvenile tuna by-catch (*e.g*. yellowfin and bigeye tuna) in purse seine fishing
   - ❖ Fish Aggregating Devices (fixed or drifting)
     - ✓ Proper management of FADs through control and monitoring
   - ❖ R&D on the use the appropriate FADs in terms of low impact to environment
   - ❖ Establishment of the fish *refugia* to protect spawning and nursery grounds
   - ❖ Establishment of closed season for conservation and management
3) **Effective Fisheries Management**
   - ❖ Fishing Fleet Management: consider maintaining or reducing fishing capacity to strike a balance of existing tuna stocks
   - ❖ Tuna fisheries management within the EEZs and sub-regional areas: consider appropriate input-output control practices
4) **IUU Fishing**
   - ❖ Develop and promote an appropriate regional catch documentation schemes or RFMOs catch documentation schemes
   - ❖ Strengthen MCS through sub-regional cooperation to prevent the IUU fishing practices by foreign vessels
5) **Socio-economics**
   - ❖ Enhance intra-regional trade of tuna raw materials and tuna products in the region
   - ❖ Promote appropriate fish-handling technology and practices at sea
   - ❖ Support the proposed eco-labeling of tuna fishery products within the ASEAN
6) **Human Resources/Capacity Building**
   - ❖ Identification of tuna species particularly juveniles of yellowfin and bigeye tuna
   - ❖ Life history of tuna focusing on the larval stages
   - ❖ Improvement of data collection systems including database at national and regional levels
   - ❖ Stock assessment using appropriate assessment model(s)

## V. Regional Cooperation to Promote Sustainable Tuna Fisheries

Thus, for the promotion of sustainable tuna fisheries in the Southeast Asian region, a regional cooperation is necessary to support tuna fisheries management in the future. In this regard, the SEAFDEC Council during its 45th Meeting in April 2013 considered the proposed development of fisheries policy framework to support tuna management at national and sub-regional areas where transboundary issues exist specifically in Sulu Sea, Celebes Sea, South China Sea, and Andaman Sea. While encouraging relevant tuna countries to pool their resources in moving towards sustainable management of tuna fisheries in the Southeast Asian region, especially in addressing the various issues and concerns (Box 1) and in order to attain the desired goal of the proposed Regional Cooperation, the SEAFDEC Council

suggested that SEAFDEC could consider developing a draft plan of action under the Regional Cooperation to include efforts in enhancing traceability, development of tuna catch certification scheme, conduct of joint stock assessment, and combating IUU fishing in tuna fisheries.

## VI. Way forward

This concept proposal for regional cooperation for sustainable tuna fisheries management in the Southeast Asian waters was raised at the 45th Meeting of SEAFDEC Council held in April, 2013, after discussion and deliberation the Council supported the proposal with a note that the initiative would not lead to creation of new tuna management mechanism in the region. In addition, the Council also recommended that the SEAFDEC Secretariat should develop a draft plan of action under the regional collaboration, to include efforts in enhancing traceability, development of tuna catch certification scheme, conduct of joint stock assessment, and combating IUU fishing in tuna fisheries. In response to the Council's recommendation, SEAFDEC plan to develop the Strategic Plan of Action for Regional Cooperation for Sustainable Tuna Fisheries in the Region with the separate target species for neritic tuna and oceanic tuna to be surfaced by the ASEAN Sectoral Working Group on Fisheries (ASWGFi) and higher authority of ASEAN for consideration and policy support. In connection to this, SEAFDEC will also support the Collaborative Research Programme on Tuna in the Sulu-Sulawesi Sub-regional Area under the cost-sharing policy using SEAFDEC Research Vessels. The first meeting will be carried out during the 3rd week of August 2013.

## VII. References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3. Globefish. 2008. Global Production and Marketing of Canned Tuna. Globefish Research Programme, vol. 93 (April 2008).
4. Infofish. 2007. Indonesian Tuna at Global Market. Infofish, Malaysia.
5. SEAFDEC (Southeast Asian Fisheries Development Center). 2010. Fishery Statistical Bulletin of Southeast Asia 2010. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 135 p.
6. SEAFDEC (Southeast Asian Fisheries Development Center). 2012. The Southeast Asian State of Fisheries and Aquaculture 2012. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 130 p.
7. SFP (Sustainable Fisheries Partnership). 2009. Scoping out: Indonesian Tuna Fisheries – Sustainable Fisheries Partnership, Indonesia.

**Attachment J**

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

**Scientific Committee**
**Ninth Regular Session**

**Pohnpei, Federated States of Micronesia**
**6-14 August 2013**

# RECORD OF THE SCIENTIFIC COMMITTEE'S WORK PROGRAMME

**Secretariat**

This is a standing document which needs to be updated as needed. The Secretariat added more information to the last version, Attachment H, SC8 Summary Report.

The purpose of this record is to allocate a unique number to individual SC projects for future reference, to describe explicit terms of reference for any project contracts, and compile historical project activities. This will be a standing document for an annual update if needed. An Informal Small Group may meet in the margin of SC9 to review and update the contents in the following matrix with budget implications to be included if needed for review and recommendation to the Commission.

**Category used in the matrix**

DS – Data and Statistics
SA – Stock Assessment
EB – Ecosystem and Bycatch
MI – Management Issues
BI – Biology
FT – Fishing Technology
ME – (Assessment) Methods

## RECORD OF THE SCIENTIFIC COMMITTEE'S WORK PROGRAMME

| Project number (priority) | Category | Description | Status |
|---|---|---|---|
| Project 1. (Priority = High) SPC-OFP services | DS | Title<br>**Database management and control**<br><br>Description<br>Incorporate data provided by Members, Cooperating Non-Members and Participating Territories (CCMs) under the Commission's data provision policy into existing databases and facilitate access of Commission Secretariat staff to those data as appropriate.<br><br>Tasks/TOR<br>• Update databases and install at WCPFC headquarters<br>• Update Catch/Effort (CES) and Regional Observer Programme (ROP) database query software installed at WCPFC headquarters<br>• Provide WCPFC Staff training as required<br><br>History<br>• The budget for SPC's data management services were proposed at SC2 and endorsed by WCPFC3 (December 2006, USD 139K) and started in 2007as a SPC-OFP's scientific service agreement (Annex I). | Active ongoing |
| Project 2. (Priority = High) SPC-OFP services | DS | Title<br>**Annual catch estimates**<br><br>Description<br>Compile estimates of annual catches by species, gear type and flag, as specified in the procedures for Scientific Data to be Provided to the Commission and in support of the functions of the Commission and its subsidiary bodies.<br><br>Tasks/TOR<br>• Compile annual catch estimates of CCMs by species and gear<br>• In conjunction with WPEA Project, conduct catch estimation workshop and compile annual catch estimates for West Pacific East Asia (WPEA) countries.<br>History<br>• SC1 reflected budget for the IPDCP and review for Vietnam's tuna fisheries, some of which was endorsed by WCPFC2. Since then, the Commission continued to support IPDCP and WPEA Project.<br>• SPC (Mr Peter Williams) continued to involve in IPDCP and WPEA Project activities as an in-kind contribution. Travel cost was provided by the Project budget. | Active ongoing |
| Project 3. (Priority = High) SPC-OFP services | DS | Title<br>**Estimates of other target and non-target catches**<br><br>Description<br>For catches for which estimates are not otherwise available, conduct statistical analyses to estimate catches, particularly in regard to a) purse-seine catches of bigeye, skipjack and yellowfin tuna, b) discards of target tuna species, and c) catches of non-target species.<br><br>Tasks/TOR<br>• Conduct analyses as described in the Description section and provide SC papers<br><br>History<br>• Related with (c) above, SPC provided WCPFC-SC8-2012/EB-WP-18 (Estimation of catches and fate of edible bycatch species taken in the equatorial purse seine fishery, | Active ongoing |

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| | | G. Pilling, S. Nichol, and S. Harley), based on SC7 recommendation in Para 457, SC7 Report.<br>• SC8 requested to continue this work (Para 450, SC8 Report). | |
| Project 4. (Priority = Medium) SPC-OFP services | DS | Title<br>**Publication of Regional Tuna Bulletin**<br><br>Description<br>Produce and publish on the Commission's website two issues of the Regional Tuna Bulletin, containing estimates of monthly catch rates for WCPO fleets, based on the most recent data available.<br><br>Tasks/TOR<br><br>History | Dis-continue |
| Project 5. (Priority = Medium) SPC-OFP services | DS | Title<br>**Publication of Tuna Fishery Yearbook**<br><br>Description<br>Produce and publish on the Commission's website the Tuna Fishery Yearbook, containing annual catch estimates by gear type, flag and species.<br><br>Tasks/TOR<br>• Refer to Description section<br><br>History<br>• Data from the previous year are presented in the current year's document | Active ongoing |
| Project 6. (Priority = High) SPC-OFP services | DS | Title<br>**Estimation of catch and effort data for assessed contribution and CMMs**<br><br>Description<br>Compile estimates of catch and effort in support of the functions of the Commission and its subsidiary bodies, such as a) estimates of annual catches by vessel flag, EEZ, and archipelagic waters, for use in determining the catch component of the Commission's assessed contributions; and b) estimates of catch and effort in support of conservation and management measures.<br><br>Tasks/TOR<br>• Estimate annual catches by vessel flag, EEZ, archipelagic waters, and IATTC/WCPFC overlap area for use in determining the catch component of the Commission's assessed contributions<br>• Provide catch and effort data regarding the revision of relevant CMMs as requested<br><br>History<br>• The estimates of catch and effort data and related analyses have been provided to the SC for review and to the Commission for the revision of relevant CMMs | Active on going |
| Project 7. (Priority = High) SPC-OFP services | DS | Title<br>**Dissemination of public domain data**<br><br>Description<br>Disseminate public domain catch, effort and size data on the Commission's website at agreed level of resolution.<br><br>Tasks/TOR<br>• Refer to Description section | Active ongoing |

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| | | History<br>• WCPFC website:<br>Home/Science and Scientific Data Functions/Tuna Fishery Data<br>• Status of the provision of data to the Commission: http://www.wcpfc.int/statprov<br>• Public domain data: http://www.wcpfc.int/science-and-scientific-data-functions/public-domain-data<br>• Coverage rates of tuna fishery data: http://www.spc.int/oceanfish/en/ofpsection/data-management/wcpfc/213/146-wcpo-tuna-fishery-data-coverage | |
| Project 8. (Priority = High) SPC-OFP services<br><br>Move this to Project 15 | WPEA | Title<br>**West Pacific East Asia Oceanic Fisheries Management Project**<br><br>Description<br>The objective of the project is to strengthen national capacities 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). Refer to Project Document for details.<br><br>Tasks/TOR<br>• Participate in the work of data collection and annual catch estimation of the WPEA countries (Participate in the WPEA OFM Project)<br>• WPEAOFM has two overall components: i) monitoring, data enhancement and fishery assessment; and ii) policy, institutional strengthening and fishery management.<br><br>History<br>• Originally started as the Indonesia and Philippines Data Collection Project (Projects 14) and compilation of information on the tuna fisheries of Vietnam.<br>• Implementation of the IPDCP (2004-2009)<br>• Implementation of the 1st phase of the WPEA OFM project (2010-2012)<br>• Refer to SC3-GN-WP-07 Report of the Steering Committee on IPDCP.<br>• WCPFC Secretariat and UNDP is working on Phase 2 of WPEAOFM | Active ongoing (The 1st phase of WPEA OFM finished in March 2012) |
| Project 9. (Priority = Medium) SPC-OFP services | DS | Title<br>**Data format**<br><br>Description<br>Develop data standards for port sampling and observer programmes in association with WCPFC Secretariat.<br><br>Tasks/TOR<br>• Refer to Description section<br><br>History<br>• Data standards have been adopted by the Commission | Completed |
| Project 10. (Priority = High) SPC-OFP services | DS | Title<br>**Data rules of the Commission**<br><br>Description<br>Advise the Executive Director regarding the development of a) Rules and Procedures for the Access to and Dissemination of Data, and b) the Information Security Policy.<br><br>Tasks/TOR | Completed (retain as required for periodic inputs) |

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| | | • Will require ongoing periodic monitoring as the information and data management policies and procedures of the Commission evolve.<br><br>History<br>• This has been in each annual work plan for many years. There has not been much year-to-year progress. It would be better to engage in this process only periodically (e.g. once every three years). Also need legal advice beyond the expertise of SPC. | |
| Project 11. (Priority = High) SPC-OFP services | DS | Title<br>**Data gaps**<br><br>Description<br>Identify known data/information gaps in the current stock assessment, particularly in relation to operational level CPUE data.<br><br>Tasks/TOR<br>• Determine the status of CCM's provision of scientific data to the Commission and produce SC papers on data gaps<br>• Rescue of historical commercial catch data from countries in the western Pacific Ocean, including Vietnam (ref. Project 15)<br><br>History<br>• A number of potential explanations for different data gaps were identified, including the time and resources required to access and collate historical records, the long voyage times for some distant-water longline fleets and the large and dispersed nature of small boat fleets in Indonesia and the Philippines.<br>• A number of members cited specific issues with the summary of data gaps presented in the paper and SPC-OFP undertook to revise the information accordingly in consultation with the relevant members.<br>• SPC continued to produce data gap related documents since SC1 (WCPFC-SC1-ST-IP-02) and SC8 produced WCPFC-SC8-2012/ST-WP-1 (Scientific data available to the WCPFC). | Active ongoing |
| Project 12. (Priority = High) SPC-OFP services | DS | Title<br>**Data gaps – Development/maintenance of data gaps website**<br><br>Description<br>Within the next 12 months, deploy on WCPFC website a prototype computer programme that will allow gaps in data to be easily identified.<br><br>Tasks/TOR<br><br>History<br>• ST-SWG priority.<br>• Undertaken in 2008 jointly with WCPFC Secretariat. | Ongoing<br><br>~~Completed 2008~~ |
| Project 13. (Priority = High) SPC-OFP services | DS | Title<br>**Data gaps – Data forms**<br><br>Description<br>Review current unloadings data forms used in the region, and the proposed WCPFC transhipment reporting form, to determine their adequacy for scientific purposes.<br><br>Tasks/TOR<br>• Review of data forms<br><br>History<br>• ST-SWG priority. | Completed 2008 |

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| Project 14. (Priority = High) Consolidate with Project 8 | DS | Title<br>**Indonesia and Philippines Data Collection Project**<br><br>Description<br>Indonesia and Philippines Data Collection Project (IPDCP)<br><br>Tasks/TOR<br>• IPDCP: Data collection from port sampling in Indonesia and the Philippines.<br><br>History<br>• Refer to SC3-GN-WP-07 Report of the Steering Committee on IPDCP.<br>• 2004-2009: IPDCP activities in Indonesia and the Philippines.<br>• 2010-2012: WPEAOFM Project activities<br>• WCPFC Secretariat and UNDP is working on Phase 2 of WPEAOFM | ~~Active ongoing~~ Completed |
| Project 15. (Priority = High)<br><br>Move Project 08 to this row | WPEA | Title<br>**West Pacific East Asia Oceanic Fisheries Management Project (WPEA)**<br><br>Description<br>The objective of the project is to strengthen national capacities 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). Refer to Project Document for details.<br><br>Tasks/TOR<br>• Participate in the work of data collection and annual catch estimation of the WPEA countries (Participate in the WPEA OFM Project)<br>• WPEAOFM has two overall components: i) monitoring, data enhancement and fishery assessment; and ii) policy, institutional strengthening and fishery management.<br>• Specific project activities include:<br>- Recover historical tuna catch data in the WPEA countries<br>- Data collection from port sampling<br>- Maintenance of database<br>- Capacity building in data collection/management and stock assessment<br>- Strengthening policy, legal and institutional arrangements to fully comply with WCPFC requirements<br>- Review of tuna association activities<br>- Development of national tuna management plan<br><br>History<br>• Originally started as the Indonesia and Philippines Data Collection Project (Projects 14) and compilation of information on the tuna fisheries of Vietnam.<br>• Implementation of the IPDCP (2004-2009)<br>• Implementation of the 1st phase of the WPEA OFM project (2010-2012)<br>• Refer to SC3-GN-WP-07 Report of the Steering Committee on IPDCP.<br>• WCPFC Secretariat and UNDP is working on Phase 2 of WPEAOFM<br><br>Note<br>• The original TOR of Project 15 was to rescue historic tuna catch data, but now this activity is imbedded into WPEA Project under the same Project number 15. From now on, Project 8 will not be cited, instead, Project 15 will represent WPEA Project. | Active ongoing (Merged to Project ~~14~~08) |
| Project 16. (Priority = Medium) | DS | Title<br>**Commission's publication and distribution of identification/training material for data collection**<br><br>Description | Completed |

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| | | Publication and distribution of Commission's training and educational materials.<br><br>Tasks/TOR<br>• Development of training materials and the production of material to facilitate the identification of target and non-target species by fishermen, observers, and port samplers with the objective of improving data quality.<br><br>History<br>• During 2007, additional guides were developed by the FT-SWG on longline and purse-seine bycatch species.<br><br>Comments:<br>1. Work included the production of three identification guides for distinguishing yellowfin from bigeye tuna in three condition states (fresh, brine frozen, damaged) useful for the training of observers and port samplers. The guides were produced in English and have since been translated into seven languages for use by all tuna RFMOs. Additional photographic guides were produced to assist the identification of longline and purse seine non-target species. Expenditures under this Project were mainly used to fund the reproduction and distribution of these guides to various agencies and organizations for training purposes.<br>2. These guides are still available on the Commission website at no cost (Documents SC3-FT-IP-05, 06, 07 at http://www.wcpfc.int/meetings/2007/3rd-regular-session-scientific-committee) but funds for their printing and distribution in hard copy may be desirable in the future.<br>3. Recommend that this project be moved to a list of inactive but potentially useful projects. | |
| Project 17. (Priority = High) | DS | Title<br>**ROP – development of data fields**<br><br>Description<br>Draft list of minimum data fields for the Regional Observer Programme be annotated with explanations of what each field is and why it is needed and detail describing the format (e.g. units of measure, codes) to be used when collecting each field.<br><br>Tasks/TOR<br>• As shown in the Description above.<br><br>History<br>• ST-SWG priority.<br>• Undertaken by WCPFC Secretariat during 2008. | Completed |
| Project 18. (Priority = High) | DS | Title<br>**Sampling size**<br><br>Description<br>Determine appropriate sample sizes for length-frequency sampling strategies.<br><br>Tasks/TOR<br>• Relates to all target species but yellowfin was identified as priority species.<br><br>History<br>• SA-SWG priority<br>• Incorporate this project into Project 60 | Inactive and Deleted |
| Project 19. (Priority = High) | DA | Title<br>**ROP – development of data fields**<br><br>Description | Inactive |

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| | | Identification and description of operational characteristics of the major WCPO fleets and identification of important technical parameters for data collection.<br><br>Tasks/TOR<br>• Includes characterization of operational features at both vessel and set or operational levels useful for effort standardization and the evaluation of fishing efficiency, targeting and bycatch mitigation.<br>• Includes use of simple proxies and other means as tangible indicators of increasing fishing power (i.e. individual or fleet landings per annum, and/or estimates of the number of FADs deployed each year).<br>• Includes monitoring of operational features related to depths fished by longline hooks and depths of purse-seine nets.<br>• Includes monitoring and reporting on new developments in fishing gear and practices, fishing modes and related shore side developments as they relate to changes in fishing power.<br>• Supply time-depth recorders and hook timers to regional observer programs undertaken by SPC-OFP.<br><br>History<br>• FT-SWG priority.<br>• WCPFC9 approved the inclusion of data fields into ROP data fields on i) the mass of added weight attached to branch lines, ii) distance between weight and hook (in meters), and iii) the fate (dead, alive or injured) and number of seabirds for each species in each of these categories and whether the seabirds were released alive or discarded dead. | |
| Project 20. (Priority = Low) | DS | Title<br>**Measurement of fishing capacity**<br><br>Description<br>Examine and review the technical aspects of capacity measurement and monitoring of fisheries within the WCPFC Convention Area.<br><br>Tasks/TOR<br>• This project may be undertaken by the TCC, but the FT-SWG TOR was modified in 2006 to accommodate capacity work.<br>History<br>• FT-SWG priority.<br><br>Comments:<br>1. FT-SWG no longer exists so no progress.<br>2. Recommend that this Project be moved to a list of inactive but potentially useful projects. | Inactive |
| Project 21. (Priority = Low) | MI | Title<br>**Socioeconomic influences on fishing behavior**<br><br>Description<br>Investigate and promote studies on socioeconomic influences on fishing strategies, spatio-temporal fishing patterns, and influences on effective fishing effort.<br><br>Tasks/TOR<br>• As noted in the Description section above<br><br>History<br>• FT-SWG priority.<br>Comments:<br>1. FT-SWG no longer exists so no progress.<br>2. Recommend that this Project be moved to a list of inactive but potentially useful | Inactive |

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| | | projects. | |
| Project 22. (Priority = High) SPC-OFP services | SA | Title<br>**Stock assessment**<br><br>Description<br>Undertake stock assessment for target and non-target species as requested by the Commission.<br><br>Tasks/TOR<br>• Refinement of data and data structure used for stock assessment.<br>• Quantification of changes in fishing efficiency due to changes in fishing gears and fish finding technologies – Medium Priority. (Used to model changes in selectivity over time required in MFCL assessment models - Cross-reference with Project 27 for non-OFP project work)<br>• Quantification of changes in longline selectivity due to changes in gear types and patterns of deployment – Medium Priority. (Used to model changes in selectivity over time required in MFCL assessment models. SPC-OFP services as time allows.)<br><br>History<br>• Annual commitment.<br>• SC8 and WCPFC9 approved Project 69 (Improvement of MFCL) and Project 70 (Improvement of stock assessments in line with recommendations from the report of the peer review for the 2011 bigeye tuna stock assessment) | Active ongoing |
| Project 23. (Priority = High) SPC-OFP services | SA | Title<br>**CPUE analysis**<br><br>Description<br>Undertake standardization of longline catch and effort data, including where appropriate operational-level data, and the construction of indices of stock abundance for species of interest to the Commission.<br><br>Tasks/TOR<br>• There are many issues to explore relating to CPUE standardization. Need to develop a specific work programme on this with funding support.<br><br>History<br>• Annual commitment<br>• Compare with Project 29 | Active ongoing |
| Project 24. (Priority = Medium) SPC-OFP services | SA | Title<br>**Indicator analysis**<br><br>Description<br>Development and reporting of stock indicators for those key species not formally assessed.<br><br>Tasks/TOR<br>• Conduct stock indicator analysis and formulate most-up-to-date management advice to Commission if stock assessment is not undertaken.<br><br>History<br>• SC4-SA-WP-09 (Compendium of fisheries indicators for target tuna species)<br>• SC8-SA-WP-02 (A compendium of fisheries indicators for bigeye, skipjack, yellowfin, and south Pacific albacore tunas and south Pacific swordfish) | Active ongoing |
| Project 25. (Priority = High) | SA | Title<br>**Sensitivity analysis** | Active ongoing |

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| SPC-OFP services | | Description<br>Continued exploration of sensitivity of stock assessment outcomes to structural assumptions in models and data issues, including the comparison of various stock assessment models.<br><br>Tasks/TOR<br>• This work also includes the development of better diagnostics to more objectively determine plausible model structure.<br>• Work programme for 2008 included a comparison of MFCL, SS-2 and other stock assessment models for yellowfin or bigeye tuna.<br>• This will be more routinely incorporated into the assessments if it is felt to be informative.<br><br>History<br>• ME-SWG priority. | |
| Project 26. (Priority = High) | SA | Title<br>**Stock assessment of South Pacific swordfish**<br><br>Description<br>Stock assessment of the SP swordfish.<br><br>Tasks/TOR<br>• Data compilation and stock assessment of South Pacific swordfish<br><br>History<br>• SA-SWG priority (NP swordfish belongs to 'northern stocks' and assessment by ISC)<br>• 2006: Full stock assessment of swordfish in the southwest Pacific.<br>• 2008: Full stock assessment.<br>• 2011: Data collection and CPUE analysis.<br>• In March 2012, WCPFC8 agreed to conduct swordfish stock assessment as requested by the European Union. SPC-OFP is undertaking this work and conducted CPUE analysis in 2012.<br>• Stock assessment will be finalized in 2013 for presentation at SC9 | Active ongoing (periodic) |
| Project 27. (Priority = Medium) | SA | Title<br>**Changes in catchability**<br><br>Description<br>Investigation and quantification of changes in catchability of target and non-target species, including bycatch and incidental species, over time not included in the CPUE standardization.<br><br>Tasks/TOR<br>• Many factors, not reported in logbooks, influence catchability. The comparison of catch rates obtained by individual research projects where details of gear and fishing practices have been extensively documented may allow changes in catchability to be investigated and possibly quantified.<br><br>History<br>• SA-SWG priority (cross-reference Project 23/22). | Inactive (links with other projects) |
| Project 28. (Priority = Medium) | MI | Title<br>**Harvest control rules**<br><br>Description<br>Development of procedures and decision rules (harvest control rules) to assist the interpretation of stock assessment results and the formulation of management recommendations. | Active ~~(Due for completion 2012)~~<br><br>See Project |

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| | | Tasks/TOR<br>Develop harvest control rules for skipjack and south Pacific albacore tuna, including the most simplistic (e.g. constant catch and constant effort) for SC8 and one of the slightly more complex harvest control rules (e.g., state-dependent rules) for MOW, and compare their performance against some indicators of interest to fisheries managers.<br><br>History<br>• SA-SWG priority.<br>• SC8-MI-WP-03 (Introduction to harvest control rules for WCPO tuna fisheries). | 58 and 63 –<br><br>58: Evaluation of reference points and decision rules (harvest control rules))<br><br>63: Identifying provisional decision rules |
| Project 29. (Priority = High) SPC-OFP services | SA | Title<br>**Refinement of stock assessment models**<br><br>Description<br>[Further refinement of the stock assessment model, MFCL, including simulation testing of new developments as appropriate and refinement of models for CPUE standardization]<br>[Refinement of models for CPUE standardization]<br><br>Tasks/TOR<br>• Work programme for 2008 included designing a more efficient recruitment parameterization (High priority) and incorporation of length-based selectivity (Medium priority).<br>• There are a number of other matters that need to be addressed, including a long-term project to re-write the software to make it more transparent, better documented, and include new features (multi-sex, species, and stock options).<br><br>History<br>• ME-SWG and SA-SWG priority.<br>• SC5-SA-IP-07 (Update of recent developments in MULTIFAN-CL and related software for stock assessment)<br>• WCPFC9 approved Project 69 (Improvement of MultiFan Catch at Length). So MFCL part of this project can be moved to Project 69.<br><br>Comments<br>• Compare with Project 23 (CPUE analysis) | Active ongoing – refer to Project 69 |
| Project 30. (Priority = Medium) SPC-OFP services | SA | Title<br>**Recruitment analysis**<br><br>Description<br>Development of recruitment indices independent of the MFCL model, including the investigation of recruitment and oceanographic trends.<br><br>Tasks/TOR<br>• Development of recruitment indices for incorporation into stock assessment models (e.g. | Deleted as requested by the SC4 |

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| | | for yellowfin tuna based on further investigation of the relationship between oceanography and recruitment estimates from MFCL) (Para 31.d, Attachment J, SC4 Report)<br>• Required to index recruitment in stock assessment models. Major advances made in 2007 need to be followed up and formally incorporated into assessments.<br>History<br>• SA-SWG and ME-SWG priority | |
| Project 31. (Priority = High) | SA | Title<br>**Models for CPUE standardization**<br><br>Description<br>Improve existing, and explore alternative, models for standardization of effort and the construction of indices of stock abundance.<br>- To improve existing fishing catch effort standardization models for construction of stock assessment indices for key tuna species in the WCPO (bigeye, yellowfin, skipjack and albacore) and to explore and develop alternative standardization models.<br><br>Tasks/TOR<br>• Includes tasks identified by the ME-SWG at SC3: the continued identification of factors that influence CPUE, understanding and quantification of the changes in catchability over time not included in the CPUE standardization models, and identification of alternative catchability trends for inclusion in stock assessment models, and the calculation of regional weighting factors.<br>• Specific tasks include:<br>- Identify the relative importance of factors which influence catch per unit effort (CPUE) in the major WCPO fisheries (longline and/or purse seine).<br>- Through the use of standardization models, quantify time-series variation in catchability for key tuna species for inclusion into WCPFC stock assessments.<br>- Develop alternative catchability trends for inclusion in stock assessment models.<br>- Review regional weighting factors currently used in the bigeye and yellowfin tuna assessments and identify potential improvements.<br>- Incorporate the Additional Information that you provided during communication with Research Sub-Committee into this study.<br><br>History<br>• SA-SWG and ME-SWG priority.<br>• SC5-SA-WP-07 (Generalized linear Bayesian models for standardization of CPUE with incorporation of spatial-temporal variations) | Inactive |
| Project 32. (Priority = Medium) | SA | Title<br>**Incorporation of uncertainty in projections**<br><br>Description<br>Further consideration of how to reflect uncertainty in projections.<br><br>Tasks/TOR<br>As noted in the Description section above<br><br>History<br>• ME-SWG priority.<br>• Move to Project 28 | Active ongoing (now Project 28) |
| Project 33. (Priority = ~~Medium~~) Low | SA | Title<br>**Development of new stock assessment models and associated software**<br><br>Description<br>Development of new stock assessment models and associated software. | Inactive (links to project 60) |

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<tr><td></td><td></td><td>Tasks/TOR<br><br>History<br>• ME-SWG priority.</td><td></td></tr>
<tr><td>Project 34. (Priority = High) SPC-OFP services</td><td>SA</td><td>Title<br>Options for contributing to a reduction in fishing mortality for bigeye and yellowfin tuna, including FAD closure<br><br>Description<br>Further review of spatio-temporal aspects of catches of juvenile bigeye and yellowfin tuna caught in association with FADs by updating the analysis presented in WCPFC3-2006-16. Refine the assessment of management options presented in the paper on the basis of the latest available fishery information.<br><br>Tasks/TOR<br>• Research items to be considered over the three-year planning horizon:<br>a) With new skipjack and bigeye tuna assessments and the 2007 yellowfin assessment, conduct multi-species management options analyses, including economic outcomes of options on each sector.<br>b) Purse-seine fishery characterization – as a first step in developing an operational model of the fishery and more formal management strategy evaluation work.<br>c) More spatial analysis – perhaps adopting the statistical approach of estimating latitude, longitude and seasonal effects on associated set (small juvenile) yellowfin and bigeye tuna catches.<br><br>History<br>• WCPFC3-2006/16 (Proposal in respect of para. 11 of CMM 2005-01)</td><td>Completed</td></tr>
<tr><td>Project 35. (Priority = High)</td><td>SA</td><td>Title<br>Refinement of bigeye parameters Pacific-wide: A comprehensive review and study of bigeye tuna reproductive biology<br><br>Description<br>To further conduct biological analyses, to review sensitivity of the new parameters, and to strengthen the need toward the Pacific-wide study<br><br>Tasks/TOR<br>a) Objective: To obtain accurate scientific information on maturity, spawning locations, sex ratios, and fecundity for inclusion in stock assessments of bigeye tuna in the Pacific Ocean.<br>b) Items to be considered as a joint research between IATTC and WCPFC<br>Based on tagging studies to date, the movements of bigeye are geographically restricted. The limited amount of mixing across the Pacific Ocean can create differences in life history characteristics as a function of differences in oceanography and genetic structure. Therefore, obtaining size and age based estimates of bigeye reproductive characteristics from spatial strata across the Pacific Ocean would be useful for inclusion in bigeye stock assessments, since current estimates are based on inadequate spatial strata and limited sample sizes to have much confidence for inclusion in Pacific-wide assessments.<br><br>History<br>• Original proposal
<table>
<tr><td colspan="2">Pilot study</td><td colspan="4">Pacific-wide study</td></tr>
<tr><td>2009</td><td>2010</td><td>2011</td><td>2012</td><td>2013</td><td>2014</td></tr>
<tr><td>30,000</td><td>29,000</td><td>62,000</td><td>236,000</td><td>350,000</td><td>129,000</td></tr>
</table>
• Adjusted proposal, as of December 2012 (WCPFC9 budget)</td><td>Active (Due for completion 2016)</td></tr>
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| | | <table><tr><td>Planning stage</td><td colspan="3">Pilot study?</td><td colspan="5">Pacific-wide study?</td></tr><tr><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td><td>2013</td><td>2014</td><td>2015</td><td>2016</td></tr><tr><td>15K</td><td>30K</td><td>30K</td><td>31K</td><td>55K</td><td>70K</td><td>75K</td><td>75K</td><td></td></tr></table><br>• It is important to address some of the outstanding issues related to the biological parameters for bigeye, but we also need to ensure work is done on other species for which much less data are available. Hopefully, the priority species will identify themselves through the ecological risk assessment process. In the WCPO, we have a range of similar or even more critical issues related to yellowfin and albacore.<br>• SC8-SA-WP-03 (Bigeye tuna age and reproductive biology progress report)<br>• SC7-SA-WP-01(Bigeye tuna age, growth and reproductive biology progress report)<br>• SC6-BI-WP-01 (Bigeye tuna age, growth and reproductive biology progress report)<br>• SC4 recommended this study and WCPFC5 (2008) endorsed<br>- Sampling period: Oct 2009 – Jan 2010, present results to SC6 (2010)<br>- Sampling delayed and extended to Aug 2010.<br>- Lap analysis: Sep – Nov 2010<br>- Final report to WCPFC Secretariat in Dec 2010<br>• SC3 (2007) allocated budget for the feasibility study and produced document SC4-BI-WP-07. | |
| Project 36. (Priority = High) | SA | Title<br>**Age and growth of the target tuna species**<br><br>Description<br>This can be part of Project 35 where biological samples for yellowfin and skipjack are also collected.<br><br>Tasks /TOR<br>• An initial project within this category is regional differences in growth from length-frequency data for yellowfin and bigeye.<br><br>History<br>• Studies on age and growth have been priority of the Biology SWG. | Active (Part of project 35) |
| Project 37. (Priority = High) | EB | Title<br>**Analysis of FAD impacts on trophic dynamics**<br><br>Description<br>Analysis of FAD impacts on trophic dynamics<br><br>Tasks/TOR<br>• **This work is required for a better understanding of the biological impacts of FADs.**<br><br>History<br>• **Budget level**: USD 70,000 over two years (SPC and University of Hawaii proposal).<br>• SPC noted that the only progress on this is the collection of samples for isotope analyses and fatmeter for condition. Lab analyses have not been undertaken. SPC will host a PhD student from the University of South Hampton in 2013 who will address hypotheses on this topic but the results from this work will not be available until SC10 in 2014. We might want to grant an extension to this project.<br>• SC5-EB-IP-05 (Progress in the study of the pelagic ecosystem trophic dynamics)<br>• SCTB16 Working Paper YFT-7 (2003. The biology of FAD-associated tuna: Temporal dynamics of association and feeding ecology) | Active (Due for completion 2014) |
| Project 38. (Priority = Low) | SA | Title<br>**Otolith microchemistry study**<br><br>Description | Active |

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| | | Recent advances in extraction of microchemistry samples from fish otoliths provide the potential for observing regional water chemistry differentiation in the otoliths of pelagic species; hence a natural tag for estimating stock mixing and large-scale tuna movement.<br><br>Tasks/TOR<br>• Feasibility study to determine the effectiveness of otolith microchemistry to estimate stock mixing and large-scale tuna movement.<br><br>History<br>• **Budget level: USD** 60,000 over one year (SPC and University of Hawaii proposal).<br>• Independent of WCPFC funding, David Itano (UH, now NMFS) has been involved in an otolith microchemistry project for stock discrimination of yellowfin and bigeye tuna in the central Pacific.<br>• SPC (Simon Nicol) has some ongoing otolith microchemistry with CSIRO for albacore. | |
| Project 39. (Priority = High) | SA | Title<br>**Regional study of the stock structure and life-history characteristics of South Pacific albacore**<br><br>Description<br>WCPFC4 (2007) endorsed funding to a 3-year project that was developed by Australia in conjunction with New Zealand, SPC-OFP and other CCMs. The project can directly address stock assessment needs for one of the principal target species in the WCPO and can be of direct benefit to a range of CCMs. It is targeted for final delivery to the Scientific Committee in August, 2011. The Commission's funding of USD 25,000 in 2009 was a partial support to the first year of the whole project worth USD 500,000 over three years (Table 6 of the SC4 Summary Report).<br><br>Tasks/TOR<br>• Collect biological samples (otoliths, spines, gonads & muscle) from albacore caught in the southwest Pacific in cooperation with AFMA, SPC and MFish using the sub-sampling regime designed in the tactical project1.<br>• Determine length-weight conversion factors for albacore in the eastern tuna and billfish fishery<br>• Depending on successful age validation, determine the age of 2000 albacore and investigate age-related stock parameters including catch-at-age and regional/sexual differentiation in growth<br>• Determine reproductive-based stock parameters for South Pacific albacore including sex ratio statistics, maturity schedule(s), spawning fraction and batch fecundity (by size/age) using macroscopic and modern histological techniques<br>• Provide key population biological parameters on age, growth, maturity and fecundity to harvest strategy and stock assessment scientists<br><br>History<br>• BI-SWG Priority.<br>• A proposal to undertake this work was developed by Australia and conjunction with New Zealand, SPC-OFP and other CCMs (e.g. New Caledonia, French Polynesia, FFA countries).<br>• **Total Budget**: AUD 820,000 over three years and the Commission supported USD 25,000 for 2008, 2009, and 2010 to CSIRO (Jessica Farley).<br>• This project was successfully finished and the final report was submitted to the Secretariat in July 2012, and posted on SC8's website. | Completed |
| Project 40. (Priority = Medium) | SA | Title<br>**Life-history characteristics of non-target species**<br><br>Description<br>Life-history characteristics of non-target species identified by the ERA as high risk. | Completed 2010 |

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| | | Tasks/TOR<br>Conduct ERA.<br><br>History<br>• BI-SWG priority. | |
| Project 41. (Priority = Medium) | EB | Title<br>**Development of a biological database for inclusion on the WCPFC website.**<br><br>Tasks/TOR<br>1. Development of a bycatch mitigation database for inclusion on the WCPFC website.<br><br>History<br>• BI-SWG priority.<br>• The Commission contracted with SPC for the development of "Bycatch Mitigation Information System" (BMIS), which is annually updated with TCC's budget.<br>• ~~Development of bycatch and bycatch mitigation database (currently BMIS is developed and managed by SPC, funded by TCC budget).~~<br>• If any use is to be made of this database, there would be considerable ongoing work required to populate the various database tables. Some of this, but not all, could be done under other OFP service items (bycatch estimation).<br>• There is also a concern that the additional components added on (e.g. ERA attributes, non-target catch estimates and species utilisation) probably weren't envisaged at the start and the work involved will go beyond the time/funds originally envisaged in the contract.<br>• ~~Some funding would need to be allocated in future budgets if this work is to be ongoing.~~ | Active<br><br>See Project 50 |
| Project 42. (Priority = High) | SA | Title<br>**Pacific-wide tagging project.**<br><br>Description<br>• Main objectives are to obtain information on movement, stock structure, growth, mortality, behavior, habitat utilization, and vulnerability for use in stock assessments for yellowfin, bigeye and skipjack tunas.<br>• The Commission supports coordination fee for this project.<br><br>Tasks/TOR<br>- Undertake a preliminary analysis of the vertical distribution of skipjack, yellowfin and bigeye tunas associated with FADs, as indicated by acoustic tagging data. This item is related to the analysis of data from the PNG Tagging Project and scientists from other CCMs will participate in this project. Future work will be in the context of Phase 2 tagging.<br>- Ongoing and newly funded research with sonic and archival tags in Hawaii, PNG and other areas. Ongoing. (Currently funded SPC-OFP and University of Hawaii projects).<br><br>History<br>- Refer to GN WP-10 for the Phase 2 proposal of regional tuna tagging.<br>• Funding is a limiting factor for Pacific Ocean tuna tagging experiments and should be sought from a broad range of sources, including member and non-member countries with substantial financial interests in these fisheries, Global Environment Facility, and non-governmental organizations, particularly foundations interested in supporting scientifically based tuna conservation efforts.<br>• The budget required for a two-year pan-Pacific tagging project would be at least USD 9 million for conducting a wide coverage project in the WCPFC Convention Area alone. Approximately USD 2.4 million has been identified through SPC projects. To provide some additional perspective, the Indian Ocean Tuna Commission tagging project over three years in a much smaller area than the Pacific (or even the Convention Area) cost USD 19 million. | Active (Due for completion 2015) |

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| Project 43. (Priority = High) | EB | Title<br>**Ecological risk analysis, including productivity-susceptibility analysis (2008-2010)**<br><br>Description<br>SC3 (2007) recommended this study and approved by WCPFC4 (Dec. 2007) as a three-year project (2008-2010). After this, SC6 (2010) recommended Shark Research Plan and WCPFC7 (Dec 2010) approved the Plan for 2011-2012. WCPFC9 (Dec 2012) approved the revision of a 3-year MOU with SPC (Jan 2013-Dec2015) which includes Shark Research Plan.<br><br>Tasks/TOR<br>• Conducting multi-species productivity-susceptibility analyses (PSAs) and integrating national and regional scale risk assessment processes<br>• Identifying areas of spatial and temporal overlap of seabird and sea turtle interactions with tuna fisheries<br>• Estimating sea bird mortality<br><br>History<br>• Ongoing ERA work programme submitted to SC3 and endorsed (cf. EB-WP-3). WCPFC4 (Dec. 2007) approved for ERA during 2008-2010.<br>• Includes USD 30,000 for identifying areas of spatial and temporal overlap of seabird and sea turtle interactions with tuna fisheries in the WCPO (ACAP).<br>• ERA budget of USD 130,000 was included in SPC-OFP scientific services budget in 2009 (SC5) which was approved at WCPFC6 (Dec. 2009) for use in 2010.<br>• WCPFC7 (Dec 2010) switched ERA to shark research:<br>WCPFC7 Report:<br>*144. WCPFC7 approved the shark research plan and the reallocation of existing funds within the scientific services budget (USD 792,000 in 2012) to support shark assessments during 2011 and 2012.* | Completed (ERA completed in 2010)<br><br>See Project 48, 54, 68 |
| Project 44. (Priority = High) | EB | Title<br>**Seabird and turtle education and extension of fishers (Promotion of mitigation methods to fishers).**<br><br>Description<br><br>Tasks/TOR<br><br>History<br>SC9-EB-IP-04. Progress Report on the Development of a Seabird Identification Guide for use by tuna RFMOs | On-going<br><br>~~Completed 2012~~ |
| Project 45. (Priority = High) | EB | Title<br>**Education and dissemination of information relating to turtle de-hooking devices.**<br><br>History<br>SC5-GN-WP-13 (WCPFC Guidelines for the Handling of Sea Turtles)<br>SC5-GN-WP-14 (WCPFC Guidelines for the Handling of Sea Turtles - Graphics) | Completed 2012 |
| Project 46. (Priority = Medium) | EB | Title<br>**Ecosystem modeling**<br><br>Description<br>Development/review of models, such as full development of an EcoSim model, for evaluation of fishery and environmental impacts on an ecosystem, including development of reference points.<br><br>Tasks/TOR<br>Refer to Project 62 | Active<br><br>Merge with Project 62?? |

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| | | History<br>• Required modeling and assessing fishery impacts on ecosystems.<br>• This is separate from the ERA work. SPC-OFP will be undertaking work under SciFish project on continued development of SEAPODYM model and application to WCPO pelagic ecosystems. | |
| Project 47. (Priority = Medium) Low until enough observer coverage | EB | Title<br>**Turtle population assessments.**<br><br>Tasks/TOR<br>• Three-year project to continue into 2009, involving collation of data eventually leading to quantitative assessments. | Inactive |
| Project 48. (Priority = Medium) | EB | Title<br>**Survival of hooked and released seabirds**<br><br>History<br>- Will require sourcing external funding for satellite or archival tags. | Inactive<br><br>See Project 43, 54, 68 |
| Project 49. (Priority = Medium) | EB | Title<br>**Turtle tagging and associated materials.**<br><br>History<br>- Will require sourcing external funding for satellite or archival tags. Conventional tags can probably be obtained at little or no cost from SPREP. | Inactive |
| Project 50. (Priority = Low) | EB | Title<br>**Offal discards and haul-back mitigation studies.**<br><br>Description<br>To study the effects of offal discards and haul-back<br><br>Tasks/TOR<br><br>History (bullets below moved to Project 41)<br>~~• Development of bycatch and bycatch mitigation database (currently BMIS is developed and managed by SPC, funded by TCC budget).~~<br>~~• If any use is to be made of this database, there would be considerable ongoing work required to populate the various database tables. Some of this, but not all, could be done under other OFP service items (bycatch estimation).~~<br>~~• There is also a concern that the additional components added on (e.g. ERA attributes, non-target catch estimates and species utilisation) probably weren't envisaged at the start and the work involved will go beyond the time/funds originally envisaged in the contract.~~<br>• ~~Some funding would need to be allocated in future budgets if this work is to be ongoing.~~ | ~~Active~~<br>Inactive<br><br>~~ongoing (TCC funded BMIS; Remainder Inactive)~~ |
| Project 51. (Priority = High) | EB | Title<br>**Extension services to member countries for within EEZ ERA**<br><br>Description<br>• ERA methods can value add to ecosystem approach to fisheries management approaches being adopted by WCPFC member countries for fisheries planning and management at the EEZ scale.<br>• The extension services will be capacity building of ERA skills within these countries. | Completed 2009 |

Project 52. (Priority = High) SPC-OFP services

EB

Title

**Implementation of Shark Research Plan**

Description

SC6 (2010) recommended a Shark Research Plan and WCPFC7 (Dec 2010) approved the Plan for 2011-2012. WCPFC9 (Dec 2012) approved the revision of a 3-year MOU with SPC (Jan 2013-Dec2015) which includes implementation of the Shark Research Plan. WCPFC7 (Dec 2010) switched the budget portion for ERA included in the SPC's scientific services to the implementation of the shark research plan (Para 144, WCPFC7 Report).

Tasks/TOR

- Refer to the Shark Research Plan.

History

- EB-SWG priority.
- Shark Research Plan was proposed at SC6 and adopted at WCPFC7.
- CMM 2006-05 (replaced by 2010-07) requested that shark stock assessments be undertaken for key shark species.
- Shark research plan was approved by WCPFC7.
- WCPFC Designated[6] Key Shark Species

| Common Name | Scientific Name | Related actions and/or measures |
|---|---|---|
| Blue shark* | *Prionace glauca* | CMM 2008/06<br>WCPFC Stock Assessment 2013 |
| Oceanic white tip* | *Carcharhinus longimanus* | CMM 2008/06<br>WCPFC Stock Assessment 2012 |
| Shortfin mako shark* | *Isurus oxyrinchus* | CMM 2008/06<br>WCPFC Stock Assessment 2014 |
| Longfin mako shark* | *Isurus paucus* | CMM 2008/06<br>WCPFC Stock Assessment 2014 |
| Pelagic thresher shark* | *Alopias pelagicus* | CMM 2008/06 |
| Bigeye thresher shark * | *Alopias superciliosus* | CMM 2008/06 |
| Common thresher shark* | *Alopias vulpinus* | CMM 2008/06 |
| Silky shark* | *Carcharhinus falciformis* | CMM 2009/04 |
| Porbeagle shark | *Lamna nasus* | CMM 2010/07<br>(Reported south of 20 degs South) |
| Winghead hammerhead shark | *Eusphyra blochii* | CMM 2010/07 |
| Great hammerhead shark | *Sphyrna mokarran* | CMM 2010/07 |
| Scalloped hammerhead shark | *Sphyrna lewini* | CMM 2010/07 |
| Smooth hammerhead shark | *Sphyrna zygaena* | CMM 2010/07 |
| Whale shark | *Rhincodon typus* | Adopted at WCPFC9 |

*Core key shark species that are the focus of the shark research plan

Active ongoing

[6] For designation process refer to: http://www.wcpfc.int/doc/SC-08/Process-Designating-WCPFC-Key-Shark-Species-Data-Provision-and-Assessment

<table>
<tr><td></td><td></td><td>
<ul><li>Shark stock assessment</li></ul>
<table>
<tr><th>Year</th><th>Assessed species</th></tr>
<tr><td>2012</td><td>oceanic whitetip and silky shark (silky shark stock assessment was not accepted by SC8)</td></tr>
<tr><td>2013</td><td>Silky (revisit), NP blue shark, SP blue shark (CPUE only)</td></tr>
</table>
</td><td></td></tr>
<tr><td>Project 53. (Priority = Medium)</td><td>EB</td><td>Title<br>Investigation into fishing activities and catch composition of small vessels (e.g. longline vessels <24m)<br><br>Tasks/TOR<br>• To create a better understanding of the catch and effort and operational activities of small high seas vessels so that appropriate management measures (e.g. sharks and seabirds) can be considered for these vessels.<br><br>History<br>• EB-SWG priority.</td><td>Inactive</td></tr>
<tr><td>Project 54. (Priority = Medium)</td><td></td><td>Title<br>Bycatch mitigation study in longline fisheries<br><br>Description<br>Review scientific data to assess the inter-relationship between the effects of bycatch management measures using different longline gear types and mitigation measures on catches of turtle, shark and other target and non-target longline species.<br><br>Tasks/TOR<br>• Assess the impact of circle hooks, line weighting and other mitigation methods on the capture of target species, sea turtles, seabirds and sharks.<br><br>History<br>- EB-SWG priority.<br>- Some work has been done in the Atlantic and we could assess that.</td><td>Inactive<br><br>See Project 43, 48, 68</td></tr>
<tr><td>Project 55. (Priority = Medium)</td><td>EB</td><td>Title<br>FAD impacts on juvenile tuna and non-target species<br><br>Description<br>Undertake 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 gear in influencing purse-seine catches taken in association with FADs, with a view to identifying their impact in relation to mitigation measures to reduce catches of juvenile tuna and non-target species by purse-seine gear.<br><br>Tasks/TOR<br>1. Evaluate methods to reduce catches of small tuna, especially small bigeye tuna and other bycatch species taken by purse seine operations on floating objects.<br>2. Evaluation of methods shall examine pre-set avoidance of bycatch and options for safe releasing bycatch from the net and deck.<br>3. Research should be conducted onboard a tuna purse seine vessel whenever possible.<br>4. Evaluate various specifications and use of FADs and fishing gears in influencing purse seine catches taken in association with FADs.<br><br>History</td><td>Active<br><br><s>(Due for completion 2012)</s></td></tr>
</table>

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<ul>
<li>FT-SWG priority.</li>
<li>Includes seeking collaboration with industry to design of industry-associated studies related to selectivity and avoidance of small tunas and bycatch on floating objects. Assistance of the commission in promoting industry cooperation with in-kind contribution of vessel time is requested.</li>
<li>PNG supported USD 25,000 for FAD Bycatch Mitigation Research and David Itano working with ISSF conducted this research (contracted in January 2011). Funds have been used as per the project proposal to support established FAD bycatch mitigation programmes as the funds were insufficient to mount a stand-alone project of effective scope. Funds to date have been used to support bycatch mitigation research sponsored by ISSF. This project will be fully reported to SC8 as funds will be fully expended to close the project in 2012.</li>
<li>SC8 meeting documents on FAD study
<table>
<tr><td>SC8-EB-WP-11</td><td>Overview of the ISSF Bycatch Mitigation Research Cruise in the WCPO</td></tr>
<tr><td>SC8-EB-WP-12</td><td>The post-release condition of FAD associated silky sharks (Carcharhinus falciformis) caught in tuna purse seine gear. Rev 1</td></tr>
<tr><td>SC8-EB-WP-13</td><td>Behavior of target and non-target species on drifting FADs and when encircled by purse seine gear.</td></tr>
<tr><td>SC8-EB-WP-15</td><td>Review of Japan’s approaches to reduce bycatch of juvenile bigeye tuna by purse seine on FADs in tropical area of the western and central Pacific Ocean.</td></tr>
<tr><td>SC8-EB-WP-16</td><td>Study on the methods to reduce the by-catch of juvenile Bigeye tuna in purse seine FADs operations Rev 1.</td></tr>
<tr><td>SC8-EB-WP-17</td><td>Study on the methods to mitigate the bycatch of juvenile bigeye tuna by introducing Double-FADs with light stimulus for tuna purse seine fishery in the Western and Central Pacific Ocean</td></tr>
</table>
</li>
</ul>
</td>
<td></td>
</tr>
<tr>
<td>Project 56. (Priority = Medium)</td>
<td>EB</td>
<td>
Title<br>
Utilize underwater videos and other tools to characterize species, size composition and spatial distribution of tunas aggregating around floating objects.<br><br>
Description<br>
The issue of bycatch and small tuna fishing mortality on floating objects has become a problem shared by every RFMO that deals with tropical tuna issues. In the WCPO the issue has been expanded to include concern over the increased take of juvenile yellowfin tuna on floating object sets. These issues were recognized during the Third Regular Session of the Scientific Committee to the Commission (13-24 August 2007, Honolulu, Hawaii). It was suggested that an inexpensive and practical means to visually verify the size and species of fish aggregated to floating objects should be investigated. The gear may be tested on Hawaii anchored FADs and used during the equatorial research cruises on moored oceanographic buoys of the TOGA/TAO array, drifting FADs and floating objects. No specific funding was requested to conduct these tests above hardware costs.<br><br>
Tasks/TOR<br>
The scope of work will draw on, amongst other research and activities:<br>
a. A comparison study of echo sounder and visual images to investigate the ability to selectively target desirable sizes and species;<br>
b. A feasibility study or further research plan for the application of any findings from the comparison experiment above.<br>
c. Compile recommendations on any inexpensive and practical means to mitigate the mortality of small tuna on floating objects
</td>
<td>Completed</td>
</tr>
</table>

| | | | |
|---|---|---|---|
| | | History<br>• FT-SWG priority<br>• The unit used in the EPO by IATTC cost approximately USD 3,000. On advice from IATTC, it will likely be necessary that gear be suitable to depths of at least 100 m due to deeper thermocline and mixed layer depth in the WCPO. This will require greater pressure ratings and length of cables.<br>• This project was conducted by D. Itano for two years and project outputs were presented at SC meetings. | |
| Project 57. (Priority = High) | MI | Title<br>**Limit reference points**<br><br>Description<br>Identifying provisional limit reference points for the key target species in the WCPFC Convention Area.<br><br>Tasks/TOR<br>• Identify candidate indicators (e.g. $B_{current}/B_o$, $SB/SB_{MSY}$) and related limit reference points (e.g. $B_{current}/B_o$,=$X$, $SB/SB_{MSY}$=$Y$), 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.<br>• Using past assessments, evaluate the probabilities that related performance indictors exceed the values associated with candidate reference points.<br>• Evaluate the consequences of adopting particular limit reference points based on stochastic projections using the stock assessment models.<br>• Undertake a literature review or 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).<br>• Include the consideration of multi-specific effects on harvest control rules.<br><br>History<br>• Several researches on reference points have been conducted by SC.<br>• SC8-MI-WP-01 (*Evaluation of stock status of south Pacific albacore, bigeye, skipjack, and yellowfin tunas and SWP striped marlin against potential limit reference points*) | Active<br><br>~~(Due for completion 2012)~~ |
| Project 58. (Priority = Medium) | MI | Title<br>**Evaluation of reference points and decision rules (harvest control rules).**<br><br>Description<br>SC7 detailed three work areas to support the Commission's establishment of reference points:<br>1) evaluating the LRPs;<br>2) identifying candidate TRPs; and<br>3) introducing the concept of harvest control rules to operationalize reference points in the WCPFC.<br><br>Tasks/TOR<br>• Undertake a formal evaluation (e.g. Management Strategy Evaluation and robustness of stock assessments) of reference points and decision rules to guide the long-term management of key target species in the WCPFC.<br><br>History<br>• As of SC8, WCPFC-SC considered limit reference points, target reference points, and harvest control rules<br>• Develop harvest control rules for skipjack and south Pacific albacore tuna, including the most simplistic (e.g. constant catch and constant effort) for SC8 and one of the slightly more complex harvest control rules (e.g., state-dependent rules) for MOW, and compare | Active<br><br>~~(Due for completion 2012)~~<br><br>See Project 28 and 63 |

<table>
<tr><td></td><td></td><td>their performance against some indicators of interest to fisheries managers.<br>• SC8-MI-WP-03 (Introduction to harvest control rules for WCPO tuna fisheries)</td><td></td></tr>
<tr><td>Project 59. (Priority = Medium)</td><td>EB</td><td>Title<br>Management strategy evaluation (MSE) for non-target and protected species using semi-quantitative models.<br><br>Tasks/TOR<br>• ERA will identify species at risk from to the effects of fishing. For some of these species, the information available will be insufficient for a robust statistical stock assessment approach. However, a need to evaluate management options for these species will remain.<br><br>History</td><td>Inactive</td></tr>
<tr><td>Project 60. (Priority = High)</td><td>DS</td><td>Title<br>Collection and evaluation of purse-seine species composition data.<br><br>Description<br>• Collection of fish weight data onboard longline and purse-seine vessels using “at sea” scales.<br>• Continued study into sampling regimes for size and species composition of purse-seine catches.<br>• Port sampling programmes to determine the accuracy of cannery receipts in Noro, Solomon Islands and possibly other ports.<br>• Collaboration with other tuna RFMOs to examine factors affecting the sampling of purse-seine species composition.<br><br>Tasks/TOR for 2013<br>• Collect paired grab and spill samples from the WCPO purse-seine fishery and quantify the bias in species and size compositions determined from grab samples.<br>• Compare species compositions determined from i) logsheets, ii) grab samples, iii) spill samples, iv) cannery receipts, and v) port sampling of landing categories of catches delivered to the cannery at Noro, Solomon Islands and possibly other ports.<br>• Document spill sampling protocol.<br>• Develop procedures to correct historical catch and size data covering the WCPO purse-seine fishery for biases.<br><br>History<br>• In April 2009 (to be presented at SC5 in 2009), USD 54,500 was contracted to fund the “Collection and Evaluation of Purse-Seine Species Composition Data”. In December 2009, USD 54,500 was budgeted and in 2010, USD 90,000 was endorsed to support this project.<br>• In December 2011, no further budget was allocated to this project but requested to submit a “Plan for Improvement of the Availability and Use of Purse Seine Catch Composition Data” (WCPFC8-2011-IP/06). SC8 will consider budgetary implications of this Plan.<br>• 2013 = USD 75,000.
<table>
<tr><th>Proposed</th><th>Approved</th><th>Implemented</th></tr>
<tr><td>Early 2009: SPC submitted a proposal for funding support from the 2009 unobligated budget</td><td></td><td>Outputs: SC5-2009-ST-WP-03</td></tr>
<tr><td>USD 54,500 by SC5 (2009)</td><td>By WCPFC6 for 2010 activity</td><td>Outputs: SC6-2010- ST-WP-02</td></tr>
<tr><td>USD 60,000 by SC6</td><td>By WCPFC7 for 2011 activity</td><td>Outputs: SC7-2011- ST-WP-03</td></tr>
</table>
</td><td>Active<br><br>(Due for completion 2013)</td></tr>
</table>

| | | | |
|---|---|---|---|
| | | SC7-2011- ST-IP-02 | |
| None | USD 90,000 by WCPFC8 (Mar. 2012) for 2012 activity | Outputs:<br>SC8-2012-ST-WP-02<br>SC8-2012-ST-WP-03 | |

| | | | |
|---|---|---|---|
| Project 61. (Priority = High) | EB | Title<br>**North Pacific striped marlin mitigation methods.**<br><br>Tasks/TOR<br>• Analyze catch rates with regard to gear and operational modifications, spatio-temporal and oceanographic considerations.<br>• Modeling to incorporate gear and spatio-temporal effects to identify potential factors contributing to striped marlin catch reductions in North Pacific longline fisheries.<br><br>History<br>SC6-2010-EB-WP-01 (Evaluation of longline mitigation to reduce catches of North Pacific striped marlin in the Hawaii-based tuna fishery) | Completed 2010 |
| Project 62. (Priority = Medium) | EB | Title<br>**SEAPODYM simulation modeling.**<br><br>Description<br>Evaluation of fishery and environmental impacts on an ecosystem, including development of reference points<br><br>Tasks/TOR<br>• Collaboration between Collecte Localisation Satellites, Space Oceanography Division and SPC-OFP.<br>• Development of a Pacific swordfish application.<br>• Simulation experiments to improve the model calibration for tuna species, using higher resolutions of fishing data and oceanic environmental data.<br>• Model calibration for albacore with a basin-scale application, including both north and south populations.<br>• Incorporation of conventional and archival tagging data in the model calibration.<br>• Projection of impact of global climate change on distribution and abundance of tuna stocks.<br><br>History<br>• Required modeling and assessing fishery impacts on ecosystems.<br>• SPC-OFP will be undertaking work under SciFish project on continued development of SEAPODYM model and application to WCPO pelagic ecosystems.<br>• SC8-2012-EB-IP-06 (Project 62: SEAPODYM Working progress and applications to Pacific tuna and billfish populations and fisheries) | Active ~~ongoing see Project 46~~ |
| Project 63. (Priority = High) | MI | Title<br>**Identifying provisional decision rules.**<br><br>Description<br><br>Tasks/TOR<br>• For the key target species in the WCPFC, develop candidate harvest strategies (decision rules) based on present stock status.<br>• Define and/or quantify assessment uncertainty and articulate how this is to be incorporated within decision rules.<br><br>History | Active ~~Completed 2012 possible extension~~ Merge with Project 28 (Harvest control |

| | | | |
|---|---|---|---|
| | | • SC8-MI-WP-03 (Introduction to harvest control rules for WCPO tuna fisheries) | rules) and Project 58 |
| Project 64. (Priority = High) | SA | Title<br>**Stock assessment of Southwest Pacific striped marlin**<br><br>Description<br>Revised stock assessment of southwest Pacific striped marlin<br><br>Tasks/TOR<br>• A project to undertake this work is being developed by Australia in conjunction with New Zealand, SPC-OFP and other CCMs.<br>• This species is not one of the principal target species assessed by SPC-OFP but is an important target species for a number of CCMs. Australian and New Zealand scientists are proposing to undertake this work, and are seeking the Commission's endorsement because the research will have broader regional benefits. Support from the Commission would help secure funds from funding sources from Australia and New Zealand.<br><br>History<br>• 2011: Collation of South Pacific striped marlin data for a planned stock assessment in 2012 (USD 30,000), which is coordinated by S. Brower (New Zealand) – SC6 Report, Para. 514<br>• SC8-2012-SA-WP-05 (*Stock Assessment of Striped Marlin (Kajikia audax) in the Southwest Pacific Ocean*) | Completed 2012 |
| Project 65. (Priority = High) | SA | Title<br>**Peer review of stock assessment.**<br><br>Description<br>Conduct independent peer review<br><br>Tasks/TOR<br><br>History<br>• In 2012, a peer review was conducted on the 2011 bigeye stock assessment (SC8-2012-SA-WP-01)<br>• Include any others (e.g. Yellowfin Center of Independent Experts review). | Active ongoing |
| Project 66. (Priority = High) | MI | Title<br>**Identification and evaluation of target reference points (TRPs)**<br><br>Description<br>One research conducted by SPC. TRPs are supposed to be determined by fishery managers and MOW will consider this issue.<br><br>Tasks/TOR<br>Identify specific TRPs by species<br><br>History<br>• SPC-OFP conducted the Commission's consultancy in 2012 to identify and evaluate candidate target reference points for skipjack, including empirical reference points such as those based on CPUE as well possible target reference points derived from stock assessment models (SC8-2012-MI-WP-02) | Active<br><br>One research completed 2012 |
| Project 67. (Priority = | SA | Title<br>**Range contraction of tropical tunas, sharks, and billfish** | Active (Due for |

| | | | |
|---|---|---|---|
| High) | | Description<br><br>Tasks/TOR<br>• Recognizing that biomass for most WCPO stocks is estimated to be at historical lows and concerns have been raised by non-tropical coastal states about declines in the abundance of tropical tuna species, this project seeks to:<br>a) examine existing data to examine the spatial distribution of tropical tunas and related species is changing through time and with change is abundance;<br>b) develop models that allow the simulation testing of alternative hypotheses about spatial distribution patterns including range contraction; and<br>c) provide advice on the how the preservation of the spatial distribution of tropical species may impact on target and limit reference points.<br><br>History<br>- This is a newly proposed project in 2012 and no funding is sought from WCPFC at this time. | completion 2015) |
| Project 68. (Priority = High - once there is sufficient observer coverage) | EB | Title<br>**Estimation of seabird interaction, bycatch and mortality**<br><br>Description<br><br>Tasks/TOR<br>• EB-SWG priority<br>• Subject to the requests by CMM 2007-04<br><br>History | Inactive<br><br>See Project 43, 48, 54 |
| Project 69. (Priority = ) | SA | Title<br>**Improvement of MultiFan Catch at Length**<br><br>Description<br>Among the recommendations to improve stock assessments for bigeye tuna in the WCPO identified by the Review Panel and SPC stock assessment scientists during the peer review of the 2011 Bigeye Tuna Stock Assessment, were some specifically for the model used, i.e. MFCL, as tabulated in Attachment F of the SC8 Summary Report.<br><br>Tasks/TOR<br>The work to be done is detailed and prioritised in Attachment A. The items that will receive attention in 2013 are shaded and the rest will be covered in 2014.<br><br>History<br>SC8 recommended a budget of USD 40k. WCPFC9 endorsed the recommendation of SC8 and agreed the proposed budget of USD 40k. | |
| Project 70. (Priority = ) | SA | Title<br>**Iimprovement of stock assessments in line with recommendations from the report of the Peer Review for the 2011 Bigeye Tuna Stock Assessment**<br><br>Description<br>A number of improvements for stock assessments for bigeye tuna in the WCPO were identified by the Review Panel and SPC stock assessment scientists during the peer review of the 2011 Bigeye Tuna Stock Assessment. These recommendations were reviewed at SC8 and the findings of that review are tabulated in Attachment F of the SC8 Summary Report. | |

| | | | |
|---|---|---|---|
| | | Tasks/TOR<br>Work should proceed in line with the prioritization and timing indicated in the SC8 Summary Report Attachment F.<br><br>History<br>SC8 recommended that a budget of USD 160k p.a. for 3 years (2013-2015) and WCPFC9 agreed the proposed budget of USD 160,000 p.a. for 3 years. | |

**Abbreviations used in the table**

ACAP = Agreement on the Conservation of Albatrosses and Petrels
BI-SWG = Biology Special Working Group
BMIS = Bycatch Mitigation Information System
CCM = Members, Cooperating Non-members and participating Territories
CMM = conservation and management measure
CPUE = catch per unit effort
CSIRO = Commonwealth Scientific and Industrial Research Organisation
EB-SWG = Ecosystems and Bycatch Mitigation Special Working Group
EEZ = exclusive economic zone
EPO = eastern Pacific Ocean
ERA = ecological risk assessment
FAD = fish aggregation device
FT-SWG = Fishing Technology Special Working Group
IATTC = Inter-American Tropical Tuna Commission
IPDCP = Indonesia and Philippines Data Collection Project
ISSF = International Sustainable Seafood Foundation
ME-SWG = Methods Special Working Group
MFCL = MULTIFAN-CL (a stock assessment modeling approach)
PNG = Papua New Guinea
RFMO = regional fisheries management organization
SA-SWG = Stock Assessment Special Working Group
SC = Scientific Committee of the Western and Central Pacific Fisheries Commission
SEAPODYM = spatial ecosystem and population dynamics model
SPC = Secretariat of the Pacific Community
SPC-OFP = Oceanic Fisheries Programme of the Secretariat of the Pacific Community
SPREP = Pacific Regional Environment Programme
ST-SWG = Data and Statistics Special Working Group
TCC = Technical and Compliance Committee of the Western and Central Pacific Fisheries Commission
TOR= terms of reference
USD = United States dollars
WCPFC = Western and Central Pacific Fisheries Commission
WCPO = western and central Pacific Ocean
WPEAOFM = West Pacific East Asia Oceanic Fisheries Management Project

**Attachment K**

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

**Scientific Committee**
**Ninth Regular Session**

**Pohnpei, Federated States of Micronesia**
**6-14 August 2013**

## GUIDELINES OUTLINING THE PROCESS FOR FORMULATING THE WORK PROGRAMME AND BUDGET OF THE SCIENTIFIC COMMITTEE

The Fourth Regular Session of the Scientific Committee (SC4) adopted the process for formulating SC's work programme and budget as identified in Table 1 below. SC5 further considered Table 2 (Research proposal assessment criteria) and a template for project proposals in Table 3 and adopted the process as a revision. Further discussion was undertaken at SC9 where Table 1 was reviewed. This process may be reviewed as needed.

**Table 1:** Schedule outlining the process for implementing SC's work programme and science budget and identifying projects to be supported by the WCPFC science budget.

| Month | Task/Activity | Responsibility |
|---|---|---|
| 1) SC meeting in August, year 1 | 1. Review, prioritize (High, Medium, Low) and update Record of SC work programme<br>2. Select appropriate high priority projects for funding<br>3. Scope new high priority projects (objectives, scope and tasks, and expected outputs)<br>4. Formulate budget for SC's consideration<br>5. ISG recommends specific projects to SC plenary for consideration and adoption. | Informal Small Group, including Research Sub-Committee (RSC), makes recommendations on Task/Activity to SC plenary for consideration and adoption. Research Sub-committee includes Secretariat (coordinator), SC Chair, Theme Convenors, and Expert Advisors |
| 2) December, year 1 | 1. Commission reviews and endorses SC-recommended projects including the budget. | Commission |
| 3) January – July, year 2 | 1. Call for expressions of interest projects by posting advertisement on WCPFC's website<br>2. Secretariat distributes scoring matrix with received proposals to RSC members.<br>3. RSC members score projects, consider/negotiate budgets and scope of work with proposers.<br>4. RSC selects final projects for funding.<br>5. Secretariat finalizes contracts with selected consultants. | Secretariat, RSC, proposer |
| 4) August, year 2 | 1. Secretariat reports to SC on the progress described in section 3) above<br>2. Redo steps 1–4 in section 1) above. | Secretariat, ISG, RSC, SC, |

| | | |
|---|---|---|
| 5) December, year 2 – July, year 3 | 1. Same as shown in section 2) – 3) above | Commission, Secretariat, RSC, proposer |
| 6) August, year 3 | 1. Consultants present papers contracted in section 3) to SC detailing the work undertaken and results achieved.<br>2. Secretariat reports to SC on the progress described in section 5) above<br>3. Redo steps 1–4 in section 1) above | Consultant<br><br>Secretariat, ISG, RSC, SC |

**Table 2:** Research proposal assessment criteria.

| Assessment criteria | Score (1–5) | Justification for score |
|---|---|---|
| **Attractiveness** | | |
| Is the proposal aligned with a priority project listed in the Commission's Scientific Work Programme and the budget allocated to it? | | |
| Is the need and are the planned outputs/benefits well-defined and relevant? | | |
| Adoption and uptake. What is the level of impact and likelihood that the project outputs will be adopted? Is the pathway for uptake described? | | |
| Cost effectiveness: Is the project cost effective? Is it using other sources to lever additional funds? | | |
| Is there an appropriate level of collaboration between the applicant and other relevant researchers, fisheries managers and the fishing industry? | | |
| **Feasibility** | | |
| Are the objectives clearly specified and are they consistent with the planned project outputs/benefits? | | |
| Sound methodology: Is the project design/method well described and is it consistent with the projects objectives? | | |
| Likelihood of success: Are the project objectives likely to be achieved? | | |
| Is there a strategy for managing data arising from the project so that it will be easily accessible by others in the future? | | |
| Applicant's expertise/experience. Does the research team have the ability, capacity and track record to deliver the outputs? | | |
| **Total score** | | |

# Scores for assessing proposals: 1 = very low; 2 = low; 3 = medium; 4 = high; 5 = very high

**Table 3:** Proposals should address, as a minimum, the issues below.

| Part A: Administrative summary | Part B: Project proposal description |
|---|---|
| 1) Project title<br>2) Organization<br>3) Administrative contact<br>4) Principal investigator and CV<br>5) Commencement and completion date<br>6) Project budget summary: salaries, travel, operating and other | 1) Background and need (also identify which project within SC's work programme the proposal addresses)<br>2) Objectives and benefits<br>3) Project outcomes<br>4) Form of results<br>5) Methods<br>6) Risks of project not achieving project objectives<br>7) Schedule of milestones<br>8) Data management plan<br>9) Other related projects<br>10) Collaborations<br>11) Project staff and CVs<br>12) Detailed costs against milestones |

**Attachment L**

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

**Scientific Committee**
**Ninth Regular Session**

**Pohnpei, Federated States of Micronesia**
**6–14 August 2013**

# SCIENTIFIC COMMITTEE'S RESPONSES TO THE RECOMMENDATIONS OF THE PERFORMANCE REVIEW

- **Action (active /completed/ ongoing)**
- **Issue (policy/ management/ legal/ compliance/financial)**
- **Priority (high/ medium/ low/ underway)**

| Section | Recommendation | SC's responses | Action | Issue | Committee | Priority | Progress |
|---|---|---|---|---|---|---|---|
| | **Section 3 Convention and supporting instruments** | | | | | | |
| 3.2.8. 2003 FAO Technical Guidelines on the Ecosystem Approach to Fisheries (EAF) | • The Convention gives ample scope for development and implementation of the ecosystem approach to fisheries (EAF). However, the institutional mechanism established to facilitate implementation should be reviewed. Relevant recommendations relating to the need for review of the terms of reference and functions of the Ecosystem and Bycatch Specialist Working Group (EB-SWG) are made in Section 3.2.9, also taking into account the issues relating to bycatch and discards.<br>• A technical evaluation of the implementation of the EAF is provided in Section 5.4.2 of this document. Implementation of the EAF for Pacific Island developing States, which are also members of WCPFC, is supported by the Pacific Islands Forum Fisheries Agency (FFA). FFA has completed ecosystem approach to fisheries management (EAFM) reports for Cook Islands, Federated States of Micronesia, Palau, Tonga and Vanuatu. | • The Secretariat will coordinate a review of the EB Theme terms of reference (TOR) and functions intersessionally and propose amendments to include mechanisms to facilitate EAF implementation for SC to consider at SC10. | Active | Policy | SC/WCPFC | Medium | SC discussion |
| 3.2.9. 2010 FAO International Guidelines on Bycatch | • It is recommended that the terms of reference and functions of the EB-SWG should be evaluated with a view to the implementation of the "2003 FAO Technical Guidelines on the Ecosystem Approach to Fisheries and the 2010 FAO International Guidelines on Bycatch | • The Secretariat will propose a way forward that will allow SC to implement the recommendations in the two | Active | Policy | SC/WCPFC | High | SC discussion |

| Section | Recommendation | SC's responses | Action | Issue | Committee | Priority | Progress |
|---|---|---|---|---|---|---|---|
| Management and Reduction of Discards | Management and Reduction of Discards", and that priorities be agreed for the SWG as appropriate. In addition, it is recommended that conservation and management measures (CMMs) should reflect the implementation of these instruments, including provisions on management and reporting. | documents, SC will review the work and agree on priorities to implement these at SC10. | | | | | |
| | **5. Conservation and management** | | | | | | |
| South Pacific albacore | • Other explanations are possible for observed southern albacore biomass trends and further analyses appear justifiable;<br>• Despite the apparent appropriateness of the 2011 southern albacore assessment, the resultant conclusions are somewhat more pessimistic than previous assessments (i.e. $B/B_{MSY}$ closer to 1). Uncertainty still surrounds the current levels of fishing mortality and there appears to be justification for further research to improve the assessment model, as well as a need for an updated assessment in 2012;<br>• The South Pacific albacore stock is neither currently overfished, nor is overfishing occurring. Current biomass levels appear sufficient to support contemporary catch levels. However, any catch or effort increases are likely to result in declining catch rates, especially for longline catches of adult albacore. This will not only affect vessel profitability, but will also mandate management of vessels in strict conformity with CMM 2010-05; and<br>• There is probably a need to focus more on albacore longline fisheries north of 25°S, where considerable biomass depletion appears to be occurring with obvious implications for management. | • Noted<br>• Stock assessment is scheduled in 2015<br>• Update of CMM 2010-05 will be made in due course<br>• Indicator analysis and 2015 stock assessment will address this recommendation | Active | Science / Management | SC/TCC/ WCPFC | High – important issues for southern States and the effort has increased | Work is underway for more discussion at SC and TCC in 2013 |
| Bigeye | • WCPFC is to be commended for the several improvements forthcoming from the 2011 bigeye assessments compared with previous years;<br>• Such improvements would benefit further through the tabulation of annual bigeye purse-seine catch estimates, along with the estimation methods used;<br>• Continued research on tuna, particularly bigeye, life history characteristics should be encouraged. The importance of including scientists from the WCPFC region is recognized and should also be encouraged; | • Noted<br>• SPC will consider these recommendations when they conduct the 2014 stock assessment, including improvement of stock assessment by addressing peer review recommendations. | Active | Science / Management | SC/WCPFC | High<br>To be addressed initially by SC and SPC in the assess-ments | 2013/01 and SC for 2013 |

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| | • The Commission should encourage the Scientific Committee (SC) to continue its research-focused work on bigeye as outlined in para. 133 of the "Summary Report for the Seventh Regular Session of the Scientific Committee";<br>• SC and the Commission should be encouraged to actively address concerns attached to the possibility that bigeye is approaching, or is already in, an overfished state;<br>• Bigeye maximum sustainable yield (MSY) levels could rise if the fishing mortality of small fish is reduced. An added concern in this regard is that the harvesting of juvenile fish has led to a greater than 50% reduction in MSY from pre-1970 levels. While a reduction in the catch of small bigeye will allow more sustainable overall yields, recent overfishing will lead to further potential yield losses in the future. The priority attention of both SC and the Commission should be focused on this situation;<br>• There is some indication that 100% observer coverage of the bigeye purse-seine fleet will allow for fishery discards to be better assessed in the future. SC and the Commission are encouraged to give this notion serious operational consideration;<br>• Recently-developed, operational longline indices for bigeye have provided more optimistic perceptions of stock status than using aggregated longline data. A formal analysis of this observation should be encouraged to ensure that it is in fact appropriate and that is does not further stress a bigeye stock close to being overfished;<br>• Indonesia and the Philippines are encouraged to submit complete 2010 data for their bigeye surface fisheries. These should include purse-seine effort data;<br>• The Commission is encouraged to consider using a spatial management approach for measures aimed at ensuring sustainable bigeye fishing mortality levels, exploitation rates and depletion from various regions within the WCPFC Regulatory Area;<br>• The Commission should consider adopting additional measures above | • Project 35 (bigeye biology) will cover<br>• An ongoing activity<br>• CMM on tunas will consider this<br>• Noted<br>• SPC will consider this.<br>• Done<br>• The Commission will consider this.<br>• The Commission will consider this.<br>• Repeatedly emphasized. | | | | | |

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| | those expected from the current CMM so as to secure further reductions in bigeye fishing mortality, to ensure the return of the mortality rate *to* $F_{MSY}$.<br>• All Members, Cooperating Non-Members and Participating Territories (CCMs) are encouraged to provide data in strict accordance with WCPFC's data rules for scientific data. | | | | | | |
| Skipjack | • WCPFC is to be commended for the several improvements forthcoming from the 2011 skipjack assessments compared with previous years;<br>• The Commission is encouraged to again address concerns raised by the 2010 and 2011 SC statements[7] on reduction of skipjack availability at high latitudes as a result of high catches in the equatorial region;<br>• The Panel notes the relatively healthy nature of the skipjack stock;<br>• SC's ongoing efforts to improve the skipjack assessment model, aimed at enhancing understanding of stock status changes, are much appreciated;<br>• The Commission is encouraged to closely monitor future increases of western and central Pacific Ocean (WCPO) fishing effort on skipjack to mitigate catch rate declines associated with further biomass declines;<br>• The Commission is also encouraged to manage total purse-seine fishing effort in the WCPO as a matter or priority to limit increased fishing mortality of bigeye and yellowfin. Improving estimates of purse-seine catch species composition is very much supported, as are other associated sampling and data collection efforts. | • SPC will review these recommendations when they conduct the 2014 stock assessment.<br>• SC work programme Project 67, range contraction of tropical tunas, sharks and billfish, has been active since 2012.<br>• Noted<br>• Noted<br>• Noted<br>• The Commission will consider management issues. | Active | Science / Management | SC/WCPFC | High<br>Initially an issue for SC and SPC in the assess-ments | SC 2013 discuss-ion |
| Yellowfin | • WCPFC is to be commended for the several improvements forthcoming from the 2011 yellowfin assessments compared with previous years;<br>• The Commission is encouraged to give serious consideration to SC's advice that yellowfin fishing mortality in the western equatorial region should not increase;<br>• The Commission is encouraged | • Noted<br>• The Commission will consider this. | Active | Science / Management | SC/TCC/ WCPFC | High<br>SC and SPC to consider initially | SC 2013 discuss-ion then 2013/01 |

[7] These statements read: "There is concern, yet to be substantiated, that high catches in the equatorial regions could result i n range contraction of the stock, thus reducing skipjack availability to higher latitude (e.g. Japan, Australia and New Zealand) fisheries"

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| | to consider ways to reduce yellowfin juvenile fishing mortality;<br>• Projections for the yellowfin stock are essentially "optimistic" and that fishing mortality should remain below $F_{MSY}$ until 2021 and spawning biomass should remain above $SB_{MSY}$. The Commission is encouraged to give this situation serious attention; and<br>• Noting the highly positive results of the external review of the yellowfin tuna assessment by the Center for Independent Experts, the Panel is very much in sympathy with the view that such external reviews should be undertaken subject to terms of reference agreed by SC. In that respect, any independent review that does not access all available and relevant information, and/or operates under its own terms of reference, could seriously undermine SC's provenance. The Commission is, therefore, encouraged to reinforce the standing of SC as the source of the Commission's scientific advice and to ensure that this advice is not challenged by inappropriate, unclear or independently driven terms of reference that have not been agreed on by SC itself (further Panel comments on the issue of independent assessments of SC's work is provided in Section 5.6). | • The Commission will consider this.<br>• The Commission will consider this.<br>• Noted, and the Commission will consider this. | | | | | |
| Bigeye and yellowfin data | • WCPFC is encouraged to urge CCMs to provide annual bigeye and yellowfin catch and effort, and size composition, data for all fleets in the format required by the rules and requirements adopted by WCPFC as "Scientific Data to be Provided to the Commission".<br>• To the extent possible, the Commission should also consider requesting members to provide data by end of April after each fishing year so that SPC can have sufficient time to redo its models if necessary. | • CCMs are routinely reminded of their obligations to provide these data according to the "Scientific Data to be Provided to the Commission", which is evaluated on an annual basis through the SC data gaps paper, the WCPFC Compliance Monitoring and the Technical and Compliance | Active | Science and reporting | SC/WCPFC | Issues for SC and SPC to consider | 2013/01 |

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| | | Committee (TCC). | | | | | |
| South Pacific swordfish | • The ongoing shortage of data on which to base a comprehensive assessment of South Pacific swordfish is a matter of concern;<br>• WCPFC is encouraged to urge the European Union (EU) and the Secretariat of the Pacific Community (SPC) to devote all efforts to improving the WCPFC SPO swordfish data holdings;<br>• SC should be encouraged to undertake analysis of SPO swordfish fishery indicators for SC8; and<br>• Using information forthcoming from the above, and contained in Williams et al. (2011), SC should formally assess SPO swordfish as soon as possible, taking into account TCC data and statistical advice. | • SC conducted new full stock assessment in 2013.<br>• EU provided data.<br>• Done at SC8<br>• Done at SC9 | Complete | Science | SC/WCPFC | ssessment under way | Assess-ment due in 2013 |
| Southwest Pacific striped marlin | • The only available assessment for southwest Pacific striped marlin is now five years old. A new assessment, and utilization of any new information on the stock, are strongly encouraged and should be done as a matter of urgency. | • Recent 2012 stock assessment and 2013 research on catch hotspots addressed the recommendation. | Complete | Science / Management | SC/WCPFC | Assess-ment under way | ~~Assessment planned 2014~~ |
| North Pacific striped marlin | • Concerns expressed over the continued lack of an assessment for the North Pacific striped marlin stock appear justified;<br>• The Panel was concerned by the fact that information on the assessments undertaken by the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) was not readily available or accessible, and, therefore, recommended that transparency in this regard be considerably improved. Most noticeably, and ideally, all assessments undertaken by ISC should be peer reviewed and the results of these reviews made readily available for scrutiny by both SPC and SC;<br>• ISC, SPC and SC should be strongly encouraged to ensure that such an assessment is collectively undertaken in 2012;<br>• This assessment should be undertaken in conjunction with that recommended for the Southwest Pacific striped marlin; and<br>• To achieve and expedite the above, | • ISC conducted North Pacific striped marlin stock assessment in 2012, and SC8 reviewed.<br>• ISC stock assessments conducted in 2013 (North Pacific blue shark, Pacific blue marlin, Pacific bluefin tuna) are now under the external review process.<br>• Done<br>• Done<br>• Done | Complete | Science / Management | SC/WCPFC | SC and NC are working on this assessment | Assess-ment completed more discussion in 2013 |

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| | the Commission's attention is drawn to a need to clarify ISC's standing in respect of North Pacific striped marlin, as well as in relation to relevant provisions of the Convention and WCPFC's Rules of Procedure. | | | | | | |
| North Pacific albacore | • Note should be taken of the current situation regarding assessment of North Pacific albacore, particularly the independent review of the current North Pacific albacore measure by ISC; and<br>• It may be worth considering that the current North Pacific albacore measure be reviewed to ensure that it is able to actually restrain fishing mortality, particularly in light of past data shortcomings. | • Noted. Next assessment is planned in 2014 and will address these recommendations.<br>• CMM 2005-03 will be maintained pending a new assessment.<br>• The current measure attempts to restrict the increase of F from the current level. | Active | Science / Management | SC/WCPFC | High - SC to consider | SC discussion |
| Pacific bluefin tuna | • Note should be taken of the current situation regarding assessment of Pacific bluefin tuna; and<br>• WCPFC is encouraged to update its Pacific bluefin assessments, reduce Pacific bluefin fishing mortality to 2002–2004 levels, and provide for monitoring of fishing mortality for age 0–3 fish. | • Current CMM 2012-06 addressed monitoring of juvenile fishing mortality.<br>• ISC conducted full stock assessment in 2012 and SC reviewed in 2013. This may strengthen the measure. | Active | Science /Management | SC/NC | High - concerns have been expressed about this stock | Assessment updated will need more discussion in 2013 and beyond |
| North Pacific-swordfish | • Note should be taken of the current situation regarding assessment of North Pacific swordfish; and<br>• WCPFC is encouraged to update its North Pacific swordfish assessments in 2013 at the latest. | • According to 2010 stock assessment and 2013 projection, ISC advised that this stock is healthy. | Active | Science / Management | SC/WCPFC | Medium for SC to consider | SC discussion |
| | **5.4. The ecosystem approach** | | | | | | |
| 5.4.2. Key developments | • WCPFC is to be commended for pursing a pragmatically-focused ecosystem approach built on the ERA of direct linkages between fishing and the WCPO ecosystem(s);<br>• The Commission and SC are also to be commended for developing various mitigating measures to address fishery-species interactions for seabird, turtles | • List what data would be useful to expand data collection for fisheries and ecosystem interactions, and priorities information to be collected on | Active and ongoing | Management | SC/TCC/WCPFC | WCPFC has done a lot of work in this area | Ongoing SC and TCC |

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| | and sharks in particular;<br>• WCPFC is encouraged to expand data collection for potential fisheries and ecosystem interactions to provide priority information on such interactions to monitor interaction extent, mitigation effects and interaction effects;<br>• WCPFC is encouraged to further consider other effects likely to arise from fishing operations on the WCPO ecosystem. Such effects include lost, or abandoned, fishing gear and potential marine ecosystems[8] risks. At-sea monitoring may be necessary before such risks are identified;<br>• The question of general biodiversity protection does not appear to have been addressed as yet and the WCPF is encouraged to consider ways (e.g. using spatial protection) how this might be achieved;<br>• A number of regional fisheries management organizations (RFMOs) have instituted Scientific Observer Programmes to monitor and gather information on fisheries-ecosystem interactions and effects. Within the bounds of what may be practicable, WCPFC is encouraged to consider how such programmes[9] may assist its ecosystem work in terms of promoting an EAFM and ecological risk assessment (ERA) approach regionally;<br>• Some other RFMOs (e.g. the North Atlantic Fisheries Organization, NAFO) put policy guidelines in place for their EAFM approaches. These are sufficiently flexible to include recent best practice developments such as those initiated under UNGA Resolution 61/105. The Commission is encouraged to give the development of such tools serious consideration in the interests of strategically mapping out where it is going with its ERA activities. In these terms, a designated area of WCPFC's website for consolidating discussion on ecosystem issues might also be worth considering; and<br>• Following the previous comment, SC is | interactions to monitor the extent, mitigation effects and interactions rates with fishing gear. SC work plan should include the development of models to guide strategic development of an ecosystem based approach to managing these fisheries including the development of a regional plan of action on sharks and seabirds.<br>• SC include in its work plan investigations into biodiversity protection; the effects likely to arise from fishing operations on WCPO ecosystem risks. | | | | and the bycatch database is at SPC Issues for initial consid era-tion by SC | |

[8] For example, such risks include transference of alien and potential damaging species in bilge water. They also include considerations such as light pollution, net entanglements, etc.

[9] For example, a concern has been raised that the recent observer coverage of 3.6% in Australia's Eastern Tuna and Billfish Fishery (ETBF) makes estimation of Turtle-Fisheries interactions highly uncertain. The deployment of onboard mounted cameras as a means to collect much of the same data currently collected by observers has been identified as a potential solution

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| | encouraged to develop "plausible models" of WCPFC ecosystem to guide strategic development of its EAFM and to focus on key ecosystem components, including by means of a more structured regional plan of action on sharks and seabirds. | | | | | | |
| | **5.5. Data collection and sharing** | | | | | | |
| 5.5.2. Data submission requirements | • In general, information on data submission requirements appear adequate;<br>• However, some longline catch data are only provided after a lag of several months,[10] some CMMs lack the necessary infrastructure to ensure accurate and timely data submissions, and data are sparse for species other than billfish or tuna;<br>• The Commission is urged to encourage the Secretariat to make such information easily accessible, particularly with respect to ensuring that data deadlines are met, and especially for fisheries subject to CMMs in force, and/or requiring assessment;<br>• Serious consideration should be given to providing an enduring, and detailed "Data Submission" item on WCPFC's website as a "one-stop shop" for all data submission information; and<br>• To improve transparency attached to the timely submission of data, submission dates should be monitored by the Secretariat with the attached information being made available on the password protected portion of WCPFC's website | • Data gaps by data source and flag State are regularly posted on WCPFC's website. The SC data gaps paper provides a list and evaluation of the provisions of scientific data.<br>• WCPFC's Information Management System (IMS) now provides a web-based system so that the data-provision evaluation in individual CCM Compliance Monitoring Reviews are readily accessible to CCMs on WCPFC's website through secure login, including the facility for CCMs to respond to the evaluation where required. | Active | Science /Data | SC/WCPFC | High - SC to consider and advise | IMS work underway to improve data entry |
| 5.5.3. Data holdings | • WCPFC, SPC and CCMs are to be congratulated on the comprehensive data holdings now available for WCPFC stocks;<br>• Consideration should however be given to ensure that the provenance of WCPFC data holdings and the data held by the SPC are complementary and compatible; and<br>• Ongoing and timely publication of the WPCFC Tuna Fishery Yearbook is to be | • Considerable improvements; will be an ongoing priority. | Active | Science | SC/SPC-OFP/WCPFC | High - SC to consider and advise | SC discussion |

[10] In some cases in excess of 18 months after fishing has occurred

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| | commended. | | | | | | |
| 5.5.4. Data gaps | • WCPFC is encouraged to give serious consideration to SC7's concerns for data identified in Section 5.5.1, as well other data interests highlighted below;<br>• All CCMs are encouraged to provide data in a timely manner, and in strict accordance, with WCPFC's "Scientific Data to be Provided to the Commission";<br>• Indonesia and the Philippines are encouraged to submit complete 2010 data for their bigeye surface fisheries, including purse-seine effort data;<br>• Continuing difficulties attached to submission of Regional Observer Programme (ROP) data should be noted, and submission of such data is to be encouraged;<br>• Improving estimates of purse-seine catch species composition is very much supported, as are associated sampling and data collection efforts (Section 5.2);<br>• WCPFC is encouraged to urge CCMs to provide annual bigeye and yellowfin catch and effort data, as well as size composition, for all fleets in the format required by WCPFC as "Scientific Data to be Provided to the Commission";<br>• The ongoing shortage of data on which to base a comprehensive assessment of SPO swordfish is a matter of concern;<br>• WCPFC is encouraged to urge the EU and SPC to devote all efforts to improving the WCPFC SPO swordfish data holdings;<br>• WCPFC is encouraged to expand data collection for potential fisheries and ecosystem interactions to provide priority information on such interactions, to monitor its extent and effects, as well as the mitigation measures adopted and their results;<br>• Indonesian archipelagic waters catches should be included in the annual catch estimates between 2000 and 2010;<br>• Data inputs into pre-2000 Indonesian tuna fisheries annual catch estimates should be reviewed;<br>• Historical annual catch estimates using data from each of the domestic Vietnamese fisheries should be | (see below)<br>• Undertaken on a regular basis.<br>• Done<br>• ROP data submissions continue to improve.<br>• Significant progress.<br>• Undertaken on a regular basis.<br>• Improvements in the provision of SWO data but this work in ongoing.<br>• EU has now provided all operational data.<br>• Uncertain of the scope of the recommendation.<br>• Indonesia now includes archipelagic waters in their catches.<br>• Outstanding<br>• Historical estimates back to 2000 have been produced but not for years prior to 2000.<br>• Done<br>• Outstanding<br>• Major issues resolved. Ongoing.<br>• Some progress. Ongoing. | Active and ongoing | Science /Data | SC/WCPFC | High - SC to consider and advise | SC discussion |

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| | reconstructed;<br>• Logbook and port sampling data collection for Vietnamese purse-seine and gill net fisheries should be established;<br>• Vietnamese observer data should be reviewed to ensure their collection is in line with observer data collected elsewhere;<br>• Coastal States, fishing States, Chinese Taipei and Korea should be encouraged to specifically indicate whether double-counting of their reported catches is occurring or not;<br>• The four CCMs concerned — Japan, Korea, China and Chinese Taipei — should be encouraged to notify their intent to provide operational catch and effort data on longline fishing targeting bigeye and yellowfin to WCPFC;<br>• Submission of aggregated Chinese catch and effort data in the Pacific Ocean for 2003 to 2007 should be encouraged; and<br>• Capacity building should continue in Philippines, Vietnam and Indonesia, through the WPEA Project. | • Submitted.<br>• Significant progress. Ongoing. | | | | | |
| 5.5.5. Data access and sharing | • WCPFC is to be commended on the way in which it compiles and manages its data and information holdings, particularly in respect to the levels of access it provides, whilst also providing for data confidentiality when necessary; and<br>• The Commission and SC may wish to give thought to protecting the intellectual property contained in various assessment reports in the event of publication of such reports outside the organization (e.g. in scientific journals). | • Noted<br>• Noted | Ongoing | Science /Data | SC/WCPFC | Low - Issues for SC's consideration and advice | SC discussion |
| 5.6. Quality and provision of scientific advice | • Due recognition should be given to the vibrancy and high quality of scientific advice being provided to WCPFC by SC and SPC;<br>• The Commission is also encouraged to formally define SC's provenance as the key supplier of scientific advice to the Commission;<br>• The Commission is encouraged to resolve the remaining issues still outstanding from the 2008 "Independent Review of the Commission's Transitional Science Structure and Functions";<br>• Notable issues to be assessed include those highlighted above, namely:<br>• The need to strengthen confidence in | • Noted<br>• Noted<br>• Under consideration<br>• Done<br>• SC4-Appendix M was replaced by SC5-Attachment P, | Active | Science / Policy | SC/WCPFC | High - This appears to be an issue for WCPFC to decide, not SC | SC and WCPFC discussion on roles and responsibilities |

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| | data custodianship service so as to improve data submission shortfalls;<br>• Update guidelines[11] for processing the SC's work programme;<br>• Provide a mechanism to allow SC to request scientific information directly from ISC;<br>• Clarify the respective roles of SC and ISC in providing advice to the Northern Committee (NC) and SC. As the statutory WCPFC scientific advisory body, SC should lead endorsement of work done by the Commission's scientific advisors (see above); and<br>• Establish an Ad Hoc Group on Socioeconomic Issues;<br>• Subject to the above, the Commission is encouraged to clarify the role of ISC, and its associations with the Commission and SC, particularly in respect to direct exchanges of scientific information and advice;<br>• To encourage scientific transparency with respect to assessments being undertaken the same rigor should be applied to all the scientific advice provided to the Commission, to extent possible, in a standardized manner;<br>• SC is encouraged to continue developing a WCPFC Strategic Research Plan;<br>• SC is also encouraged to develop a summary document (i.e. "Blind Freddy's Guide") that provides information on the assessment it undertakes, as well as on the underlying science being pursued. This document should be produced in lay and easy- to-follow language aimed at enhancing understanding across all WCPFC participants (not just scientists); and<br>• The question of broadening scientific capacity available within CCMs should be considered further, possibly with a view to developing a WCPFC institutional policy on the matter, which would identify ways how such | which is updated by SC9.<br>• A mechanism was proposed through a revised memorandum of understanding (MOU) but declined at WCPFC7.<br>• A meeting will be convened to sort out the roles of SC and ISC<br>• Request the Commission to consider.<br>• Already reflected in the MOU between WCPFC and ISC.<br>• Done (SC provides scientific advice in a standardized manner: "Stock status" and "Management advice and implications").<br>• Done (Strategic Research Plan of the SC 2012–2016).<br>• Done (SC's Summary Report is an easy version of SC's working papers).<br>• Scientific capacity building is an ongoing activity through SPC's stock assessment and | | | | | |

[11] Appendix M of the SC4 Report. (At: http://www.wcpfc.int/meetings/2008/4th-regular-session-scientific-committee)

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| | capacity could be grown within the region. It is noted that a number of RFMOs (e.g. CCAMLR, ICCAT) have such policies in place to augment scientific capacity and build scientific expertise available to members from developing countries (as per the 1995 United Nations Fish Stocks Agreement[12] Articles 25.1(c) and 25.2). | data workshops, Western Pacific East Asia Oceanic Fisheries Management projects, and Japan Trust Fund projects. The Commission may consider developing a specific institutional policy. | | | | | |
| | **5.7. Adoption of conservation and management measures** | | | | | | |
| Skipjack | • The Panel notes that the skipjack stock is healthy, but that concerns have been expressed about high catches in the equatorial region, which could lead to a reduction in the availability of the species in high latitudes.<br>• It should also be noted that CMM 2008-01, although directed at bigeye tuna and yellowfin tunas, as discussed above, because it imposes limits on total purse-seine fishing effort, it also indirectly positively affects the skipjack stock.<br>• Considering the multispecies natures of the purse-seine fishery, the Panel welcomes the revision of 2008-1 currently scheduled for WCPFC 8, with the expectation that skipjack stock will be addressed by it in a more direct way. | • Noted | Active | Management / Science | SC/WCPFC | High - This is a critical stock and this advice should be considered by SC | Yes - picked up in 2012/01 and will be in 2013/01 |
| Southwestern Pacific striped marlin | • Considering that: a) six years have already passed since the first attempt to assess the condition of the southwest Pacific striped marlin stock, b) the significant uncertainties regarding the parameters used in the model; and, even more so, c) its results, indicating that the levels of fishing mortality might be approximating or have already exceeded $F_{MSY}$ and that current spawning and biomass levels were likely | • Recent 2012 stock assessment and 2013 research on catch hotspots addressed the recommendation. | Complete | Science Management | SC/TCC/WCPFC | Assessment under way | SC discussion |

[12] At: http://www.un.org/depts/los/convention_agreements/convention_overview_fish_stocks.htm

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| | close or already below $B_{MSY}$, the Panel strongly urges that a new assessment of<br>• This stock be undertaken as a matter of priority. To this aim, any new information available should be taken into account.<br>• Considering the species is taken almost exclusively as bycatch, the measure in place for this stock (2006-04), limiting the number of fishing vessels fishing for striped marlin in the Convention Area south of 15°S is ineffective because it does not address the actual catch taken. The Panel, therefore, urges the Commission on the basis of the new stock assessment to be done as matter of priority, to adopt and implement clear measures to limit fishing mortality. | • Commission will review and update or revise CMM 2006-04. | | | | | |
| North Pacific striped marlin | • The Panel urges that a new assessment of the stock be done as a matter of priority;<br>• Despite the 2010-01 measure being a positive step to reduce fishing mortality for the species, the Panel noted that the stipulation of a proportionate reduction in paragraphs 4 and 5 of the measure makes it difficult to figure out what is the actual catch limit for the species. This measure, including eventual catch limits, shall be revised upon the results of the new assessment to ensure that fishing mortality for the species is compatible with Convention objectives. | • North Pacific striped marlin stock assessment was completed in 2012 and SC provided advice to the Commission. ISC also made a projection in 2013 and SC reviewed.<br>• The Commission will review and update the current CMM 2010-01 in the future. | Complete | Science | SC/WCPFC | Assess-ment completed by ISC for consideration by SC | SC discussion |
| North Pacific albacore | • Considering that the stock of the North Pacific albacore has been assessed and is presently not overfished nor suffering overfishing (see Section 5.2), the present measure (2005-03), limiting the level of fishing effort to the one in 2005, despite being old, seems adequate and commensurate with the status of the stock.<br>• The Panel welcomes the independent review of the current ISC North Pacific albacore CMM, to ensure that fishing mortality is restrained in any future formulation of the measure. | • Noted<br>• Noted | Complete | Science | SC/WCPFC | NA | SC discussion |
| Pacific Bluefin tuna | • The present status of the Pacific bluefin tuna stock is not clear from available documents, particularly with respect to specific biological | • Refer SC9-SA-WP-10 (ISC's 2012 Pacific bluefin tuna | Active | Management | SC/WCPFC | High - Refer to SC | SC discussion |

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| | reference points, including present fishing mortality in relation to $F_{MSY}$ or $F_{0.1}$, for instance. This limitation makes it very difficult for the Panel to assess the status of the stock and the adequacy of current CMM;<br>• It is noted that CMM 2010-04 will be reviewed by NC on 2012 based on new ISC stock assessment for Pacific bluefin tuna;<br>• In respect of the above, the Panel notes that the SC has repeatedly advised a reduction of Pacific bluefin tuna fishing mortality to 2002–2004 levels or below. In particular, the reduction of juvenile (age-0–3 years) fishing mortality has also been advised, and NC has been requested to monitor it;<br>• The Panel urges the Commission to take account of the results of the new stock assessment and to develop biological reference points and clear harvest rules for this species as a matter of priority. | stock assessment report) and SC9-GN-IP-02 (ISC plenary report) for recent information on the current stock status.<br>• Done<br>• NC has been taking care of this as an ongoing issue.<br>• In response to a request by NC, ISC's Pacific Bluefin Working Group provided a suite of candidate references points. | | | | for consideration at next meeting | |
| North Pacific swordfish | • Although the North Pacific swordfish stock was assessed not to be overfished or suffering from overfishing, in 2009, the Panel encourages the Commission to consider advice offered by SC 9 on the scheduled NC assessment of North Pacific Swordfish in 2013. | • ISC's Billfish Working Group is planned to complete an updated North Pacific swordfish stock assessment in 2014. | Active | Science | SC/WCPFC | Medium - Refer to SC for advice to WCPFC | SC discussion |
| | **6.3. Monitoring, control and surveillance (MCS)** | | | | | | |
| 6.3.5. Other standards for verification of fisheries data | • The Panel notes, with concern, that several requirements with regard to data provision established in various CMMs, including timeliness, are not being adequately observed by CCM;<br>• It is unclear to the Panel to what extent the Secretariat validates the fisheries data submitted to it and the steps adopted to rectify obviously incorrect data (e.g. fishing taking place on land, due to misreporting of geographic position). | • The WCPFC Secretariat is not involved in the validation of fisheries catch data.<br>• SPC provides comprehensive validation and auditing in the data management systems used for processing fisheries data collected by Pacific Island countries, including field range checks, distance checks, | Complete | Science/Management | SC/TCC/<br>WCPFC | SPC cleans data as it is processed. | SC discussion |

| Section | Recommendation | SC's responses | Action | Issue | Committee | Priority | Progress |
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| | | positions on land, comparison with VMS data. These data are subsequently forwarded to WCPFC. | | | | | |