Standing Committee on Tuna and Billfish

SCTB12 • 16-23 juin 1999 • TAHITI

REPORT OF THE TWELFTH MEETING OF THE STANDING COMMITTEE ON TUNA AND BILLFISH

16–23 June 1999

Papeete, Tahiti

French Polynesia

November 1999

Prepared for publication and printed by the
Secretariat of the Pacific Community
Noumea, New Caledonia

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SUMMARY OF DISCUSSIONS

1. PRELIMINARIES

1. The Twelfth Meeting of the Standing Committee on Tuna and Billfish (SCTB12) was held from 16–23 June 1999, in Papeete, Tahiti, at the invitation of the French Polynesian Government. The Oceanic Fisheries Programme (OFP) of the Secretariat of the Pacific Community (SPC), New Caledonia, served as Secretariat for the meeting, and *Service des Ressources Marine* (SRM), French Polynesia, kindly hosted the meeting in Tahiti.

2. SCTB12 was attended by participants from American Samoa, Australia, Canada, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Japan, Kiribati, Korea, Nauru, New Caledonia, New Zealand, Niue, Northern Marianas, Palau, Papua New Guinea, Philippines, Samoa, Taiwan, Tonga, Tuvalu, USA, Vanuatu and Wallis and Futuna. Participants from the regional and international organisations of the Inter–American Tropical Tuna Commission (IATTC), Forum Fisheries Agency (FFA) and SPC also attended.

3. The agenda is presented in Appendix 1. The working papers presented at the meeting are listed in Appendix 2. The list of participants is presented in Appendix 3.

1.1 Opening Ceremony

4. The meeting opened with an address by the Minister of Marine Resources of French Polynesia M. Llewellyn Tematahotoa (Appendix 4). This was followed by a choral performance from the youth choir of *Tipaerui*, a prayer by M. Michel Mahuta, and an address by M. Jean Aribaud, the High Commissioner of the French Republic in French Polynesia. After an additional performance by the youth choir, the nominated SCTB12 chairman, Dr Ziro Suzuki, National Research Institute of Far Seas Fisheries (NRIFSF), Japan, gave a welcoming address, and was followed by an address from ‘Akau’ola, the Secretary of Fisheries, Tonga, on behalf of the Pacific Islands countries.

1.2 Confirmation of Chairman and Appointment of Rapporteurs

5. Dr Suzuki was confirmed as Chairman of SCTB12.

6. The appointment of coordinators for each SCTB working group was confirmed: Mr Tim Lawson for the Statistics Working Group, Mr Dan Su’a for the Albacore Research Group, Mr Naozumi Miyabe for the Bigeye Research Group, Dr Gary Sakagawa for the Yellowfin Research Group and Mr Peter Ward for the Billfish and Bycatch Research Group. The meeting was informed that the Coordinator for the Skipjack Working Group, Mr Joel Opnai, was unable to attend; Dr Antony Lewis was nominated and confirmed as interim chair in his place.

7. The SCTB12 Secretariat (OFP) assumed responsibility for coordinating the rapporteuring process and compiling the report of the meeting, with the assistance of participant rapporteurs. The SCTB12 Secretariat provided rapporteurs for agenda items 1–3 (Mr Keith Bigelow, Mr Aymeric Desurmont, Mr Tim Lawson, Mr Wade Whitelaw and Mr Peter Williams), agenda item 10 (Dr John Hampton) and agenda items 11–12 (Mr Williams). Rapporteurs for each SCTB working group were appointed as follows:

- **Agenda item 4 – Statistics Working Group:** Dr Shui-Kai Chang & Mr Lawson;

- **Agenda item 5 – Skipjack Research Group:** Mr Tim Park, Dr Chris O'Brien & Mr Miyabe;
- **Agenda item 6 – Albacore Research Group:** Mr Bigelow & Dr Talbot Murray;
- **Agenda item 7 – Yellowfin Research Group:** Mr Ward, Dr George Watters & Dr Norm Bartoo;
- **Agenda item 8 – Bigeye Research Group:** Mr Josh Mitchell, Dr Lewis, Dr Murray & Dr Robert Campbell;
- **Agenda item 9 – Billfish and Bycatch Research Group:** Mr Ward, Mr Williams, Mr Park, Dr O'Brien, Mr Whitelaw & Dr Murray.

1.3 Adoption of the Agenda

8. The agenda was adopted without modifications.

1.4 Adoption of the Report of the Eleventh Meeting of the SCTB

9. The report of the Eleventh Meeting of the SCTB, held in Honolulu, Hawaii, from 28 May to 6 June 1998, was adopted.

2. OVERVIEW OF WESTERN AND CENTRAL PACIFIC OCEAN TUNA FISHERIES

2.1 Regional Overview

10. Dr Lewis provided a brief overview of the Western and Central Pacific Ocean (WCPO) tuna fisheries, referring the meeting to Working Papers (WP) GEN–1 and SWG–2. The presentation described each of the fisheries by gear and fleet, with emphasis on 1998 catches relative to those of recent years.

11. The total WCPO catch of major tunas during 1998, was estimated at 1,773,787 metric tonnes (mt), a substantial increase (more than 200,000 mt) on the 1997 catch, and the highest on record for the WCPO, eclipsing the 1991 tuna catch of 1,647,000 mt. The purse seine fishery accounted for an estimated 1,158,326 mt (65%) of the total catch, with pole-and-line taking an estimated 262,678 mt (15%), the longline fishery an estimated 193,850 mt (11%), and the remainder (9%) taken by troll gear and a variety of artisanal gears, mostly in eastern Indonesia and the Philippines. The WCPO tuna catch represented 77% of the total estimated Pacific Ocean catch of 2,281,444 mt in 1998, and 52% of the provisional estimate of world tuna catch (3,400,121 mt).

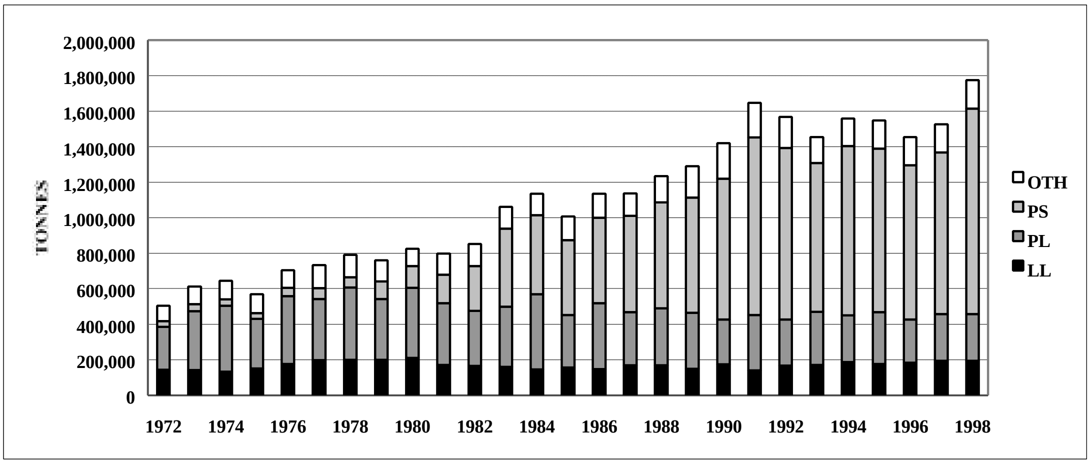

Figure 1. Catch (mt) of albacore, bigeye, skipjack and yellowfin in the WCPO, by longline (LL), pole-and-line (PL), purse seine (PS) and other (OTH) gear types

12. The 1998 catch by species (Figure 2) featured a record catch of skipjack (1,166,861 mt), which accounted for nearly all of the 200,000 mt increase on the 1997 figure, and which dominated the total species catch (66%). Yellowfin (407,391 mt; 23%) and bigeye (97,603 mt; 5%) catches were down slightly on the 1997 levels, while the slight increase in albacore[1] catch (101,933 mt; 6%) over the 1997 level made it the highest for the past 20 years. The drop in bigeye catch was believed to be due to less fishing activity occurring in the eastern area of the WCPO during 1998, where the shallower thermocline, in conjunction with the use of drifting FADs, accounts for higher availability of bigeye to the purse seine gear.

[1] includes catches of north and south Pacific albacore west of 150^0 W, which comprised 87% of the total Pacific Ocean albacore catch of 117,000t in 1998; the subsequent section, "Tuna Fishery Catch by Species - Albacore" is concerned only with catches of south Pacific albacore, which make up less than 40% of the WCPO catch.

13. The 1998 purse seine catch of 1,158,326 mt was an all-time record and eclipsed the previous record of just under 1,000,000 mt for 1991. The purse seine skipjack catch for 1998 (888,740 mt – 77%) contributed most of this record catch, and was over 250,000 mt more than the 1997, which was acknowledged as a relatively poor year for skipjack, but a good year for yellowfin. The yellowfin catch (250,279 mt – 21%) showed a slight increase on the 1997 levels, and bigeye (19,307 mt – 2%) was well down on the approximately 30,000 mt catch during 1997. The four major fleets increased their catches during 1998 compared to 1997, with the Taiwanese fleet making the largest gains by increasing their catch by nearly 100,000 mt. The Pacific Islands domestic purse seine fleets now contribute 100,000 mt, or nearly 10% of the total purse seine catch, with the PNG fleet taking 47,200 mt during 1998 compared with 23,800 mt in 1997 (see WP SWG–2). The increases in total catch were accompanied by significant increases in catch rate in most cases.

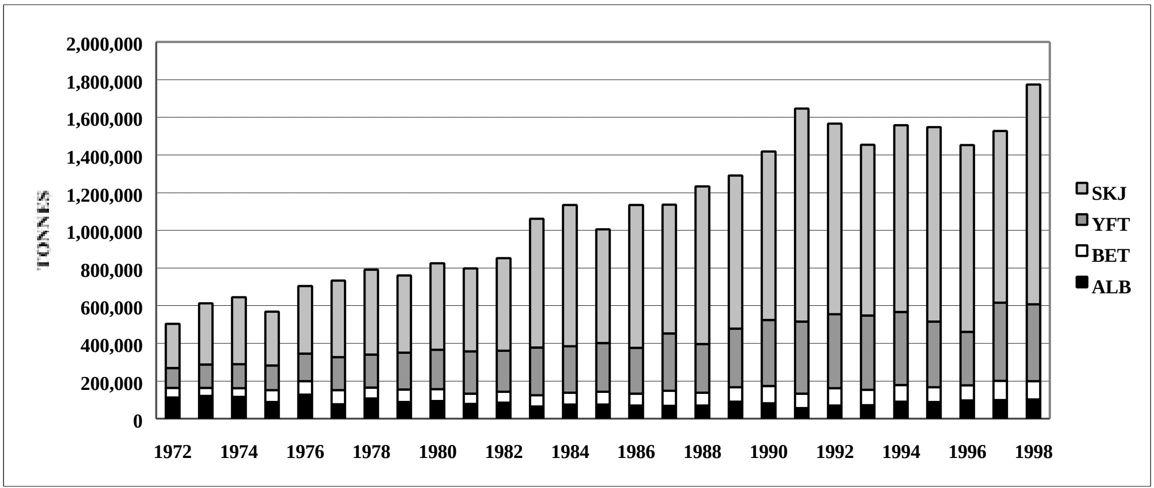

Figure 2. Catch (mt) of albacore (ALB), bigeye (BET), skipjack (SKJ) and yellowfin (YFT) in the WCPO.

14. The pole-and-line catch of 262,678 mt during 1998 showed a slight decrease on the 1997 level; this gear now accounts for only 15% of the total WCPO catch. As in previous years, skipjack accounts for the vast majority of the catch (86%); albacore taken by the Japanese coastal and offshore fleets in the temperate waters of the north Pacific (9%), yellowfin (4%) and a small component of bigeye (1%) make up the remainder of the catch. By fleet, the Japanese distant-water and offshore (118,822 mt) and the Indonesian fleets (86,466 mt) accounted for most of the catch; the Solomon Island fleet accounted for 22,089 mt.

15. The 1998 longline catch in the WCPO of 193,850 mt accounts for only 11% of the total WCPO catch, but rivals the much larger purse seine catch in value. This catch represents only a marginal increase on the 1997 catch of 193,448 mt. The overall species composition of the 1998 longline catch was 32% yellowfin, 34% albacore and 33% bigeye, but these values vary markedly by area and fleet (WP GEN–1: Figures 13 & 14). As in previous years, most of the 1998 WCPO catch was taken by the large vessel distant-water fleets of Japan, Korea and Taiwan. The continuing decline in the Micronesian-based offshore fleets (primarily Mainland China and Taiwan), and increase in the number of Pacific Island domestic longline vessels, were noted.

16. The 1998 troll catch (4,893 mt) showed only a slight increase on the 1997 level, in contrast to the albacore longline catches. As in previous years, the fleets of New Zealand and United States accounted for nearly all of the catch, which in turn consists almost exclusively of albacore tuna.

2.2 National Tuna Fishery Reports

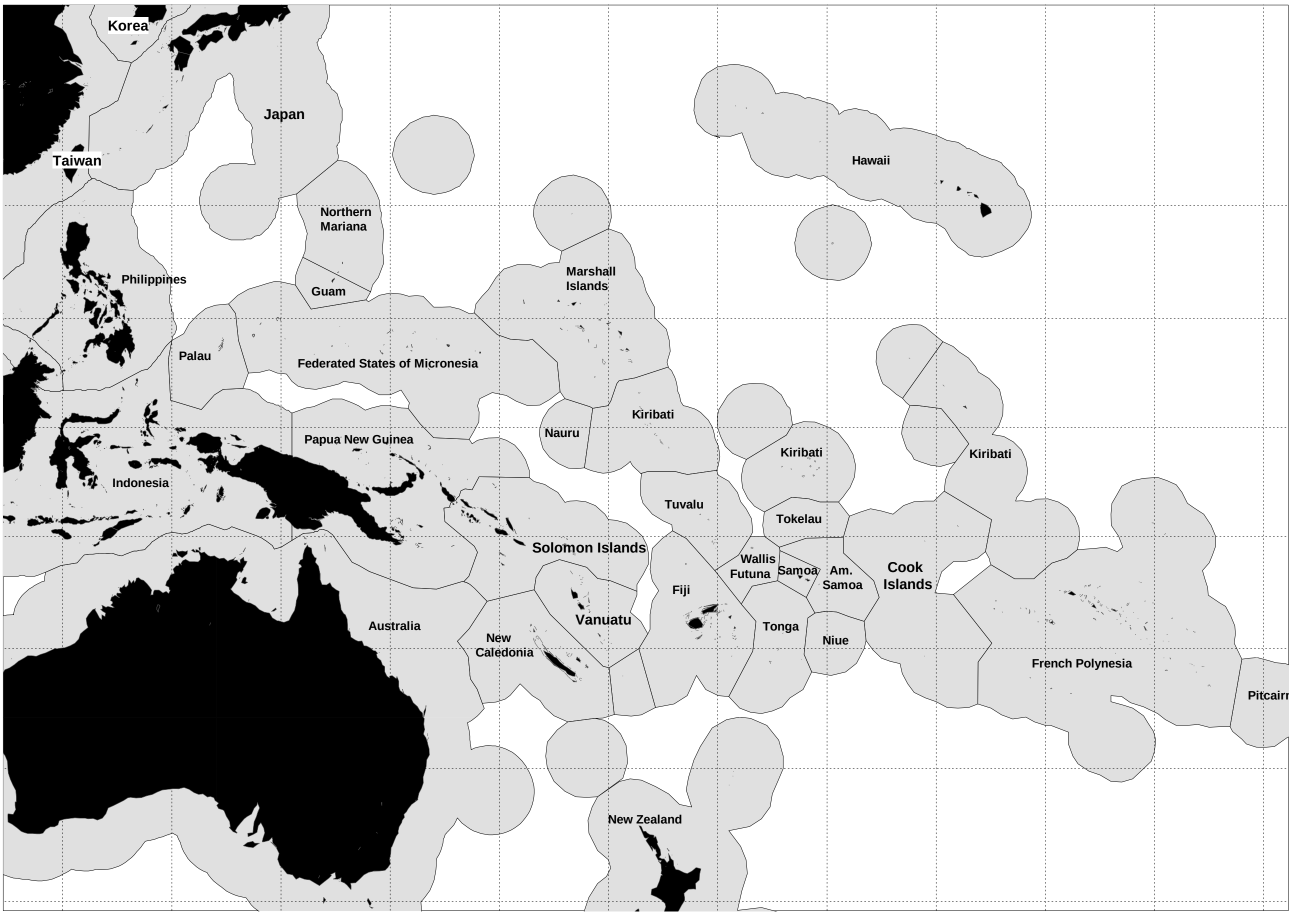

Figure 3. Countries and territories of the western and central Pacific Ocean.

American Samoa

17. Mr Dan Su'a presented WP NFR–1. The local fishery currently consists of vessels utilising longline and troll gears. In 1997, there was a significant development in the fishery when a number of vessels switched from trolling to longline, realising better catches and economising on fuel costs. In 1998, a total of 47 longline and troll vessels were active in the local fishery. These vessels target albacore tuna primarily for the local canneries, but sometimes sell their catch to local stores, restaurants or donate catch to families and relatives. Total estimated longline landings for 1998 were 804,147 lbs (~364 mt), including 627,580 lbs (~284 mt) of albacore and 58,475 lbs (~27 mt) of yellowfin. Total troll landings for 1998 were 79,776 lbs (~36 mt), including 34,573 lbs (16 mt) of skipjack and 25,672 lbs (12 mt) of yellowfin. Fishing effort decreased during 1998 primarily due to a decline in the albacore price at the canneries.

18. Potential exists for expanding the local longline fishery to cater for a sashimi-grade market and training in chilling and conservation techniques has begun in order to establish a market in the future.

Australia

19. Mr Peter Ward presented WP NFR–2. Activity by Australian longliners increased substantially during 1996–98, with many operators purchasing larger vessels, and thereby extending the range of longline activities further offshore. In addition to the new vessels joining the fleet, longliners were more active. Effort, for example, doubled from 4 million hooks in 1996 to 9 million in 1998. This includes 0.55 million hooks set in international waters, outside the eastern AFZ. Landings of yellowfin in 1998 (1,844 mt processed weight) were 20 per cent higher than 1997 levels. In 1996–97 many Australian longliners relocated from New South Wales to southern Queensland where they used night–set squid baits to target broadbill swordfish and bigeye tuna. Landings of swordfish (1,773 mt) and bigeye (1,032 mt) continued to increase in 1998. Also noteworthy was an increase in striped marlin catches to 448 mt.

20. The longline fishery has been managed as a limited entry fishery since 1989, with a range of secondary input controls, such as boat replacement regulations. Recently, industry agreed to the introduction of gear-based, statutory fishing rights. Each operator will be allocated gear units, e.g., a longliner might be allowed to carry up to, for example, 1,000 hooks. Using average days of fishing, the gear units will equate to a total effort limit of 10 million hooks per year for the longline fishery. The total effort limit was derived from preliminary advice on sustainable catch levels (10 million hooks equates to a catch of 2,000 mt of swordfish which is considered sustainable for the fishery). However, the introduction of input controls and changes in longline activity will complicate stock assessments which are based on longline catch rates.

21. Australian fishers use pole-and-line and purse seine to take skipjack tuna off southern New South Wales. This is a seasonal fishery, characterised by high inter–annual variability in catches and fishing activity. Skipjack catch peaked at 6,000 mt in 1992 then fell below 1,500 mt a year. The 1998 season was one of the poorest on record, with only 513 mt landed. The 1999 season was much better, with about 2,000 mt landed. The Eden cannery was to close in mid–1999. This will cause drastic reductions to the skipjack fishery because the cannery took all of the pole-and-line catch and much of the purse seine catch. It will also have ramifications for the sale of longline bycatch, such as albacore, and low grade catches of yellowfin and bigeye tuna.

Canada

22. Mr Neil Williscroft presented WP NFR–3. Canadians have fished albacore in the north Pacific Ocean with troll vessels using feathered jigs since the mid 1930s. The Canadian albacore jig fishery is currently composed of two fleets. The coastal fleet, consisting of vessels 35 to 60 feet (11 to 18 metres) in length, operates within the Canadian and United States fishing zones, concentrating their effort primarily from the southern Oregon coast to the northern tip of Vancouver Island. The high seas fleet is comprised of larger vessels — most greater than 60 feet (18 metres) — with crews of two to four that remain at sea for trips of several months. These vessels, which are equipped with large freezers, operate primarily from west of the dateline to the Canadian zone in the north Pacific. Since the 1980s, a smaller fleet has fished south Pacific albacore between the New Zealand zone and 140°W.

23. In recent years, between two and five vessels have fished south Pacific albacore during the November to March seasons. They have landed their catch at ports in American Samoa, Fiji, French Polynesia and Canada. Based on preliminary analyses of transshipment records and discussions with some of the skippers, landings in this fishery are estimated to range from 100 to 250 mt per annum.

The Department of Fisheries and Oceans is currently analysing logbooks, sales slips and transshipment data in order to arrive at more detailed estimates over the last ten years. At least two Canadian vessels fished for south Pacific albacore during the 1998/99 season.

Cook Islands

24. Mr Josh Mitchell presented WP NFR–4. Current government policy gives preference to licensing vessels local vessels based in the Cook Islands. There are currently however only two local 'mini' longline vessels (16 and 10 metres respectively) operating in the EEZ. In addition to this there is a sizeable 'poti maroro' troll fleet operating throughout the Cook Islands. These small artisanal craft and the two longline vessels service the domestic market. Catch statistics for these vessels are currently being compiled.

25. The Government has licensed fifteen foreign vessels to fish in the EEZ under bilateral access agreements in 1998 and 1999. The foreign fleet is composed of eight Korean vessels, five American Samoan–based vessels and two French Polynesian vessels. Only four of these vessels fished in the Cook Islands EEZ on a year round basis, and provided data that could be used for catch estimation. All of the foreign vessels targeted albacore tuna for the cannery in Pago Pago, with the exception of the French Polynesian vessels which took their catch back to Tahiti.

26. Total reported catch from 1998 to mid–1999 was estimated to be approximately 780 metric tonnes, though no data was provided from Korean vessels, which were the majority of the fleet by numbers. However, it is considered that these vessels did not fish much in the EEZ during 1998, so would not have contributed significantly to the total catch figure. Catch rates were over twice as high (55 kgs per 100 hooks) in 1998 than in 1999 (24 kgs per 100 hooks). This catch rate is thought to have been influenced by the El Nino event which occurred around that time.

27. Catch composition was dominated by albacore which comprised over 77 percent of the catch. The remainder of the catch was mostly composed of yellowfin (12%) and bigeye (7%).

Federated States of Micronesia

28. Mr Tim Park presented paper NFR–5. The current logsheet estimate of the 1998 total catch by the tuna fishery in the FSM EEZ is 46,902 mt. The estimated target tuna catch is 46,256 mt. The total target tuna catch is 41% less than that of 1997. The target annual catch of tuna has declined markedly and consistently since 1995 – the 1998 catch is only 18 percent of the 1995 total catch and is understood to be related to the recent strong El Nino event.

29. During 1998, total tuna catch for the three gear types were: purse seine–39,278 mt; longline–6,026 mt; and pole-and-line–952 mt.

30. The purse seine catch contributed 85 percent of the total tuna catch. It was the decline in effort and catch of the purse seine fishery in the FSM that mainly contributed to the decrease in the overall catch. The longline catch also declined (19 percent less than 1997 catch). This decline in catch was mostly due to a decline in the number of Chinese longliners (44 percent drop in the number of vessels) and hence their effort. The pole-and-line fleet recorded its lowest-ever catch in FSM during 1998.

31. The reduced purse seine effort in the FSM led to a reduction in purse seine transhipment volumes. The transhipment volumes of the principal ports of Chuuk and Kosrae are dependent on the Taiwanese and Korean fleets, respectively. The displacement of these fleets to the south east,

and out of the FSM, meant that vessels utilising ports in the vicinity of fishing grounds which were in other countries. The total purse seine transhipment volume in the FSM ports in 1998 was only 46,155 mt. Chuuk was the main port with 39,405 mt transhipped by purse seiners.

32. A total of 2,525 mt of fish were transhipped by longliners in the FSM ports. The Mainland Chinese fleet contributed most of the fish offloaded (1,533 mt). Bigeye tuna accounted for most of the fish offloaded (1,304 mt) compared to yellowfin (1,121 mt) and the higher proportion exported (94 percent) compared to yellowfin (79 percent).

33. The MMA Fisheries Observer Program completed 55 trips during 1998. The placements covered a range of gear and flags fishing in the FSM. The coverage was 2.1% of the total number of trips made by vessels in the FSM, according to logsheet data. The number of trips was limited by the usual observer program logistics for most of the fleets. An outdated Memorandum of Understanding (MOU) with the Japanese fleets led to an unacceptable (0.6%) coverage of the Japanese longline fleet. The low coverage for scientific purpose was acknowledged and an increase in the number of trips on Japanese vessels is being pursued.

34. It was noted that a revised Fisheries Law (Title 24) has been submitted to the FSM Congress, with the purpose of revisions to allow greater incentives for vessels to fish in the FSM through allowance of longer Foreign Fishing Agreement periods and a simpler agreement review process. Also, in early July 1999 the FSM will have a National Referendum and will vote to determine ammendments to the FSM Constitution that propose to give sovereignty of the FSM EEZ to the four FSM states rather than the National Government.

35. During the ensuing discussion, it was noted that the comparatively poor catches by the purse seine fleets in FSM waters during recent years was related to the effects of ENSO events, and not a reduction in the number of licensed vessels. The dramatic increase in catches for the first few months of 1999 over 1998 levels, tends to confirm the notion that La Nina years are more productive in FSM waters than El Nino years.

Fiji

36. Mr Illiapi Tuwai presented WP NFR–6. The Fiji tuna fisheries consist mainly of longline and pole–and–line fishing with some small-scale artisanal fishing targeting FADs. The 1998 catches were similar to 1997, though the number of longliners increased slightly to 40. Presently, there is only one pole-and-line vessel; the longline fleet has 50 percent of the vessels less than 60 GRT in size. The average longline CPUE in 1998 was up from the previous year. Presently there are 10 licensed foreign longliners, though other vessels unload at the cannery. Total landings are more than 12,000 mt, which includes purse seiners and US trollers.

37. Fiji, taking account of the precautionary approach, has implemented guideline Total Allowable Catches (*TACs)* for the fisheries, but these levels have not yet been approached. There is a small troll fishery that utilises FADs and sells to the local market. Transhipments are only carried out in Suva with an increase over last year to 10,000 mt. Port samplers are used during these transhipments. Fiji is now also investigating the use of alias to help develop the domestic fishery.

French Polynesia

38. Mr Stephen Yen presented WP NFR–7. The French Polynesian tuna fishery comprises four different fleets–the domestic longline fleet is the most recent, being less than ten years old. The other three have been operating for more than 30 years: the DWFN fleets fishing in French

Polynesian EEZ, the “bonitiers” (small-scale pole-and-line vessels) and the “poti-marara” (small boats using many different techniques to target pelagic or non-pelagic species).

39. Combined catches of these fleets averaged 6,000–10,000 mt each year for the last 5 years. The continued growth in the domestic longline fleet saw landings almost double from 1994 to 1998 (2,650 mt to 5,300 mt). At the same time, the “poti-marara” fleet declared catches have almost tripled due to a better data collection and the expansion of the fleet. “Bonitier” and foreign fleets (essentially Korean since 1992) declared catches have been constant, around 1,000 mt and 2,000 mt, respectively.

40. In 1998, albacore represented more than 43% of total domestic catches due to: (i) international market opportunities for loined frozen or fresh albacore; (ii) a favourable fishing zone (between 11° and 18° South) for this species; (iii) no defined fishing strategy and (iv) the El Nino event. Other species catches have remained stable but for a slight increase in bigeye catch (from 300 up to 400 mt). Catches of bigeye for the Korean fleet constitutes 44% of their total catch.

41. The local market is still very important with 4,000 mt of tuna and other pelagic species consumed, but exports are rising, especially for frozen albacore loins. Shore facilities are expanding with two buildings, one for frozen fish and one for fresh fish exports, being built in Papeete.

42. The French Polynesia Government’s production target of 11,000 mt is becoming a reality, but as the local market approaches saturation, more efforts will have to be made to increase the quantities exported.

43. The bilateral agreement with Korea did not present the opportunity to place observers on the Korean longliners. It is hoped that the next agreement will include provision for observers. In 1998, 68 of the 70 licensed Korean vessels fished in the French Polynesian EEZ.

Japan

44. Mr Miyabe presented WP NFR–8. Recent trends on fleet size and catches were presented for the pole-and-line, purse seine and longline fisheries. Statistics were compiled for the area 50°N–50°S and west of 150°W. Statistics for the pole-and-line fishery are not similar to previous years because data were compiled using different criteria. Fleet size is stable for the purse seine fishery (35 vessels in 1998) but the size of both the longline (1,573 vessels in 1997) and pole-and-line (598 vessels in 1997) fleets is declining.

45. Total longline catch has declined in recent years. Preliminary catch for 1997 was over 70,000 mt. Catches of yellowfin and billfishes have decreased, while albacore catches have increased. The spatial extent of areas fished has continued to decline.

46. Pole-and-line catch was greater than 150,000 mt in 1997; however total catch and effort increased slightly. Catch was mostly composed of skipjack (115,000 mt), with lesser amounts of albacore (30,000 mt), yellowfin (3,600 mt) and bigeye (2,400 mt). The proportion of albacore in the catches continues to increase. The spatial distribution of the pole-and-line fleet changes dramatically throughout the year. During the 3rd quarter all pole-and-line effort occurs near Japan where skipjack and albacore are targeted. Fishing effort is also distributed near Japan during other quarters, but effort is also expended in equatorial waters.

47. Purse seine effort has remained stable in recent years. The preliminary catch estimate of 240,000 mt in 1998 is the largest in the history of the fishery. The increase is due to a large catch of

skipjack (200,000 mt). Through bilateral access agreements, the purse seine fishery fished in Kiribati in 1997 and in the Marshall Islands in 1998.

48. Clarification was provided that the increasing catch in the pole-and-line fishery was north Pacific albacore. There was an inquiry for information on tagging programmes and the Japanese delegates indicated that they could provide information at a later date.

Kiribati

49. Mr Rimeta Tinga presented WP NFR–9. The tuna fisheries in Kiribati can be categorised as (1) the offshore industrial tuna fishery and (2) the coastal artisanal fishery. The industrial tuna fishery consists of the distant-water fishing nations (DWFNs) operating in Kiribati waters under access agreements with the Kiribati government, and domestic vessels operated by the government-owned fishing company Te Mautari Ltd (TML). The artisanal tuna fishery consists of 326 small outboard–powered motor boats based on several Kiribati islands trolling tuna and tuna-like species.

50. The artisanal tuna fishery is most active in south Tarawa and supplies much of the needed daily foodfish requirement for the locals through roadside shops. This fishery is monitored through surveys conducted on an annual basis; data collected through surveys suggest that annual estimated landings from this fleet are of the order of several hundred metric tonnes. Catch rates of up to 20 mt per week have been recorded for the south Tarawa fleet, although the average fleet-wide rate is around 0.5 mt per week.

51. The Kiribati government places high priority on the development of a small-scale commercial longline fishery based in Kiribati. A feasibility project looking at the possibility of establishing a small-scale longline fishery, funded through the Pacific Development Fund (PDF), commenced during 1998. It is hoped that this project, and the planned re-structuring of TML, will provide a viable opportunity for Kiribati to develop this fishery in the future.

52. The level of DWFN purse seine fishing in Kiribati waters is strongly linked to ENSO events– El Nino years typically provide more productive fishing grounds in Kiribati waters than in La Nina years. For example, a catch of approximately 200,000 mt of tuna was taken by purse seine fleets in Kiribati waters during 1997. The level of longline fishing by DWFN fleets in Kiribati waters has shown a gradual decline over the past 5 years.

Korea

53. Dr Dae-Yeon Moon presented WP NFR–10. A total of 169 longliners were actively fishing for tuna in the Pacific Ocean during 1998, compared to 148 in 1997. The longline catch decreased 2 percent from 35,316 mt in 1997 to 34,532 mt in 1998. The longline catch of bigeye increased from 14,557 mt in 1997 to 18,679 mt in 1998, while the yellowfin catch decreased from 12,267 mt to 9,623 mt. Longline fishing in 1998 was primarily in the area between 20°N and 20°S, which was similar to 1997.

54. A total of 26 purse seiners were actively fishing for tuna in the Pacific Ocean during 1998, compared to 27 in 1997. The purse-seine catch increased 26 percent from 159,469 mt in 1997 to 200,905 mt in 1998. The purse-seine catches of skipjack and yellowfin increased by 23.7 and 33.6 percent respectively. Purse-seine fishing was primarily to the west of 180° in 1998, compared to 1997, when fishing extended as far east as 150°W.

55. Longline catch and effort data for 1994–1997 and purse-seine catch and effort data for 1996–1997 are currently being processed. Biological sampling of purse seiners has been carried out at domestic landing sites once a month since November 1993 to obtain size data and information on the reproductive biology of skipjack and yellowfin.

Nauru

56. Ms Lara Atto presented WP NFR–11. There are no domestic commercial fisheries in Nauru waters due to a lack of infrastructure, for example harbour facilities. There are two boat ramps that local fisherman use to launch small aluminium boats for subsistence fishing. Fishermen primarily troll for pelagic species, but may also conduct bottomfishing. Roadside monitoring provides a minimum estimate of local catches. Local catches for 1998 were estimated to be (at least) 125 mt, with skipjack (49 mt) and yellowfin (57 mt) comprising most of the catch, and the remainder made up of bigeye (8 mt) and other species (10 mt–rainbow runner, blue marlin and sharks). A fish market will be established in July 1999 to provide a facility for local fishermen to market their catch. There are currently three FADs deployed in Nauru waters and additional FADs will be deployed to ensure that the supply of fresh fish is maintained.

New Caledonia

57. Mr Régis Etaix-Bonnin presented WP NFR–12. During recent years, two different types of tuna longliners were operating in New Caledonia: (1) freezer vessels (greater than 200 GRT) capable of staying at sea for more than one month and offloading their catch to the canneries in the region (only one vessel active in 1998), and (2) smaller longliners (less than 100 GRT) targeting bigeye and yellowfin tuna with monofilament gear for export to the fresh sashimi market in Japan (10 vessels active in 1998).

58. Catch statistics are based on three different sources of data: fishing logsheets since 1983, customs statistics, and unloading data since 1994. The highest catch of the last five years was reported in 1998 with almost 1,750 mt of tuna and associated species. Catches of bigeye have constantly increased since 1994 when monofilament gear was first introduced. Striped marlin contributes more than 50% of the total billfish catch in weight (due to its high catchability from September to November), black marlin 18%, blue marlin 7% and swordfish 10%.

59. New Caledonia tuna longliners target species suitable for the Japanese sashimi market. In 1998, however, more than one third of the total catch, including all of the by-catch (mahi-mahi, wahoo, etc.), were sold on the local market in competition with fish from artisanal fisheries. It was suggested that this situation could happen in other Pacific Island countries developing their domestic longline fishery.

60. In 1999, four more local monofilament longliners are scheduled to begin fishing in the waters of New Caledonia. Another project might also be concluded which could lead to a total fleet of more than fifteen small longliners. There is also a possibility that French purse seiners, aiming at fishing in the WCPO, might be based in the Northern Province of New Caledonia in forthcoming years.

New Zealand

61. Dr Talbot Murray presented WP NFR–13. A number of seasonally important tuna fisheries operate in the New Zealand EEZ (valued at $NZ 24.3 million in 1996); these include albacore troll,

bigeye and southern bluefin tuna longline, and skipjack purse seine fisheries. In addition several important tuna and billfish species are caught as bycatch in the longline fishery (albacore and yellowfin tuna and swordfish).

62. Marlins do not feature in New Zealand commercial landings, although striped marlin are an appreciable longline bycatch, because of prohibitions on landing billfish other than swordfish. No targeting of billfish of any species is permitted by commercial fishers. A substantial recreational big gamefish fishery targets marlins during the summer catching over 2,000 fish, most of which are tagged and released.

63. The total number of vessels fishing for tunas has varied from 271, in 1989–90, to 584 in 1994–95, declining over the past two years to 361 vessels fishing in 1996–97. Most of these vessels fish in the albacore troll fishery with 58 vessels actively longlining and 6 purse seining in 1996–97. Most are small to medium sized vessels (average lengths ranging from 12.7 to 29.8 m) mostly over 20 years old. Domestic catches in 1996–97 were 3,725 mt of albacore (substantially lower than the previous 3 years), 104.9 mt of bigeye (an increase over the previous 4 years), 5,780.5 mt of skipjack (the highest catch since 1986–87), 159.5 mt of yellowfin (a slight decrease over last year) and 282.8 mt of swordfish (a steadily increasing domestic catch).

64. It was noted that legislation prohibiting the landing of marlin species on longline vessels operating in New Zealand waters eventuated through perceived detrimental impacts on stocks, these views being expressed by the recreational fishing lobby in the early 1980s. At this stage, there appears to be no specific interest in targetting swordfish, as has been the case during recent years in neighbouring waters of Australia.

Niue

65. Mr Sione Leolahi presented WP NFR–14. Fisheries policy in Niue is to protect the inshore marine resources, mainly contributing to the commercial and subsistence food supply, and also to maximize offshore licensing arrangements. Commercial domestic fishing is conducted by small (9–15 metre) aluminium vessels registered to fish. Logsheets are currently distributed to local fishermen in order to retrieve data for domestic fishing, although technical and funding assistance are required to effectively cater for data collection from local fishermen.

66. Foreign access arrangements include US purse seine vessels under the USMLT and bilateral arrangements with three distant-water longline fleets (Taiwan, Korea, and American Samoa). Longliners mainly target albacore and transship in Pago Pago. Data received from the foreign fleets fishing in the Niue EEZ need to be improved, in particular to include non-target species (e.g. wahoo and billfishes) that may not have international market value, but are highly valued in domestic markets.

67. Joint ventures have been discussed with a company in Tonga and future work will require further investigations and feasibility studies to address potential for joint ventures with neighbouring island states.

68. A gamefishing organisation has recently been formed with the interest from the tourism sector. Niue will seek assistance to identify policy and future plans for gamefishing activities in the Niue EEZ.

Palau

69. Ms Evelyn Oiterong presented WP NFR–15. The Palau Maritime Agency is responsible for the development and management of the fisheries. Presently the offshore fisheries operate under a new five-year agreement with Korean vessels with a total of 26 purse seiners licensed, as well as 45 permits for Japanese vessels (16 longline and 29 purse seiners). There are three locally based fishing companies (more than 30 licences) which contribute significant funds to the economy. There were fewer vessels fishing in 1998. Over 200 air shipments were made in 1998 compared to over 330 in 1997. This decrease is mainly due to changes in air schedules, which adversely affected the fish quantity shipped to Japan.

Papua New Guinea

70. Mr Ludwig Kumoro presented WP NFR–16. Tuna is harvested commercially in PNG by both purse seine and longline methods. Longline activity dates back to the 1950s, while Japanese purse-seine fishing began in 1967 followed by the US, Taiwan, Korea and the Philippines.

71. A domestication policy for longline was introduced in 1994–1995. This policy prohibited the issuance of licences to foreign longline vessels, which in turn facilitated the emergence of the domestic longline fleet. The domestication of the purse-seine fishery has also proceeded in more recent years. Domestic vessels are provided a 5–year licence, compared to one year for foreign purse-seiners, and are allowed access to fish within the archipelagic waters. Domestic longline vessels increased from two in 1994 to 25 in 1998 (around 15 active). The domestic purse-seine vessels increased from two in 1994 to 13 in 1998.

72. Korean and Taiwanese purse seine fleets ceased operation in PNG waters during 1998. From around 100 purse-seiners in 1994, there remain around 46 under the multilateral, FSM and bilateral arrangements.

73. Production by the domestic purse-seine fleet was 1,751 mt in 1994 and 47,223 mt in 1998 with a total of 98,712 mt for the 5-year period (1994-98). This catch was composed of 74% skipjack, 23% yellowfin and 3% bigeye. The total catch by the domestic longline for 1994 was 30 mt, this increasing to 355 mt in 1998. The total for years 1994–98 was 1,387 mt, and comprised 80% yellowfin, 12% albacore and 8% bigeye tuna.

74. Present shore facilities include a fish cannery in Madang, which produces 30 mt per day with the capability of developing to 50 mt later this year, a wharf facility and a cold storage facility to be completed this year. Products from this cannery are exported to Europe and US.

75. The PNG National Fisheries Authority (NFA) launched a ‘Tuna Management Plan’ early this year; also in draft form is a ‘FAD Management Policy’. There are also observer and port sampling programmes that cover both domestic and DWFN vessels.

76. The NFA currently are undertaking a research program on both domestic purse seine and longline vessels. The research program is aimed at determining:

- The catch by species, both target and by-catch.
- Size class of yellowfin and bigeye harvested by longline and purse-seine.
- Determine interactions between longline and purse seine gears on stocks of yellowfin and bigeye in PNG waters.

Philippines

77. Mr Noel Barut presented WP NFR–25. The Philippine fisheries is categorized into two sectors, namely the municipal and the commercial sectors. The municipal sector covers the fishing vessels up to 3 GRT, while the commercial boats are those fishing vessels of 3 GRT and above. Commercial fishing vessels are prohibited to fish within 15 km from the shoreline, which are considered municipal waters under the new Fisheries Code of 1998. Under the previous law, commercial fishing vessels could fish outwards from 7 km of the shoreline.

78. The major commercial fishing gears used in capturing tunas are the purse seine, ringnet and handline. Other gears used are the longline, mostly through a joint venture agreement with a Taiwanese company, round-haul seine and troll line. Municipal gears are the mini-ringnet, gillnet, handline, multiple handline, troll line, etc .

79. From 1994 to 1997, the catch of yellowfin and bigeye generally shows a steady increase. Skipjack catch, on the other hand, has remained stable for the last three years at around 110,000 mt. The catch of small tunas has been variable–catches dropped to 115,734 mt during 1995 from 139,535 mt in 1994 but showed a significant increased in 1997 with a catch of 135,067 mt. The catch of billfishes also increased from 7,055 mt in 1994 to 11,449 mt. in 1997.

80. An inventory of the commercial fishing vessels and gears is now on-going as mandated by the 1998 Fisheries Code. Results of the inventory will be presented at the next SCTB meeting.

81. At present the national fisheries statistics do not segregate catches of tunas by fishing gears and instead present catches in total country production. This is also true for all other fish species.

82. The Philippine tunas are exported in many ways: fresh, chilled or frozen; dried or smoked and in processed (canned) form. The total export in 1994 was 78,410 mt and in 1997 was 89,115 mt. The major Philippine tuna importers are Japan, U.S.A, Germany, United Kingdom and South Africa. Japan is the major market for the Philippine sashimi grade tuna. Other countries import mostly the canned tuna.

83. The collection of catch and effort data will continue under the National Stock Assessment Program. Planned improvements in the collection of fisheries statistics include (i) the segregating of catch by gear, (ii) collecting data on the number of gears catching different fish species, (iii) collecting information on the number of days fishing and other data that will be useful in stock assessment studies.

Samoa

84. Ms Anne Trevor presented WP NFR–17. It was noted that the 1998 catch rate, which is mainly based on albacore, was quite low – possibly due to El-Nino effects. Presently the domestic longline industry (based on alias) employs over 1,000 people and provides a significant economic input to the economy. More than 90% of the fleet is involved in the longline fishery. Presently there are problems with congestion at the fishing grounds i.e. too many boats in too small an area. There has been an increase in the number and size of boats built by local builders under instruction of boat owners, however many of these vessels are considered unsafe. The government is therefore assisting in having larger safer alias designed and built. There have recently been a number of fatalities of fishermen, possibly due to unsafe vessels and inadequate training. It was noted that while training workshops were held, unfortunately it was usually the owners and not the skippers who attended. A

new marina and storage and holding facilities (StarKist) are to be constructed in Apia that should alleviate some of the present problems.

85. It was discussed how a new commercial fisheries management approach is being investigated. It was noted how the CPUE has decreased steadily since the introduction of the alia fleet from 6.3 fish/100 hooks in 1994 to 2.3 fish/100 hooks in 1998. The total catch increased from 300 mt in 1993 to over 7,000 mt in 1998.

Taiwan

86. Dr Shyh-Bin Wang presented WP NFR–18. During 1998, 52 distant-water longliners fished in the Pacific Ocean. In the past, these vessels have fished primarily in the south Pacific and in tropical waters; however, in recent years, some vessels have targeted north Pacific albacore on a seasonal basis. Average catches during 1996–1998 have been 19,000 mt of albacore, 1,000 mt of yellowfin and 800 mt of bigeye.

87. From 1996 to 1998, 42 purse seiners fished in the Pacific Ocean. The total purse-seine catch reached an historical high of 259,000 mt in 1998. During 1998, the proportion of the catch from unassociated schools increased from 44 percent to 64 percent, while the proportion from log schools decreased from 53 percent to 35 percent. Fishing effort during 1998 was primarily in the EEZs of Papua New Guinea and the Federated States of Micronesia, and adjacent high seas areas.

88. Since 1996, the Overseas Fisheries Development Council (OFDC) has compiled catch and effort logsheet data and size data for offshore longliners that land their catch in Taiwan. The total catch during 1998 was 40,434 mt, including 193 mt of albacore, 3,530 mt of bigeye, 8,955 mt of yellowfin, 1,900 mt of swordfish, 9,910 mt of billfish, 1,450 mt of skipjack and 14,506 mt of other species. Catches during 1995–1998 have remained stable.

Tonga

89. ‘Akau’ola presented WP NFR–19. He noted the accuracy of data that was being collected in Tonga may be questionable. He noted that Tonga is exporting around 20 mt of fish per week (airfreight), but was not sure of the species composition, but includes pelagic and demersal species. The amount exported is presently dependent upon the freight capacity of airlines. There are 11 longliners currently active with a target limit of 20. The Ministry has recently enforced the licensing requirements of all commercial fishing vessels over six metres to ensure better collection of catch and effort data. There has been a significant increase in the catch of pelagic species from 1997 to 1998 with albacore, the main species caught, increasing from 48 mt to 238 mt. The other species, in descending order, are; yellowfin, marlin, bigeye, other and skipjack. The total catch in 1998 was around 416 mt, though this may be under-reported.

Tuvalu

90. Mr Samuelu Telii presented WP NFR–24. Tuna are harvested in Tuvalu at the subsistence level through a growing semi-commercial artisanal fishery is supplying local markets, and also by DWFN fishing fleets licensed to fish in Tuvalu waters. Japan, USA and two Korean fishing companies currently have bilateral agreements to fish in Tuvalu waters. These agreements provide substantial revenue to Tuvalu–the last five years this revenue has been 10–29% of the Total Recurrent Budget. Catches by the DWFN purse seine fleets operating in Tuvalu waters have ranged from 4,500 mt to nearly 22,000 mt in recent years.

91. Several initiatives are planned for the future. These include, (1) the establishment and monitoring of community fishing centres on all islands of Tuvalu for the purpose of increasing catches for the local market; (2) improvement of infrastructure (e.g. port and transport facilities); (3) establishment of a market network (both domestic and export), and (4) looking at the feasibility of establishing a domestic longline fishery.

United States of America

92. Mr Al Coan presented WP NFR–20. U.S. distant-water purse seine, longline and troll fisheries and several small-scale longline, handline, troll and pole-and-line fisheries operate in the central-western Pacific (CWP). Distant-water fisheries operate throughout the CWP and small-scale fisheries operate within EEZs.

93. Thirty-nine U.S. distant-water purse seiners operated between 10°N and 10°S latitude and 130°E and 150°W longitude in 1998. Catch rebounded from a decreasing trend that started in 1995 and increased from 144,082 mt in 1997 to 176,763 mt in 1998. Skipjack tuna catch led the rebound and increased 59%. Average sizes of fish caught in 1998 were slightly smaller than those caught in 1997, and larger fish continue to be caught in free-swimming schools sets than in drifting object sets (e.g. logs and fish aggregating devices, FADs). In 1998, as in 1997, the fleet concentrated the majority of its sets (55%) on drifting objects. Eighty-nine percent of the 1998 catch was landed or transshipped to canneries in American Samoa. Eighty-three percent of the catch was processed in American Samoa and the remainder in other canneries in the Pacific region, Puerto Rico and Europe.

94. Three longline fisheries operate in the CWP. The largest is a distant-water fishery based in Hawaii, targets bigeye tuna and swordfish and accounts for 90% of the U.S. CWP longline catch. In 1998, 114 vessels caught 4,802 mt of tropical tunas and billfish (excluding swordfish), an increase from 4,543 mt caught in 1997, due to a record high bigeye catch in 1998. The Hawaii-based longline fleet landed the majority of its catch at the local fish auction where the catch was measured for processed weight. Average size of bigeye tuna and blue marlin in the 1998 catch was slightly larger than in 1997, and yellowfin tuna and striped marlin slightly smaller. The other two longline fisheries operate in American Samoa and FSM/Marshall Islands. The American Samoa fleet increased from 22 vessels in 1997 to 27 in 1998, caught 535 mt of mainly south Pacific albacore and landed its catch to local markets or canneries where the catch was measured for fork length. Four U.S. vessels operated in FSM/Marshall Islands targeting yellowfin tuna and landed 175 mt of yellowfin and bigeye tuna and south Pacific albacore at ports in Guam, Palau, and Fiji.

95. A U.S. distant-water troll fishery and four (Hawaii, American Samoa, Guam and Northern Marianas) small-scale troll, handline or pole-and-line fisheries operated in 1998 in the WCPO. The distant-water troll fishery of 35 vessels caught 1,721 mt of albacore during the 1997-98 season, an increase over the 1,403 mt caught in the 1996-97 season. Most of the catch was landed at canneries in Fiji. Small-scale troll and handline fisheries operating in Hawaii, Guam, Northern Marianas and American Samoa in 1998 targeted yellowfin and skipjack tuna and caught 2,488 mt of tropical tunas and blue or striped marlin. A small-scale pole-and-line fishery of 6 vessels operated in Hawaii's EEZ and caught 338 mt of mainly skipjack tuna in 1998.

96. By-catch estimates were made in the distant-water purse seine and longline fisheries. Purse seine by-catch estimates were from logbook and observer data and indicate that 840 mt to 970 mt of mainly skipjack tuna and 250 mt to 900 mt of other species (mainly rainbow runner) were discarded

at sea (observer data raised to 100%). Longline by-catch estimates were from logbooks and indicate that 1,820 mt of mainly sharks were discarded.

Vanuatu

97. Mr Kalo Pakoa presented WP NFR–22. There was no domestic longline activity for most of 1998, with the only longline vessel active ceasing operations early in the year. This vessel was operated by a New Zealand company since 1996 and caught around 38 mt of tuna, billfish and other species during 1996, and approximately 16 mt during 1997; yellowfin (60%), albacore (11%) and striped marlin (5.5%) were the main species taken by this vessel.

98. A total of 13 Taiwanese longline vessels were licensed to fish in Vanuatu waters during 1998; this is the lowest number since agreements begun in 1988. It was noted that provision of logsheets from this fleet remains poor.

99. Vanuatu's concern in the area of management and conservation of the region's vast tuna resources has seen the country take a pro-active approach with the establishment of a new association to act on behalf of the government to enforce control over its flagged vessels. The new association, *Offshore Tuna Enterprise (Vanuatu) Ltd.*, through the endorsement of the Vanuatu government, will act as a representative of the members of the association in tuna activities in the region, and monitor, manage and control activities of Vanuatu flagged vessels in the WCPO tuna fisheries.

100. Future prospects and developments include (a) the development of a new Tuna Management Plan, (b) attempt the re-development of the former South Pacific Fishing Company (SPFC) base at Santo to handle a domestic fishery, and (c) develop observer capabilities once there is an established domestic fishery.

101. The meeting noted the difficulties in obtaining catch and effort data for the Korean-owned, Vanuatu-flagged purse seine fleet.

Wallis and Futuna

102. Mr Bernard Guegan provided an overview of tuna fishing developments in Wallis and Futuna. He explained that since there is no commercial tuna fishing in Wallis and Futuna, and no foreign vessels licensed to fish in the EEZ, a working paper had not been produced.

103. Currently, there are only very small-scale fisheries in Wallis targeting reef or deep bottom species. FADs are sometimes used to provide bait for these fisheries. The first retail fish shop in Wallis opened last year, creating an opportunity for fishermen to sell their catch.

104. The Wallis & Futuna government is studying ways of developing a local tuna fishery. French Polynesia has been contacted and has agreed to help by providing technical advice and training possibilities.

2.3 Economic Condition of the Fishery

105. Mr Karl Staisch presented WP GEN–2. The 1998 price of skipjack used for canning was stable at around US$1,150 per metric tonne up to August, but then rapidly declined to around US$600 per metric tonne by December. This trend was due to the comparatively larger catches of skipjack taken by purse seine vessels since mid 1998 which caused an over-supply on the market;

this trend continued into 1999 and saw some vessels remain in port as it was considered uneconomical to continue fishing at such low prices. The price increased slightly by March 1999 and some vessels returned to the fishery, but the price has once again dropped in the past few months.

106. Prices of yellowfin used for canning also dropped sharply in the second half of 1998, but as yellowfin catches in other oceans did not increase (as had been the case in the Pacific during recent years), the drop in price was only reflected in local markets (e.g. Bangkok), and not the European market.

107. The condition of the Japanese sashimi markets during 1998 was not too different from recent years–the market remained sluggish and tuna prices were generally low. There was an 8% decrease in domestic landings, but there was a 15% increase in imports. The supply of fresh bigeye and yellowfin increased by about 9% for 1998 with total imports for the year being around 81%. Despite lower prices on the Japanese markets (a decrease by about 4% during 1998), there has been a steady increase in supply of fresh yellowfin and bigeye to Japan markets. The main suppliers to this market are Taiwan and Indonesia, with the Solomon Islands and FSM being the main Pacific islands suppliers. There are problems in many Pacific island countries with limitations in air freight–costs of freight and other high domestic costs continue to restrict the expansion of exports for the fresh tuna market. For the frozen tuna market, imports increased by about 28% for bigeye and 6% for yellowfin during 1998; prices fell by about 18% for bigeye and 8% for yellowfin.

108. The five-year low of the yen to the $US did not prevent the imported fresh and frozen yellowfin and bigeye from reaching their highest levels since 1995. This highlights the strength and overall importance of the Japanese sashimi market.

109. There is considerable interest in developing loining plants in the region. Construction has commenced in the Marshall Islands on a plant and is scheduled for completion by November 1999. Elsewhere, there is another plant planned for PNG. It was noted that the drop in tuna prices in late 1998 may have led to the decline in interest amongst potential investors of shore-based processing facilities. FFA, ACIAR and SPC are currently working on a bio-economic model which examines the inter-relationships of price, fleet costs and fishing effort. It is hoped that this will shed some light on the supply/price volatility of the market.

3. REPORTS BY ORGANISATIONS

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

110. Dr Robert Campbell provided a brief overview of recently completed, current and future research from the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Division of Marine Research. It was stressed that current research is now starting to focus more on the tropical pelagic species. Recently completed projects include: (1) preliminary assessment of yellowfin tuna resources off eastern Australia, (2) evaluation of performance indicators for swordfish, and (3) a guide to Indo-Pacific billfish. Projects nearing completion are: (1) yellowfin tuna origin of recruits and delineation of stocks using otolith microchemistry and microsatellite genetics, (2) ocean colour relationship to tuna and swordfish catch – a possible indicator to predict tuna distribution, and (3) historic recreational catch and effort data analysis.

111. New research initiatives include: (1) seasonal and long term migration and habitat preferences of bigeye using both archival and conventional tagging techniques, (2) reproductive dynamics of

swordfish, (3) operational model of the tuna and billfish fishery off eastern Australia, and (4) a genetic study to determine the structure of swordfish populations.

Food and Agriculture Organization of the United Nations (FAO)

112. The OFP briefly reported on three recent initiatives relevant to the SCTB group, on behalf of FAO. The first initiative is the FAO Tuna Atlas, a CD ROM version containing maps of catch and effort for the global tuna fisheries stratified by 5°x5° grids, which will soon be accessible via the Internet. The second initiative is the planning of the Expert Consultation on Implications of the Precautionary Approach for Tuna Research will be held in Phuket, Thailand in March 2000. The meeting will be a follow-up to the introductory meeting on this subject, held prior to SCTB11 last year, and will look at how the precautionary approach will be applied from several perspectives: data collection, stock assessment, environment, and biology and gear technology. Participants will be made up of research staff from the international tuna organisations IATTC, SPC, ICCAT, IOTC and CCSBT. The third initiative is a five-year project, funded through the Japan Trust Fund, which will provide technical assistance in the form of an attachment to SPC for four years to assist in the review, collection and dissemination of data related to tuna fisheries in the WCPO.

Inter–American Tropical Tuna Commission (IATTC)

113. Dr George Watters reported on the work of the IATTC. The IATTC collects information and conducts research on the catches of tunas and other pelagic species inside the EPO (defined here as the area bounded by 40°N, 40°S, 150°W, and the coastlines of North, Central and South America). As of June 3, 1999 the IATTC membership included Costa Rica, Ecuador, El Salvador, France, Japan, Nicaragua, Panama, the United States, Vanuatu, and Venezula. In the EPO, the surface fleet (purse seiners and baitboats) caught 264,426 mt of yellowfin, 141,630 mt of skipjack, and 34,712 mt of bigeye during 1998.

114. Traditionally, yellowfin has dominated the surface catch in the EPO, but since about 1994 catches of skipjack and bigeye have provided larger proportions of the total catch by purse seiners. The increased catches of skipjack and bigeye are largely the result of an increase in the number of floating object sets made by purse seiners. From 1987 to 1994, purse seiners made an average of 3,043 floating object sets in the EPO. In 1997, purse seiners made 7,308 floating object sets in the EPO, and in 1998 purse seiners made 6,425 such sets. Many of the floating object sets made in recent years are on drifting FADs and occur in an area between about 6°N and 16°S from about 93°W to 140°W.

115. In 1998, the IATTC adopted two resolutions to regulate the catch of tunas in the EPO. In October 1998, the IATTC adopted a quota of 225,000 mt for yellowfin inside an area known as the Commissions Yellowfin Regulatory Area (CYRA, this area is identified in the IATTC's annual reports). On November 26, 1998 the CYRA was essentially closed to targeted yellowfin fishing. In June 1998, the IATTC adopted a resolution prohibiting floating object sets in the EPO after 45,000 mt of bigeye had been caught by the surface fishery. The catch of bigeye by the surface fishery during 1998 was less than 45,000 mt; therefore, the fishery was not restricted by a bigeye catch limit.

116. In October 1998, the IATTC adopted a resolution to regulate the use of FADs in the EPO. This resolution had three components: 1) a prohibition of the use of tender vessels (non-fishing vessels that deploy, maintain, repair, and pick up FADs) in the EPO; 2) a prohibition on the "transshipment of tuna on the high seas by purse-seine vessels fishing for tunas in the EPO"; and 3)

a limitation on the number of FADs that a fishing vessel could carry. This latter limitation was to be decided through consultation among the Parties.

117. The IATTC adopted one additional resolution in October 1998. This resolution established limits, for 1999, on the capacities of the purse seine fleets of individual nations. It was agreed that these limits would not set a precedent for succeeding years.

Interim Scientific Committee on Tuna and Tuna-like Species in the North Pacific Ocean (ISC)

118. Dr Gary Sakagawa reported on the recent initiatives of the ISC group. The ISC group, an informal group based on science and collaboration, currently consists of representatives and observers from Canada, Japan, Korea, China, Taiwan, USA, IATTC, SPC and PICES. The most recent meeting of this group was held in Honolulu, Hawaii during February 1999, and produced three major achievements: (1) the reporting of the ISC–sponsored 2nd Symposium on Pacific Swordfish, held in Hawaii during 1997, (2) the establishment of an agreed protocol on data exchange amongst members of the group, and (3) the decision to proceed with a research plan to correct weaknessess in the available data and stock assessment tools, identified from an introductory study assessing swordfish stocks in north Pacific fisheries. The next ISC meeting is scheduled to be held in Japan during 2001.

Pelagic Fisheries Research Program (PFRP)

119. The PFRP was established in 1992 at the University of Hawaii to augment the scientific information available to the Western Pacific Regional Fishery Management Council to create policies for the management of fisheries for pelagic species in the United States EEZ in the Western Pacific (including Hawaii, Guam, Commonwealth of Northern Marianas, and American Samoa). The PFRP funds projects on all topics relevant to fisheries management including biology, stock assessment, oceanography, economics and social aspects of fishing communities. Grants are awarded competitively on the basis of peer-reviewed research proposals. As of 1999, the PFRP has sponsored more than 35 different projects some, of which were in response to discussions of the SCTB, for example, the yellowfin reproductive biology, yellowfin stock assessment, and bigeye stock assessment projects. The PFRP also promotes regional research by other means including hosting workshops, sponsoring visiting scientists and the publication of the quarterly PFRP Newsletter.

4. STATISTICS WORKING GROUP (SWG)

4.1 Statistics Working Group Session on Data Collection Forms

120. At its previous meeting in June 1998, the Statistics Working Group agreed that one of the procedures for coordinating the collection of data would be to establish minimum standards for data collection forms and to review data collection forms that are used in the region. In this regard, a special session of the Statistics Working Group was held immediately prior to SCTB12, from 14 to 15 June 1999, to consider proposed minimum standards for catch and effort logsheets (see WP SWG-5) and to review logsheets developed by the New Zealand Ministry of Fisheries and the Australian Fisheries Management Authority. The session was attended by Mr Noel Barut, Dr Shui-Kai (Eric) Chang, Mr Al Coan, Mr Régis Étaix-Bonnin, Mr Masatake Kato, Mr Tim Lawson, Dr Miki Ogura, Dr Robert Skillman, Mr Karl Staisch, Mr Arsène Stein, Dr Ziro Suzuki, Ms Anne Trevor, Dr Shyh-Bin Wang, Mr Peter Ward, Mr Peter Williams and Mr Gordon Yamasaki. The session was chaired by Mr Lawson, the SWG Coordinator. Mr Coan was rapporteur.

121. The SWG reviewed the proposed minimum standards for catch and effort logsheets. Some of the proposed data items were eliminated and several others were identified. The minimum standards that the SWG agreed upon are presented in Appendix 5.

122. During the discussion of vessel attributes, the SWG noted that gross registered tonnage (GRT) is calculated differently by various nations and agreed that the manner in which GRT is specified should be documented. In this regard, Mr Miyabe and Mr Skillman were asked to provide information on specifications of GRT in Japan and the United States, respectively, to the next meeting of the SWG.

123. During the review of the Australian logbooks, it was suggested that observers be placed aboard domestic longliners to conduct at least a small number of trips with the objective of verifying the detailed data recorded in the logbooks. It was noted that the use of scientific observers from the SPC Oceanic Fisheries Programme may be appropriate for this purpose.

124. The SWG Coordinator noted that SPC had placed observers on the vessels of all the region's major longline fleets, except for Australia's fleet. The group proposed that SPC investigate the possibility of placing scientific observers on Australian longliners to collect data that are comparable to those available for other longline fleets in the region.

125. The results of the review of the New Zealand and Australian logsheets are presented in Appendices 6 and 7 respectively.

126. The SWG also considered its future work on data collection forms. The SWG agreed that it was important to have logsheets that collect essential and desirable data. It was also considered necessary to independently verify those data through observer programmes and port sampling. The SWG discussed the usefulness of reviewing logsheets of other fishing nations. The SWG decided that this would indeed be useful and decided to continue these reviews at the next SCTB meeting. The following forms were identified as candidates for review:

- logsheets developed by the SPC/FFA Tuna Fishery Data Collection Forms Committee;
- the longline logsheet used by the *alia* longline fleet in Samoa, which is based on the SPC/FFA Forms Committee logsheet;
- logsheets used by the Japanese pole-and-line, longline and purse-seine fleets;
- logsheets used by the Taiwanese distant-water longline fleet; and
- logsheets used by United States longliners and troll vessels.

127. It was agreed that a special session of the SWG on data collection forms will be held in 2000, immediately prior to SCTB13, to review the logsheets developed by the SPC/FFA Forms Committee. It was noted that the Forms Committee will subsequently consider the results of the SWG review at the Forms Committee's next meeting, which is planned for December 2000.

128. It was also agreed that a group consisting of Dr Chang, Mr Coan, Mr Lawson and a participant from Japan will review the Japanese logsheets, and possibly others, and report the results of the review to the SWG Session on Data Collection Forms to be held prior to SCTB13.

4.2 Coordinator's Report on Data Collection, Compilation and Dissemination

129. Mr Lawson presented WP SWG–1, "Status of data collection, compilation and dissemination". Regarding the Statistics Working Group objective of coordinating data collection,

the procedures established at SCTB11 included (a) establishing minimum standards for data collection forms and reviewing forms used in the region, (b) developing coverage tables, and (c) developing a regional sampling design for port sampling and observer programmes. Concerning data collection forms, it was reported that the SWG Session on Data Collection Forms (see section 4.1) had established minimum standards for catch and effort logsheets and had reviewed logsheets from New Zealand and Australia, and that another session will be held next year at SCTB13 to review other logsheets. It was also reported that the SPC/FFA Data Collection Forms Committee had met from 9 to 10 December 1998 in Brisbane and had made extensive revisions to certain observer and port sampling forms, but had not revised catch and effort logsheets. Concerning coverage tables, which consist of annual coverage rates for logsheet data, landings data, port sampling data and observer data for each fleet, it was reported that the National Marine Fisheries Service had provided information on the coverage by logsheets of the United States purse-seine and troll fleets and that the OFP continues to maintain a large number of coverage tables for all fleets for which it holds data, but that no other fishing nation (e.g. Japan, Korea, Philippines, Taiwan) had responded to the request. Concerning the development of a regional sampling design, it was noted that this would be covered under a separate agenda item.

130. The procedures for coordinating data compilation include reviewing the status of data compilation for annual catch estimates, historical annual catch estimates, information on the use of processed weights or whole weights for estimates of annual longline catches, the number of vessels by size category, catch and effort data, and length data. Detailed information on the compilation of data is given for each fishing nation in WP SWG–1.

131. Concerning the compilation of annual catch estimates, it was reported that most annual catch estimates for 1998 had been received, except for the domestic fisheries of Indonesia, for which no estimates have been provided for 1995–1998. The SWG was directed to continue to attempt to determine the availability of annual catch estimates covering Indonesian fleets and obtain any available estimates.

132. It was also reported that no annual catch estimates have been provided covering the purse seiners flagged in Vanuatu or Kiribati. The purse seiners flagged in Vanuatu include two ex-Korean and several ex-Taiwanese vessels, and one ex-Japanese seiner is flagged in Kiribati. Annual catch estimates covering these vessels are not available from Japan, Korea or Taiwan; therefore, Vanuatu and Kiribati were strongly encouraged to establish procedures for compiling data covering these vessels.

133. Concerning the compilation of historical annual catch estimates, the meeting was reminded that in 1998, the tables of annual catch estimates compiled for SCTB (see WP SWG–2) were extended from 1970 back to 1950. Many historical estimates have now been provided, notably by the National Research Institute of Far Seas Fisheries (NRIFSF) of Japan, the United States National Marine Fisheries Service (NMFS) and the Overseas Fisheries Development Council (OFDC) of Taiwan. As a result of the provision of Japanese pole-and-line estimates for 1951–1971, the time series of skipjack catches for the WCPO is now complete back to 1951. The time series for south Pacific albacore is also complete; however, the time series for bigeye and yellowfin will not be complete until Japanese longline estimates for 1950–1961 have been provided.

134. Concerning the compilation of information on the use of processed weights or whole weights for annual catch estimates for longline, several fishing nations responded to the request for information and some estimates, such as those for New Caledonia, were revised to represent the catch in whole weight.

135. Concerning the compilation of statistics on the number of vessels by size category, information was provided by NRIFSF, the New Zealand Ministry of Fisheries and NMFS. Information was also presented in the SCTB12 national fishery reports for Fiji and Tonga. Information is also available for several fleets from data held by the OFP. The SWG will continue to request information on the number of vessels by size category and if sufficient information is available, then tables will be presented at future SCTB meetings.

136. Concerning the compilation of catch and effort data, logsheet data covering the fleets of SPC member countries and territories are provided on a regular basis. Logsheet data covering the United States purse-seine fleet are provided by the Forum Fisheries Agency. NMFS provided catch and effort data grouped by time-area strata covering United States trollers targeting south Pacific albacore in 1996–1998 and Hawaii-based longliners fishing in 1991–1996.

137. Logsheet data covering the fleets of Japan, Korea and Taiwan are also provided by SPC members; however, these data are compiled under access agreements and coverage is incomplete. Catch and effort data grouped by time-area strata are therefore requested from Japan, Korea and Taiwan. In January 1999, NRIFSF provided data covering Japanese longliners in 1996 and purse seiners in 1997. In March 1999, OFDC provided data covering Taiwanese distant-water longliners in 1996. No data were provided covering Japanese pole-and-line vessels, Korean longliners or purse seiners, or Taiwanese purse seiners. There continue to be certain problems with catch and effort data provided by Japan and Korea. For Japanese longline data, catches are reported in units of numbers of fish, but not in weight. Japanese pole-and-line data for 1993 and 1994 were provided for the area south of 25°N, rather than the whole Pacific as for previous years. Japanese purse-seine data have not been stratified by school association. Korean purse-seine data have been provided with effort in units of "days on which a set was made", rather than "days fished or searched".

138. Concerning the compilation of length data, NMFS provided an update of length data covering trollers in 1996–1998 and the National Institute of Water and Atmospheric Research Ltd provided an update of length data covering New Zealand trollers in 1997–1998 on behalf of the New Zealand Ministry of Fisheries. Length data covering many fleets are available from port sampling programmes and observer programmes in SPC member countries and territories; however, coverage is low. No response to requests for length data were received from Japan, Korea or Taiwan.

139. The participants from Japan, Korea and Taiwan were requested to inform the meeting concerning the status of requests for data made on behalf of SCTB. Mr Miyabe advised that there should be a clear separation of data submission to the SCTB and OFP. Japan agreed to provide catch and effort data to OFP under certain conditions agreed between the Government of Japan and SPC in December 1992. Participation at SCTB is in a personal capacity, rather than as representatives of governments, whereas the Japanese data are owned by the Government and therefore not all data can be made available to the SCTB. It is unfortunate but this may not be solved completely under the current circumstances. In response to a question from the Chairman, the SWG Coordinator advised that for all practical purposes, there was no difference between the compilation and dissemination of data by the OFP and by the SCTB. In particular, he noted that the policy for the dissemination of data and, hence, the conditions of confidentiality, of the OFP and of SCTB are exactly the same.

140. Regarding the provision of Korean longline catch and effort data for the period 1994–1997, Dr Moon advised that they are being compiled and will be processed for publication by July 1999. The purse-seine data will also be compiled and processed for publication in the same manner as in

the past years and provided later in 1999. Regarding the effort units of Korean purse-seine data, he agreed that the data of 1980–1995 that have been provided in units of “days on which a set was made” should be changed to “days fished or searched”. Yet he expressed his concern that due to the volume of data the task will not be finished in the near future. Regarding length data, the National Fisheries Research and Development Institute has collected length data from purse seiners at local landing sites and has also collected length data from some longline vessels, but these data still need to be validated before they can be used.

141. Dr Chang advised that Taiwanese catch and effort data have been regularly submitted in the past. Since new information on historical distant-water longline logsheet data for 1964–1994 were obtained from the NMFS Honolulu Laboratory, the historical data will be revised as soon as some uncertainties in the existing data and the new data be checked and validated. The revised data for 1964–1994 will be provided to the SCTB when this task has been completed. Regarding length data, they are being compiled and will be provided to the SCTB in their entirety in the future.

142. The procedure for coordinating the dissemination of data by the Statistics Working Group include reviewing instances of dissemination on an annual basis. It was reported that 24 releases of data occurred between January 1998 and June 1999. Details of each of the releases are presented in WP SWG–2. It was also reported that catch and effort data for driftnet, longline, pole-and-line and purse seine, grouped by 5° latitude, 5° longitude and month, for all fishing nations combined, are now available on the SCTB page of the SPC website at http://www.spc.org.nc/oceanfish/Html/SCTB/Data/index.htm. The data are available in FoxPro DBF files, together with text files containing database formats and notes on the sources of data.

4.3 Statistical Areas

143. After a presentation by the SWG Coordinator, it was agreed that a group consisting of Dr Campbell, Dr Hampton, Mr Lawson, Dr Lewis, Dr Murray, Dr Sakagawa, Mr Stein, Dr Watters and Mr Yen would meet to consider this subject. The group met on 18 June 1999. Mr Pierre a Teriitehau, Permanent Secretary of the Ministère de la Mer of French Polynesia, also attended. The group agreed that the statistical areas should be interpreted as referring only to the areas covered by the tables of annual catch estimates presented in WP SWG–2 and that the area for the WCPO should not be interpreted as representing an “area of interest” of the SCTB. Therefore, it was agreed that this statistical area will be referred to as the “WCPO”, rather than the “SCTB statistical area”. It was recognised that longitude 150°W was an appropriate boundary between the fisheries in the WCPO and the EPO, given the distribution of surface catches.

144. The statistical areas accepted by the group are presented in Figure 4. The northern boundary of the WCPO and EPO is 50°N. The southern boundary of the WCPO and EPO is 50°S. The western boundary of the WCPO is the coast of Asia and Australia, including the lines from 50°S northwards along 141°E to the south coast of Australia, from the north coast of Australia northwards along 129°E to 08°S, westwards along 08°S to the coast of the Indonesian peninsula, from the Indonesian peninsula eastwards along 02°30N to the Malaysian peninsula. The eastern boundary of the WCPO and the western boundary of the EPO is 150°W. The eastern boundary of the EPO is the coast of the American continents. It was noted that the portion of the WCPO and EPO that is south of the equator is the area covered by the tables of annual catches of south Pacific albacore in WP SWG–2.

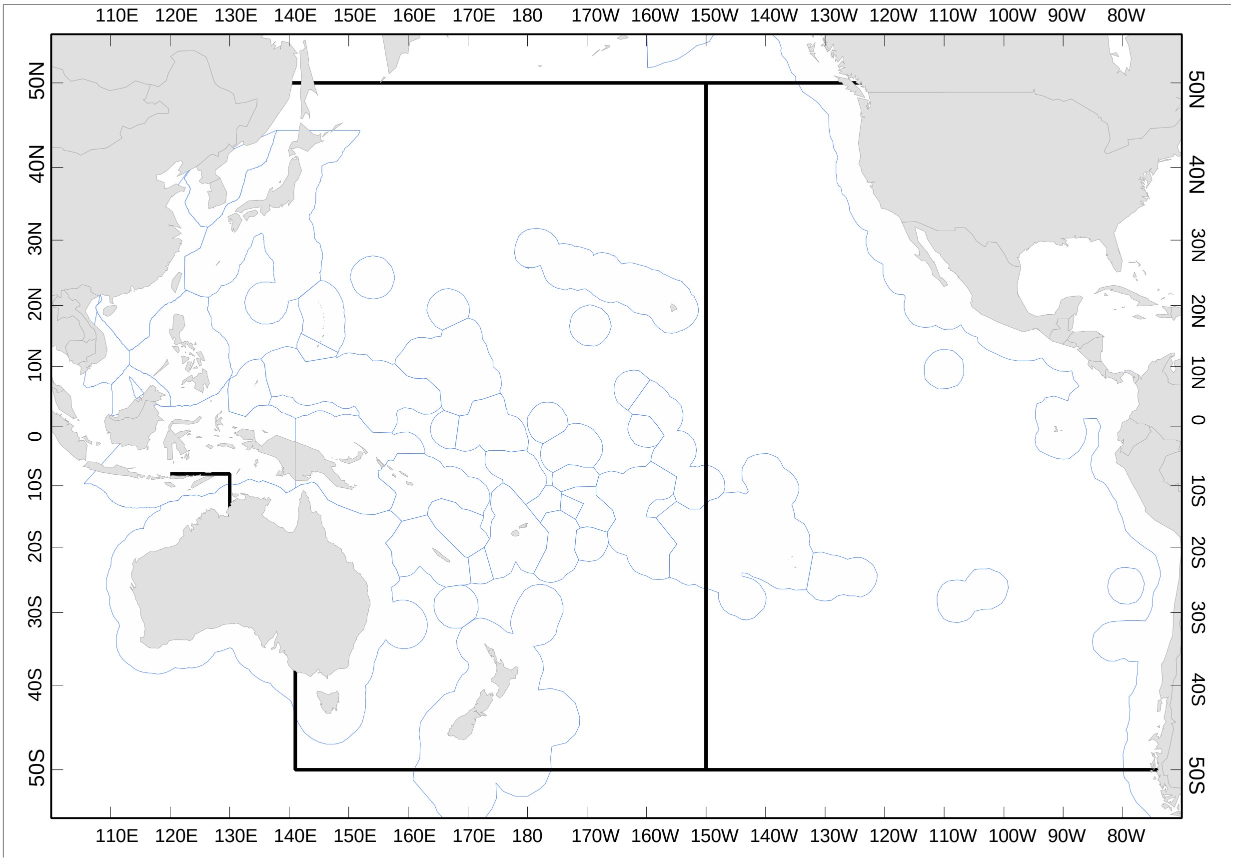

Figure 4. Western and Central Pacific Ocean (WCPO) and Eastern Pacific Ocean (EPO)

4.4 Factors Affecting the Proportion of Bigeye in Purse-Seine Sets

145. The SWG Coordinator presented this subject by reviewing how annual purse-seine catches of bigeye and yellowfin were adjusted in WP SWG–2. Bigeye are usually mis-identified as (or not distinguished from) yellowfin in logsheet and landings data; therefore, annual catch estimates for bigeye are usually severely under-estimated. Estimates of bigeye and yellowfin for most fleets were therefore adjusted using port sampling data provided by NMFS covering the United States purse-seine fleet. The port sampling data were used to obtain annual estimates of the true proportion of bigeye in the combined catches of yellowfin and bigeye. The proportions were estimated for associated and unassociated schools. During 1989–1995, the proportion of bigeye in the combined catch averaged less than 1 percent for unassociated schools and about 13 percent for associated schools. Given the large difference between school types and noting that the distribution of the catch by school type has varied among fleets and years, the estimates of the proportion of bigeye in the combined catch were estimated for other fleets and years by taking a weighted average of the annual proportions for each school type estimated from the sampling data covering the United States fleet, where the weights were the catch by school type for each fleet and year. Applying the weighted average estimate of the proportion of bigeye in the combined catch, for each fleet and year, to the unadjusted combined catches resulted in the adjusted estimates of the annual bigeye catch. (See Working Paper SWG–2 for a full discussion of the methodology.) At the previous SCTB meeting in June 1998, the question was raised whether it was appropriate to apply the estimates of the proportion of bigeye in the combined catch, for each school type, based on data for the United States fleet to other fleets, given that the areas fished by the other fleets are known to have been different.

146. Mr Coan presented WP SWG–4. The objective of the study was to investigate differences in areas fished by the United States and Japanese purse-seine fleets in the western and central Pacific. Differences in areas fished by the two fleets were shown and the related appropriateness of using species composition samples for the United States fleet to separate bigeye from yellowfin catches of the Japanese purse-seine fleet was discussed. Catch and effort data from both fleets for the period 1981 to 1998, and NMFS species composition samples for 1989 to 1998 were used.

147. The species composition samples were stratified by 1°, 5°, 10° and 20°. Analyses of variance of the proportion of bigeye in the species composition showed that the most significant effects were between 1° and 5° strata. As the size of the strata increased to 10° and 20°, the effect of area on the difference in bigeye proportions decreased. Latitude effects were more significant than longitude effects for 1° and 5° area strata. Longitude effects became more significant than latitude effects for 10° and 20° area strata.

148. When 1° area strata were compared, very few of the strata fished by the United States fleet were also fished by the Japanese fleet. The percentage of strata fished by both fleets varied from 13 percent in 1983 to 40 percent in 1981. The United States fleet fished further to the east and the Japanese fleet fished further to the west and north, particularly during the 1980s. The percentage of strata fished by both fleets increased as the strata size increased to 5°, 10° and 20°.

149. Based on these results, it was concluded that substitution of species composition samples between fleets could lead to inaccurate estimates of the actual bigeye and yellowfin catches. However, since the NMFS species composition samples are the only data available for estimating bigeye catches by purse-seine fleets, the authors recommended continuing to maintain two sets of tables of annual catch estimates, one for adjusted yellowfin and bigeye catches and one for unadjusted catches. They also recommended using NMFS species composition samples only for areas fished by both fleets. Finally, they encouraged species composition sampling of all purse-seine catches.

150. During the discussion, it was noted that the statistical tests were done using the proportion of bigeye in the overall species composition and not the proportion of bigeye in the combined catch of yellowfin and bigeye for each school type. Since the proportion of bigeye by school type is known to be different and since the catch by school type is known to have varied among the purse-seine fleets, it is not unexpected that the statistical tests resulted in significant differences. It was suggested that it may be more useful for evaluating the appropriateness of applying the species composition samples for the United States fleet to other fleets if the statistical tests were conducted using the proportion of bigeye in the combined catch of yellowfin and bigeye for each school type, since these are the values used in the adjustment procedure.

151. Mr Bigelow presented WP SWG–3. Bigeye catch estimates are currently determined for the Japanese and United States purse-seine fleets by port sampling. Estimates for the remaining fleets are based on the assumption that the proportions of bigeye in associated and unassociated sets are similar to those for the United States fleet. In 1998, the Yellowfin Research Group noted concern in the application of the estimating catches of non-US fleets. Given the potential bias in bigeye catch estimation, the objectives of this study were to (a) statistically compare bigeye composition between purse seine fleets and (b) consider an alternative statistical method (regression trees) to analyse factors affecting the composition of bigeye and estimate the total catch.

152. Results indicated that there were no significant differences in bigeye composition in unassociated sets between fleets. However, there were significant differences in bigeye composition in associated sets between fleets. Bigeye composition in associated sets was characterised by high variability between sets.

153. Tree-based regressions offer an alternative method to quantify what factors influence the proportion of bigeye in purse-seine catches. The final tree had four predictors as latitude and fleet were excluded. The order of relative importance was 1) school association, 2) longitude, 3) year, 4) month. Vessel flag was not identified as a predictor. Catch estimates from the tree-based regressions differed depending on if the initial data were un-transformed or square-root transformed. Differences based on data transformation require further investigation. Tree-based regressions on un-transformed data show good coherence with the current extrapolation method from 1993 to 1997, a time frame when sampling occurred on all fleets. From 1988 to 1997, annual catch estimates based on the regression ranged from 7 to 37 thousand mt.

154. Subjects raised during the discussion concerned the effect of transforming the data; the use of observer data instead of port sampling data for the United States fleet; the relationship between the port sampling data and observer data for the United States fleet; the inclusion of discards by observers and their exclusion by port samplers. It was suggested that another approach may be to use a technique that separates the problem into an analysis of the probability of obtaining zero bigeye schools and an analysis of factors affecting the proportion of bigeye in positive bigeye schools.

4.5 Towards a Regional Sampling Design for Port Sampling and Observer Programmes

155. The SWG Coordinator gave a brief presentation to introduce this subject. There are several regional and national observer programmes and many national port sampling programmes operating in the region. There are four main gear types, i.e. longline, pole-and-line, purse seine and troll, and many fishing nations, operating in diverse areas. The complexity of the structure of the fisheries and the sampling programmes implies that the development of a regional sampling programme will not be straightforward.

156. The primary research objectives of observer programmes are usually (a) the collection of species composition data for target and major non-target species, (b) the collection of length data for target species, and (c) the collection of data on catches of minor non-target species. The primary objectives of port sampling are to collect data on the species composition and lengths of the landed catch.

157. The tasks in developing a regional sampling programme could include (a) the compilation of existing species composition data for target and major non-target species, length data for target species, and catch data for non-target species; (b) the analysis of factors affecting variation in primary variables, such as the species composition, length-frequencies, and catch rates for non-target species; (c) the evaluation of the relationship between the variance in primary variables, on the one hand, and the number of strata and the number of samples per stratum, on the other; and (d) the determination of sampling protocols.

158. The issue of how the various sampling programmes might be coordinated was raised. It was suggested that this issue might best be addressed by first developing a regional sampling design

based on the analysis of the available data and then comparing it to the actual programmes. The level of coordination of the various programmes that might be necessary should then be apparent.

159. The meeting was advised that IATTC is considering revising its sampling programme for length data, since the current sampling programme is based on area strata that were developed in an ad hoc fashion as the fishery expanded.

5. SKIPJACK RESEARCH GROUP (SRG)

160. Dr Lewis led the session of the Skipjack Research Group, in the absence of the regular Coordinator, Mr Opnai.

5.1 Regional Fishery Developments

161. Dr Lewis presented an overview of the skipjack fishery referring to papers WP GEN-1 and WP SWG-2. The skipack catch comprises two-thirds of the total catch of the four target species in the WCPO. It is the principal catch of the surface purse seine and pole-and-line fisheries as well as the artisanal fisheries of the Philippines and eastern Indonesia. The skipjack catch has been increasing since the 1970s when it was initially dominated by the pole-and-line fishery. During the 1980s the purse seine fishery developed and has dominated the catch since that time. In 1998, the skipjack catch reached a record level of 1,167,861 mt – this increase accounting for nearly all of the 200,000 mt increase in the total species catch for the WCPO.

162. The 1998 skipjack catch by gear was: purse seine–889,000 mt (76%); the pole-and-line–225,000 mt (19%); and the unclassified gears of Indonesia, Philippines and Japan–51,000 mt (5%). The Indonesian component of the pole-and-line catch has been estimated as their 1994 catch, since no data have been supplied since that time.

163. Skipjack catch is mostly equatorial with the majority of the rest taken in the home-water fishery of Japan. The spatial distribution of the skipjack in equatorial areas is strongly influenced by ENSO events (see Agenda Item 5.2 – Environmental effects on skipjack availability and production).

164. The 1998 skipjack catch increased for each of the four principal purse seine fleets, with a notable resurgence of vessels setting on associated schools. An increase in the proportion of associated sets was particularly evident in U.S. fleet activities with the use of man-made drifting FADs; in contrast, this practice was not as apparent with the Japanese fleet. The annual US purse seine skipjack CPUE for associated sets remains variable – catch rates declined from 1994 to 1997, but rebounded strongly in 1998. The US purse seine catch rates for unassociated school sets have shown a gradual increase since the 1980s (Figure 5).

165. The skipjack CPUE for the Japanese pole-and-line fleet has shown an increasing trend over the past decade. These increases coincide with the departure of the less competitive vessels and the acquisition of improved technology, for example bird radar.

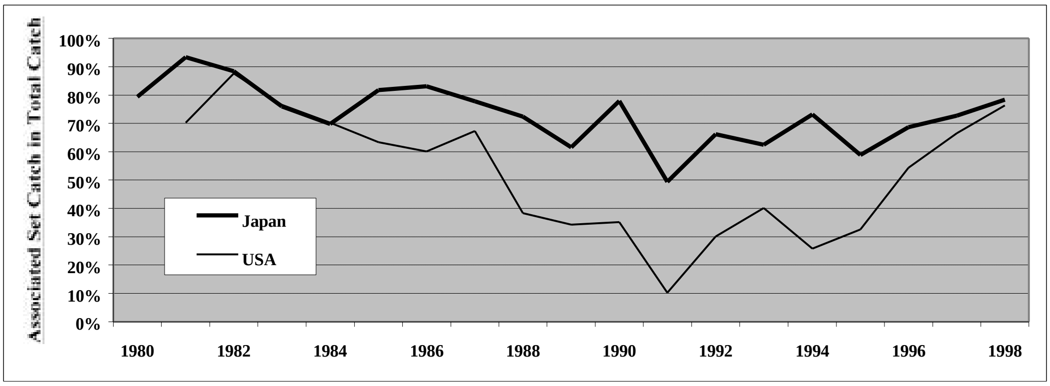

Figure 5. Proportion of catch from associated sets – US and Japanese fleets

166. The skipjack size composition data from equatorial fisheries indicate they were generally between 30 cm and 70 cm fork length (FL) and there was little difference in the length composition between associated and unassociated sets. A recruitment pulse appears in November to January of most years.

167. It was noted that CPUE among the four principal purse seine fleets differed until the recent years, where annual CPUE was similar for these fleets. This was due to fleets now fishing more in common areas, a result of increased access arrangements and the recent trend of fishing further east. Also, there was some evidence of sharing catch information amongst fleets.

168. Dr Sakagawa presented WP NFR–21, describing the activities of the US purse seine fleet during 1998. The 1998 total catch of the U.S. purse seine fishery was 176,763 mt with a feature of the statistics being the decline of the skipjack CPUE over the years 1993–1997 to 12 mt per day, and the rebound to 21 mt per day in 1998. The yellowfin CPUE declined slightly in 1998. Skipjack comprised about 70% of the target tuna catch. The distribution of the effort and catch differed between the NMFS reporting areas, with Area 1 being most active in the early part of 1998 then Area 2 producing most of the catch and being particularly productive in the middle part of the year. Areas 3 and 4 were less productive. The ENSO event concentrated effort around the 180° meridian.

169. There was a noted difference in the proportion of unassociated, log and FAD sets with catches to the east and west of 180°. Dr Sakagawa noted the need to distinguish catches taken from log (natural) and FAD (man-made) sets.

170. In response to a question on the impact of the current low prices on the fleet this year, Dr Sakagawa replied that the fleet was suffering and that many vessels have voluntarily decided to tie up for a period of 30 days on a rotational basis. He added that vessels were getting very large catches and that the EPO was also producing large catches of skipjack. Dr Watters illustrated this with a figure showing that the catch rates were equivalent to 1978 levels, which was the highest recorded in the EPO. He related this to an increase in the number of associated sets.

171. Dr Ogura provided information on the Japanese pole-and-line fishery, referring the meeting to WP SKJ–4, which described catch trends, the licensing system, vessel size classes, the fishing grounds, and searching devices used on the vessels. DWFN pole-and-liners, typically over 200 GRT, freeze their catch, while smaller vessels (i.e. <200 GRT) use refrigerated seawater for catch storage. Fishing grounds are spread widely throughout the WCPO and skipjack is the main target species, although albacore is an important species in the northern fishing ground off Japan during the summer season. Since 1970s, several devices thought to affect fishing effort, have been

developed: a new bait tank system (which has improved the ability to store baitfish for longer periods), bird radar, sonar, and satellite image receivers.

172. Information on new equipment (i.e. the four searching devices described above) had been added to the logbook and enabled the standardisation of skipjack CPUE to be undertaken. The GLM analysis included area, season, albacore catch, four searching devices, and interactions. Both standardized and nominal abundance indices of skipjack showed slightly increasing trend until 1980s, but after that standardised CPUE increased less than that of nominal CPUE. The standardised abundance indices determined for the periods around 1980 and 1990 were at almost the same level as that obtained from analyses of data collected from large–scale tagging programmes (SSAP and RTTP) during those periods. Although effectiveness of searching devices were different among areas, the new bait tank system and the sonar showed effectiveness in almost all areas. However, there were negative effects for some devices in some areas, and the authors stated that further research and review of the data quality are required.

173. The areas in this study were arbitrarily assigned and are not related to any scientific or regulatory mechanism. It was noted that there had been a recent reduction in annual catches for study area 3.

5.2 Biological and ecological research

Age and growth

174. A paper was not presented, but Dr Lewis reviewed existing information. Skipjack growth rates appear highly variable with space and time, and there is a need to reduce the uncertainty of growth estimates. To assist in this matter, Dr Hampton indicated that SPC plans to conduct an exploratory examination of otoliths in the near future, with the intention of comparing growth estimates from otoliths with those from tag-recapture and length-frequency analyses.

Early life history studies

175. Dr Ogura presented results summarised in WP SKJ–2. Surveys for juvenile skipjack were undertaken between October and December for 5 years using a high-speed, mid-water trawl net with a large opening. Information on the horizontal and vertical distributions, diet and growth (determined from otoliths) of juvenile skipjack were presented. Dr Ogura also presented WP SKJ–3. While acknowledging that the information gained on non-tuna species was limited (as juvenile tunas were the target), it did provide an insight into the variety of prey species available and some aspects of their distribution and diel behaviour.

Movements and mixing

176. Dr Sibert presented results (no paper available) from an analysis using diffusion models to explore tag-recapture data. Analysis of SSAP data showed consistency in observed and predicted movements, with the model predicting the time and location of recapture, showing diffusion estimates being higher for tropical areas than sub-tropical areas. RTTP data, on the other hand, were problematic as they were decomposed by time (this markedly increased computing time). The major difference between the data sets was that the SSAP tags were released in pulses, whereas the RTTP tags had been released continuously over time. The development of diffusion models is ongoing, and the RTTP data will be re-analysed in an attempt to overcome the problems due to the data structure.

177. The differences in the experimental design of these two projects, as well as major differences in the skipjack fisheries in operation during the two periods, required the method use an advection-diffusion-reaction model and the SSAP results be modified for application to the RTTP results. The major difference related to the stratification of tag-release groups into monthly “cohorts”. When this change was introduced the model appears to predict the time and place of the RTTP recaptures accurately. The diffusion estimates range from less than 100 to over 10,000 nm^2/month and the natural mortality estimate is approximately 0.1 $month^{-1}$.

178. Dr Sibert also described preliminary work on fish stock management horizons. The average distance a fish might move in its lifetime as well as the equilibrium population density at any place on a disk for specific values of diffusion, natural mortality and fishing mortality are two useful applications of diffusion models. Equilibrium population density computations can be used to estimate a measure of the size of a fishery management area. Results indicate that the radius of effective fishery management zones might be around 300 to 600 miles for fish with diffusion and mortality characteristics of skipjack. Management policies should be consistent with the movement and mortality characteristics of the target species of the fishery. Dr Sibert, however, emphasised that these analyses were preliminary.

179. Dr Hampton revisited the subject of discussion posed during the late 1980s – “Is international management of tuna necessary ?”. Dr Sibert replied that policy needs to be consistent with biology and that international co-operation was needed at different levels. He also recommended caution using the model as it did not include factors such as productivity. Dr Watters asked what would happen in the model if natural mortality was modified. Dr Sibert replied that decreasing natural mortality would mean the fish would move farther, and there was therefore a relationship between natural history of the animal and the scope of its management. Dr Julian Pepperell noted that skipjack are dispersive in behaviour, so how would the model apply to billfish. Dr Sibert replied that the model was only good for fish with dispersive behaviour. Mr Tinga asked about the intensity of the diffusion to which Dr Sibert replied the take-home message is that a big EEZ is better than a small EEZ.

Environmental effects on skipjack availability and production

180. Dr Patrick Lehodey presented WP SKJ–1, describing the results of a tuna forage model which uses oceanographic data, food production information and natural mortality to model tuna movement. Results are encouraging and it is possible to describe the impact of ENSO events on tuna habitat, movement and availability (see Figure 6). Currently, the food production and population components of the model are analysed separately. Development of a combined model is ongoing, as are plans to apply the model to other tuna species.

181. A member from the IRD noted that the skipjack model was easier for surface fisheries such as skipjack but that it would be more difficult with bigeye and a depth parameter. He also noted that the model should be verified with a stomach contents study. Dr Lehodey replied that there were few stomach content data from large-scale surveys in the Pacific.

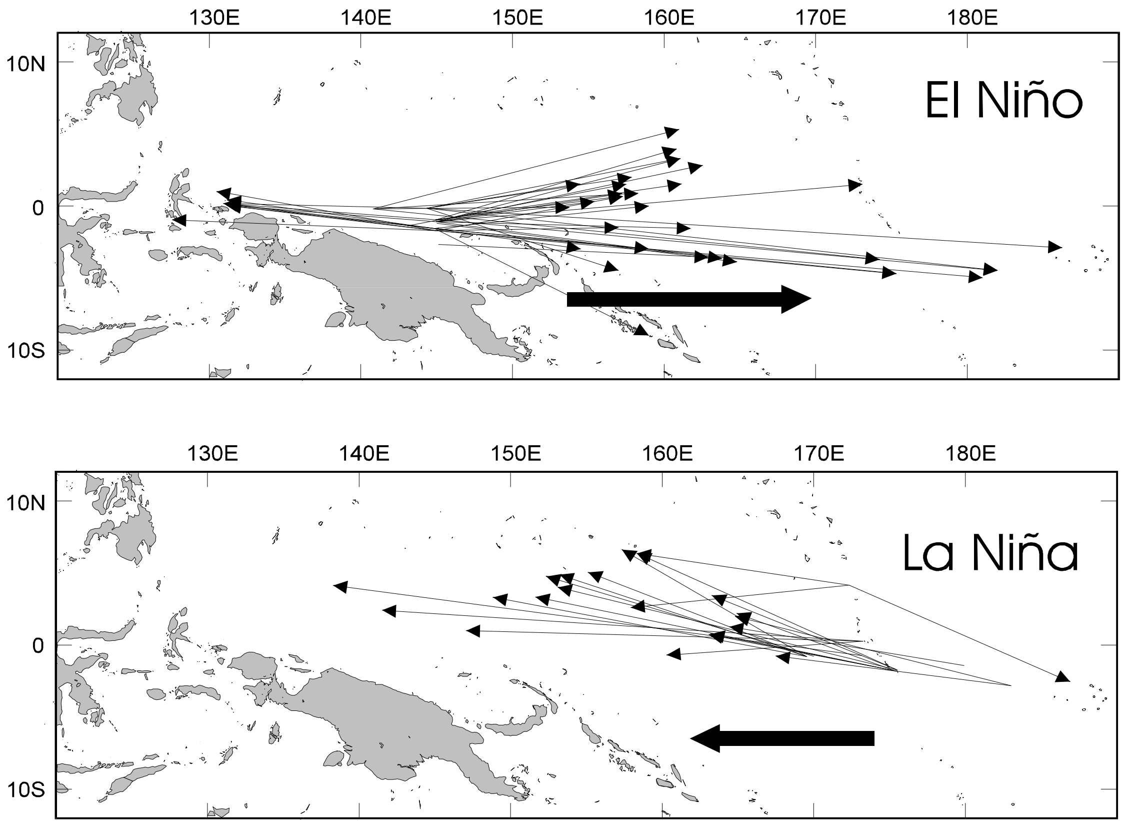

Figure 6. Displacement of tagged skipjack tuna during an El Niño (May 1991- Feb. 1992) and La Niña (Mar. 1992 – Oct. 1992) phase (WP SKJ–1).

182. Dr Hampton noted that the Eastern Tropical Pacific had higher forage concentrations than the western tropical Pacific, but the catch is lower and that water clarity may be a factor. Dr Lehodey noted that there was an inverse relation to primary productivity. Dr Campbell asked whether, given that sea-surface temperature data are now more readily available, the model could be run in real time. Dr Lehodey replied that he was not sure if the data were appropriate for the scale of the fishery and that, for finer scale analyses, more parameters were needed.

5.3 Stock assessment

183. The discussion on skipjack stock assessment initially focussed on the use of length-based models. Dr Hampton expressed his intention to apply MULTIFAN–CL model next year to WCPO skipjack in collaboration with Japanese scientists; this work will utilise catch and effort, length frequency and tagging data going back to 1970. It was noted that length frequency data indicated a consistency in skipjack growth. The inclusion of effective effort, a product of the recent work of Dr Ogura, will be pursued for possible use in the model.

184. Dr Mark Maunder introduced his length-based model, which was used to assess the stock dynamics of skipjack in the EPO (WP SKJ–5). The method is a form of length-structured statistical catch-at-length analysis, and does not model the age-structure of the population. It differs from age-structured statistical catch-at-length analysis in that it assumes growth is dependent only on length as opposed to assuming a distribution of length-at-age, and therefore allows length specific processes to modify the distribution of length-at-age. The model is spatially structured to allow for differences between regions and models movement between the sub-populations. The model has been used to investigate the effect of the recently expanding floating object fishery in the central

EPO, but can also be used to investigate environmental effects on recruitment, growth and catchability, or test hypotheses about recruitment and movement.

185. Two comments were made on the pattern of natural mortality rate (M) by size apparent from the model results : (i) there appears to be an increase of M at around 50 cm and above, and (ii) a relatively low level of M for small fish (30-35 cm), in contrast to estimates from tagging data in the WCPO which indicate a quite high value. Several participants expressed interest with his growth rule, especially on the transition matrix.

186. Dr Hampton introduced a multi-gear, multi-species and age-structured model, which is under development at the OFP (WP RG–1). This model can address issues of spatial interactions among fisheries as well as interactions caused by the fishery-specific size difference in its catch. It is hoped that this model will ultimately be used for stock assessment purposes.

187. Discussion on reference points suggested that there was no reason to change the group's position with regard to reference points of skipjack. The Coordinator suggested to keep the statement made last year on this topic; "*There seemed to be some consensus that even though it is not at present known what an appropriate reference point should be for WCPO skipjack stocks, the state of the fishery is nevertheless safely below any reference point that could reasonably be imagined*".

5.4 Research coordination and planning

188. It was agreed to tabulate the prioritised research needs to allow better coordination in addressing tasks in the future.

- apply the MULTIFAN–CL assessment model to look closer at the status of stock as well as to set a reasonable and applicable reference point;
- obtain annual catch statistics for those fisheries where information is lacking;
- monitor available fishery indicators from various fisheries;
- collect and examine more detailed information on fishing operations obtained through observer program or other relevant research;
- study schooling and aggregating behaviour;
- examine age, growth and mortality through the entire life history of the animal.

5.5 Summary statement

189. A summary statement for skipjack was drafted, circulated to participants and discussed during Agenda Item 11. The accepted wording appears below.

SKIPJACK RESEARCH GROUP (SRG) – SUMMARY STATEMENT

Skipjack contribute two thirds of the WCPO catch of the four main tuna species. The best available estimates indicate that the 1998 skipjack catch in the WCPO was the highest on record (1.17 million tonnes, just exceeding the 1991 catch), with purse seine fleets providing both the majority of this catch (76%) and the catch increase observed during 1998. Available indicators (purse seine, pole-and-line) show variable catch rates over time in the fishery, but with no suggestion of a downward trend. Recent studies have begun to provide some understanding of environmental influences on fluctuations seen in skipjack availability and productivity of the stock in the WCPO.

Tag-based assessments from the early 1990s found regional exploitation levels to be low to moderate at catch levels similar to those in recent years; combined with the absence of clear trends in fishery indicators, this would suggest that the current catches are certainly sustainable. However, given the importance of the skipjack fishery, there is a need to improve the statistical coverage of the fisheries, which remains poor in some areas (e.g. Indonesia, Philippines), to develop improved assessment models which would be amenable to reference point-based management, to develop fishery indicators for use in stock assessments, and to continue to develop an understanding of processes affecting stock productivity and recruitment.

6. ALBACORE RESEARCH GROUP (ARG)

190. The Albacore Research Group Coordinator, Mr Su'a, led the session of the Albacore Research Group.

6.1 Regional Fishery Developments

191. Trends in catch, CPUE and size composition were reviewed by Dr Lewis, referring to WP GEN–1. There are two separate stocks of albacore in the Pacific and fishery estimates were only provided for the south Pacific stock as this is the only stock considered by the group. South Pacific albacore are exploited by a variety of domestic and foreign longline fleets as well as troll fleets from New Zealand and the USA. In the 1990s, total albacore catch ranged from 31,000 to 37,000 mt and was dominated by the longline fleet (23,000–30,000 mt) with lesser amounts from the troll fleet (4,000–8,000 mt). Albacore longline catches have escalated in several domestic longline fisheries, especially Samoa and French Polynesia. Catches in 1998 in these two countries totalled 9,700 mt (6,500 mt– Samoa; 3,200 mt–French Polynesia), or greater than 25% of the south Pacific catch. The Taiwanese distant-water fleet is the major foreign fleet targeting albacore. The fleet operates in a wide latitudinal range in the south Pacific, with high catch rates at temperate latitudes and lower catch rates in the tropics and sub-tropics. Annual CPUE in the troll fishery is more variable than the longline fishery especially for vessels that operate in the sub-tropical convergence zone (STCZ). Length composition includes three modes of juvenile fish in the troll fishery and one combined mode of adult fish in the longline fishery.

192. Mr Gordon Yamasaki provided information about monitoring at Pago Pago, American Samoa where most south Pacific albacore are landed. NMFS has conducted port sampling since 1962, primarily monitoring the longline fishery. Currently, longline vessels include: 1) 30 to 35 Taiwan vessels either registered in Taiwan or other countries e.g Honduras, Belize, Philippines, 2) five Korean vessels flagged in Panama, 3) four domestic Tongan vessels, and 5) approximately 50 permanent domestic longline vessels, of which less than 10 make regular deliveries. Logbooks have been collected by NMFS since 1964. Logbook coverage was initially high (80%), but is presently low (<20%). Transshipment within Pago Pago is becoming increasing more important as changes occur in the Taiwanese fleet. Transshipment to freezer carriers is occuring more often due to the long delay (1 month) in offloading at the canneries. Unfortunately, there is no data collection when vessels offload to freezer carriers. The price for albacore has increased in the last few months.

193. Dr Norm Bartoo presented an overview of the US south Pacific albacore troll fishery (WP ALB–3). The 1997–98 troll season was similar to previous years, with a preliminary catch estimate of 1,089 mt and a CPUE of 52 fish per day (Figure 7). The average fork length from port sampling

was 66 cm, but the sample size was small (n=200), since most vessels unloaded in Fiji. Size samples are biased upwards because some vessels discard small albacore.

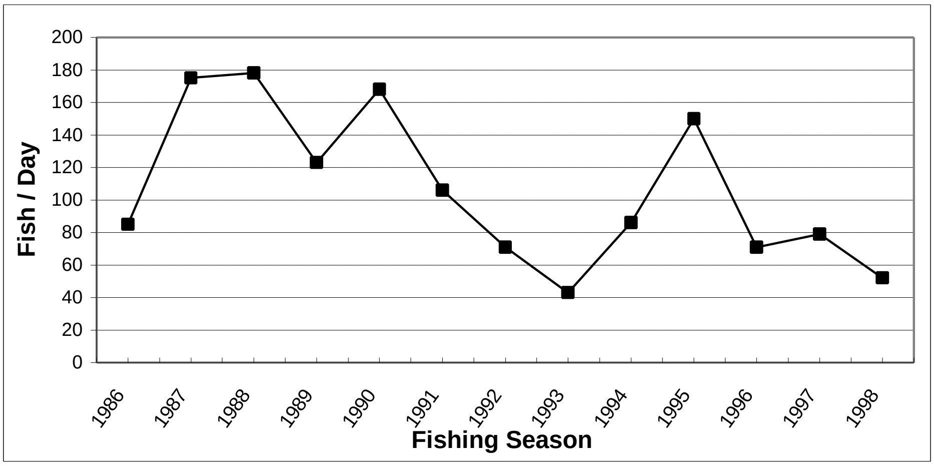

Figure 7. CPUE by US Troll fleet in the south Pacific (WP ALB–3)

194. Dr Murray reported that the number of vessels trolling for albacore increased from 213 vessels in 1989–90 to a maximum of 470 vessels in 1993–94; vessels trolling for albacore have subsequently declined to 289 in 1996–97. Total albacore catches over this period have ranged from about 3,000 mt to over 6,000 mt, most of which is by trolling. Albacore landings in 1996–97 was 3725.5 mt, an appreciable decline relative to the preceding two years (6,316 mt in 1995–96 and 6,196 mt in 1994–95). The nominal CPUE trend for the New Zealand albacore troll has exhibited a declining trend of about 2.8 fish per 100 hook-hours each year. The decline in albacore landings is not thought to be due to changes in abundance but rather to economic factors.

6.2 Biological and ecological research

195. The ARG Coordinator reviewed information on stock structure and movement noting that albacore is the best known of tuna species, with separate north and south Pacific stocks. Tagging has shown considerable trans-Pacific movements and although there is a tendency for albacore to move northward (in the south Pacific) as they grow older, there is no evidence of movements across the equator. Albacore are moderately long-lived, reaching 10 years old. Spawning occurs in summer months in both hemispheres with larvae found in tropical and sub-tropical latitudes.

196. Dr Bartoo presented WP ALB–2 which provided a north Pacific example of long term trends in albacore catch with respect to environmental factors. A twenty year time series of catches and climatic indices showed circumstantial evidence of large scale decadal effects. It was suggested that these long-term effects on productivity could be due to changes in either catchability, availability or abundance. It was noted in discussion that similar long-term effects had been seen in the Atlantic. Dr Chien–Hsiung Wang also noticed that his analysis of last year had found a relationship between albacore CPUE and SST when lagged by one year. Dr Bartoo noted that one of his climatic indices (sea surface pressure) had an implicit lag of 6 months, and that SST might involve a longer lag.

6.3 Stock assessment

197. Dr Wang applied a production model to evaluate the current status of the south Pacific albacore stock (WP ALB–1). Previous analyses using a similar model suggested that the albacore stock was overexploited; however, the present analysis determined that stock status was healthy. The significant differences regarding stock status between model iterations resulted from excluding

catch data from 1967 to 1973. He thought this was justified because this period corresponded to the advent of the longline fishery, and vessels may not have been actively targeting albacore tuna. During the thirty-year time-series, annual biomass had an estimated mean of 85,000 mt (range 52,000–188,000 mt). A new technique was incorporated into the production model to address the risk of stock collapse which corresponded to seven management policies. Risk was estimated through the relative size of fishing mortality and the intrinsic growth rate. As an example, the risk of collapse during the last three years was considered low. There was renewed criticism that the model indicated that annual production was similar to standing biomass, which is abnormal for a long-lived fish. Dr Wang acknowledged the comments about the apparent high annual production.

198. Dr Hampton indicated that no further updates had been conducted on the length-based age-structured (MULTIFAN-CL) assessment model for albacore. In order to update the assessment it is necessary to incorporate the improved Taiwanese longline statistics when they become available, as these data are the most important longline fishery indicator for albacore. Ideally, the model will be updated for 1994 to 1997 for the next SCTB. Future improvements to the model may include: 1) re-structuring the analysis to better incorporate recent fishery developments (e.g. Samoa, American Samoa and French Polynesia) and fishery data (port sampling, catch and effort) from New Zealand, 2) separating fleets by nationality, and 3) considering the likelihood of localising the model to smaller spatial scales.

199. Dr Sibert presented (no paper tabled) information from a MULTIFAN-CL analysis of the effects of El Niño on south Pacific albacore recruitment. Earlier analysis had shown an apparent relationship between recruitment and SST with a two-year lag for surface fisheries and a 4.5-year lag for longline fisheries. These model results suggested high steady recruitment for the period 1962–74 followed by lower and more variable recruitment since about 1974. Results have shown predicted recruitment to be significantly correlated ($r = 0.767$; $\alpha = 0.9$ to 0.95) with the southern oscillation index (SOI). This suggests that large-scale oceanographic processes may mediate recruitment and that it may be useful to parameterise SOI or other environmental indices to better predict recruitment. It was noted that observed albacore recruitment doesn't always appear to fit those that are predicted, and it would be worthwhile repeating the MULTIFAN–CL model work with the benefit of an additional four years data spanning several ENSO events.

6.4 Research coordination and planning

200. The following research needs were identified:

- Additional observer coverage and improvement of transhipment information;
- Continue to refine the Taiwanese longline statistics, especially in the 1960s and 1970s within the time-series when targeting may have been directed towards bigeye rather than albacore. Possibly stratify longline effort by targeting due to its importance in assessments;
- Understand how fleet behaviour (albacore targeting) may be related to economic factors as well as resource availability; and,
- Update the MULTIFAN–CL assessment by including the improved Taiwanese longline data, re-structuring the analysis to better incorporate recent fishery developments, and considering the likelihood of localising the model to smaller scales.

6.5 Summary statement

201. A summary statement for albacore was drafted, circulated to participants and discussed during Agenda Item 11. The accepted wording appears below.

ALBACORE RESEARCH GROUP (ARG) – SUMMARY STATEMENT

Albacore occurring in the south Pacific constitute a single stock. The best fishery estimates indicate that the 1998 albacore catch (41,000 tonnes) was the highest annual catch this decade. South Pacific albacore were mainly harvested by the longline fleet (88%) with a lesser amount contributed by the troll fleet (12%). Longline catches have escalated in several domestic longline fisheries, especially Samoa, American Samoa and French Polynesia. In these three countries, the 1998 catch totalled 10,000+ mt or nearly 25% of the entire south Pacific catch.

The Taiwanese distant-water longline CPUE provides the best long-term indicator for the fishery, and catch rates in 1998 were high (>4 albacore per 100 hooks) compared to fishery performance earlier in the decade. Trolling catch rates of the USA and New Zealand fleets are more variable than those of the longline fishery, possibly due to factors affecting availability rather than changes in stock abundance.

A length-based age-structured stock assessment (MULTIFAN–CL) applied from 1962 to 1993 suggested that current levels of south Pacific albacore catch are sustainable given moderate exploitation rates and recent increases in catch rates of domestic and distant-water longline fisheries. In addition, there was some evidence of ENSO impacts on both catchability and recruitment. A recent production model analysis is also consistent with the good stock condition interpretation.

The MULTIFAN–CL assessment needs updating, and could be improved by updating Taiwanese longline statistics, re-structuring the analysis to better incorporate recent fishery developments, consideration given to the likelihood of localizing the model to smaller scales, incorporating assessment of precautionary reference points and better understanding how fleet behaviour or albacore targeting may be related to economic factors.

7. YELLOWFIN RESEARCH GROUP (YRG)

202. The YRG Coordinator, Dr Sakagawa, led the session of the Yellowfin Research Group. He suggested that the YRG settle on some specific objectives that would serve as the focus for the next 3 to 5 years. In this way, the group can become more proactive and the research more relevant for fishery administrators. He proposed four objectives for consideration by the group in the year ahead:

- Review fishery information for accuracy and completeness;
- Review progress with stock assessment research;
- Determine the condition of the stock and re-evaluate safe level of exploitation;
- Identify gaps in information for improving stock assessment and for monitoring the safe level of exploitation;

7.1 Regional Fishery Developments

Overview

203. Dr Sakagawa provided an overview of the yellowfin tuna fishery for 1998, drawing on information in WP GEN–1. At 407,000 mt, the 1998 catch of yellowfin was one of the highest on record. Longline (62,000 mt) and pole-and-line (11,000 mt) catches were down on 1997 levels, whereas purse seine (250,000 mt) and miscellaneous gear (84,000 mt) catches had increased. He highlighted the very large catches of yellowfin in archipelagic waters of the Philippines and eastern Indonesia and in equatorial waters around 180°. He noted that the equatorial catches shifted mainly to the west of 180° in 1998 after being mainly to the east of 180° in the El Nino period of 1997–1998.

204. Yellowfin CPUE continues to be high, and there is no clear trend in any of the four purse seine fleets (Figure 8; note under-reporting for Taiwan fleet prior to 1993). Purse seine effort, which is typically defined as 'days of fishing', may have changed owing to changes in the type of set. Since 1994, US purse seiners, for example, have increasingly used FADs so that this now appears to be the predominant set type. Consequently, CPUE for unassociated sets might be a better index of yellowfin abundance.

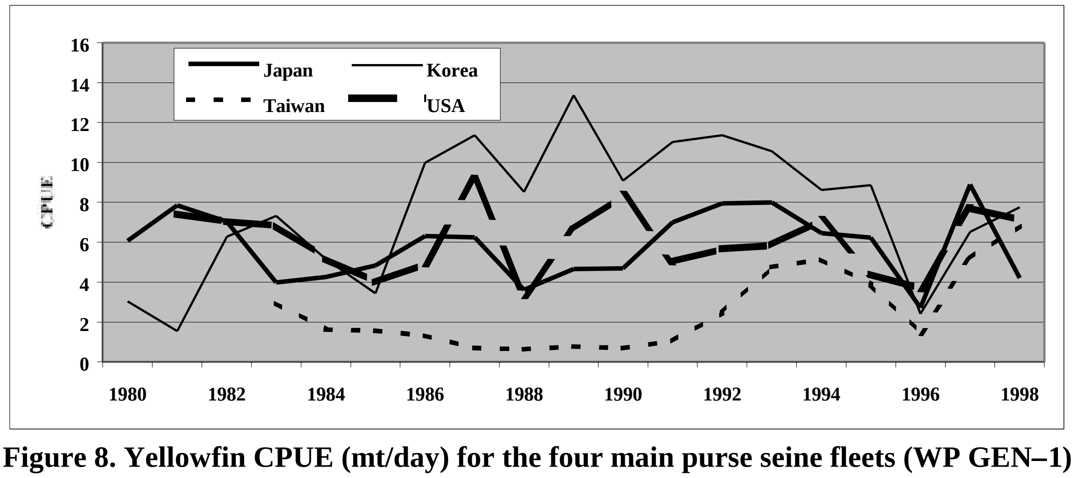

Figure 8. Yellowfin CPUE (mt/day) for the four main purse seine fleets (WP GEN–1)

205. Nominal yellowfin CPUE reported by Japan longliners shows a substantial decline and levelling off since a peak in 1978. This is believed to be at least partly related to increased targeting of bigeye by that fleet.

206. Data provision remains a significant problem for yellowfin stock assessment. For example, data have not been provided for Indonesian longline and pole-and-line fisheries since 1994 (the 1994 estimates are simply repeated for later years). The timing of data submissions is also a major problem, with data not available for distant-water longline fisheries for two or more years after the fishing year.

Purse seine equipment and operations

207. Dr Norm Bartoo presented preliminary results of analyses of US purse seine CPUE standardised against vessel specifications, using data from 58 vessels licensed under the US Multi-lateral Treaty. Vessel specifications included GRT (606–1960 t), vessel length (51–74 m), net length (290–3100 m), net depth (55–1700 m), block pull (6.6–35.0 t) and line pull 19–80 m/minute). CPUE ranged from 17 to 42 metric tonnes per day and from 26 to 54 metric tonnes per set. Loess fits to the relationship between CPUE and various categories of the six variables revealed no significant trends in CPUE. Although not statistically significant, CPUE increased with block pull and, especially, line pull. The authors stressed that many errors were found in the vessel specification data, and that those errors might have affected the results.

208. The YRG noted that the analyses imply that as net depth increased encounters with tuna schools increased; however, it was more logical to expect that deeper nets should catch more tuna from encountered schools. The YRG also noted that the study should be repeated with a time series of vessel specification data. Dr Bartoo informed the group that a time series of vessel specifications might be available for further work, but it may be difficult to correct errors in the historical data.

209. The YRG emphasised the importance in documenting the use of FADs and to quantify developments in FAD modifications (e.g. depth of streamers, use of bait, etc.). IATTC had found that the configuration of FADs appendages had changed over time. In a 1992–98 study of four purse seiners, the depth of appendages had increased to 20 m. This resulted in decreased CPUE for yellowfin and skipjack, and increased CPUE for bigeye.

Longline equipment and operations

210. A study of Japanese longliners revealed that small longliners used shorter branchlines and floatlines, so that their longlines fished shallower than those of larger longliners. Such differences were not reflected by the number of hooks-per-basket reported in logbooks.

211. Analyses of data on gear configuration reported in logbooks by Korean longliners (WP RG–6) show changes in materials used for branchline leaders (also called ‘snoods’). Before 1988 all Korean longliners used wire, but monofilament had gradually replaced wire so that 90% of longliners now use monofilament. Monofilament leaders are believed to have improved yellowfin and bigeye CPUE while decreasing the CPUE of billfishes and sharks.

212. In Australia, many operators had bought larger vessels, extending the range of longline activities further offshore. Many now used night–set, squid baits to target swordfish and bigeye. This would result in low estimates of yellowfin CPUE if targeting was not taken into account. Many Australian longliners were adopting satellite technology, such as ocean colour, to increase their catch rates. In southern waters, regulations required longliners to use tori poles to deter seabird strikes on baits. The use of tori poles and other bird deterrents might improve catch rates by increasing the number of baits available in the water. Soak time is also important, with Australian

longliners using briefer soak times so that fish had less opportunity to free themselves from the hook.

213. Information on targeting had been collected through post-fishing interviews for Hawai'i–based longliners and, more recently, nominated in logbooks. New Zealand longliners also nominated targeted species in logbooks. YRG speculated on the reliability of targeting information reported by fishing masters (some might change the nominated target if it did not agree with the catches taken). In Hawai'i, observers had reported that the nominated target species could change during fishing trips, particularly within the first few days of fishing. It was also pointed out that albacore dominated catches in many fisheries but were rarely nominated as a target.

214. The YRG updated developments in the use of live bait in longline fisheries, which had been reviewed to some extent at the 1998 YRG meeting. Live bait is believed to approximately double yellowfin CPUE in some situations, but had little effect on the CPUE of other commercial species, notably bigeye. Regionally, the use of live bait does not seem to have increased over the past year or two; milkfish production had declined in Guam and proposed farms had not been established in Yap and Chuuk.

Purse seine vessel efficiency

215. Japan was assembling information on purse seine gear and vessel specifications; the data include vessel horse power, speed, number of speed boats, number of radar buoys (before and after fishing trips), net dimensions (length, depth and mesh size of the bag) and electronic equipment. These data are being compiled through interviews with 12 fishing masters, and it is hoped that a historical time series can be compiled. However, the work has revealed problems in distinguishing set type, e.g. purse seiners made multiple sets on 3–4% of days. Furthermore, work is required on apportioning effort where purse seiners set on FADs at dawn then fished free-swimming schools on the same day. This fishing strategy was increasingly used, especially as coastal purse seiners ventured further offshore.

216. In the Philippines, purse seiners owned by large companies are obliged to continue fishing until their catch exceeds 12 mt for the day. Filipino purse seiners usually operate with a network of about 40 FADs. Usually, skiffs are sent to check FADs for tuna. Since the early 1990s, they had used a fishing strategy where several payaos are slowly towed together, thereby combining the tuna that were aggregating under each payao. The YRG recognised that this practice must improve their performance, so that the traditional unit of fishing effort —day of fishing—was inappropriate for estimating CPUE. Furthermore, FADs probably affect the ecology of tunas and the tropho-dynamics of the pelagic ecosystem. Further research is required on tuna behaviour and the relationship between FAD aggregation and abundance. In this and other fisheries it will be important to collect detailed information on natural logs and FADs, including their location and abundance.

Observer data / CPUE

217. Mr Staisch reported that the SPC / FFA Tuna Fishery Data Collection Forms Committee had harmonised the forms used in regional and national observer programs. Mr Staisch stressed the importance of information and intelligence reported by observers in cruise reports, which did not always appear on standard data sheets or in databases. Observers also collected data on bycatch and discards that cannot be reliably collected through logbooks. For target species, logbook estimates were invariably lower than estimates derived from observer placements. This is sometimes due to under reporting, but is also related to discarding and the non-reporting of shark-damaged fish.

7.2 Biological and ecological research

Age and growth

218. Dr Lehodey presented WP YFT–2. This paper is an update of WP 12 of the 11th SCTB. In the study, both otolith counts of daily micro-increments and tagging data were used to investigate the growth of yellowfin tuna in the WCPO. Tagging data were used to estimate the monthly growth rate, and these data indicate a significant decrease of the growth rate for fish from about 50-60 cm fork length (FL). A sample of 180 yellowfin otoliths covering the largest possible size range (20-145 cm FL) and with a minimum number of individuals of undetermined sex, was used to estimate the growth curve. However, the sex of yellowfin tuna < 35-40 cm can rarely be distinguished, and there were no females >140 cm FL. The von Bertalanffy model did not satisfactorily describe the growth of yellowfin tuna over the whole size range. The growth rate appears to decrease early in life with a maximum decrease between ages of 0.5 to 1 year (about 45-70 cm FL). Therefore, a modified von Bertalanffy (MVB) growth model was proposed in which K varied according to a normal distribution. The fit of the MVB model showed a significant improvement of fit to the otolith readings. The mean age at which K reaches its maximum decrease was estimated to be 0.94 year (FL = 65 cm). Compared to the von Bertalanffy model, the modified model gives a lower estimate of L_{∞} (151.7 cm). The MVB model also describes the growth of tagged fish better than the standard von Bertalanffy model. Variation in daily increment density was also investigated along transverse sections from a sub-sample of 20 otoliths. There was a clear change in increment density, with two phases of increasing density separated by a period of low or stable increase of increment density. This pattern, and the variation observed in monthly growth rates deduced from tagging data, are in good agreement with theoretical results expected from the MVB.

219. The paper concluded that the new results confirm and improve the previous analysis. Additionally, a separate analysis of length frequency data (see MULTIFAN-CL following) strongly suggests the existence of a reduced growth rate for yellowfin about 1 year old. The fitted MVB curve proposed in the present study for yellowfin tuna in the WCPO differs substantially from those estimated in other oceans, especially in the age range of 1 to 3 years. Consequently, these results could impact stock assessment results from population dynamics models.

220. The YRG discussed differences between the new growth curve for yellowfin in the WCPO and those determined in previous studies. Although gear selectivity, inter-annual variation in growth rates, and area-specific differences in growth rates might account for differences between growth functions, it was noted that many previous growth functions for yellowfin were based on analyses of length frequency data. In contrast, the new growth curve was based on an analysis of otolith data.

221. The YRG noted that there is a fundamental discrepancy between growth data derived from otoliths and from tagging data for yellowfin in the WCPO. Tagging data suggest slower growth rates than otolith data. The YRG agreed that this difference should be investigated further.

Larval and juvenile studies

222. Dr Ogura presented WP SKJ–2. Athough this paper dealt predominantly with juvenile skipjack, Dr Ogura noted that some juvenile *Thunnus* spp. were captured during the midwater trawl surveys conducted around Palau and the Micronesian Islands during October to December, 1992-1996. The majority of the *Thunnus* spp. were yellowfin. The YRG noted that although available

data on juvenile yellowfin were limited, the information contained in WP SKJ–2 was of interest to the YRG.

223. Dr Sakagawa noted that data on other pelagic species caught in the mid-water trawl surveys around Palau and the Micronesian Islands (previously described by Dr Ogura during a presentation of WP SKJ–3) might also be useful to the YRG. These data contain information on the distribution and density of ocean anchovy, a major prey item for yellowfin in the WCPO.

Reproductive biology

224. Dr Watters briefly reviewed the results of a recently published study by Mr Kurt Schaefer on the reproductive biology of yellowfin in the EPO. Although the manuscript contains results from extensive analyses, Dr Watters highlighted only three results relevant to YRG discussions: 1) spawning was widespread in the EPO; 2) the observed proportions of reproductively active females were correlated with monthly SSTs; and 3) the estimated length at 50% maturity was significantly less for males (69 cm) than for females (92 cm).

225. The YRG noted that the sizes (males and females) at 50% maturity appear to be smaller for yellowfin in the EPO than in the WCPO.

Stock structure

226. Dr Campbell reported on an ongoing otolith microchemistry project being undertaken by John Gunn (CSIRO Marine Research). This project is investigating the source of yellowfin tuna recruits to the fishery off eastern Australia and the possibility of sub-population partitioning of the yellowfin tuna stock in the western Pacific.

227. Otolith samples have been collected from age 0+ fish from a range of sites around the western Pacific: Fiji, Indonesia, Philippines, Solomon Islands, Coral Sea and off NSW, Australia. In total, 1,929 samples have been collected, and have been spread over a 5-year period to allow estimation of the inter-annual variability in the genetic and micro-chemical signals. Fish estimated to be 1+, or older, have been collected from eastern Australia, and the chemical and genetic signals compared with those from the same cohort collected in previous years from other sites.

228. The results of the study indicate significant differences among the sites for most of the chemical elements probed. Analysis of the samples from the first year, however, showed no significant differences between fish caught in the Coral Sea and off the NSW coast, or between the Coral Sea and the Solomon Islands. It is hypothesised that this is due to the fact that the majority of fish caught off NSW originate from the Coral Sea or an area with similar water chemistry. Similarly, it is likely that the Coral Sea and the Solomon Islands are linked. The results from the second year of samples indicated a different pattern of similarities between sites, suggesting that the pattern of recruitment into eastern Australian waters is likely to display inter-annual variation, possibly due to changes in regional oceanography. Genetic studies are also being undertaken in order to investigate possible differentiation of the yellowfin tuna populations. The project will be completed in 1999 and a full report made available to the SCTB next year.

7.3 Stock assessment

Standardised Effort and CPUE

229. Mr Bigelow presented WP YFT–3. Longline catch and effort data are a critical input to the length-based age-structured assessment model (MULTIFAN–CL). Both yellowfin and bigeye are actively targeted by most longline fleets in the Pacific, but trends in nominal longline effort may differ from trends in effort fished within yellowfin or bigeye habitats because of gear modifications that occurred over the fishery time-series (>35 years). The SPC OFP applied an effort standardisation method to standardise longline effort and CPUE using habitat preferences and physiological constraints, in combination with environmental data.

230. The essential elements in the standardisation are the specification of the depth distribution of the longline gear taken from hooks-between-floats information and the species depth distribution based on habitat preferences from acoustical tracking and oceanographic (Ocean Global Circulation Model–OGCM) information. The model was illustrated for Japanese 1°x1° grid–quarter data (1966–1996) for yellowfin in the WCPO. Model results are consistent with previous qualitative information on changes in targeting practices in the longline fishery. After 1975, the Japanese fleet deployed deeper gear to increase the catchability of bigeye tuna. In the tropics, the model indicates that "effective effort" in the yellowfin habitat (typically the mixed layer) for the three distant-water longline fleets has declined since 1980. Nominal CPUEs declined in the 1980s and 1990s; however, standardised CPUE trends appear stable in the tropics over the last 30 years. After 1985, standardised CPUEs in the main yellowfin area (20°S–20°N, 140°E–180°) are approximately 20% greater than nominal CPUEs.

231. The YRG recognised that the trends in standardised CPUE (Figure 9) did not show declines that are apparent in the trends of nominal CPUE. The YRG noted that trends in nominal CPUE do not account for changes in the targetting practices of distant water longline fleets operating in the WCPO. During the mid-1970s, distant water longline fleets began to set hooks deeper and target bigeye rather than yellowfin. This change in targetting is taken into account by the time series of standardised CPUEs.

232. It was noted that the results in WP YFT–3 could be sensitive, to some extent, to assumptions made in the standardisation model. In particular, the YRG commented that sensitivity analyses should be done to explore the effects of 1) different assumptions about the depth distribution of hooks on longlines with different numbers of hooks between floats; 2) changes in branch line lengths that are known to have occurred over the course of the time series; 3) the assumption that the gear configurations of different distant water longline fleets are similar; and 4) different assumptions about the oceanographic habitat (temperature and dissolved oxygen) requirements of yellowfin. Related to this latter point, the YRG noted that habitat requirements may be different for large and small yellowfin, that it is preferable to define habitat requirements by tracking fish across a variety of oceanographic conditions, and that yellowfin habitat might be more satisfactorily described by mixed-layer depth rather than temperature and dissolved oxygen. A sensitivity analysis exploring the effects of these topics could be conducted with Monte Carlo techniques.

233. The YRG noted that it would also be useful to extend the standardisation farther back in time and to compare the results with those from other analysis methods like GLMs (Figure 10).

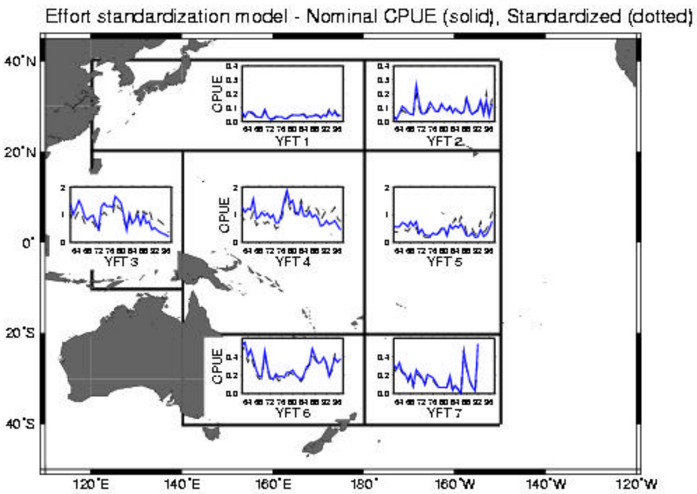

Figure 9. Comparison of nominal (solid) and standardised (dotted line) yellowfin CPUE in the Japanese longline fishery in the WCPO (WP YFT–3)

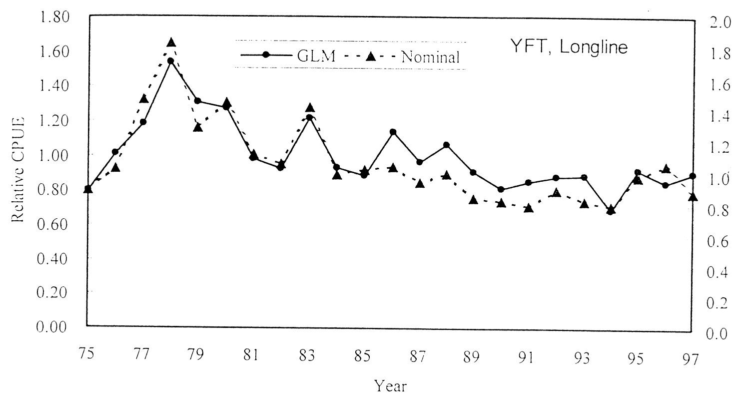

Figure 10. Trend of nominal and standardised longline CPUE for yellowfin tuna (WP NFR–8)

234. It was acknowledged that the standarisation method used to estimate the effective number of hooks fishing in a particular oceanographic habitat requires good knowledge about the physiological requirements of the species being studied. Unfortunately, physiological research does not appear to be a priority topic for research funding agencies. The YRG noted that the results in WP YFT–3 highlight the importance of physiological and behavioural research for stock assessment.

MULTIFAN-CL

235. Dr Hampton presented WP YFT–1. This WP contained an update of the MULTIFAN-CL analysis of yellowfin tuna catch, effort, length-frequency and tagging data. Since SCTB11, enhancements to the analysis have included:

- The inclusion of 1996 and 1997 data to the analysis;
- The use of effective longline effort, allowing reasonable assumptions to be made concerning the spatial and temporal constancy of longline catchability;
- The use of a more flexible growth function to reflect the “non-von Bertalanffy” features of the juvenile portion of the growth curve;
- The incorporation of tag pooling to improve computational efficiency; and
- The use of a more stable parameterisation of initial population sizes.

236. Estimated recruitment shows considerable variation at seasonal and lower frequency time scales. There is some suggestion of a decline in recruitment since the early 1990s, which results in a decline in population biomass over the same period. However, biomass is not particularly depressed relative to the early part of the time series. The model appears to provide a reasonable fit to each of the data classes included in the likelihood function. A slight degradation in fit to the tagging data for returns greater than about 18 months at liberty requires further investigation. The model results are generally consistent with understanding of yellowfin tuna biology, and several aspects of the results are in agreement with independent data. Suggested improvements to the analysis include: inclusion of fisheries data back to at least 1962, testing of seasonal recruitment hypotheses, and the formal incorporation of reference point based assessment into the model.

237. The YRG noted that results presented at SCTB11 showed a large fraction of the yellowfin biomass was distributed in areas with low CPUE and little fishing effort (the subtropical and temperate areas at the northern and southern edges of the area defined for the model). This previous result was viewed as counterintuitive, and results from the latest version of MULTIFAN–CL showed a more sensible distribution of yellowfin biomass in the WCPO. This revision was largely a result of using the standardized effort series for the longline fleet (described in preceeding paragraphs) and linking relative abundance to standardised CPUE. The YRG further noted that estimates of movement rates between the subtropical/temperate and tropical areas would be expected to have large standard errors.

238. In light of the discussion described in the previous paragraph, the YRG noted that the areas developed for the model should not be considered as an optimal stratification of the WCPO.

239. The YRG noted the high exploitation rate estimated for Area 3 (the western most equatorial area in the model). This rate was estimated to be high because exploitation rates were estimated as total catch divided by average local abundance for a year and many fish were caught in this relatively small area. Many of these fish were small fish captured by the Philippine ringnet/purse seine and the Indonesian fisheries.

240. Mr Miyabe acknowledged the important progress made on the current implementation of MULTIFAN–CL for yellowfin in the WCPO, but raised a number of concerns. Mr Miyabe noted the good fit to the longline data but, noting the cells marked "No effort data" and "No length data" in Figures 2 and 3 of WP YFT–1, he was concerned that data coverage from other fisheries was relatively poor. He also noted that the large number of estimated parameters and the constraints placed on some of these parameters during the estimation process made it difficult to understand how the model might be sensitive to various assumptions. Along these lines, Mr Miyabe also felt that it would be important for uncertainty in the parameter estimates to be quantified, perhaps with confidence intervals. Some of the results were difficult to evaluate because WP YFT–1 did not contain information on estimated movement rates, and he further noted that the fishing grounds of the distant water longline fleets extend beyond the eastern boundary of the model area. In this regard, it may be necessary to consider movement of yellowfin between the WCPO and EPO. Finally, Mr Miyabe thought it would be valuable to compare the time series trend of recruitment in the WCPO to that in the EPO.

241. In response to Mr Miyabe's last comment, Dr Watters presented a time series of recruitment estimates for yellowfin in the EPO estimated from cohort analyses conducted by the IATTC. In the EPO, estimates of yellowfin recruitment are generally thought to describe at least two distinct production regimes with relatively higher production (greater recruitment) occuring since about the

mid-1980's. This trend is in direct contrast to the recruitment trend predicted for yellowfin in the WCPO, where, from Figure 13 in WP YFT–1, it appears that recruitment has declined since about the mid 1980's.

242. Dr Hampton noted that he was currently writing a more detailed progress report on the development of the model for the PFRP. He commented that the report would be available to interested parties and that it would contain more detailed information that should deal with some of Mr Miyabe's concerns.

243. The YRG acknowledged that it might be useful to hold a workshop specifically for people to become familiar with MULTIFAN–CL. This might facilitate a greater understanding of the model, its assumptions, and its results. Such a workshop would be especially useful if MULTIFAN–CL is applied to other tuna stocks in the WCPO.

Fishery interactions

244. Dr Hampton presented WP RG–1, the application of a multi-species, multi-gear, age-structured simulation model to the estimation of fishery interaction. The simulation model attempts to place available information on various aspects of tuna biology and fisheries in a simulation framework. At this stage, the model has not been subject to a formal parameterisation, but has been roughly tuned to total catch data for the various fisheries considered.

245. Interaction was investigated by varying the effort levels of the various fleets in the model, and observing the resultant impact on the catches of other fleets. In general, significant levels of interaction were only observed when effort in the largest fisheries, such as the purse seine fishery, was manipulated. However, even in these cases, interaction could be described as low to moderate. It was noted that small interactions in terms of changes in catches can translate into significant impacts on the economics of a fishery, and a similar model to that described has been used, in a document prepared in co-operation with economists from the FFA, to estimate bio-economic characteristics of the fishery interactions. The YRG acknowledged that it is important to consider the economic implications of interacting fisheries and requested that this document be made available to the SCTB if possible.

Production model

246. Dr Sun reported that work on a production model for yellowfin in the WCPO is continuing. Progress on this model is currently delayed because data from Korean fisheries have not yet been made available. It is expected that the work will be completed in the upcoming year, and that an updated report will be made to the next meeting of the SCTB.

Abundance Indicators

247. Mr Arnaud Bertrand presented WP YFT–4. Acoustics methods were used around French Polynesia to characterise the pelagic habitat and then to make a direct estimate of tuna abundance. The study utilised a 38 kHz echo-sounder with a depth range of 500 m. A density of 1.33 fish per km^2 (about 33.8 kg per km^2) of tuna was estimated. With such a density, the biomass of tuna targeted by longliners in French Polynesia (yellowfin, albacore and bigeye) was estimated to be about 100,000 mt in the French Polynesian EEZ, north of 20°S, in a region with a surface area of 2,900,106 km^2. At this time, it is not possible to quantify the uncertainty in these estimates, but this study shows that indications of longline tuna abundance can be estimated by acoustic methods

independently of fishing experiments, even if, at present, species recognition between tunas can not be performed.

248. The YRG recognised the importance of developing acoustic methods to estimate the biomass of tunas. Acoustic methods could provide a valuable source of fishery-independent data to use in stock assessments, but it will be important to consider that these data are likely to only provide a snapshot of conditions in local areas. It was further noted that acoustic surveys are currently very expensive to conduct, and it may be some time before these surveys can be widely applied.

249. The YRG noted that results in WP YFT–4 should only be interpreted as an assessment of the amount of tuna available to longline fisheries because fish in the surface layers were not adequately surveyed. It would also be necessary to design a separate study to conduct an acoustic investigation of how tunas relate to seamounts.

250. The YRG also noted that acoustic methods were being developed for bigeye assessment in the Atlantic and agreed that it would be important to keep informed of developments there.

7.4 Other issues

Estimation of Total Allowable Catch (TAC)

251. A presentation on the New Zealand experience (WP YFT–5) in moving to a management regime which required calculation of TAC for all stocks/species was done with the specific preamble that under the MHLC expected in the near future, the SCTB may well be asked to provide TAC for various stocks/species. Further, it was asked how specific biological reference points might relate to TAC. In the New Zealand experience TACs for a large number of stocks were required at short notice.

252. New Zealand approached the problem by:

- defining operational definitions (MSY, TAC, MCY, etc.) and formalising estimation rules;
- developing short- and mid-term research plans to address management information needs;
- developing an open, transparent stock assessment system involving stakeholders, and
- producing annual reports of assessment findings.

253. The discussion noted that it was timely for SCTB to consider preparing delivery of such information. It was suggested that the SCTB consider : 1) developing a stock assessment process, 2) developing specific research plans to produce the information likely to be required by the MHLC, and 3) determine which reference points are best suited to the various species/stocks involved.

254. There was considerable discussion on the appropriateness of specific reference points, for example, the use of MSY in the process of determining reference points. The Chair deferred much of the discussion until the section on MHLC Issues (agenda item 10). However, among the key points made were: (i) the precautionary approach will need to be explicitly incorporated in the advice provided; (ii) reference points based on biomass will need to be included; (iii) the SCTB needs to be proactive in positioning itself to provide information to the MHLC quickly, and (iv) educating the MHLC about appropriate reference points and uncertainty and risk. In this respect, the meeting was referred to the findings of the Precautionary Workshop held just prior to SCTB11.

Impact of Environmental Regime Shift

255. A brief discussion on recent work dealing with environmental regime shifts was held to keep participants cognisant of such work and implications for SCTB work. The presentation of WP ALB–2 was summarised, noting that short term or high frequency (ENSO) environmental signals can be seen in albacore catch data as can low frequency (decadal scale) signals. Participants noted that such signals are seen in both temperate and tropical ocean systems in all oceans. These low frequency signals have been interpreted as changes in environmental regimes and have been linked to changes in productivity, catchability or availability as well as distribution changes. It was noted that there are few references specific to the southern hemisphere relating resource changes to regime shifts.

7.5 Research coordination and planning

256. Based on current discussions and reference to SCTB11, the YRG identified specific tasks and individuals to be addressed prior to SCTB13. These tasks are summarized under headings of Statistics, Research Studies and General.

Statistics

257. Statistical tasks for YRG are :

- Recover historical data on purse-seine fishing equipment (e.g. use of helicopter, bird radar, sonar, radio beacon on FADs, weather FAX, depth and length of net, mesh size, etc.) and on purse-seine operations (e.g. Use of FAD and logs, scout vessels, etc.) for studies on changes in effective fishing effort. (**A. Coan, Miyabe, Park, Sun**)
- Recover historical data on longline equipment (e.g. type of line and hook, sonar, weather FAX, line shooter, etc.) and on longline operations (e.g. type of bait, set time, soak time, etc.) for studies on changes in effective fishing effort**. (Miyabe, Park, Chang, Yen, Skillman, Ward, Etaix-Bonnin, Tuwai**)
- Recover historical length-frequency data for the Philippines fisheries**. (Hampton, Miyabe, Barut**)
- Develop plan for recovery and verification of historical catch data for fisheries with missing or uncertain data. (**SWG**)
- Develop plan for implementing requirements for timely collection, processing and reporting of catch statistics for all fisheries. (**SWG**)

Research Studies

258. Research tasks to be undertaken for YRG are :

- Conduct studies on age and growth, particularly to validate the assumption of one otolith increment per day for the otolith ageing technique, and to understand the causes of the apparent slow growth rate of tagged fish. (**All**)
- Conduct further analyses in application of the “habitat” method for estimating effective longline fishing effort. (**Bigelow, Miyabe**)
- Analyze observer and port-sampling data for consistency in the yellowfin tuna-bigeye tuna composition in the U.S. purse seine data. (**Sakagawa**)

- Organize a workshop of experts (SCTB members and others) to evaluate the underlying structures (organization, equations, assumptions, control rule bias, etc.) of the MULTIFAN-CL model for accuracy in assessing the condition of the stocks and for estimating biological reference points, using document YFT−1 as reference. (**YRG Chair; SCTB Chair**)
- Complete final phase of stock structure study using otolith microchemistry and report results. (**Gunn**)
- Conduct studies on fishery-independent methods for monitoring stock abundance, such as acoustical methods, LIDAR, larval survey, etc. (**All**)

General

259. General tasks related to the YRG are :

- Review the Chairman's proposed objectives for the YRG for relevance and acceptance and develop a time horizon for meeting the objectives. (**All**)
- Keep abreast of MHLC's evolving requirements for scientific advice and develop a strategy for meeting MHLC needs, including incorporating recommendations from SCTB's Workshop on the Precautionary Approach. (**All**)
- Continue efforts to assemble a complete database of historical information for conducting stock assessments. (**All**)

7.6 Summary statement

260. A summary statement for yellowfin was drafted, circulated to participants and discussed during Agenda Item 11. The accepted wording appears below.

YELLOWFIN RESEARCH GROUP (YRG) – SUMMARY STATEMENT

The yellowfin tuna catch for the western and central Pacific Ocean (WCPO) has increased since the 1980's, when purse seine fishing began its significant expansion in the WCPO. Although expansion has slowed in recent years, the catch has reached record high levels. The best estimate of the 1998 catch is about 407,000 mt, which is among the highest on record. This is an increase for the purse seine and other gear catches, and a decrease for the longline and pole-and-line gear catches over 1997 catches.

This level of catch appears to be sustainable and is not adversely impacting the stock. Evidence for this conclusion is based on the time series of purse-seine CPUE (Figure 8), which is variable but with no particular trend, and the time series of standardised longline CPUE which is flat (Figure 9), or with a downward trend (Figure 10), depending on fishing area and type of analysis. Other indicators (the MULTIFAN–CL length-based age-structure model and tagging data) show exploitation at low to high levels depending on the yellowfin tuna statistical area, but on a whole and at the stock level, exploitation is at a low to moderate level.

In short, the WCPO yellowfin tuna stock appears to be in good condition and able to safely sustain the current level of catch.

8. BIGEYE RESEARCH GROUP (BRG)

261. The BRG Coordinator, Mr Miyabe, led the session of the Bigeye Research Group.

8.1 Regional Fishery Developments

Overview of bigeye fisheries

262. Mr Miyabe provided an overview of WPCO bigeye fisheries. Although the catch for bigeye for the total Pacific Ocean accounts for a relatively small portion (8% of the total tuna catch in the Pacific Ocean), its economic value is substantial (approximately one billion US dollars annually). In 1998, the catch was 100,000 mt and 70,000 mt for the WCPO and EPO, respectively. The catch has increased gradually in the WCPO, with increases in both longline and purse seine catches. On the other hand, the surface fishery catch in the EPO increased markedly in 1994, but showed a decline in the longline fishery catch; the total EPO catch has stabilized between 70,000 and 90,000 mt. The longline catch in the EPO has declined from 83,000 mt in 1994 to about 35,000 mt in 1998, and has been replaced with large purse seine catches since 1993. The purse seine catch in the EPO increased from about 8,000 mt in 1993 to over 50,000 mt in 1996 and 1997. It then declined to 34,000 mt in 1998.

263. In regard to size composition of the catch, it was noted that the size of bigeye in the purse seine catch was generally much smaller than that for the longline catch, and there appeared to be little overlap of size classes between the two gears. This is different to the yellowfin length frequency data presented during the YRG session, which showed some overlap between yellowfin taken by purse seine and longline gears.

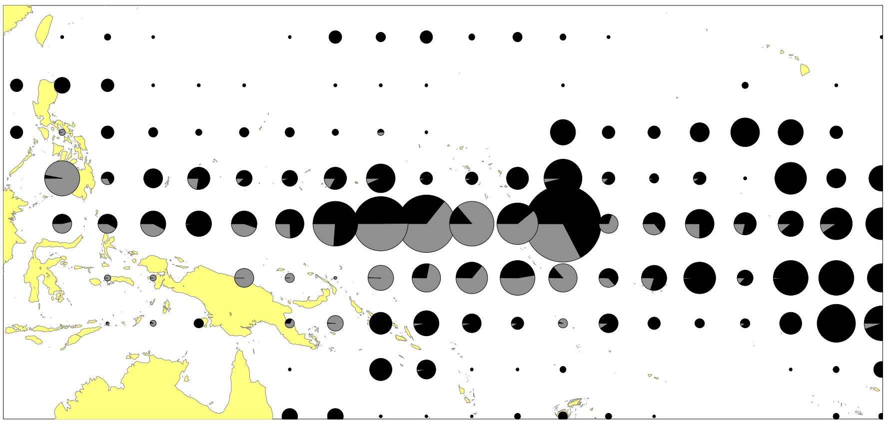

Figure 11. Distribution of logsheet-reported bigeye catch in the WCPO during 1997 (black: **longline;** grey**: purse seine)**

264. The largest catch of bigeye by the Japanese purse seine fleet was recorded in 1997. The catch from this fleet is sorted according to market size and inevitably results in small bigeye being included as a part of the yellowfin catch. The Japanese purse seine fleet fished further eastwards during 1997 than in previous years and became increasingly involved in the use of FADs, both factors contributing to higher catches of bigeye.

265. As with the Japanese purse seine fleet, the Korean purse seine fleet include small bigeye in the catch of yellowfin due to the difficulty in distinguishing bigeye with small yellowfin. However, it was estimated that about 5 percent of the total reported catch from log-associated sets were bigeye,

and about 10 percent of the reported yellowfin catch were bigeye. Verification of the bigeye catch through port sampling was difficult as much of the catch is exported to other countries. The issue of why fish were being discarded was raised, and it was noted that some fish were too small to sell, and that often there was only room in the hold for marketable catch.

266. Japan reported an increase in the total longline catch of bigeye in 1997 (data for 1998 were not yet complete to comment on more recent catch levels). There was generally no change in the nominal CPUE for WCPO bigeye taken by the Japanese longline fleet.

267. In response to a question regarding the notion that various changes in the gear configuration by the Korean longline fleet was expected to increase the catch of bigeye, Dr Moon replied that much of the gear configuration data available was anecdotal, although some was available from logsheets. The meeting noted that this type of information was important in determining standardised effort and CPUE, and that there was a need for more detail.

268. Only a small amount of bigeye (~1400 mt in 1998) is taken by Taiwanese DWFN longline vessels annually, as the fleet targets albacore as the principal species. The Taiwanese offshore fleet, on the other hand, caught approximately 9,000 mt during 1998 (WP SWG–2, page 34). The OFDC has collected gear information since 1995 and would be willing to provide this information for comparison to other fleets.

269. The Australian domestic longline vessels have been targeting swordfish by using lightsticks and setting at night since 1996. As a consequence, there has been a substantial increase in the bigeye catch. The bigeye catch increased from 100–200 mt in 1996 to over 1,000 mt during 1998.

Estimation of Juvenile Catch

270. The BRG Chair revisited WP SWG–3 and WP SWG–4, presented in the Statistics Working Group session.

271. With respect to WP SWG–4, the Coordinator stated that there were three main recommendations to come out of this paper. 1) continue to maintain two sets of tables: adjusted and unadjusted yellowfin and bigeye purse seine catch to allow for corrections in the future; 2) use only NMFS species composition samples from areas fished by both fleets, and 3) encourage species composition sampling of purse seine catches from other fleets.

272. In reviewing WP SWG–3, the Coordinator noted the problem in obtaining representative samples from highly mobile fleets, which may not be taken into account by assumptions made in this study.

273. The meeting noted that it would be worthwhile to look closer at purse seine fleet dynamics with respect to both yellowfin and bigeye catches in the future. In particular, variation in areas fished and set types employed amongst the purse seine fleet should have a more in-depth review before the next SCTB.

8.2 Biological and ecological research

Age and growth

274. The results of two recent studies on bigeye growth based on tagging data/daily micro-increment otolith readings (WP BET–2), and bands in dorsal spine sections (WP BET–3), were presented by Drs Lehodey and Sun, respectively.

275. Dr Lehodey described the relatively good fit of a modified von Bertlanffy growth model to the combined otolith/tagging dataset, with evidence of a slowing of growth at a size of around 60 cm (during the second year of life). Although fish older than 3 years were not able to be aged with confidence, the combination of otolith and tagging data (large numbers of long term recoveries > 3 years were available) enabled a growth curve covering the whole age range of the population to be obtained. Estimates of growth curve parameters were similar to some earlier Pacific Ocean studies, but showed some difference from Atlantic Ocean studies. No evidence for sexual dimorphism in growth was found. Although the growth estimates remain to be absolutely validated, and more work is required on the growth variations observed, they are available for inclusion in stock assessments.

276. Dr Sun described how two zones are formed in the dorsal spine each year, with the opaque zone being formed during a rapid growth period in October/November in the study area (far western Pacific, north of the Equator). In the readings, allowance was made for the re-absorption by vascularisation of early growth bands as fish increased in size, although it was noted that this does introduce some uncertainty regarding the absolute age of older fish. A non-linear method provided the best fit to the data, and fitted growth curves were similar to those of several previous studies in the region. No evidence of sexual dimorphism in growth was found; in discussion, it was noted that such dimorphism may be obscured by the sex ratio (increasingly in favour of males at sizes > 145 cm FL), but that it was probably less marked for bigeye than for other tuna species e.g. yellowfin and albacore.

277. Given the clear modal progression seen in some length frequency datasets (see WP GEN–1), it was recommended that all possible datasets be utilized to generate a composite growth model for bigeye. The Coordinator indicated that such an approach might be used in the MULTIFAN–CL model currently under development.

Reproduction

278. Dr Sun described the results of a study carried out in the far western Pacific using gonad samples from mostly adult fish taken by the offshore longline fleet. The sex ratio was dominated by males at sizes above 145 cm; an extended spawning season was suggested with peaks in March and June; a daily spawning interval was proposed, with estimated average batch fecundity of 3.47 million oocytes, and minimum size at maturity of 100cm.

279. It was noted that a joint project starting next year (2000) involving IATTC and NRIFSF in the Central and Eastern Pacific Ocean will sample fresh/live fish from both longline and purse seine catches for reproductive (post-ovulatory follicle) studies. An offer was made to contribute material from the WCPO if this was of interest. Regarding sampling by the two main gears, the SCTB Chair noted that, although previous work with yellowfin tuna had shown that reproductively active females were rarely taken by longline gear, ripe female bigeye were often taken by longline.

Tagging

280. Dr Sibert described the results of the Hawai'ian Tuna Tagging Project, which started in 1997, with the aim of releasing 6,000 tagged bigeye and yellowfin per year in the Hawaiian EEZ for two years, on both offshore seamounts and buoys, and inshore waters. Over 13,000 fish have been released to date, with a return rate of around 10%. Results so far are indicative of different residence times around the Cross seamount for bigeye and yellowfin, suggest that fishing mortality accounts for about 10% of the total attrition at the seamount, and indicate that exchange rates between the seamount and inshore areas are low. Few long-range returns have yet been received (one yellowfin from Baja California) and publicity efforts are continuing. It is not clear whether the lack of long range returns is real at this early stage, or reflects non-reporting.

281. The IATTC indicated plans to undertake a large scale bigeye tagging project in the EPO over a 1–2 year period, probably using a pole-and-line fishing vessel fishing in conjunction with floating objects. Although several donors have been approached, funding has yet to be obtained and the experimental design has not been completed.

282. Reference was made to the results of the earlier SPC/CSIRO bigeye tagging in the Coral Sea, published last year. These also indicated greater attrition rates for yellowfin, and considerable seasonal site fidelity for some bigeye.

283. The Coordinator also drew attention to Japanese tagging of bigeye with conventional tags which has started with longline-caught fish (30 released so far, plus albacore and sharks); a report on this work, plus archival tagging of bigeye planned for waters around Japan, will be presented at the next SCTB.

284. Other archival tagging of bigeye has been carried out in Hawaii (NMFS), with 50 releases so far and another 30 planned. The one recapture so far has provided a wealth of useful information, indicating the utility of this approach. Plans by SPC/CSIRO to undertake archival tagging of bigeye in the Coral Sea later this year were noted.

8.3 Stock assessment

285. Mr Bigelow presented results of an effort standardisation analysis (WP BET–1) to estimate abundance indices for bigeye in the eastern and in the western and central Pacific noting that CPUE in the EPO is twice that of the WCPO. In his presentation, he reviewed decadal changes in spatial distribution of CPUE, noting appreciable changes in longline use over the history of the fishery which complicate CPUE interpretation. Prior to the mid-1970s longlines were set shallower (in yellowfin habitat) than in subsequent years when longlines were increasingly set in the bigeye habitat. In the habitat standarization model used, temperature has a major effect, hook depth has an intermediate effect and dissolved concentration has only a minor effect. The results of the analysis suggest that the bigeye nominal CPUE trend is overly optimistic and that effective effort has probably doubled in the WCPO. This paper prompted extensive discussion and a number of factors were suggested for possible investigation in future elaborations of this approach to CPUE. These included: using global circulation model results to add a current shear parameter; adding bycatch as a measure of competition for hooks; relaxing temperature and dissolved constraints; adding information on time of setting and hauling; and considering a two stock hypothesis.

286. A GLM standardization of the Taiwanese distant water and offshore fleets CPUE (WP RG–3) was presented by Dr Chi-lu Sun. The offshore fleet has been fishing for bigeye since 1988. The

standardised CPUE trend shows an increase in CPUE from 1988 to 1994 followed by a decline to 2 fish per 1,000 hooks in 1998. Comparison of the two fleets indicate that the offshore fishery, targeting yellowfin, have bigeye CPUEs that are 3–8 times higher than the distant water fleet targeting albacore. Discussion noted that the offshore fleet fished primarily west of 180° and suggested that some of the differences may also be due to areas fished. It was also pointed out that some Guam based boats in the offshore fleet had started using live milkfish for bait, although it was earlier noted that this may mostly affect yellowfin catch rates. Dr Sun agreed that this could be an important factor but that there was no information on bait use although he had been told by fishers that the use of squid during particular moon phases also increased catch rates. These observations served to highlight the usefulness of bait use during fishing as a potentially important factor in CPUE standardization.

287. Dr Hampton briefly reviewed findings from an earlier presentation (WP RG–1) relating to bigeye. He highlighted the fact that these were only initial results based on simplistic assumptions to show the potential of the model and there was now a need to refine this approach.

288. Mr Miyabe reviewed work building on last years bigeye VPA noting that he had tried to use MULTIFAN-CL to improve his catch-at-age matrix. However, since MULTIFAN-CL did not yield reasonable age classes there were no new results to present this year.

289. Dr Watters presented a brief summary of three cohort analyses conducted by the IATTC to assess bigeye in the EPO. To provide background material, Dr Watters referred to the presentation made under "Reports of Organizations" and highlighted the recent increase of bigeye catch by purse seiners making sets on FADs. In general, bigeye caught by surface gear have decreased in size during the last 5 years. Length frequency data from the longline and surface fisheries were converted to catches at age by decomposing monthly length frequency distributions that were previously raised to the total catch into 20 normal distributions. This was done under the assumption that bigeye live about 10 years and that there are two cohorts produced per year. Cohort analyses were performed under the assumption that the instantaneous rate of natural mortality (M) was constant after recruitment to the fishery and was equal to 0.4, 0.6, or 0.8. These three values of M were used because there is considerable uncertainty about the natural mortality rate for bigeye in the EPO. The cohort analyses were tuned so that estimates of abundance were compatible with standardized longline CPUEs.

290. All three cohort analyses (M = 0.4, 0.6, and 0.8) estimated similar biomass trends, and biomass of bigeye in the EPO was either stable or increasing from the early 1970s through the mid-1980s and decreasing thereafter. The degree of decline in biomass estimated for the late 1980s and 1990s varied between the three cohort analyses. Estimates of recruitment obtained from the three cohort analyses were quite different. With M = 0.4, recruitment was estimated to have increased over the period from 1971 to 1996. With M = 0.8, recruitment was estimated to have been highly variable with no apparent trend during this period.

291. Dr Hampton reviewed the results of a one day meeting held immediately prior to the SCTB on developing a bigeye stock assessment model using the MULTIFAN-CL approach (WP BET–6). This meeting had focused on reviewing the approach, available data, and what will be needed as input files and other supplementary information. The objective of the one year programme, funded by PFRP, will be to evaluate the suitability of the MULTIFAN-CL approach for a bigeye assessment. The meeting agreed to initially stratify the Pacific into six regions and if the data did not support this stratification to collapse these areas into three longitudinal bands. The fisheries and factors likely to be important in the model were also identified. Collaborators in this project (SPC–

OFP, IATTC, and NRIFSF) will meet early in 2000 to finalise details and preliminary results will be presented at the next SCTB. Supplementary comments from project members noted that it was critical to ensure that the MULTIFAN-CL approach was appropriate and that the complexity of the model made it difficult to visualise the components and how they interact. It was suggested, and generally supported, that it would be valuable to invite a few modellers not involved in the project to the next planning meeting. It was also suggested that it may be useful as a first step to use simulated data to get a better understanding of how the model will work. It was also noted that while the MULTIFAN-CL model is well developed, that aside from the comments already raised, it must be remembered that data and information on the bigeye stock is still relatively poor. In this instance, it may be more appropriate to use this model on a better known stock, like yellowfin, and use a simpler modelling approach for bigeye.

8.4 Research coordination and planning

292. The chair introduced this section by mentioning the Pacific Bigeye Tuna Research Coordination Workshop, which was held in Honolulu in November 1998. A report of this meeting is provided in WP BET–5. The meeting was held to discuss and review the prospectus on a large-scale tagging project on bigeye tuna in the Pacific Ocean that had been tabled by Dr Sibert at SCTB11. A copy of the updated prospectus was provided in WP BET–5.

293. In speaking to the updated prospectus, Dr Sibert pointed out that while the project was ambitious, the need arose from the fact that the Pacific Ocean is the largest ocean on the planet and the current hypothesis that bigeye in the Pacific belong to only a single stock. These two features make it difficult for a single organisation to undertake the work necessary to determine movement rates of bigeye throughout the Pacific. In view of this, the prospectus consolidates the ideas and reasons for this work from both traditional and non-traditional sources. Unfortunately, there has been little success in attracting funding for bigeye research using this prospectus at this stage.

294. The meeting gave general support to the prospectus (as it did at SCTB11). Some suggestions were made that perhaps the prospectus does not stress strongly enough the need and urgency for the work to be undertaken, (the different CPUE trends for bigeye in the WCPO and EPO, together with long-term declines in the WCPO and a decline in the EPO in more recent years). The meeting was informed that a large-scale tagging project on bigeye in the Atlantic (being undertaken to provide estimates of age specific natural mortality) was about to begin. Dr Sibert expressed a willingness to continue to pursue the promotion of the prospectus, and asked for suggestions for improvements from SCTB.

8.5 Summary statement

295. A summary statement for bigeye was drafted, circulated to participants and discussed during Agenda Item 11. The accepted wording appears below.

BIGEYE RESEARCH GROUP (BRG) – SUMMARY STATEMENT

Although the catch of bigeye for the total Pacific Ocean accounts for a relatively small portion (8 % of total tuna catch in the Pacific Ocean), its economic value is substantial (approximately 1 billion US $ annually). In 1998, the catch was 100,000 mt and 70,000 mt for the WCPO and EPO, respectively. The catch increased gradually in the WCPO reflecting increases in longline and purse-seine catches. On the other hand, the surface fishery catch in the EPO increased markedly beginning in 1994 with decline in the longline fishery catch, and the total catch has stabilized between 70,000 and 90,000 mt. The longline catch in the EPO declined from 83,000 mt to about 35,000 mt in 1998, and has been replaced with large purse-seine catch since 1993. The purse-seine catch in the EPO increased from about 8,000 mt in 1993 to over 50,000 mt in 1996 and 1997. It declined to 34,000 mt in 1998.

Because a comprehensive stock assessment for this species is hindered by the scarcity of data and the absence or poor estimates for some key biological parameters, the current stock status is uncertain. To overcome this situation, the application of the integrated model (MULTIFAN–CL model), which utilizes all available data and estimates all parameters simultaneously, is planned for the coming year.

The Group, however, noted that preliminary estimates of relative stock abundance from standardized longline CPUE indicate a decline in abundance since the late 1970s in the WCPO and since 1990 in the EPO. Although the estimates require further developments, the preliminary results raise concern of overfishing and decline in adult biomass. Cohort analysis performed by the IATTC for the stock in the EPO also indicated a similar decline in the adult biomass. The Group therefore strongly recommends that directed research efforts supporting the appropriate stock assessment be urgently undertaken, for example, (i) determine better estimates of the bigeye catch by surface fisheries, (ii) determine estimates of mixing rates and movements of fish across the range of the stock, and (iii) determine estimates of biological parameters (growth and size-specific natural mortality rates).

9. BILLFISH AND BYCATCH RESEARCH GROUP (BBRG)

296. The BBRG Coordinator, Mr Ward, led the session of the Billfish and Bycatch Research Group. He highlighted the important work of the BBRG in the future, bearing in mind that over one hundred bycatch species are taken in the western and central Pacific tuna fishery. These include species that have some commercial importance to foreign fishing fleets (e.g. billfish and sharks), and several species, such as wahoo and mahi mahi, that are important sources of food and income to Pacific-island communities. Pacific-island nations are also interested in developing their own commercial gamefishing industries, and therefore will seek advice on the target species taken in these fisheries. Catches of marine wildlife, such as turtles, are reported to be rare in most areas, but these reports need to be verified. Billfish and bycatch have the potential to drive fishery management, given the generally healthy status of most commercial tunas in the WCPO. BBRG's task is to harness disparate national and regional research resources to address a wide range of species and issues, in a data-poor environment.

297. Unlike the other Species Research Groups, BBRG does not yet have a history of stock assessment to draw on. BBRG needs to define its objectives, develop a workplan, estimate catch levels, assess impacts and, eventually provide advice for fishery management.

298. The theme of this year's meeting was **billfish**, both as target and bycatch in WCPO tuna and game-fisheries. The meeting attempted to reduce the topic into manageable pieces and develop a comprehensive description of the current situation, identify major issues and future work.

299. A brief overview of the billfish species taken in WCPO tuna longline fisheries was presented (WP BBRG–2).

9.1 Recent developments in fisheries taking billfish

300. The following summarises information on billfish catches in National Fisheries Reports presented at SCTB12; this has been augmented with discussions under this agenda item.

301. In **American Samoa** a longline fishery began to develop in 1995. WP NFR–1 and WP NFR–20 provide estimates of longline catches of billfishes, which are mostly blue marlin and black marlin. Small quantities of blue marlin have been reported in the established troll fishery for albacore. Bycatch data are available through port sampling. Historical information on bycatch are available and can be provided.

302. In **Australia** (WP NFR–2), estimates of the magnitude of longline catches of non-target species have been derived from observer data from Japanese longliners and research programs that have placed observers on domestic longliners. There is a developing longline fishery for swordfish and, at times longliners target striped marlin. The striped marlin catch is increasing, reaching almost 400 t in 1998. Other billfishes caught by longline include black marlin, sailfish and spearfish. Black marlin are an incidental catch of longliners, especially in September–December, close to the Great Barrier Reef off North Queensland. These catches have concerned recreational fishers since the 1970s when charter boats established a fishery for black marlin near Cairns. To allay angler concerns over commercial catches of marlins, Australia excluded Japanese longliners from large areas of the AFZ off north Queensland since 1980. Since 1986 there has been a voluntary agreement for Japanese longliners to release live black marlin and blue marlin. A voluntary agreement also existed for domestic longliners to release black and blue marlin. In 1995, expansion of activities by Australian longliners in Area ‘E’ (waters off Cairns, Queensland) rekindled recreational concerns over the commercial catch of billfish. In 1998 the release of black marlin and blue marlin, whether alive or dead, was made mandatory for domestic longliners.

303. Billfish catches are considered to be very rare (or absent) in the **Canadian** troll fishery in the SCTZ of the south Pacific (WP NFR–3).

304. Foreign longliners targeting albacore in the **Cook Islands'** EEZ reported small catches of marlins (breakdown of species available) in 1998 and 1999 (WP NFR–4). Historical bycatch data are available from logsheets provided by longliners. There are several gamefishing companies, but no mechanisms for data collection as yet.

305. Logbook data shows that the various longliners fishing in **FSM**’s EEZ take marlins (mostly blue marlin, swordfish and occasionally black marlin). WP NFR–5 presents estimate of longline landings of billfishes which are available on the SPC database for 1980–98. Some marlin are sold locally, but most are frozen and eventually shipped to Japan. Logbook data also shows that purse seiners occasionally catch marlins. FSM’s observer programme has detailed estimates of marlin catch and discarding for both fishing methods. There is one gamefishing boat in FSM, but it only rarely catches marlin.

306. **Fijian** longliners take a variety of billfishes, particularly swordfish, blue marlin, striped marlin and sailfish. Longliners rarely discard billfishes; most are exported to Honolulu and the remainder are sold on local markets or consumed by crew members. WP NFR–6 presents 1994–98 logbook estimates of domestic billfish catches. Foreign longliners targeting albacore in Fiji’s EEZ and more widely in the south Pacific, tranship striped marlin and blue marlin though Fijian ports.

307. In **French Polynesia** a range of fishing methods—bonitier, "poti marara" and longline—have reported catches of billfishes (WP NFR–7). The longline fishery accounts for most of the marlins and all of the swordfish. Logbook data are available for 1994–98. The breakdown of 1998 billfish catch (500 mt) by longliners was striped marlin–100 mt, short-billed spearfish–17 mt, sailfish–5 mt, black marlin–0.6 mt, blue marlin–377 mt. WP RG–2 presents estimates from longline fishing experiments that used various longline configurations and had a billfish catch of striped marlin, blue marlin and swordfish. Gamefishing is popular in French Polynesia with around 10 charter vessels and numerous recreational anglers targeting blue marlin (typically landing 20–40 mt per year). They also catch striped marlin and occasionally, black marlin. Some angler and charter operators are concerned over potential adverse impacts of longlining on gamefishing strike rates.

308. **Japan** (WP NFR–8) has a long history of billfish catches in longline fisheries of the western and central Pacific. In some areas and at some times longliners have targeted billfishes, such as swordfish and striped marlin. Longline logbook data extends back to 1962. Catch was reported in logbooks as numbers, then raised using average weights (stratified by month and 10°x20° rectangles) reported by research longliners and selected commercial longliners. Sailfish were not distinguished from spearfish prior to 1994. As in other longline fisheries, the catch data tend to reflect retained catches, and are believed to rarely include discards. Billfishes, mainly blue marlin, are occasionally taken by purse seine. There have been substantial catches of billfish from the coastal fisheries; the coastal fleets (harpoon, driftnet and longline) comprise small vessels, typically less than 20 GRT. Historically, the catch was about 3,000 mt annually, but has since declined to about 1,000 mt in recent years. The driftnet fleet historically targetted black marlin in the south China Sea, but is now largely inactive. The coastal harpoon fishery targets striped marlin and swordfish, and account for around 500 mt per year.

309. **Kiribati** (WP NFR–9) collates logbook estimates of billfish catches in their EEZ. The data are exclusively for DWFN longliners (1994–97). The main species are swordfish and blue marlin, although striped marlin, black marlin and sailfish are also reported. Data for earlier years are available on the SPC database. Gamefishing on Kiritimati has been established for a few years, but no information was available on the billfish species.

310. Data from **Korean** longliners fishing in the tropical western and central Pacific are available back to the late 1960s. WP NFR–10 present longline catches of the major billfish species (except short-billed spearfish), many billfish are not identified to the species level. Billfish ranged from 7–16% of the total weight of retained catch during 1990–97. Billfishes, mainly blue marlin, are occasionally taken by Korean purse seiners, but are not usually recorded on logsheets.

311. Billfish, mainly blue marlin, are taken by foreign longliners fishing in **Nauru**'s EEZ (WP NFR–11).

312. Logbook data show that striped marlin are the most common billfish taken by longliners in **New Caledonia**'s EEZ (WP NFR–12). Striped marlin are most common during September–November. Black marlin and swordfish are also reported and, to a lesser extent, blue marlin, sailfish and short-billed spearfish. Swordfish are most common during summer. There are a few gamefishing charter operators and many recreational anglers who mostly fish off the south–west coast of New Caledonia; even though the recreational fishery is well developed, accurate statistics on the level of catch from this fishery are not yet available.

313. Billfish catch in **New Zealand**'s EEZ is comprised primarily of striped marlin and swordfish with small amounts of blue marlin and black marlin, short-billed spearfish and sailfish (WP NFR–13). Longliners are not permitted to retain billfish, except for incidental catches of swordfish, so there are no marlin landings. Most billfish hooked by longliners are striped marlin (observer records indicate that about 70% of the striped marlin are alive when released). The magnitude of the commercial bycatch in 1996–97 was estimated to be 570 fish (95% CI = 370–792 fish). In contrast, the recreational gamefishery caught about 1900 striped marlin, 68% of which were tagged and released. The recreational gamefishery has been responsible for tagging more than 7,000 billfish since the 1970s. Gamefishers rarely catch swordfish. The longline bycatch of swordfish has been increasing for several years, reaching 283 t in 1996–97.

314. Billfish catches in **Niue** come almost exclusively from the foreign longline fleets licensed to fish in Niue's EEZ. Gamefishing has been recently established, and the catch from this fishery is normally sold at local markets or provided for social functions.

315. Longliners operating in **Palau**'s EEZ catch and land various billfish species, mainly blue and striped marlin. Catches are frozen and eventually shipped to Japan. BBRG noted that species identification at port sampling (i.e. after processing) is problematic and makes reconciliation of logsheet-reported billfish catch difficult.

316. WP NFR–25 provides annual estimates of commercial and municipal landings of billfishes in the **Philippines**, 1994–97. Billfish species include swordfish, marlin (species not specified) and sailfish. It was noted that port sampling suggest there are more marlin than swordfish, but the Bureau of Agriculture Statistics data show otherwise. There is little or no information available on the recreational fishery in the Philippines. It is believed that around 200 small marlin have been tagged and released, but this is the extent of available information at this stage.

317. Longliners fishing in **PNG**'s EEZ take a variety of billfishes. Swordfish and striped marlin are rare, but blue marlin, black marlin and sailfish are common (WP NFR–16). Billfish are also taken on purse seine vessels, but these are typically used for crew consumption.

318. The longline fishery that is developing in **Samoa** catches and lands billfishes, mostly blue and black marlin. Data on billfish catch are collected through port sampling and local market surveys. There are some problems in species identification by port samplers. One commercial gamefish charter operation targets marlins; there are 6–8 privately-owned gamefishing boats targeting marlin. To date, there is no central data collection system for game boats.

319. Data from **Taiwanese** longliners fishing in the tropical western and central Pacific are available back to the late 1960s. WP NFR–18 presents annual estimates of offshore longline catches of billfish (species not specified) for 1995–98. Billfish are rare in the catches of distant-water longliners targeting albacore in the south Pacific (occasionally they land marlins, mainly swordfish and blue marlin). Billfish are more common in the catches of offshore longliners targeting bigeye and yellowfin in tropical waters. Logbook data show considerable seasonal variation in the catch composition of offshore longline catches for 1998, although blue marlin tend to comprise the majority of the billfish catch. It was noted that there is a tendency to misidentify blue and black marlin on some of the offshore Taiwanese longline vessels operating out of Micronesia. Billfish, mainly blue marlin, are occasionally taken by Taiwanese purse seiners.

320. Longliners targeting albacore in **Tonga** report catches of marlins, mainly swordfish and blue marlin (WP NFR–19). Misidentification problems have arisen in the past mainly due to the fact that the Tongan language does not distinguish between billfish species; that is, there is only one word to describe billfish. There is an active gamefishing body in Tonga (Tongan International Gamefishing Association–TIGFA). It was noted that a draft gamefishing data collection form had recently been prepared by the OFP and that this form awaits review by TIGFA.

321. Billfish catches in **Tuvalu** are restricted to foreign longline and purse sine fleets licensed to fish in their EEZ.

322. In the North Pacific, the targeting practices of US **Hawaii**-based longliners have varied with some vessels targeting swordfish while others target bigeye and yellowfin. The swordfish catch for 1998 was around 3,299 mt, blue marlin around 600 mt and striped marlin around 500 mt. American purse seiners report catches of marlins (mostly blue marlin) on logbooks, although marlin bycatch is not landed (WP NFR–21). A gamefishery for marlins (mainly blue marlin) has operated from Kona since the late 1980s. International tournaments are regularly held, involving up to 100 boats. Concern of interaction with the commercial longline fleet was partly responsible for the closure to longlining of waters within 50 nm of the Hawaiian Islands. A few vessels troll or handline fishing gear and also take a small amount of marlin in their catch. The annual recreational catch of marlin in Hawaii is estimated to be around 200 mt, most of which are blue marlin. Some of the billfish taken in this fishery are tagged and released, but the majority are sold locally as a condition of the charter.

323. Taiwanese longliners targeting albacore in **Vanuatu**'s EEZ are believed to have a bycatch of billfish. Logbook reports for a locally-based longliner that fished in 1996–97 show occasional catches of marlins (mainly striped marlin, but also black marlin and blue marlin) and a few swordfish and sailfish (WP NFR–22). Vanuatu has a developing gamefishing industry. It hosts an international gamefishing tournament each year, and four gamefishing vessels currently operate in Vanuatu. They catch many yellowfin and mahi mahi, but tend to target blue marlin. Occasional catches and tag–releases of sailfish, black marlin and striped marlin have also been reported (to date around 40 marlin have been tagged). There is concern over the potential for commercial longline fishing adversely affecting strike rates in the gamefishery. WP NFR–22 lists further development needs of the gamefishery: government support, database systems, the supply of tags and the deployment of anchored FADs.

Conclusions

324. The following conclusions were drawn from BBRG's discussions of recent developments.

(a) In several fisheries, billfish catches are not reported to species level.
(b) Purse seiners occasionally report catches of billfish, such as blue marlin, in logbooks. Billfish bycatch occurs in purse seine sets on FADs which are becoming more common (they are extremely rare in purse seine sets on free-swimming schools).
(c) Logbook data on billfish catches are becoming available for most longline fisheries. The reliability of many logbook estimates is not known, especially regarding the quantities and species of billfish discarded. This extends to uncertainty over the survival of billfish that are released by commercial longliners and those tagged and released by anglers.
(d) Observer data are available for several fisheries, however estimates are yet to be developed for billfish catch levels in most fisheries.

(e) Important gamefisheries are established in Hawaii, Australia, New Zealand and French Polynesia. Small developing gamefishing industries exist in Vanuatu, Fiji, New Caledonia, Samoa, Solomon Islands, Tonga and Micronesia.
(f) There are concerns over the potential for commercial longline fishing adversely affecting strike rates in the gamefishery.
(g) Individual operators often maintain records of gamefishing activities, but regular monitoring programs and central databases are rare. There is also a need to provide many operators with logbooks and tagging kits.

9.2 Reports on research and assessment in progress

Experiences in monitoring large-scale gamefishing tournaments

325. Dr Pepperell described a recent project (full report available from the presenter) which collected and collated catch and effort data by organized game fishing off the East Coast of Australia. The project involved full participation from the relevant gamefishing clubs and was successful in developing and implementing a standardized catch/effort monitoring system. The intent was to integrate a novel monitoring system within the already existing practice of 'self-policed' routine radio reporting by the game fishing fleet during tournaments. The project also involved the deployment of 'dockside observers or interviewers' to validate catch and effort data. These 'dockside observers' allowed the collection of ancillary data on other species, e.g. mahi mahi, and other 'non point-scoring' fish, which are not normally recorded within the club system, providing important insights into the total catch composition, including by-catch.

326. The project has resulted in the implementation of standardised recording sheets within the club system that recorded: effort (number of boats and number of days and hours fished), fishing methods, captures by species, weights and fish tagged. Monitoring commenced in 1994 and is ongoing. The project has also shown the benefits of biological monitoring and sampling at tournaments, in particular: correct species identification, standardized measurement of lengths and weights, reproductive status, and studies on feeding, genetics, parasites and physiology.

Catch rates and average size of blue marlin in the Kona charter fishery

327. The Kona charter vessel fishery accounted for about half the charter fishing activity in the State of Hawaii. Since the late 1980s onwards charter vessel fishing activity had greatly increased at Kona due to expansion of the small boat harbor at Honokohau. At the same time longline fishing in Hawaii also expanded with the advent of a new fishery for swordfish and bigeye tuna. A 50 nautical mile longline closed area was established by the Western Pacific Regional Fisheries Management Council (WPRFMC) around the main Hawaiian Islands in the early 1990s in response to concerns by small vessel recreational, charter and commercial troll/handline fishermen over competitive interactions with longliners. More recently a call had been made for further management action to improve the catches of blue marlin by charter vessel fishermen in Kona through expansion of the present closed area boundary or a blue marlin non-retention policy for Hawaii-based longliners.

328. Examination of longline fishing effort data from around Kona and charter vessel CPUE data showed no correlation for either blue or striped marlin, but declines in charter vessel blue marlin CPUE were correlated with the volume of charter vessel activity. This suggested that increased levels of charter vessel fishing at Kona may be resulting in some local depletion of blue marlin stocks off Kona. However, some limited acoustic tagging indicated rapid movement (and hence

implied throughput) of blue marlin through the waters off the Kona coast. It was noted that most marlin fishing around Kona occurred over a relatively small area. Furthermore, the State of Hawaii continued to develop charter vessel berths at Honokohau which may further exacerbate this problem.

329. The size frequency of blue marlin captured in the charter vessel fishery in 1998 matched that of the size distribution from 40 years of data from the Hawaii International Billfish Tournament. However, a long term decline in the average size of blue marlin landed by the Kona charter vessel fishery was noted between 1980 and 1998. The charter vessel fishery, however, continues to catch larger specimens of both blue and striped marlin than the longline fishery. Some suggestions for further analysis of the data were suggested by SCTB participants following the presentation.

Analysis of charter boat data to assess black marlin strike rates

330. WP BBRG-1 describes recent work which investigated the time series (since 1971) of black marlin strike rates in the recreational charter boat fishery near Cairns, Australia. It explores whether changes in strike rates observed in this fishery are correlated with longline effort in the region. The data were based on personal logbooks kept by a number of operators. General Linear Models (using both a Poisson model and a combined Binomial/Normal model) were used to calculate standardised annual indices of black marlin strike rates in this fishery. The indices were then correlated with the longline effort within the immediate region of the recreational fishery and within the Coral Sea basin in order to investigate the possible interaction between the two fisheries. The results indicate that there has been a long term decline in the strike rates of black marlin in the charter boat fishery, but that the mean strike rate in this fishery does not appear to the related to levels of longline effort within the region. However, these results are conditional on whether the limited amount of data available for analysis are representative. The possibility that the decline observed in strike rates of black marlin during the 1990s may be due to changes in the spatial distribution of these fish in response to changes in the oceanography within the region, is to be further investigated.

Gathering useful and consistent data from gamefishing tournaments and clubs

331. Mr Zane Grey established gamefishing in French Polynesia with a capture of a blue marlin of over 1,000 lb. in 1930 off Tahiti. Gamefishing further developed in the 1960s with the creation of the Huara Club of Tahiti in 1962. During the 1970s and 1980s, development continued with the establishment of additional clubs – there are now seven clubs established throughout the Society Isles.

332. The main target species is blue marlin, though some striped marlin and sailfish are also caught. These are the only species recorded by the clubs, as tuna, and marlins under 55 kg, are not recorded. Tag and release started in 1984 with the creation of the Tahitian International Billfish Association (TIBA). This has helped provide some indication of migration patterns. The practice of tag and release is counter to the Polynesian appreciation of marlin for food, particularly in the preparation of *poisson cru*.

333. Each year, over the past three years, there have been at least three blue marlin in excess of 1,000 lb. and more than twenty in excess of 500 lbs. In the past year, 630 marlin were captured on the Windward Isles (55 tagged and released), and 205 caught (20 tagged and released) on the Leeward Isles.

334. There is no conflict among the commercial, artisanal or sports fishery at present. However, the presenter (Mr Alban Ellacott) personally recommends the industrial fishery be limited to outside the 100 nm boundary of all islands until the stock dynamics are better known.

335. BBRG noted that the club maintained records that indicated, on average, 5–7 fish per day were caught and that a capture of a marlin required, on average, two days effort for each boat. Marlins were a part of the commercial target catch rather than bycatch.

336. BBRG also speculated on the apparent increase in striped marlin in the Australian gamefishery. Increases in technology (GPS) have allowed fishermen to target feeding areas such as the upwelling at tops of canyons to better effect. Also, a move for fishermen to use heavy gear has shortened the time from strike to capture from around one hour to about 10 minutes. There may also have been an increase in abundance as striped marlin recreational catch rates appeared to increase after the banning of commercial marlin captures in the New Zealand longline fishery. There are 7,000 releases of tagged striped marlin in Australia, yet only 40 had been recaptured. Nevertheless, 1–2% returns is normal for marlin in the world but in some areas where marlin were commercially targeted this may increase to 3-4%.

Collaborative recreational data collection

337. Mr. Whitelaw summarised the present state of gamefishing in the Pacific with the more developed game fisheries being in Australia, NZ, the US, French Polynesia and Fiji with other developing areas including Vanuatu, Tonga, the Marshall Islands and PNG. There is a paucity of available game fish catch and effort data, though some countries, notably Australia, NZ, French Polynesia and the US were making efforts to collate available data.

338. The main purposes for collecting game fish data are to provide information:

- On available game fish resources
- On catch rates, average size and species compositions,
- On fishery interactions
- On seasonal and inter annual variation in species abundance
- To assist in resource allocation
- To assist in the development of gamefishing industries
- To provide national data to assist in stock assessments
- To assist in tourism research and development,

339. Some gamefish data was collected by some gamefishing clubs within Pacific island countries, though it is sporadic and uncoordinated. Concerns were expressed that most of this data was not in a format or location that made it available to interested scientists and managers.

340. The proposal was put forward that cooperative and collaborative efforts be made to collate and archive existing data and to foster the collection of future data in a format suitable to all parties i.e. the gamefishers, charter operators, relevant ministries and involved scientists and managers. SPC will continue to further this work on a collaborative basis.

Species selectivity in longline fisheries

341. Dr Pascal Bach presented WP RG–2. Pelagic longline is a passive gear with capture depending on active movements of fish towards the gear. In many tropical areas, pelagic longline is used to target tuna. Nevertheless, this fishing method also catches a large number of non-target species. The catch of species depends on (i) the fishing gear, and (ii) fish behaviour, both natural and in relation to fishing strategy.

342. The ECOTAP program carried out fishing experiments using longlines equipped with time depth recorders and hook timers to improve knowledge of (i) the fishing depth in relation to setting strategy, and (ii) fish capture according to fishing conditions (depth strata, bait types).

343. Results validated previous bigeye targetting studies and allowed optimisation of the ratio between the target species and bycatch.

Bycatch from experimental longlining operations in French Polynesia

344. WP BBRG–8 describes experimental longlining operations carried out in French Polynesia under the framework of the ECOTAP program, conducted by the territorial organisation – SRM, and the two national institutes IFREMER and IRD. Bycatch taken by the longline gear were analysed with regard to depth of captures, “longline behaviour” (sinking and rising movements and settled periods of the baits) and survival rates.

345. Bycatch species are distributed through the water column as either shallow, deep and ubiquitous species. Knowledge on the vertical stratification of these species allows fishing strategies to reduce the capture of certain non-target species. For example, the catches of the shallowest species, mahi mahi, wahoo and short-billed spearfish, can be reduced if fishing effort is concentrated in the deepest strata.

346. Bait movement should be taken into account in any analysis of the fishing effort and captures. For example, some species tend to take ‘moving’ hooks (mainly the shallowest species) while others (mainly the deepest species) tend to take ‘settled’ hooks.

347. Some species are alive on landing and have the capacity to be released to survive. The study found that many species were dead on capture but others, such as the Chondrichthians (sharks and rays), are robust and could often be released alive.

348. Dr Misselis stated that studies on longline bycatch were necessary to (i) evaluate the impacts of longline fishing on bycatch species, and (ii) improve fishing efficiency by reducing the competition of target species with non–target species for the baited hooks. BBRG noted that hook timers and depth recorders were used to estimate movement of baits. Marlin are often dead on landing, with the striped marlin found to be the most robust with 40% surviving. This was much lower than the survival rate of marlins in New Zealand, and may be temperature related.

Review of problems on stock assessment of marlins

349. WP BBRG–6 reviews landings and catch and effort data with respect to their utility for future stock assessments on marlins. FAO statistics, which are the only statistics that cover the whole Pacific, are probably unreliable as few countries report marlin catches and species identification is likely to be poor. Furthermore, although efforts are being made to improve marlin statistics, the

historical change of coverage in the landing statistics will need to be taken into account in any stock assessment analysis. An abundance index has been derived from logbook information from the longline fishery. However, interpretation of this index is problematic as marlins are not generally targeted by longliners. In particular, horizontal coverage is limited because of incomplete overlap in the distribution of marlins and tunas (which are the target species). Vertical coverage is limited because commercial longlines are set in the water column starting at about 100m depth, and this depth is near the lower end of marlin distribution. Problems related with the horizontal and vertical coverage may be better understood with careful investigation of catch and effort data, and incorporating information on the distribution characteristics of marlins and environmental factors into future models.

Stock structure of marlins and sailfish in the Pacific

350. Dr Pepperell described (no paper submitted) the stock structure of marlins and sailfish in the Pacific in terms of distribution, spawning areas, movements and genetics. Black marlin have a wide distribution and large-scale movements, but restricted spawning areas. This species probably forms a single stock in the Pacific Ocean.

351. Striped marlin have a horse-shoe shaped distribution in the Pacific (Figure 12) and spawn throughout their distribution; however, their movements are limited. There is genetic evidence of separate north-east and south-east Pacific Ocean stocks. Furthermore, there is unlikely to be much interaction between marlins in the eastern and western parts of the Pacific Ocean.

352. Blue marlin spawn in the south-east Asia region and other equatorial areas. They move throughout the Pacific Ocean and are thought to be one stock.

353. Sailfish have a wide distribution throughout the Pacific Ocean. There is little information on sailfish movements and genetics. However, Pacific, Atlantic and Indian Oceans sailfishes appear to be separate stocks. Work is ongoing to get more samples of marlins and sailfish for genetic analysis, and information on mixing and movements.

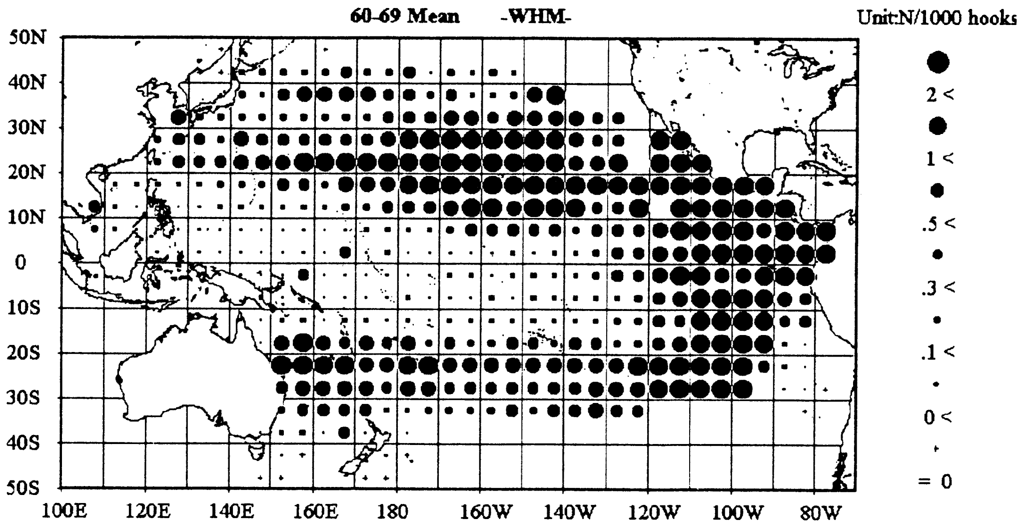

Figure 12. Geographic distribution of CPUE for striped marlin by the Japanese longline fishery in the 1960s (WP BBRG–6)

Age and growth of swordfish in waters around Taiwan

354. WP BBRG–11 provides an update of age and growth estimates of swordfish derived from counting growth rings on cross sections of the second anal fin spine. A generalised growth function fit the data well over a range of ages and matched the growth pattern of juveniles less than one year of age (growth of swordfish is fastest in the first year of life, then slows appreciably). By contrast, the standard von Bertalanffy growth equation did not fit the data well, and overestimated values for individuals less than one year old. Growth curves generated in this study were compared to those in the literature. Variations in growth are probably due to stock-specific and environmental factors. It was recommended that the influence of these factors on growth be further investigated in the future.

Current assessments and ecosystem modelling of billfish

355. Dr Watters presented work presently being conducted by the IATTC to assess blue marlin throughout the Pacific (no paper submitted). A delay-difference model has been fit to a time series of standardised CPUEs from 1955–1997. The model successfully fit the standardised CPUE series and estimates of average maximum sustainable yield ranged from 17,000 to 20,300 mt depending on the scenario used to estimate catch weights prior to 1971. The Pacific-wide catch of blue marlin during 1993–1997 averaged about 21,000 mt and estimates of the ratio of 1997 biomass to the biomass expected to produce the average MSY ranged between 1.1 and 1.9 so the stock was judged to be in good condition.

356. Dr Watters also reported on IATTC work to develop an ecosystem model for the EPO using the ECOPATH/ECOSIM framework. ECOPATH is a system of differential equations that estimate a mass balance between components of the ecosystem, and requires information about predator-prey linkages, predator energy requirements, prey biomass and productivity, and other imports and exports (including fishery removals). In general, there is little information available for these input parameters, and relatively few of them were considered to be reliable. Currently, the model is most sensitive to parameters for ecosystem components about which relatively little is known, especially *Auxis* spp. (bullet and frigate tunas) and cephalopods. Work on the model is ongoing.

Very preliminary assessment of swordfish

357. Dr Kleiber reviewed a swordfish assessment in the north Pacific that was presented at the January 1999 meeting of the Interim Scientific Committee. The assessments consisted of two production models fit to Japanese and Hawaiian longline effort and swordfish catch data from the central and western north Pacific. Both models allowed for variation in catchability by estimating a constrained time series of catchability for each of the two fleets. In a similar fashion, one model allowed for variation in carrying capacity, and the other model allowed for variation in recruitment. In fitting the data, both models had various difficulties that could be ascribed to lack of contrast in the data, consistent with a low exploitation rate of swordfish. The pattern of recruitment variation estimated by one of the models indicated that these spatially homogeneous models are based on a poor understanding of the complex spatial structure of the swordfish stock and of the fishing fleets and that further development of the models will need to embrace that complexity. Dr Kleiber also described the ISC work plan for swordfish, which emphasised tagging and other work to help define the spatial complexities and movement patterns of swordfish in the north Pacific.

A simluation model used to evaluate assessment and management for the north Pacific swordfish fishery

358. WP BBRG–11 described the features of the simulation model, its underlying hypothesis, limitations and user interface. The model was designed to help evaluate the performance of stock assessment and fishery management procedures for swordfish in a data poor situation. This class of model can be used for simulation and estimation purposes. However, the current version is used primarily to generate time series of fishery or stock attributes given a set of input parameter values, user specified sampling patterns and observation error. It incorporates key features of age-structured and length-based models, and accounts for growth, reproduction, mortality, recruitment, exploitation and movement. Additional functionality will be added soon and the model should be sufficiently complete for initial use before the end of 1999.

The scope and extent of shark landings in the US Pacific

359. WP BBRG–9 summarises information on the extent, and principal participants involved in the utilisation of pelagic sharks. It focuses on the extent and magnitude of shark fin landings and its relative economic importance to the U.S. Pacific Islands of American Samoa, Hawaii and Guam. The total direct 1998 economic contribution from shark fins is estimated to have been between $US2.4 to $US3.2 million, of which Hawaii received about 61%, American Samoa 25% and Guam 14%. In 1998, the Hawaii domestic longline fishery produced about 38 mt of dried shark fins with an ex-vessel value of about $US1 million (95% of this production came from blue sharks). Fishing vessel crews are the main recipients of revenue from the ex-vessel sale of shark fins in all fleets except Taiwanese longliners in Guam. The complexity of the shark fin trade, the variety of species, sizes, grades of shark fin, and lack of available reference prices make it difficult to assign values to the commodity as a whole. International trade statistics citing fin value should be used with caution as there can be incentives for shippers to misrepresent value. Volumes can also be misleading as some statistics do not differentiate between fins in various stages of processing that can affect declared weight. Overall, there is a lack of information on shark catches for all fleets except domestic longliners in Hawaii.

9.3 Interactive session: Summary of knowledge on billfishes

360. Mr Whitelaw elaborated how this session was intended to update, via a table (WP BBRG–3), existing knowledge of the three main marlin species, ascertain current and proposed research and highlight current knowledge gaps and look at research priorities.

361. Input was provided by a number of participants and the table updated accordingly (see Appendix 9). The session showed that there were major gaps in the present knowledge of marlin, especially age structure and reproductive capabilities as well as stock structure, though recent genetic work is assisting in this respect. The session highlighted that there is currently only minor work being carried out on most billfish species, though a recent stock assessment study has been undertaken on blue marlin by the IATTC. The current and proposed work is shown in Appendix 9.

9.4 Future workplan

362. The BBRG Chair provided the following assignments for the next BBRG meeting.

Task		Responsibility
1.	Develop statement on billfish stock status for consideration by BBRG3.	**Ward**
2.	Extend and update tables summarising knowledge and current work on billfish.	**Whitelaw, All**
3.	Check current and historical species identification, particularly for black marlin – blue marlin and sailfish–spearfish.	**Moon, Wang, Uozumi, Williams/Sharples**
4.	For longline fisheries, estimate current and historical levels of discarding for each billfish species.	**Ward, Williams, Wang, Moon, Uozumi, Hawaii?**
5.	Report on the life status of billfish caught by longline.	**Campbell, Bach,Williams / Sharples**
6.	Document average weight data used to raise Japanese billfish catches.	**Uozumi**
7.	Report on the activities of other regional billfish and bycatch groups (e.g., ISC, IATTC, conference on tagging survival).	**Watters, Kleiber, Pepperell**
8.	Continue to report estimates of annual billfish catches in National Fisheries Reports.	**Ward, All**
9.	Develop a plan for the regular reporting of annual billfish and bycatch catches.	**Lawson**
10.	Report on the availability of tags and data collection forms for developing gamefisheries.	**Whitelaw**
11.	Document targeting, fishing gear and practices in gamefisheries.	**Whitelaw, Pepperell, Yen**

9.5 Summary statement

363. A summary statement for the BBRG was drafted, circulated to participants and discussed during Agenda Item 11. The accepted wording appears below.

BILLFISH AND BYCATCH RESEARCH GROUP (BBRG)

SUMMARY STATEMENT

Good information is available on marlin stock structure and broad movement patterns. However, BBRG highlighted gaps in other information required for the development of quantitative stock assessments. Major gaps include information on age and growth, mixing rates and natural mortality. Historical catch and effort data are available for several commercial fleets, especially Japanese longliners. However, catches of billfishes are often incidental to commercial fishing operations. Consequently, there is uncertainty over the reporting of discarded catches, and catch rates need to be standardised if they are to be used as an index of stock abundance. Size data are also required. Useful catch, effort and size data might also be gathered from gamefishing operations that target billfishes.

BBRG does not yet have a history of stock assessment to draw on. BBRG did not attempt to develop a statement of stock status because of the information gaps mentioned above. In the interim, BBRG's coordinator offered to develop a statement that subsequent meetings of BBRG can consider. Thus it will eventually create an agreed statement on stock status and add to this as results of dedicated research and assessment become available.

10. DISCUSSION ON MHLC

10.1 Current status of MHLC process and implications of SCTB

364. Dr Lewis gave an overview of the MHLC process to date (WP MHLC–6), noting that at the fourth session, held in Honolulu in February 1999, discussions focused on some of the more difficult issues to be decided, including the convention area, scientific arrangements, decision making and a range of monitoring, control and surveillance issues. The timetable for future sessions includes the fifth session in Honolulu in September 1999, a further session in early 2000, before the final session of the Conference in June 2000. The fifth session will focus on funding arrangements, decision making, vessel monitoring systems, with further consideration of the convention area and species coverage also likely.

365. In discussion, Dr Suzuki questioned the need for both a Scientific Committee and “scientific experts” to advise the Commission. Several participants noted that the general view emerging in the MHLC is that this system provides the necessary checks and balances to ensure that the Commission receives objective scientific advice. It was noted that the role of the “scientific experts” would be to undertake key research and stock assessment tasks, while the role of the Scientific Committee would be to review this work, provide supplementary interpretation of the results, consider other relevant research and recommend research priorities and directions for the “scientific experts”.

10.2 Area to be covered by the Convention

366. Dr Hampton presented an assessment of the currently proposed convention area (WP MHLC–1). The assessment considered several scientific criteria in relation to the proposed area – the distributions of the key targeted tuna stocks, their spawning areas, their movements within the overall stock ranges and the distributions of their fisheries. For south Pacific albacore, the proposed convention area covers a large proportion of the stock distribution, important spawning areas and approximately 90% of the historical catch. The proposed area would therefore be adequate for south Pacific albacore stock assessment and management. For bigeye, skipjack and yellowfin tunas, the proposed convention area is deficient in not covering important components of the stock distributions, spawning areas and fisheries that occur west of the proposed western boundary (principally in archipelagic waters of the Philippines and Indonesia). The proportions of bigeye, skipjack and yellowfin historical catches falling to the west of the proposed western boundary are 16%, 23%, and 32%, respectively. It was concluded that omitting such large proportions of the existing fishery from the convention area could pose significant problems for the Commission.

367. In discussion, Dr Murray noted that there was wording in the draft convention that made provision for data collection from Philippines and Indonesian archipelagic waters, and that the Commission would take into account the catches in these areas (and throughout the range of the stocks generally) in determining management measures for the convention area. The meeting agreed that the MHLC should be made aware of the implications of excluding Philippines and Indonesian archipelagic waters from the convention area, and in particular the significance of the total catches in this area compared to the stock-wide catches.

10.3 Species to be addressed by the Convention

368. Dr Lewis briefly introduced WP MHLC–2, which provides detailed listings of species encountered by purse seine and longline fisheries in the western and central Pacific Ocean. The lists were compiled from published information and from observer data available to SPC. This information might be useful source material in considering which species should be included in a species list for the MHLC.

369. Dr Sakagawa introduced WP MHLC–3 by noting that the topic of species list for MHLC is an assignment to the U.S. from the MHLC Chairman. All international tuna conventions define the species of concern to the convention either in specific or general terms. The MHLC is faced with defining the species for the Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. At the fourth session (February 1999) of the MHLC, the Chairman requested that qualified scientists review the species lists (Annex 1 of UNCLOS and a U.S. proposal) that are being considered by the parties and to provide advice to the parties. Dr. Sakagawa suggested a procedure for reviewing the lists and for preparing the advice. He noted that available information for the review task is contained in WP MHLC–3.

370. Dr Suzuki introduced WP MHLC–4, which provided another perspective on the definition of species to be included in the MHLC convention. The idea of listing every specific highly migratory species (HMS) seems to come from literally referencing Annex 1 of UNCLOS. It should be noted that attempting to construct a complete species list is not only scientifically impossible, but possibly even detrimental to rational management of HMS. Biological information about migration for many species is inadequate to construct specific lists of HMS. A brief review of the species or groups of species covered by existing international tuna management organizations also indicates the practical superiority of defining the fish or group of fishes covered by the conventions as simply and as flexibly as possible rather than specifying the species individually.

371. The meeting agreed that Dr Sakagawa would circulate a draft of the species list compiled by the U.S. to SCTB participants for comment, before finalizing the U.S. proposal to be presented at MHLC5.

11. OTHER BUSINESS

11.1 Consideration of summary statements from the Species Research Groups

372. The meeting reviewed draft summary statements prepared by the chairs of each Species Research Group. The revised and accepted versions of each summary statement appear at the end of each Species Research Group section in this report.

11.2 Directives to the Statistics Working Group

373. The SWG Coordinator noted that thirteen directives to the Statistics Working Group were made during SCTB12. Several of the directives were repetitive, however, with certain directives being made by more than one research group, and others corresponding to activities currently being carried out by the SWG. The following represents a condensed list of directives that avoids repetition and redundancy.

- **Dr Skillman and Mr Miyabe** were directed to provide information on past and present definitions of gross registered tonnage in the United States and Japan respectively.
- **Mr Lawson and Mr Ward** were directed to examine the placement of OFP scientific observers aboard Australian domestic longliners to collect data that can be used to verify catch and effort logsheets.
- **Mr Lawson** was directed to examine possibilities of obtaining annual catch estimates covering the domestic fisheries of Indonesia for the period from 1995 onwards.
- **Dr Chang** was directed to provide revised catch and effort data covering Taiwanese distant-water longliners for use in the MULTIFAN–CL assessment.
- **Mr Bigelow** was directed to further examine the application of regression trees for improving estimates of annual catches of bigeye by purse seine.
- **Mr Williams** was directed to compile and disseminate information regarding longline fishing operations; longline gear configuration; the use of FADs; and the use of electronic equipment.
- **Mr Lawson and Mr Whitelaw** were directed to compile estimates of annual catches of striped marlin, blue marlin, black marlin and swordfish and prepare tables of annual catches for presentation at SCTB13.

11.3 Other matters

374. The SCTB12 chair, Dr Suzuki, advised the meeting that, in keeping with the philosophy of rotating responsibilities amongst SCTB participants, new co-ordinators for the Skipjack Research Group (SRG) and the Yellowfin Research Group (YRG) will be sought prior to SCTB13. He warmly thanked Dr Sakagawa, outgoing Coordinator of the YRG, for his work with this group and previously, the Western Pacific Yellowfin Research Group (WPYRG).

375. There was some discussion regarding the distribution of the SCTB12 draft report to participants immediately after the meeting. It was thought that participants might be able review the draft report during the voyage back to their home base, and that having the report available to present to supervisors and/or government officials immediately on return was desirable. However, several factors made the distribution of the draft report immediately after the meeting impractical, the most fundamental being: (1) the amount of photocopying and preparation of a draft report would be inordinately costly and require at least an additional half day to organise, and (2) several rapporteurs and presenters had to depart the meeting before it finished, and did not have time to complete and submit their contribution for the report.

376. Acknowledging the need to satisfy the requests of participants, Dr Lewis offered to produce a 4–page ‘PROMPT REPORT’, highlighting the salient points of the meeting, incorporating the summary statements for each Species Research Group. This was produced within 2–3 hours of the closure of SCTB12 and made available to participants before they left Tahiti (Appendix 9). SCTB13 will review the success of this method, and whether other methods, for example, providing the draft report to participants on 3.5–inch floppy diskettes, should be introduced.

377. An offer on behalf of the Tongan Government to host the next meeting of SCTB in Tonga was announced to the meeting.

12. CLOSE

378. In closing the meeting, Drs Suzuki, Lewis and Mr Yen individually offered thanks to the Government of French Polynesia, and in particular Ms Helene Courte, Technical Advisor to the President on External Affairs, for providing financial assistance and hosting the meeting.

379. They also thanked the Government of France for providing additional financial assistance, and the staff of SRM, IRD, and the OFP for the logistics and organisation of the meeting. The meeting was closed with a spontaneous round of applause.

TABLES OF ANNUAL CATCH ESTIMATES

Table 1. Total catches of albacore in the Pacific Ocean. Symbols: '…' = missing data; '–' = no effort, hence no catch; '0' = effort, but no catch; estimates in parentheses have been carried over from previous years

YEAR	SOUTH PACIFIC					NORTH PACIFIC					TOTAL
	LONGLINE	POLE-AND-LINE	TROLL	OTHER	SUB-TOTAL	LONGLINE	POLE-AND-LINE	TROLL	OTHER	SUB-TOTAL	
1950	-	...	-	-	-	(26,733)	(41,786)	32,746	(1,764)	103,029	103,029
1951	-	...	-	-	-	(26,733)	(41,786)	15,629	(1,764)	85,912	85,912
1952	154	...	-	-	154	26,733	41,786	23,914	1,764	94,197	94,351
1953	803	...	-	-	803	27,799	32,921	15,745	341	76,806	77,609
1954	9,578	...	-	-	9,578	20,972	28,069	12,246	208	61,495	71,073
1955	8,625	...	-	-	8,625	16,284	24,236	13,264	721	54,505	63,130
1956	7,281	...	-	-	7,281	14,347	42,810	18,768	539	76,464	83,745
1957	8,757	...	-	-	8,757	21,057	49,500	21,173	538	92,268	101,025
1958	18,636	...	-	-	18,636	18,439	22,175	14,929	180	55,723	74,359
1959	17,841	...	-	-	17,841	15,807	14,252	21,202	72	51,333	69,174
1960	22,248	45	-	-	22,293	17,373	25,156	20,105	637	63,271	85,564
1961	23,742	0	-	-	23,742	17,443	21,473	12,059	1,636	52,611	76,353
1962	35,219	0	-	-	35,219	15,772	9,814	19,753	1,933	47,272	82,491
1963	31,095	16	-	-	31,111	13,471	28,852	25,145	1,445	68,913	100,024
1964	22,930	0	-	-	22,930	15,488	27,269	18,391	1,275	62,423	85,353
1965	25,838	0	-	-	25,838	13,965	41,908	16,557	866	73,296	99,134
1966	39,113	0	-	-	39,113	25,330	24,430	15,377	1,293	66,430	105,543
1967	40,318	0	5	-	40,323	29,516	34,594	17,975	1,328	83,413	123,736
1968	29,051	0	14	-	29,065	24,669	21,503	21,462	2,337	69,971	99,036
1969	24,360	0	...	-	24,360	18,652	35,103	20,192	2,371	76,318	100,678
1970	32,590	100	50	-	32,740	16,897	28,792	21,422	1,942	69,053	101,793
1971	34,708	100	...	-	34,808	12,805	55,269	22,272	2,455	92,801	127,609
1972	33,842	100	268	-	34,210	15,748	64,512	27,521	1,669	109,450	143,660
1973	37,649	100	484	-	38,233	16,201	72,047	17,053	2,023	107,324	145,557
1974	30,985	100	898	-	31,983	13,631	78,353	21,509	1,448	114,941	146,924
1975	26,131	100	646	-	26,877	14,046	55,400	19,043	1,263	89,752	116,629
1976	24,106	100	25	-	24,231	18,024	88,036	16,183	3,240	125,483	149,714
1977	34,849	100	621	-	35,570	17,425	33,431	10,022	2,309	63,187	98,757
1978	34,858	100	1,686	-	36,644	13,627	60,827	16,636	8,121	99,211	135,855
1979	28,739	100	814	-	29,653	14,722	44,965	7,302	4,245	71,234	100,887
1980	31,027	119	1,468	-	32,614	15,667	47,125	7,768	4,753	75,313	107,927
1981	32,632	8	2,085	5	34,730	18,822	28,174	12,837	11,783	71,616	106,346
1982	28,339	1	2,434	6	30,780	17,748	30,040	6,713	14,265	68,766	99,546
1983	24,303	2	744	39	25,088	16,172	21,705	9,584	7,893	55,354	80,442
1984	20,340	0	2,773	1,589	24,702	15,831	27,045	9,354	18,808	71,038	95,740
1985	27,138	0	3,253	1,937	32,328	14,850	22,212	6,471	15,030	58,563	90,891
1986	32,641	0	2,003	1,946	36,590	13,334	16,528	4,738	11,039	45,639	82,229
1987	26,877	0	2,107	930	29,914	14,974	19,249	2,870	11,645	48,738	78,652
1988	31,530	0	3,811	5,423	40,764	14,359	6,814	4,367	19,276	44,816	85,580
1989	22,247	0	8,990	22,130	53,367	14,068	8,683	2,000	20,235	44,986	98,353
1990	22,625	0	6,305	7,441	36,371	16,412	8,647	2,905	26,336	54,300	90,671
1991	25,000	0	7,678	1,517	34,195	11,047	7,103	1,984	11,109	31,243	65,438
1992	30,722	49	6,736	20	37,527	19,827	13,888	4,935	16,906	55,556	93,083
1993	29,901	5	4,358	20	34,284	31,592	12,809	6,748	4,399	55,548	89,832
1994	33,031	2	5,729	20	38,782	31,787	26,391	11,814	3,944	73,936	112,718
1995	24,369	0	8,029	25	32,423	33,382	20,981	9,615	3,634	67,612	100,035
1996	25,801	0	7,390	25	33,216	(34,504)	23,383	16,890	1,560	76,337	109,553
1997	32,784	0	4,839	25	37,648	(34,964)	(23,383)	14,628	2,243	75,218	112,866
1998	36,466	0	4,893	25	41,384	(34,437)	(23,389)	15,361	2,711	75,898	117,282

Table 2. Total catches of bigeye in the Pacific Ocean. Symbols: '…' = missing data; '–' = no effort, hence no catch; estimates in parentheses have been carried over from previous years. Refer to WP SWG–2 for more information on purse seine bigeye/yellowfin estimates.

YEAR	WCPO					EPO						TOTAL
	LONGLINE	POLE-AND-LINE	PURSE SEINE	OTHER	SUB-TOTAL	LONGLINE	POLE-AND-LINE	PURSE SEINE	TROLL	OTHER	SUB-TOTAL	
1950	...	...	...	...	...	...	...	...	...	...	...	...
1951	...	...	...	...	...	...	...	...	...	...	...	...
1952	...	...	...	...	...	...	...	...	...	...	...	...
1953	...	...	...	...	...	...	...	...	...	...	...	...
1954	...	...	...	...	...	...	...	...	...	...	...	...
1955	...	...	...	...	...	...	...	...	...	...	...	...
1956	...	...	...	...	...	...	...	...	...	...	...	...
1957	...	...	...	...	...	...	...	...	...	...	...	...
1958	...	...	...	...	...	...	...	...	...	...	...	...
1959	...	...	...	...	...	...	...	...	...	...	...	...
1960	...	...	...	...	...	...	...	...	...	...	...	...
1961	...	...	...	...	...	...	57	156	-	-	...	...
1962	34,206	...	...	...	34,206	44,200	168	160	-	-	44,528	78,734
1963	40,727	...	...	...	40,727	65,300	75	-	-	-	65,375	106,102
1964	29,316	...	...	...	29,316	45,400	68	-	-	-	45,468	74,784
1965	28,318	...	...	...	28,318	28,600	117	-	-	-	28,717	57,035
1966	30,761	...	...	...	30,761	34,100	157	109	-	-	34,366	65,127
1967	30,353	...	...	...	30,353	35,035	748	916	-	-	36,699	67,052
1968	23,528	...	...	...	23,528	34,216	63	2,496	-	-	36,775	60,303
1969	28,904	...	...	...	28,904	50,938	-	576	-	-	51,514	80,418
1970	33,987	...	726	2,820	37,533	32,498	-	1,332	-	-	33,830	71,363
1971	34,659	...	877	3,060	38,596	29,687	58	2,494	-	14	32,253	70,849
1972	45,329	1,761	865	3,498	51,453	35,798	66	2,172	-	-	38,036	89,489
1973	35,478	1,251	1,078	4,218	42,025	52,383	131	1,848	-	-	54,362	96,387
1974	39,029	1,039	1,389	4,719	46,176	36,273	-	890	-	-	37,163	83,339
1975	52,779	1,319	1,328	4,943	60,369	42,548	28	3,695	-	-	46,271	106,640
1976	64,513	3,423	1,312	4,138	73,386	50,966	45	10,136	1	4	61,152	134,538
1977	62,934	3,325	1,587	5,637	73,483	71,039	2	7,053	-	-	78,094	151,577
1978	49,394	3,334	1,146	4,243	58,117	70,622	-	11,714	-	-	82,336	140,453
1979	56,748	2,419	2,033	4,674	65,874	56,049	-	7,531	-	1	63,581	129,455
1980	54,045	2,243	2,162	4,149	62,599	58,042	-	15,318	-	103	73,463	136,062
1981	41,239	2,596	4,315	4,929	53,079	48,438	-	10,090	-	1	58,529	111,608
1982	44,739	4,108	5,150	4,742	58,739	43,920	23	4,079	-	-	48,022	106,761
1983	41,144	4,055	9,388	5,024	59,611	77,705	21	3,144	-	95	80,965	140,576
1984	46,156	3,465	8,556	5,189	63,366	66,568	1	5,919	-	16	72,504	135,870
1985	51,064	4,326	7,311	6,125	68,826	70,731	17	4,497	-	18	75,263	144,089
1986	46,486	2,865	7,509	6,481	63,341	107,451	-	1,939	-	-	109,390	172,731
1987	60,647	3,128	11,395	5,566	80,736	102,408	-	771	-	5	103,184	183,920
1988	50,166	4,112	7,305	6,453	68,036	60,634	2	1,051	-	-	61,687	129,723
1989	51,182	4,272	12,651	7,146	75,251	64,642	-	1,470	-	-	66,112	141,363
1990	66,782	3,868	12,143	8,894	91,687	82,621	-	4,701	-	11	87,333	179,020
1991	51,225	1,909	13,411	10,288	76,833	79,430	25	3,702	-	13	83,170	160,003
1992	63,153	1,643	19,384	7,356	91,536	64,764	-	5,488	-	9	70,261	161,797
1993	57,043	2,360	14,286	7,391	81,080	64,374	-	8,043	-	26	72,443	153,523
1994	64,833	2,805	11,178	8,723	87,539	53,323	-	28,683	692	-	82,698	170,237
1995	53,014	3,807	14,101	10,405	81,327	41,056	-	36,155	1,154	-	78,365	159,692
1996	51,665	3,861	18,269	11,570	85,365	38,933	-	50,728	-	625	90,286	175,651
1997	62,219	3,706	30,732	11,628	108,285	(38,933)	-	51,391	-	2	90,326	198,611
1998	66,977	3,706	19,592	11,725	102,000	(38,933)	-	34,711	-	2	73,646	175,646

Table 3. Total catches of skipjack in the Pacific Ocean. Symbols: '…' = missing data; '–' = no effort, hence no catch

YEAR	WCPO					EPO				TOTAL
	LONGLINE	POLE-AND-LINE	PURSE SEINE	OTHER	SUB-TOTAL	POLE-AND-LINE	PURSE SEINE	OTHER	SUB-TOTAL	
1950	...	...	...	6,483	...	49,534	5,741	1,299	56,574	...
1951	...	96,214	1,748	8,602	106,564	45,617	5,790	1,109	52,516	159,080
1952	...	78,518	3,716	10,014	92,248	32,724	4,806	905	38,435	130,683
1953	...	65,546	3,371	11,403	80,321	50,812	5,171	0	55,983	136,304
1954	...	88,073	4,534	11,554	104,161	61,221	8,519	1	69,741	173,902
1955	...	92,524	2,906	12,664	108,094	51,558	6,503	1	58,062	166,156
1956	...	91,950	2,145	13,094	107,189	64,971	3,204	0	68,175	175,364
1957	...	92,156	2,813	11,955	106,924	54,414	873	10	55,297	162,221
1958	...	131,441	10,698	15,244	157,383	67,594	5,481	23	73,098	230,481
1959	...	145,447	16,941	14,853	177,241	69,495	9,477	24	78,996	256,237
1960	...	70,428	3,728	15,782	89,938	34,900	11,820	21	46,741	136,679
1961	...	127,011	11,693	18,032	156,736	27,497	40,614	384	68,495	225,231
1962	...	152,387	11,674	17,559	181,620	16,153	52,572	34	68,759	250,379
1963	...	94,757	9,592	18,354	122,703	16,549	76,829	2,318	95,696	218,399
1964	...	137,106	25,064	20,739	182,909	9,783	46,006	3,545	59,334	242,243
1965	...	129,933	4,670	20,601	155,204	19,137	58,246	999	78,382	233,586
1966	...	215,600	10,968	22,890	249,458	13,666	45,119	1,875	60,660	310,118
1967	...	168,846	10,954	24,864	204,664	17,871	97,962	4,906	120,739	325,403
1968	...	162,379	7,485	24,891	194,755	7,008	54,362	9,896	71,266	266,021
1969	...	168,084	4,400	30,031	202,515	6,591	40,879	11,763	59,233	261,748
1970	1,465	197,873	10,586	32,158	242,082	6,998	42,101	7,031	56,130	298,212
1971	1,291	180,945	14,987	29,148	226,371	11,102	87,131	6,590	104,823	331,194
1972	1,417	171,488	19,691	41,777	234,373	6,081	26,434	1,070	33,585	267,958
1973	1,608	253,007	21,547	50,326	326,488	8,789	34,737	569	44,095	370,583
1974	2,007	289,068	14,742	49,410	355,227	7,150	71,255	461	78,866	434,093
1975	1,827	217,930	18,237	50,176	288,170	13,366	110,083	487	123,936	412,106
1976	1,964	276,387	28,148	51,206	357,705	10,846	114,715	684	126,245	483,950
1977	3,049	294,522	40,122	66,420	404,113	7,218	77,228	1,968	86,414	490,527
1978	3,265	331,146	42,186	73,621	450,218	5,603	162,915	1,369	169,887	620,105
1979	2,286	283,460	65,124	60,438	411,308	5,931	124,673	1,446	132,050	543,358
1980	651	332,399	82,536	42,864	458,450	5,040	123,687	1,963	130,690	589,140
1981	857	296,445	94,931	48,300	440,533	5,780	112,948	906	119,634	560,167
1982	1,120	262,304	174,693	53,082	491,199	3,676	94,681	429	98,786	589,985
1983	2,226	300,307	324,603	56,870	684,006	4,112	53,150	903	58,165	742,171
1984	893	379,917	327,058	44,284	752,152	2,770	56,948	857	60,575	812,727
1985	1,104	250,700	309,469	43,627	604,900	918	48,375	200	49,493	654,393
1986	1,427	338,822	369,609	49,139	758,997	1,939	61,486	169	63,594	822,591
1987	2,317	262,471	373,746	47,932	686,466	2,230	59,941	197	62,368	748,834
1988	1,915	297,460	488,903	49,258	837,536	4,278	80,445	663	85,386	922,922
1989	2,510	286,781	473,926	48,570	811,787	2,892	88,468	1,033	92,393	904,180
1990	1,292	225,526	606,677	60,827	894,322	835	69,927	1,883	72,645	966,967
1991	1,541	289,210	775,319	65,499	1,131,570	1,670	59,707	1,900	63,277	1,194,847
1992	1,063	228,655	706,587	76,136	1,012,441	1,860	81,026	1,092	83,978	1,096,419
1993	940	270,121	580,666	55,734	907,461	3,633	81,500	2,256	87,389	994,850
1994	1,793	220,319	720,028	48,206	990,345	3,110	71,449	898	75,457	1,065,802
1995	1,390	271,261	722,658	60,514	1,055,823	5,237	130,974	2,038	138,249	1,194,072
1996	1,112	233,502	747,263	57,194	1,039,071	2,583	108,444	1,328	112,355	1,151,426
1997	1,408	225,616	648,946	77,919	953,889	3,292	158,214	67	161,573	1,115,462
1998	1,654	224,672	902,302	77,868	1,206,496	1,627	139,930	140	141,697	1,348,193

Table 4. Total catches of yellowfin in the Pacific Ocean. Symbols: '…' = missing data; '–' = no effort, hence no catch. Refer to WP SWG–2 for more information on purse seine yellowfin/bigeye estimates.

YEAR	WCPO					EPO						TOTAL
	LONGLINE	POLE-AND-LINE	PURSE SEINE	OTHER	SUB-TOTAL	LONGLINE	POLE-AND-LINE	PURSE SEINE	TROLL	OTHER	SUB-TOTAL	
1950	...	...	...	8,919	...	-	65,921	15,856	-	879	82,656	...
1951	...	...	938	10,415	...	-	65,499	6,598	-	727	72,823	...
1952	...	...	2,565	10,539	...	-	66,108	13,735	-	1,067	80,910	...
1953	...	...	1,260	10,871	...	-	43,920	16,121	-	-	60,041	...
1954	...	...	4,001	11,763	...	-	46,541	7,625	-	-	54,166	...
1955	...	...	2,944	12,633	...	665	50,811	13,086	...	...	64,562	...
1956	...	...	724	12,818	...	1,578	58,828	21,470	...	...	81,876	...
1957	...	...	1,496	13,481	...	9,365	58,402	15,544	...	...	83,311	...
1958	...	...	3,338	14,682	...	7,803	46,776	20,560	...	...	75,139	...
1959	...	...	4,316	15,673	...	4,497	30,053	28,126	...	...	62,676	...
1960	...	...	1,438	15,919	...	7,629	26,199	79,976	...	...	113,804	...
1961	...	...	2,777	17,044	...	16,640	16,762	84,897	-	984	119,283	...
1962	52,245	...	6,975	18,150	77,370	14,118	11,855	59,597	-	-	85,570	162,940
1963	50,257	...	2,277	18,676	71,210	22,941	7,678	53,624	-	726	84,969	156,179
1964	42,164	141	3,647	20,183	66,135	20,002	4,327	83,547	-	776	108,652	174,787
1965	41,896	173	3,752	20,958	66,779	18,315	7,417	71,160	-	321	97,213	163,992
1966	56,217	71	5,844	23,409	85,541	10,906	5,852	74,228	-	531	91,517	177,058
1967	28,568	52	3,395	26,303	58,318	11,065	5,214	73,188	-	1,557	91,024	149,342
1968	34,652	17	6,888	26,084	67,641	16,188	4,698	93,942	-	3,376	118,204	185,845
1969	41,113	262	3,857	26,609	71,841	17,837	7,560	119,322	12	1,964	146,695	218,536
1970	53,080	209	9,299	29,473	92,061	13,859	4,688	145,867	33	5,038	169,485	261,546
1971	49,674	473	10,847	31,379	92,373	7,790	5,469	114,416	343	2,611	130,629	223,002
1972	51,090	7,455	11,765	35,938	106,248	15,944	6,149	169,467	422	1,090	193,072	299,320
1973	56,828	7,447	16,900	41,964	123,139	12,570	4,355	200,204	19	675	217,823	340,962
1974	54,102	6,582	19,574	47,367	127,625	9,793	8,659	200,451	6	1,248	220,157	347,782
1975	60,554	7,796	15,209	49,188	132,747	13,205	6,114	195,442	5	581	215,347	348,094
1976	70,735	17,152	16,826	41,351	146,064	15,698	3,688	232,266	5	368	252,025	398,089
1977	87,974	15,253	18,509	55,827	177,563	12,279	2,093	196,427	21	276	211,096	388,659
1978	109,384	12,764	13,863	39,189	175,200	10,507	4,172	175,747	123	492	191,041	366,241
1979	104,950	11,461	31,362	47,238	195,011	10,209	5,191	184,236	13	234	199,883	394,894
1980	117,423	13,130	35,614	43,148	209,315	12,952	1,649	156,878	15	883	172,377	381,692
1981	92,541	19,322	62,877	49,979	224,719	8,346	1,595	179,371	5	842	190,159	414,878
1982	83,824	13,838	73,542	47,115	218,319	9,664	1,605	123,272	16	190	134,747	353,066
1983	83,588	13,342	106,103	49,827	252,860	10,208	4,271	88,779	18	1,188	104,464	357,324
1984	69,752	13,617	109,681	52,675	245,725	10,365	3,090	141,635	8	328	155,426	401,151
1985	73,558	17,995	105,367	60,259	257,179	12,481	1,081	215,610	-	301	229,473	486,652
1986	62,079	12,867	104,719	64,425	244,090	22,292	2,519	265,473	-	282	290,566	534,656
1987	73,999	14,825	156,648	57,883	303,355	19,213	5,110	266,800	-	336	291,459	594,814
1988	81,080	13,600	99,244	64,963	258,887	13,354	3,743	283,318	25	948	301,388	560,275
1989	64,024	14,521	164,335	68,911	311,791	17,072	4,189	284,621	2	563	306,447	618,238
1990	72,277	14,269	175,239	89,253	351,038	30,669	2,664	268,871	-	1,751	303,955	654,993
1991	59,421	13,014	211,038	100,603	384,076	26,135	2,909	234,974	-	1,069	265,087	649,163
1992	68,990	15,747	240,852	67,118	392,707	16,333	3,885	232,811	-	3,153	256,182	648,889
1993	64,372	14,385	243,108	71,194	393,059	19,031	5,089	223,519	-	3,463	251,102	644,161
1994	67,241	14,614	223,584	83,929	389,368	22,919	3,755	213,177	-	1,455	241,306	630,674
1995	73,352	16,858	185,745	100,109	376,064	15,331	1,284	220,486	-	2,047	239,148	615,212
1996	81,280	17,432	123,254	108,753	330,719	12,974	3,733	245,313	-	1,056	263,076	593,795
1997	75,267	14,610	259,606	110,423	459,906	(12,974)	4,386	252,244	-	27	269,631	729,537
1998	66,099	14,222	255,640	110,355	446,316	(12,974)	5,173	258,958	-	236	277,341	723,657

Table 5. Total catches of albacore, bigeye, skipjack and yellowfin in the WCPO. Symbols: '…' = missing data

YEAR	ALBACORE		BIGEYE		SKIPJACK		YELLOWFIN		TOTAL
	MT	%	MT	%	MT	%	MT	%	
1950	68,910		...		...		...		...
1951	68,910		...		106,564		...		...
1952	69,135		...		92,248		...		...
1953	61,852		...		80,321		...		...
1954	58,680		...		104,161		...		...
1955	49,289		...		108,094		...		...
1956	64,512		...		107,189		...		...
1957	79,556		...		106,924		...		...
1958	59,456		...		157,383		...		...
1959	48,179		...		177,241		...		...
1960	64,903		...		89,938		...		...
1961	60,100		...		156,736		...		...
1962	52,163	15	34,206	10	181,620	53	77,370	22	345,359
1963	59,373	20	40,727	14	122,703	42	71,210	24	294,013
1964	56,838	17	29,316	9	182,909	55	66,135	20	335,198
1965	77,726	24	28,318	9	155,204	47	66,779	20	328,027
1966	84,313	19	30,761	7	249,458	55	85,541	19	450,073
1967	93,459	24	30,353	8	204,664	53	58,318	15	386,794
1968	68,101	19	23,528	7	194,755	55	67,641	19	354,025
1969	76,454	20	28,904	8	202,515	53	71,841	19	379,714
1970	70,736	16	37,533	8	242,082	55	92,061	21	442,412
1971	98,570	22	38,596	8	226,371	50	92,373	20	455,910
1972	111,227	22	51,453	10	234,373	47	106,248	21	503,301
1973	121,358	20	42,025	7	326,488	53	123,139	20	613,010
1974	114,901	18	46,176	7	355,227	55	127,625	20	643,929
1975	89,241	16	60,369	11	288,170	51	132,747	23	570,527
1976	126,722	18	73,386	10	357,705	51	146,064	21	703,877
1977	76,745	10	73,483	10	404,113	55	177,563	24	731,904
1978	106,485	13	58,117	7	450,218	57	175,200	22	790,020
1979	88,796	12	65,874	9	411,308	54	195,011	26	760,989
1980	94,648	11	62,599	8	458,450	56	209,315	25	825,012
1981	79,690	10	53,079	7	440,533	55	224,719	28	798,021
1982	84,366	10	58,739	7	491,199	58	218,319	26	852,623
1983	64,407	6	59,611	6	684,006	64	252,860	24	1,060,884
1984	74,461	7	63,366	6	752,152	66	245,725	22	1,135,704
1985	74,558	7	68,826	7	604,900	60	257,179	26	1,005,463
1986	68,728	6	63,341	6	758,997	67	244,090	22	1,135,156
1987	66,696	6	80,736	7	686,466	60	303,355	27	1,137,253
1988	70,305	6	68,036	6	837,536	68	258,887	21	1,234,763
1989	90,993	7	75,251	6	811,787	63	311,791	24	1,289,822
1990	81,370	6	91,687	6	894,322	63	351,038	25	1,418,417
1991	55,891	3	76,833	5	1,131,570	69	384,076	23	1,648,370
1992	72,498	5	91,536	6	1,012,441	65	392,707	25	1,569,182
1993	72,573	5	81,080	6	907,461	62	393,059	27	1,454,173
1994	92,828	6	87,539	6	990,345	63	389,368	25	1,560,080
1995	88,615	6	81,327	5	1,055,823	66	376,064	23	1,601,829
1996	97,611	6	85,365	5	1,039,071	67	330,719	21	1,552,766
1997	99,599	6	108,285	7	953,889	59	459,906	28	1,621,679
1998	102,350	6	102,000	5	1,206,496	65	446,316	24	1,857,163

Table 6. Total catches of albacore, bigeye, skipjack and yellowfin in the WCPO, by gear type. Symbols: '…' = missing data

YEAR	LONGLINE		POLE-AND-LINE		PURSE SEINE		OTHER		TOTAL
	MT	%	MT	%	MT	%	MT	%	
1950	...		...		...		15,793		...
1951	...		138,000		2,685		19,408		...
1952	...		120,304		6,281		21,014		...
1953	...		98,467		4,631		22,603		...
1954	...		116,142		8,535		23,378		...
1955	...		116,760		5,850		25,441		...
1956	...		134,760		2,869		25,985		...
1957	...		141,656		4,309		25,678		...
1958	...		153,616		14,036		30,132		...
1959	...		159,699		21,257		30,805		...
1960	...		95,629		5,166		31,782		...
1961	...		145,647		14,470		35,355		...
1962	129,640	38	161,116	47	18,649	5	35,954	10	345,359
1963	123,639	42	121,193	41	11,869	4	37,312	13	294,013
1964	104,010	31	161,105	48	28,711	9	41,372	12	335,198
1965	106,302	32	171,597	52	8,422	3	41,706	13	328,027
1966	147,721	33	238,501	53	16,812	4	47,039	10	450,073
1967	121,124	31	199,379	52	14,349	4	51,942	13	386,794
1968	107,266	30	178,993	51	14,373	4	53,393	15	354,025
1969	110,998	29	200,453	53	8,257	2	60,006	16	379,714
1970	133,241	30	222,558	50	20,611	5	66,002	15	442,412
1971	127,881	28	234,716	51	26,711	6	66,602	15	455,910
1972	142,988	28	241,566	48	32,321	6	86,426	17	503,301
1973	141,552	23	331,616	54	39,525	6	100,317	16	613,010
1974	132,789	21	370,365	58	35,705	6	105,070	16	643,929
1975	150,053	26	279,302	49	34,774	6	106,398	19	570,527
1976	175,695	25	382,398	54	46,286	7	99,498	14	703,877
1977	196,258	27	345,134	47	60,218	8	130,294	18	731,904
1978	199,600	25	407,221	52	57,195	7	126,004	16	790,020
1979	200,295	26	342,405	45	98,519	13	119,770	16	760,989
1980	211,113	26	395,016	48	120,312	15	98,571	12	825,012
1981	171,438	21	346,545	43	162,123	20	117,915	15	798,021
1982	163,796	19	310,291	36	253,385	30	125,151	15	852,623
1983	158,738	15	339,411	32	440,094	41	122,641	12	1,060,884
1984	143,942	13	424,044	37	445,295	39	122,423	11	1,135,704
1985	156,696	16	295,233	29	422,147	42	131,387	13	1,005,463
1986	146,745	13	371,082	33	481,837	42	135,492	12	1,135,156
1987	169,325	15	299,673	26	541,789	48	126,466	11	1,137,253
1988	169,253	14	321,986	26	595,452	48	148,073	12	1,234,763
1989	149,057	12	314,257	24	650,912	50	175,596	14	1,289,822
1990	173,823	12	252,310	18	794,059	56	198,225	14	1,418,417
1991	141,307	9	311,236	19	999,768	61	196,058	12	1,648,370
1992	168,882	11	259,982	17	966,823	62	173,495	11	1,569,182
1993	171,091	12	299,680	21	838,060	58	145,342	10	1,454,173
1994	188,404	12	264,131	17	954,790	61	152,756	10	1,560,080
1995	179,755	11	312,907	20	922,504	58	186,663	12	1,601,829
1996	187,766	12	278,178	18	888,786	57	198,036	13	1,552,766
1997	200,046	12	267,315	16	939,284	58	215,034	13	1,621,679
1998	199,037	11	265,990	14	1,177,534	63	214,602	12	1,857,163

Table 7. Total catches of albacore, bigeye, skipjack and yellowfin in the EPO. Symbols: '…' = missing data

YEAR	ALBACORE		BIGEYE		SKIPJACK		YELLOWFIN		TOTAL
	MT	%	MT	%	MT	%	MT	%	
1950	34,119		...		56,574	33	82,656	48	173,349
1951	17,002		...		52,516	37	72,823	51	142,341
1952	25,216	17	...		38,435	27	80,910	56	144,561
1953	15,757	12	...		55,983	42	60,041	46	131,781
1954	12,393	9	...		69,741	51	54,166	40	136,300
1955	13,841	10	...		58,062	43	64,562	47	136,465
1956	19,233	11	...		68,175	40	81,876	48	169,284
1957	21,469	13	...		55,297	35	83,311	52	160,077
1958	14,903	9	...		73,098	45	75,139	46	163,140
1959	20,995	13	...		78,996	49	62,676	39	162,667
1960	20,661	11	...		46,741	26	113,804	63	181,206
1961	16,253	8	...		68,495	34	119,283	58	204,031
1962	30,328	13	44,528	19	68,759	30	85,570	37	229,185
1963	40,651	14	65,375	23	95,696	33	84,969	30	286,691
1964	28,515	12	45,468	19	59,334	25	108,652	45	241,969
1965	21,408	9	28,717	13	78,382	35	97,213	43	225,720
1966	21,230	10	34,366	17	60,660	29	91,517	44	207,773
1967	30,277	11	36,699	13	120,739	43	91,024	33	278,739
1968	30,935	12	36,775	14	71,266	28	118,204	46	257,180
1969	24,224	9	51,514	18	59,233	21	146,695	52	281,666
1970	31,057	11	33,830	12	56,130	19	169,485	58	290,502
1971	29,039	10	32,253	11	104,823	35	130,629	44	296,744
1972	32,433	11	38,036	13	33,585	11	193,072	65	297,126
1973	24,199	7	54,362	16	44,095	13	217,823	64	340,479
1974	32,023	9	37,163	10	78,866	21	220,157	60	368,209
1975	27,388	7	46,271	11	123,936	30	215,347	52	412,942
1976	22,992	5	61,152	13	126,245	27	252,025	55	462,414
1977	22,012	6	78,094	20	86,414	22	211,096	53	397,616
1978	29,370	6	82,336	17	169,887	36	191,041	40	472,634
1979	12,091	3	63,581	16	132,050	32	199,883	49	407,605
1980	13,279	3	73,463	19	130,690	34	172,377	44	389,809
1981	26,656	7	58,529	15	119,634	30	190,159	48	394,978
1982	15,180	5	48,022	16	98,786	33	134,747	45	296,735
1983	16,035	6	80,965	31	58,165	22	104,464	40	259,629
1984	17,369	6	72,504	24	60,575	20	155,426	51	305,874
1985	16,333	4	75,263	20	49,493	13	229,473	62	370,562
1986	13,501	3	109,390	23	63,594	13	290,566	61	477,051
1987	11,956	3	103,184	22	62,368	13	291,459	62	468,967
1988	15,275	3	61,687	13	85,386	18	301,388	65	463,736
1989	7,360	2	66,112	14	92,393	20	306,447	65	472,312
1990	9,301	2	87,333	18	72,645	15	303,955	64	473,234
1991	9,547	2	83,170	20	63,277	15	265,087	63	421,081
1992	20,585	5	70,261	16	83,978	19	256,182	59	431,006
1993	17,259	4	72,443	17	87,389	20	251,102	59	428,193
1994	19,890	5	82,698	20	75,457	18	241,306	58	419,351
1995	11,420	2	78,365	17	138,249	30	239,148	51	467,182
1996	11,942	3	90,286	19	112,355	24	263,076	55	477,659
1997	11,706	2	90,326	17	161,573	30	269,631	51	533,236
1998	14,932	3	73,646	15	141,697	28	277,341	55	507,616

Table 8. Total catches of albacore, bigeye, skipjack and yellowfin in the Pacific Ocean. Symbols: '…' = missing data

YEAR	ALBACORE		BIGEYE		SKIPJACK		YELLOWFIN		TOTAL
	MT	%	MT	%	MT	%	MT	%	
1950	103,029		...		...		...		...
1951	85,912		...		159,080		...		...
1952	94,351		...		130,683		...		...
1953	77,609		...		136,304		...		...
1954	71,073		...		173,902		...		...
1955	63,130		...		166,156		...		...
1956	83,745		...		175,364		...		...
1957	101,025		...		162,221		...		...
1958	74,359		...		230,481		...		...
1959	69,174		...		256,237		...		...
1960	85,564		...		136,679		...		...
1961	76,353		...		225,231		...		...
1962	82,491	14	78,734	14	250,379	44	162,940	28	574,544
1963	100,024	17	106,102	18	218,399	38	156,179	27	580,704
1964	85,353	15	74,784	13	242,243	42	174,787	30	577,167
1965	99,134	18	57,035	10	233,586	42	163,992	30	553,747
1966	105,543	16	65,127	10	310,118	47	177,058	27	657,846
1967	123,736	19	67,052	10	325,403	49	149,342	22	665,533
1968	99,036	16	60,303	10	266,021	44	185,845	30	611,205
1969	100,678	15	80,418	12	261,748	40	218,536	33	661,380
1970	101,793	14	71,363	10	298,212	41	261,546	36	732,914
1971	127,609	17	70,849	9	331,194	44	223,002	30	752,654
1972	143,660	18	89,489	11	267,958	33	299,320	37	800,427
1973	145,557	15	96,387	10	370,583	39	340,962	36	953,489
1974	146,924	15	83,339	8	434,093	43	347,782	34	1,012,138
1975	116,629	12	106,640	11	412,106	42	348,094	35	983,469
1976	149,714	13	134,538	12	483,950	41	398,089	34	1,166,291
1977	98,757	9	151,577	13	490,527	43	388,659	34	1,129,520
1978	135,855	11	140,453	11	620,105	49	366,241	29	1,262,654
1979	100,887	9	129,455	11	543,358	46	394,894	34	1,168,594
1980	107,927	9	136,062	11	589,140	48	381,692	31	1,214,821
1981	106,346	9	111,608	9	560,167	47	414,878	35	1,192,999
1982	99,546	9	106,761	9	589,985	51	353,066	31	1,149,358
1983	80,442	6	140,576	11	742,171	56	357,324	27	1,320,513
1984	91,830	6	135,870	9	812,727	56	401,151	28	1,441,578
1985	90,891	7	144,089	10	654,393	48	486,652	35	1,376,025
1986	82,229	5	172,731	11	822,591	51	534,656	33	1,612,207
1987	78,652	5	183,920	11	748,834	47	594,814	37	1,606,220
1988	85,580	5	129,723	8	922,922	54	560,275	33	1,698,499
1989	98,353	6	141,363	8	904,180	51	618,238	35	1,762,134
1990	90,671	5	179,020	9	966,967	51	654,993	35	1,891,651
1991	65,438	3	160,003	8	1,194,847	58	649,163	31	2,069,451
1992	93,083	5	161,797	8	1,096,419	55	648,889	32	2,000,188
1993	89,832	5	153,523	8	994,850	53	644,161	34	1,882,366
1994	112,718	6	170,237	9	1,065,802	54	630,674	32	1,979,431
1995	100,035	5	159,692	8	1,194,072	58	615,212	30	2,069,011
1996	109,553	5	175,651	9	1,151,426	57	593,795	29	2,030,425
1997	111,305	5	198,611	9	1,115,462	52	729,537	34	2,154,915
1998	117,282	5	175,646	7	1,348,193	57	723,657	31	2,364,779

Table 9. Catches of albacore, bigeye, skipjack and yellowfin by ocean area. Symbols: '…' = missing data; estimates in parentheses have been carried over from previous years

YEAR	WCPO		EPO		ATLANTIC		INDIAN		TOTAL
	MT	%	MT	%	MT	%	MT	%	
1950	...		173,349		42,335		14,300		...
1951	...		142,341		37,617		8,200		...
1952	...		144,561		39,012		23,297		...
1953	...		131,781		38,735		26,252		...
1954	...		136,300		48,408		37,791		...
1955	...		136,465		43,120		52,683		...
1956	...		169,284		52,942		69,017		...
1957	...		160,077		77,396		56,263		...
1958	...		163,140		100,474		50,930		...
1959	...		162,667		122,384		55,265		...
1960	...		181,206		145,384		67,764		...
1961	...		204,031		135,231		73,568		...
1962	345,359	41	229,185	27	169,697	20	89,736	11	833,977
1963	294,013	36	286,691	35	188,374	23	57,268	7	826,346
1964	335,198	39	241,969	28	201,987	24	75,522	9	854,676
1965	328,027	38	225,720	26	222,254	26	77,664	9	853,665
1966	450,073	48	207,773	22	181,817	19	101,738	11	941,401
1967	386,794	39	278,739	28	184,929	19	129,351	13	979,813
1968	354,025	35	257,180	26	228,018	23	167,848	17	1,007,071
1969	379,714	36	281,666	27	236,693	23	147,218	14	1,045,291
1970	442,412	41	290,502	27	237,191	22	119,394	11	1,089,499
1971	455,910	39	296,744	26	290,960	25	120,023	10	1,163,637
1972	503,301	41	297,126	24	301,937	25	115,327	9	1,217,691
1973	613,010	45	340,479	25	306,180	22	116,608	8	1,376,277
1974	643,929	42	368,209	24	360,996	24	151,196	10	1,524,330
1975	570,527	40	412,942	29	301,679	21	130,049	9	1,415,197
1976	703,877	44	462,414	29	316,953	20	125,598	8	1,608,842
1977	731,904	44	397,616	24	372,569	23	145,924	9	1,648,013
1978	790,020	44	472,634	26	368,658	21	154,537	9	1,785,849
1979	760,989	46	407,605	25	338,014	21	137,006	8	1,643,614
1980	825,012	48	389,809	23	368,224	21	136,732	8	1,719,777
1981	798,021	46	394,978	23	413,241	24	141,990	8	1,748,230
1982	852,623	48	296,735	17	465,834	26	178,740	10	1,793,932
1983	1,060,884	55	259,629	13	423,898	22	198,156	10	1,942,567
1984	1,135,704	55	305,874	15	366,981	18	263,098	13	2,071,657
1985	1,005,463	48	370,562	18	419,412	20	304,069	14	2,099,506
1986	1,135,156	48	477,051	20	405,452	17	349,862	15	2,367,521
1987	1,137,253	48	468,967	20	384,235	16	391,785	16	2,382,240
1988	1,234,763	47	463,736	18	396,037	15	508,224	20	2,602,760
1989	1,289,822	48	472,312	18	404,828	15	529,269	20	2,696,231
1990	1,418,417	48	473,234	16	462,720	16	571,705	20	2,926,076
1991	1,648,370	53	421,081	13	500,908	16	565,479	18	3,135,838
1992	1,569,182	50	431,006	14	460,262	15	666,802	21	3,127,252
1993	1,454,173	46	428,193	14	519,932	16	756,806	24	3,159,104
1994	1,560,080	49	419,351	13	511,403	16	704,111	22	3,194,945
1995	1,601,829	49	467,182	14	483,606	15	716,871	22	3,269,488
1996	1,552,766	49	477,659	15	424,408	13	702,119	22	3,156,952
1997	1,621,679	50	533,236	16	416,558	13	(702,119)	21	3,273,592
1998	1,857,163	53	507,616	15	(416,558)	12	(702,119)	20	3,483,456

APPENDIX 1. AGENDA

1. Preliminaries
    1.1 Opening Address
    1.2 Confirmation of Chairman and Appointment of Rapporteurs
    1.3 Adoption of the Agenda
    1.4 Adoption of the Report of the Eleventh Meeting of the SCTB

2. Overview of Western and Central Pacific Ocean Tuna Fisheries
    2.1 Regional Overview
    2.2 National Tuna Fishery Reports
    2.3 Economic Condition of the Fishery

3. Reports by Organisations

4. Statistics Working Group
    4.1 Coordinator's report on data collection, compilation and dissemination
    4.2 Statistical area and sub-areas
    4.3 Factors affecting the proportion of bigeye in purse seine sets
    4.4 Estimates of annual catches
    4.5 Towards a regional sampling design for port sampling & observer programmes

5. Skipjack Research Group
    5.1 Regional Fishery Developments
    5.2 Biological and Ecological Research, and ENSO Update
    5.3 Stock Assessment
    5.4 Research Coordination and Planning

6. Albacore Research Group
    6.1 Regional Fishery Developments
    6.2 Biological and Ecological Research
    6.3 Stock Assessment
    6.4 Research Coordination and Planning

7. Yellowfin Research Group
    7.1 Regional Fishery Developments
    7.2 Biological and Ecological Research
    7.3 Stock Assessment
    7.4 Research Coordination and Planning

8. Bigeye Research Group
    8.1 Regional Fishery Developments
    8.2 Biological and Ecological Research
    8.3 Stock Assessment
    8.4 Research Coordination and Planning

9. Billfish and Bycatch Research Group
    9.1 Introduction

9.2 Issues Concerning the BBRG
9.3 Review of Monitoring, Research and Assessment
9.4 Approaches to Assessing the Status of Billfish and Bycatch
9.5 Summary of Work Plan and Action Items

10. Discussion on MHLC

11. Other Business

12. Close

APPENDIX 2. LIST OF WORKING PAPERS

Information Reports

Anonymous. **Report of the Eleventh Meeting of the Standing Committee on Tuna and Billfish, 28 May–6 June 1998, Honolulu, Hawaii, USA.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia. 107 pp.

Anonymous. **Report of the Third Meeting of the Tuna Fishery Data Collection Forms Committee, 9–10 December 1998, Brisbane, Australia.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia, and Forum Fisheries Agency, Honiara, Solomon Islands.

Overview of Western and Central Pacific Ocean Tuna Fisheries

GEN–1 Lewis A.D. & P.G. Williams. **Overview of the western and central Pacific Ocean tuna fisheries.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

GEN–2 Anonymous. **Economic overview of tuna fishery – 1998.** Forum Fisheries Agency. Honiara. Solomon Islands.

Statistics Working Group

SWG–1 Lawson, T. **Status of data collection, compilation and dissemination.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

SWG–2 Lawson, T. **Estimates of annual catches of target species in tuna fisheries of the western and central Pacific Ocean.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

SWG–3 Bigelow, K. **Estimating bigeye composition in the purse seine fishery.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

SWG–4 Coan, A. & N. Miyabe. **Comparisons of areas fished by the Japanese and U.S. purse seine fleets in the central-western Pacific.** National Marine Fisheries Service (NMFS) & National Research Institute of Far Seas Fisheries.

SWG–5 Lawson, T. **Proposed minimum standards for tuna fishery catch and effort logsheets**. Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

Research Groups

General

RG–1 Bertignac, M. **Estimating some potential interactions between fleets in the tuna fisheries of the western and central Pacific using a multi-gear, multi-species and age-structured simulation model: a preliminary account.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

RG–2 Bach, P., L. Dagorn & C. Misselis**. Species selectivity factors in longline fisheries : Results from experiments in the Society archipelago.** Institut de la recherche pour le développement (IRD), Tahiti, French Polynesia.

RG–3 Sun, C-L & S.-Z. Yeh**. Standardised catch rates of yellowfin and bigeye tunas from the Taiwanese tuna fisheries in the western Pacific.** Institute of Oceanography, National Taiwan University, Taipei, Taiwan.

RG–4 Matsumoto, T., N. Miyabe & K. Ikehara. **Fishery Indicators from the Japanese Tuna Fisheries in the Western Central Pacific, as of 1998.** National Research Institute of Far Seas Fisheries, Japan.

RG–5 Hwang S.-J., Y.-C. Park & D.-Y. Moon. **Scientific Observations for Korean Tuna Purse Seine Fishery in the Western and Central Pacific Ocean**. National Fisheries Research and Development Institute (NFRDI), Pusan, Republic of Korea.

RG–6 Moon, D.-Y., S.-J. Hwang & Y.-C. Park. **Effect of different longline materials on catch rates of the species caught by Korean tuna longliners in the Pacific Ocean**. National Fisheries Research and Development Institute (NFRDI), Pusan, Republic of Korea.

Skipjack

SKJ–1 Lehodey, P. **Impact of ENSO on surface tuna habitat in the western and central Pacific Ocean.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

SKJ–2 Tanabe, T, M. Ogura & Moi Takahashi. **An investigation on early life of skipjack tuna, *Katsuwonus pelamis*, based on the survey cruises off Palau and Micronesia, 1992–1996.** Western Pacific Tuna and Skipjack Division, National Research Institute of Far Seas Fisheries, Japan

SKJ–3 Ogura M., T. Tanabe & M. Takahashi. **Note on the distribution and size information of pelagic species, excluding skipjack and tunas, caught by the mid-water trawl net in the tropical waters of the Western Pacific.** National Research Institute of Far Seas Fisheries, Japan

SKJ–4 Ogura, M. & Hiroshi Shono. **Factors affecting the fishing effort of the Japanese distant water pole and line vessel and the standardization of that skipjack CPUE**. National Research Institute of Far Seas Fisheries, Japan

SKJ–5 Mark Maunder. **A completely length-based and spatially-structured model for fisheries stock assessment, with application to the eastern Pacific Ocean skipjack (*Katsuwonus pelamis*) population (ABSTRACT ONLY)**. Inter–American Tropical Tuna Commission (IATTC).

Yellowfin

YFT–1 Hampton, J. & D. Fournier. **Updated analysis of yellowfin tuna catch, effort, size and tagging data using an integrated, length-based, age-structured model.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

YFT–2 Lehodey, P. & B. Leroy. **Age and growth of yellowfin tuna (*Thunnus albacares*) from the western and central Pacific Ocean as indicated by daily growth increments and tagging data.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

YFT–3 Bigelow, K. A., J. Hampton, & N. Miyabe. **Effective longline effort within the yellowfin habitat and standardized CPUE.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia and National Research Institute of Far Seas Fisheries, Japan.

YFT–4 Bertrand, A. & E. Josse**. Acoustic estimation of longline tuna abundance.** Institut de Recherche pour le Développement, Plouzané, France.

YFT–5 O'Brien, C. & T. Murray. **Sustainable management of highly migratory species in the western central Pacific Ocean: The New Zealand experience at setting total allowable catch.** National Institute of Water and Atmospheric Research, New Zealand.

Bigeye

BET–1 Bigelow, K. A., J. Hampton, & N. Miyabe. **Effective longline effort within the bigeye habitat and standardized CPUE.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia and National Research Institute of Far Seas Fisheries, Japan.

BET–2 Lehodey, P., J. Hampton & B. Leroy. **Preliminary results on age and growth of bigeye tuna (*Thunnus obesus*) from the western and central Pacific Ocean as indicated by daily growth increments and tagging data.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

BET–3 Sun, C.-L, C.-L. Huang & S.-Z. Yeh. **Age and growth of the bigeye tuna *Thunnus obesus* in the western Pacific Ocean**. Institute of Oceanography, National Taiwan University, Taipei Taiwan.

BET–4 Sun, C.-L., S.-L. Chu & S.-Z. Yeh. **Note on the reproduction of bigeye tuna in the western Pacific.** Institute of Oceanography, National Taiwan University, Taipei Taiwan.

BET–5 Sibert J. **Bigeye Tuna: Five-Year Research Plan. A Prospectus for Coordinated International Research.** Pelagic Fisheries Research Program, Joint Institute for Marine and Atmospheric Research, University of Hawaii, Honolulu, Hawaii, USA.

BET–6 Hampton, J., M. Maunder, N. Miyabe, and G. Watters. **Report of the bigeye tuna modelling workshop.** Oceanic Fisheries Programme, Secretariat of the Pacific Community. Inter-American Tropical Tuna Commission. National Research Institute of Far Seas Fisheries.

Albacore

ALB–1 Wang, C.-H. **Evaluations of current status of south Pacific albacore (*Thunnus alalunga*) stock**. Institute of Oceanography, National Taiwan University, Taipei Taiwan.

ALB–2 Au, D.W. & Daniel R. Cayan. **North Pacific Albacore Catches and Decadal–Scale Climatic Shifts**. National Marine Fisheries Service & Scripps Institution of Oceanography.

ALB–3 Childers, J. & Norman Bartoo. **Overview of the U.S. south Pacific Albacore Troll Fishery**. National Marine Fisheries Service.

Billfish and Bycatch

BBRG–1 Campbell, R., J. Pepperell & T. Davis. **Analysis of historical Charter Boat data to assess black marlin strike rates in the recreational fishery off northern Queensland, Australia**. Division of Marine Research, Commonwealth Scientific and Industrial Research Organisation, Hobart, Australia.

BBRG–2 Williams, P.G., K.A. Bigelow & A.W. Whitelaw. **Estimates of longline billfish catch in the western and central Pacific Ocean (1980–1997).** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

BBRG–3 Whitelaw, A.W. **Interactive session on billfish: present knowledge - current and future research - priorities.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

BBRG–4 Whitelaw, A.W. **Collaborative gamefish data collection.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

BBRG–5 Punt, A., R. Campbell & T. Smith. **Evaluation of performance indicators in the broadbill swordfish fishery off eastern Australia - a preliminary study**. Division of Marine Research, Commonwealth Scientific and Industrial Research Organisation, Hobart, Australia.

BBRG–6 Uozumi, Y. **Review of problems on stock assessment of marlins. Laying stress on the coverage of landing and catch and effort information in the Pacific Ocean**. National Research Institute of Far Seas Fisheries. Shimizu. Japan.

BBRG–7 Sun, C.-L., S.-P. Wang & S.-Z. Yeh. **Age and growth of the swordfish *Xiphias gladius* L. in the waters around Taiwan using anal fin spines.** Institute of Oceanography, National Taiwan University, Taipei, Taiwan..

BBRG–8 Misselis C., P. Bach, & S. Yen. **Bycatch from experimental longlining operations in French Polynesia.** Institut de la recherche pour le développement (IRD), Tahiti, French Polynesia.

BBRG–9 McCoy M., H. Ishihara & R. Clarke. **The socioeconomic importance of sharks in the U.S. flag areas of the western and central Pacific Ocean.** Gillett-Preston and Associates. Pacific Islands Area Office, Southwest Region, National Marine Fisheries Service.

BBRG–10 Oceanic Fisheries Programme. **An update on non-target, associated and dependent species (NADs).** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

BBRG–11 Labelle, M. **An operational model to evaluate assessment and management procedures for the north Pacific swordfish fishery. (ABSTRACT ONLY)** National Marine Fisheries Service, Honolulu, Hawaii.

BBRG–12 Ellacott, A. **Gathering useful and consistent data from gamefishing tournaments and clubs.** Tahiti International Billfish Association, Tahiti, French Polynesia.

MHLC

MHLC–1 Hampton, W.J. **The convention area.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

MHLC–2 Williams, P.G. **Species encountered in the western and central Pacific longline and purse-seine fisheries.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

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APPENDIX 4. OPENING ADDRESS BY THE MINISTER OF MARINE RESOURCES, FRENCH POLYNESIA

Ia Orana, Aloha, Welcome!

I would first like to thank you on behalf of the President of the Government of French Polynesia, Mr Gaston Flosse, for your participation in the 12th Meeting of the Standing Committee on Tuna and Billfish which has been organised in Tahiti. It is a great honour for French Polynesia to welcome you here at this time as over the past several years, our government has been putting a great deal of effort into developing a sector important to you all, i.e. the fishing sector.

Fisheries development in French Polynesia has been characterised by the formation of a fleet of semi-commercial offshore longline fishing vessels including *bonitier* (skipjack) boats (14 vessels) and tuna boats (40 vessels), modernisation of its coastal *poti marara* fishing fleet comprised of (more than 300 vessels) and providing training for the men and women working in this sector.

Thanks to the combined efforts of the Territory, the French government and economic stakeholders in our country, the fishing fleet has met the production objectives set for it. In 1998, catches from these vessels totalled 5,280 mt, i.e. an increase of 14% in comparison to 1997. White tuna catches in 1998 were particularly good and accounted for more than 60% of the total catch.

The average yield obtained in 1998 was 0.641 kg/hook in comparison to an average yield of 0.613 kg/hook in 1997. There was an increase in the average length of fishing trips for vessels targetting tuna for the frozen market–from 37 days at sea in 1997 to 60 days at sea in 1998. Finally, improved techniques by the fleet has also played a role in the good results obtained. Export levels remained at about 1,200 mt in 1998 as we experienced a significant increase in local consumption.

It should also be pointed out that implementation of HAACP procedures and upgrading to European standards has today allowed us to have a high-quality export product which has led to a demand of more than 4,000 tonnes in 1999.

In short, 1998 was a good year for longline fisheries in French Polynesia. I would like to invite you to take part in the visit to our shipping facilities on Friday, 18 June 1999. There you can judge for yourself the efforts which have been made.

We have not forgotten that all these efforts would be pointless if they were not accompanied by a better understanding of, and sustainable management systems for, the resources contained in our EEZ and in our neighbours' EEZs.

Finally, we have learned that your expertise will be put to use by the scientific committee of the commission which is to be created at the end of negotiations within the MHLC. We are delighted about this, as it is an indication of the quality and integrity of the work you have accomplished as part of MHLC. Your counsel will be vital to us during MHLC negotiations.

I wish you all a successful meeting and I will be pleased to meet you again when the time comes to sum up the work accomplished.

Thank you for your kind attention.

APPENDIX 5. MINIMUM STANDARDS FOR TUNA FISHERY CATCH & EFFORT LOGSHEETS

The following standards for tuna fishery catch and effort logsheets were determined at the SCTB Statistics Working Group Session on Data Collection Forms, held from 14 to 15 June 1999 in Papeete, French Polynesia, during the Twelfth Meeting of the Standing Committee on Tuna and Billfish.

The minimum standards are considered in the context of scientific research and the monitoring of catch and effort, and not in other contexts, such as management or surveillance. Hence, the minimum standards to be considered are not an exclusive set of data items to be included on logsheets. Other data items may be required for other purposes, but these are not considered here.

The data items are classified into two groups: “essential” and “desirable”. For the purposes here, “essential” data items are those that make up the set of minimum standards for the logsheet, while “desirable” data items are those not included in the minimum standard, but which may nevertheless be useful. The identification of a data item as either “essential” or “desirable” will be subjective, but the following approach may be appropriate.

“Essential” data items could be thought of as those which are the minimum necessary for (i) monitoring trends in catch and effort in tuna fisheries in the WCPO and (ii) assessing the stocks of tunas. In contrast, “desirable” data items could be considered as those in whose absence monitoring and assessment could still be carried out. Under these guidelines, the number of “essential” data items will be relatively small, while the number of “desirable” data items may be large.

VESSEL IDENTIFICATION

All gear types

The following items were considered to be *essential*:

Name of the vessel, country of registration, registration number: The registration number is the number assigned to the vessel in the country where the vessel is flagged. Each country has standard formats for registration numbers, which may include codes concerning the port of registration and the size class of the vessel. The SWG also considered the vessel’s Lloyds registration number; however, it was felt that it would not be suitable since (a) it is usually difficult to obtain and (b) many smaller vessels are not registered with Lloyds.

The following items were considered to be *desirable*:

International radio callsign, fishing permit or license number: The fishing permit or license number is the number assigned by the government of the country or territory in whose waters the vessel is fishing. The permit or license number is unique to each vessel and can be used for the purposes of vessel identification. It was noted that for purposes of vessel identification, the vessel name, country of registration and the international radio call sign could be considered equivalent to the vessel name, country of registration and the registration number.

Name of the fishing company that owns the vessel and name of the agent that represents the vessel in the port of unloading: These items may be useful in obtaining corrections or additional information concerning the data recorded on the logsheets.

VESSEL, GEAR AND TRIP ATTRIBUTES

All gear types

The following items were considered to be *essential*:

Port of departure, date of departure, port of unloading, date of arrival in port of unloading: These items can be used to cross-check the period covered by logsheet data and the period covered by landings data, such that landings data can be used to verify logsheet data.

The following items were considered to be desirable:

Time of departure, time of arrival: These items can be used to cross-check the period covered by logsheet data.

Longline

The following items were considered to be *essential*:

Gross registered tonnage: Monitoring of catch and effort is sometimes done separately for coastal, offshore and distant-water longline fleets. Vessel size is an important criterion in determining whether the vessel operates in coastal, offshore or distant-water areas. The SWG noted that GRT is calculated differently between nations. The SWG considered that a vessel's length could be considered equivalent to GRT, although it noted that length measurements are often subject to the similar problems of lack of standardisation.

Number of hooks between floats or number of hooks per basket: This measure is a proxy for average hook depth and, hence, is important in determining the effective effort for a given species. Actual baskets are rarely used nowadays; therefore "hooks between floats" may be preferred. The number of hooks between floats may vary within and between sets and so it was considered that more detail should be provided. However, (a) the number of hooks between floats reported for a given trip has been shown to be significant in determining effective effort, even though lacking in detail, and (b) it is perhaps more appropriate to obtain greater detail through observer programmes, rather than on logsheets completed by the crew.

The following items were considered to be *desirable*:

Length of mainline, number of floats or baskets, length of float line, length of branch line: These items can be used to determine the depth of hooks and, hence, effective effort.

Number of hooks per branch line, number of hooks per float: These items can be used to monitor fishing effort and targeting of sharks.

Mainline material, branchline material, presence of line shooter, engine power, rated speed of vessel, name of the captain or fishing master, reel capacity, number of reels, storage capacity: These items are related to fishing effort.

Storage method: Methods used to store the catch (i.e. ice, refrigerated sea water, air coil frozen, air blast frozen, brine frozen) can be used to determine whether the vessel operates in coastal, offshore or distant-water areas and, hence, can be useful for monitoring catch and effort.

Primary target species: This information can be used to interpret catches and catch rates and, hence, can be useful for monitoring catch and effort.

Pole-and-Line

The following item is proposed as *essential*:

Gross registered tonnage: See l*ongline* above.

The following items were considered to be *desirable*:

Number of crew, number of automatic poling devices, bait capacity, engine power, rated speed of vessel, presence of bird radar, name of the captain or fishing master, bait species, size of bait, number of poles, storage method: These items are related to fishing effort.

Purse Seine

The following item is proposed as *essential*:

Gross registered tonnage: See l*ongline* above.

The following items were considered to be *desirable*:

Net length, net depth, storage capacity, presence of helicopter, vessel engine power, skiff engine power, rated speed of vessel, name of the captain or fishing master: These items are related to fishing effort. (Additional information for vessels that engage in group seine operation may be needed; however, this was not considered.)

Amount of fish onboard at start of trip, amount of fish onboard after unloading: These items can be used to verify logsheet data with landings data.

Troll

The following item is proposed as *essential*:

Gross registered tonnage: See l*ongline* above.

The following items were considered to be *desirable*:

Number of lines, engine power, rated speed of vessel, storage capacity, source of sea surface temperature data, name of the captain, number of skiffs: These items are related to fishing effort. Sources of sea surface temperature data can include onboard thermometers; weather fax; and real-time satellite transmission

LONGLINE SETS

The following items were considered to be *essential*:

Date of set, time of set, position of set: The date and set time can be local time, ship's time or GMT/UTC, but must be consistent. The set time should refer to the start of setting the longline. The set position should be in at least minutes of latitude and longitude. The use of codes for areas depicted on maps of the fishing grounds, rather than the position in latitude and longitude, may also be appropriate for some fleets. The set position can refer to the start of set, the end of set, or the average position, but should be consistent.

Number of hooks set: This item is a measure of fishing effort.

Number of fish caught per set, by species, total weight or average weight of fish caught per set, by species: The instructions should indicate whether whole weights or processed weights should be used, and for which species, and should be in accordance with the usual practice by the fleet. For example, bigeye and yellowfin are usually gilled and gutted, while albacore are kept whole. All target species and major non-target, associated or dependent (NAD) species, should be recorded. The catch of fish that are discarded dead or in poor condition should also be recorded, in addition to all fish that are retained.

The following items were considered to be *desirable*:

Catch and discards of minor non-target, associated or dependent (NAD) species: These items will allow the estimation of total removals.

Activity: This item can be used to verify the completeness of the data. It should be recorded for each set and for days on which no sets were made. For days on which no sets were made, the date and noon position should also be recorded. Activities can include, for example, "a set"; "no fishing due to gear breakdown"; "no fishing due to bad weather"; "in transit"; "in port", etc.

End of set position, start of haul position, end of haul position (in addition to start of set position): These items can be used to correlate catch rates with oceanographic and bathymetric conditions.

End of set time, start of haul time, end of haul time (in addition to start of set time): These items can be used to determine soak times.

Bait species, use of dead or live bait: These items may affect catch rates.

Sea surface temperature and other oceanographic parameters: These items may affect catch rates.

POLE-AND-LINE DAYS FISHED

The following items were considered to be *essential*:

Activity: This item should be recorded for each day fished or searched and for days on which no fishing or searching took place. This item can be used to distinguish between days on which searching took place, but no fish were caught, and days on which no fishing or searching took place, and to verify the completeness of the data. Activities can include, for example, "a day fishing or searching with bait onboard"; "no fishing due to collecting bait"; "no fishing due to gear breakdown"; "no fishing due to bad weather"; "in transit"; "in port", etc.

Date, noon position: The date and noon position must be recorded for all days. The noon position should be in at least minutes of latitude and longitude.

Weight of fish caught per day, by species: All target species and major non-target, associated or dependent (NAD) species, should be recorded. The catch of fish that are discarded dead or in poor condition should also be recorded, in addition to all fish that are retained.

The following items were considered to be *desirable*:

Catch and discards of minor non-target, associated or dependent (NAD) species: These items will allow the estimation of total removals.

Amount of bait onboard, hours fished or searched, sighting method: These items are related to fishing effort.

Average weight of fish caught per day, by species: This item may be informative in the absence of sampling by observers or port samplers.

School association: The species composition of the catch and the size of individuals is related to the type of association. All common types of school association should be recorded with specific codes, while uncommon types of association should be recorded with a code for "other" together with instructions to explain the "other" association on the logsheet. Common types of school association may include "drifting log, debris or dead animal"; "drifting raft, FAD or payao"; "anchored raft, FAD or payao"; "live whale or whale shark"; and "free-swimming" or "unassociated" schools.

PURSE-SEINE SETS

The following items were considered to be *essential*:

Activity: This item should be recorded for each set and for days on which no sets were made. This item can be used to distinguish between days on which searching took place, but no fish were caught, and days on which no fishing or searching took place, and to verify the completeness of the data. Activities can include, for example, "a set"; "a day searched, but no sets made"; "no fishing due to gear breakdown"; "no fishing due to bad weather"; "in transit"; "in port", etc.

Date, position of set or noon position, time of set: If a set is made, then the date and position must refer to the set. If searching occurs, but no sets are made, then the date and noon position must be recorded. The date and set time can be local time, ship's time or UTC, but must be consistent. The set time should refer to the time that the skiff was put in the water. The set position should be in at least minutes of latitude and longitude.

School association: The species composition of the catch and the size of individuals is related to the type of association. All common types of school association should be recorded with specific codes, while uncommon types of association should be recorded with a code for "other" together with instructions to explain the "other" association on the logsheet. Common types of school association may include "drifting log, debris or dead animal"; "drifting raft, FAD or payao"; "anchored raft, FAD or payao"; "live whale or whale shark"; and "free-swimming" or "unassociated" schools.

Weight of fish caught per set, by species: All target species and major non-target, associated or dependent (NAD) species, should be recorded. The catch of fish that are discarded dead or in poor condition should also be recorded, in addition to all fish that are retained.

The following items were considered to be *desirable*:

Catch and discards of minor non-target, associated or dependent (NAD) species: These items will allow the estimation of total removals.

Well numbers: This item can be used by port samplers to select wells to sample. Port samplers prefer to sample wells containing fish from sets for which the date, position and school association are similar.

Average weight of fish caught per set, by species: This item may be informative in the absence of sampling by observers or port samplers.

Sea surface temperature and other oceanographic and meteorological measures, such as depth of the thermocline, and wind speed or Beaufort wind scale. These items can affect effort and catch rates.

TROLL DAYS FISHED

The following items were considered to be *essential*:

Activity: This item should be recorded for each day fished and for days on which no fishing took place. This item can be used to distinguish between days fished on which no fish were caught and days not fished, and to verify the completeness of the data. Activities can include, for example, “a day fished”; “no fishing due to gear breakdown”; “no fishing due to bad weather”; “in transit”; “in port”, etc.

Date, noon position: The date and noon position must be recorded for all days. The noon position should be in at least minutes of latitude and longitude.

Number of fish caught per day and average weight, by species: All target species and major non-target, associated or dependent (NAD) species, should be recorded. The catch of fish that are discarded dead or in poor condition should also be recorded, in addition to all fish that are retained.

The following items were considered to be *desirable*.

Catch and discards of minor non-target, associated or dependent (NAD) species: These items will allow the estimation of total removals.

Number of lines trolled by vessel, number of lines trolled by skiffs, hours fished: These items can be used to measure fishing effort.

School association: The species composition of the catch and the size of individuals is related to the type of association. All common types of school association should be recorded with specific codes, while uncommon types of association should be recorded with a code for “other” together with instructions to explain the “other” association on the logsheet. Common types of school association may include “drifting log, debris or dead animal”; “drifting raft, FAD or payao”; “anchored raft, FAD or payao”; “live whale or whale shark”; and “free-swimming” or “unassociated” schools.

Sea surface temperature, sea condition, wind speed and other meteorological conditions: These items can affect catch rates.

APPENDIX 6. REVIEW OF CATCH AND EFFORT LOGSHEETS OF THE NEW ZEALAND MINISTRY OF FISHERIES

Background

Prior to 1986 New Zealand used separate catch and effort forms for each gear/fishery; these forms were primarily to meet research requirements. For inshore and tuna fishers which operated in a range of fisheries, this meant numerous form types, each with separate data entry and data management requirements. With the introduction of fisheries management by quotas and the greater reliance on catch records, all catch effort forms were reviewed and subsequently replaced with a single form and a series of fishery specific templates. This minimised the number of forms fishers were required to carry; standardised data entry by making data fields the same across gear/fishery types; simplified data management; standardised the type of data collected across fisheries; and included information for fisheries compliance.

In the case of tuna fisheries, a major problem with the change of forms was the requirement to record catch in weight rather than number. The albacore troll fishery was most affected since fishers were used to providing catch in terms of number of fish; the purse seine fishery was unaffected because they had always provided catch in tonnes; and the domestic longline fishery had yet to begin. In the case of albacore a long time series (about 12 years of catch and effort) was lost when the consultants responsible for establishing the new data base lost the original data files after converting the recorded catches to weight based on an unknown conversion factor. In addition, in the first year of the new reporting requirements, most fishers followed instruction and reported their catch in weight. This catch recording instruction was changed back to catch in number after two years. However, about 20 percent of all tuna troll and longline catch reported on CELR forms continues to be recorded as weight and, hence, cannot be used for stock assessments.

At present, each fisher must record the catch and effort by fishing operation unless they fish in more than one statistical area, in which case multiple lines of catch and effort are filled out. As mentioned, there is a generic form and a fishery specific template which overlays the form. For each fishery the template specifies how catch and effort are to be recorded. The only exception to this system is for tuna longliners which have the option of filling out an older form developed for foreign licensed longliners (TLCER form). Over the past five years, an increasing number of domestic longliners have used ths form. New Zealand catch and effort forms will be reviewed in the near future.

Review by the SCTB Statistics Working Group

At its inaugural meeting in June 1998, the SCTB Statistics Working Group established procedures for achieving its objectives of coordinating data collection, data compilation and dissemination of data. It agreed that two of the procedures for coordinating data collection would be to establish minimum standards for data collection forms and to review data collection forms used in the region. In this regard, the logsheets developed by the New Zealand Ministry of Fisheries were reviewed at the SWG Session on Data Collection Forms, which was held from 14 to 15 June 1998, immediately prior to SCTB12. The participants at the session are listed in paragraph 120. The Catch, Effort and Landing Return, together with the Seining Template and the Other Lining Methods Template, and the Tuna Longlining Catch, Effort Return were reviewed with reference to the minimum standards presented in Appendix 5. The results of the review are presented below.

Catch, Effort and Landing Return (CELR)

The CELR form is a generic form used for a variety of fishing methods that are used to catch several species groups, including tuna. For each of seven groups of related fishing methods, a template exists that should be placed over the generic form and which contains special instructions regarding catch and effort that are specific to the group of fishing methods. The SWG considered the Seining Template, which is used for purse seining, and the Other Lining Methods Template, which is used for pole-and-line and trolling.

CELR form

1. The instructions referring to the first day of the trip and the last day of the trip do not specify whether the "first day of trip"`should be the first day on the fishing grounds or the day the vessel left port, or whether the "last day of trip" is the last day on the fishing grounds or the day the vessel reached its port of landing. It was assumed that the day the vessel left port and returned to port are commonly used, although it may be worthwhile to be specific in the instructions, at least for methods for which the transit time to the fishing grounds is such that the fishing operations do not start on the same day the vessel left port.

2. The CELR form does not include a data item for the port of departure. This data item can be useful for tracking the movements of vessels and, hence, verifying the completeness of the data.

3. The instructions specify that the date should be reported using the format of "dd/mm/yy", whereas the form only has space for "dd/mm". This discrepancy should be resolved.

4. It was noted that the three-alpha species codes listed in a table in the instructions are not consistent with the three-alpha codes developed by the Food and Agricultural Organization. The FAO codes are a global standard and are used by all regional fisheries agencies. If FAO codes are not used by national agencies, then an additional step in data processing is necessary when the data from national agencies are provided to regional agencies.

5. The instructions require that the "greenweight" (i.e. whole weight) of catches be recorded. It was considered that the form would be easier to complete if the processed weights of catches were recorded. The conversion from processed to whole weights is perhaps better accomplished during data processing. If the type of processing for each species for a given fishing method is consistent throughout the fishery, then no additional information concerning processing method will need to be reorded on the form. The instructions also indicate that the conversion factors that should be used to convert processed to whole weights are available in a separate document published by the Ministry. It may be more convenient to include a table of conversion factors in the instructions.

6. The CELR form does not include information on discards in the daily catch entries. Instead, discards are recorded in the landings data under destination codes D, "Discarded (NON-ITQ) species", and A, "Returned to or Accidental Loss at sea". It was considered that it is more appropriate to record discards on a daily basis together with the retained catches, rather than at the end of the trip together with landings.

7. The CELR form does not include information on school association for purse seining or pole-and-line fishing. Both the species composition and the length distribution of the catch are known to be related to the school association, such that more species and smaller fish are usually caught from schools associated with floating objects than from unassociated schools. It was assumed that in New

Zealand schools fished by both of these methods are primarily free-swimming, unassociated schools. If this is not the case, then information on school association should be collected.

8. The CELR form and instructions do not specify which species should be covered. It may be appropriate to specify what should be done in the event that more than five species are caught. This could be accomplished with instructions to either record only target and major non-target species or to use more than one line to record all species.

9. In general, it was noted that forms with templates are more difficult to use than forms without templates. Furthermore, it is clear that the design of the "Other Lining Methods Template" has resulted in serious deficiencies in the catch data (see below). It may therefore be appropriate to reconsider the use of templates.

Seining Template

10. The CELR form has a column labelled "Target Species, Total (kg)". The instructions specify that the target species should be recorded in the top half of the space, while the "total weight of fish taken using that fishing method" should be recorded in the bottom half of the space. There is an element of ambiguity in that the "total weight of fish taken" could be interpreted as meaning the total weight of the target species taken. If it is intended that the total weight of all species is to be recorded, then this ambiguity could be resolved in the instructions with the phrase "total weight of all species taken by that fishing method".

Other Lining Methods Template

11. The template has an instruction to record the "total catching time during the day (hours)". The definition of "catching time" is not included in the instructions and, for pole-and-line, could refer to either the time spent searching, chumming and poling or just to the time spent poling. This ambiguity should be clarified in the instructions and on the template.

12. The unit of catch written on the CELR form at the top of each of the catch columns is "kg". In contrast, the "Other Lining Methods Template" indicates that the unit of catch for tuna species should be "number of fish". This discrepancy has resulted in some CELR tuna catch data for troll being recorded in number of fish and some in kilograms. As a result, for approximately 20 percent of the CELR tuna catch data for troll, the unit of catch must be determined by comparing the catch data to the landings data in order to use the database. Unfortunately, the landings data are not recorded separately by fishing method, so the comparison is not always possible. It is recommended that the recording of tuna catches for troll conform to the minimum standards established by the SWG, i.e. with catches by troll for each species recorded in numbers of fish, together with either an estimate of the total catch in weight or an estimate of the average size of fish in kilograms. It may also be appropriate to record catches by pole-and-line in New Zealand in this manner.

13. The template has an instruction to record the "maximum number of lines used at any one time" and the "maximum number of hooks used at any one time". For trolling, handlining, and pole-and-line fishing methods, different numbers of hooks, lines, and poles may be used throughout the day. It would therefore be more accurate for estimating effort in units of line-hours or hook-hours to record the average number of lines and hooks instead of the maximum number of lines and hooks.

Tuna Longlining Catch, Effort Return (TLCER)

14. The TLCER form is to be completed for each set and does not contain any information on days at sea that are not fished, which can be useful for tracking the activities of the vessel and verifying the completeness of the data.

15. The instructions state that for foreign vessels, the international radio call sign should be recorded under "Vessel Registration Number". Since this instruction is not on the TLCER form itself, this may lead to foreign vessels recording their registration number, rather than their call sign.

16. No vessel attributes are recorded on the TLCER form; however, this information is probably recorded on permit applications.

17. There are four fields for recording the time of the start and end of setting and the start and end of hauling; however, neither the instructions nor form indicate whether local time, ship's time or UTC / GMT should be used.

18. Catches are recorded in processed weights; however, neither the form nor the instructions indicate which types of processed weights should be used, i.e. gilled and gutted for yellowfin and bigeye, trunks for billfish, etc.

19. The logsheet does not include information on discards. Information on discards is essential for estimating total removals. While it is recognised that in other fisheries fishermen often neglect to record discards, it is expected that the recording of discards will increasingly become mandatory. It may therefore be appropriate to include information on discards on the logsheet.

20. It was noted that the three-alpha species codes listed in a table in the instructions are not consistent with the three-alpha codes developed by the Food and Agricultural Organization. The FAO codes are a global standard and are used by all regional fisheries agencies. If FAO codes are not used by national agencies, then an additional step in data processing is necessary when the data from national agencies are provided to regional agencies.

APPENDIX 7. REVIEW OF CATCH AND EFFORT LOGSHEETS OF THE AUSTRALIAN FISHERIES MANAGEMENT AUTHORITY

Background

With the declaration of the 200 nm Australian fishing zone (AFZ) in 1979, Australia introduced a logbook for Japanese longliners fishing under bilateral licensing agreements. The logbook was based on the Japanese national longline logbook. In 1983 the logbook was revised to include the catch in weight of each species as well as numbers. In 1991 Australia added a shark supplement which has columns for recording the retained and discarded catches of four common shark species. Bilateral access ceased in November 1997.

Australia introduced a logbook for the domestic longline fishery when the fishery began to grow in 1986. The logbook has been revised three times, and now collects detailed information on fishing gear and practices for stock assessment and details of bycatch and marine wildlife interactions. The logbook is a day–page format to accommodate those data and to cope with multiple longline sets per day that sometimes occur in northern waters. The logbook includes information on other fishing methods (e.g. trolling) that are sometimes used in conjunction with longlining. In addition to catch and effort forms, the logbook includes forms for reporting information on the recapture of tagged fish and for size information.

Logbooks for other line methods are also a day–page format, whereas each page of the purse seine – pole-and-line logbook holds information for seven days. Purse seine – pole-and-line are covered by one logbook because those vessels often fish cooperatively.

Review by the SCTB Statistics Working Group

At its inaugural meeting in June 1998, the SCTB Statistics Working Group established procedures for achieving its objectives of coordinating data collection, data compilation and dissemination of data. It agreed that two of the procedures for coordinating data collection would be to establish minimum standards for data collection forms and to review data collection forms used in the region. In this regard, the Longline Tuna Fishing Log, the Pelagic Longlining Daily Fishing Log, the Tuna Minor Line Daily Fishing Log and the Purse Seine and Pole Daily Fishing Log developed by the Australian Fisheries Management Authority were reviewed at the SWG Session on Data Collection Forms, which was held from 14 to 15 June 1998, immediately prior to SCTB12. The participants at the session are listed in paragraph 120. The logsheets were reviewed with reference to the minimum standards presented in Appendix 5. The results of the review are presented below.

Australian (Foreign) Longline Tuna Fishing Log

1. The logsheet does not include information on discards. Information on discards is essential for estimating total removals. While it is recognised that in other fisheries fishermen often neglect to record discards, it is expected that the recording of discards will increasingly become mandatory. It may therefore be appropriate to include information on discards on the logsheet.

2. The position recorded for each day is the noon position, rather than the start of set position. If the set is soaking at noon, then the noon position will be a reliable indicator of the set position. However, it would be more precise if the start of set position was recorded.

3. The logsheet does not provide space for recording an activity code, which can be useful for tracking the activities of the vessel and verifying the completeness of the data. It is assumed that if no fishing occurred on a given day, then this would be noted in the comments. This should be made explicit in the instructions.

4. The logsheet does not provide space for entering the type of processed weight for each species. For certain species, more than one type of processing is used, e.g. small swordfish are usually trunked, while large swordfish are usually filleted. The instructions should indicate which type of processed weights should be used for each species.

Australian Pelagic Longlining Daily Fishing Log

5. The Boat / Gear Details Form (Gearsheet) does not provide space for entering storage method, which can be used to identify the type of vessel (offshore or distant-water).

6. The logsheet provides space for entering moon phase. Since moon phase can be calculated from the date, the moon phase is redundant.

7. It was noted that the logsheet includes local species names (e.g. blue whaler shark instead of blue shark), which was considered appropriate.

8. While the logsheet includes information on the number of fish kept and the number of fish released, it is not clear how to record catches of sharks that have been finned and then discarded. This could be resolved by specifying in the instructions that sharks that have been finned and then discarded should be recorded as discards.

9. The instructions do not specify whether processed or whole weights should be used for recording the catch in weight. The instructions should specify which types of processed weights should be used for each species. The types of processed weights for each species should correspond to the common practice of the fleet.

10. An illustration on the logsheet instructions entitled "How to Measure Your Fish" shows the fork length as the distance between the tip of the lower jaw and the caudal fork. The fork length of tunas is usually defined as the length between the tip of the upper jaw and the caudal fork, rather than the lower jaw.

11. The logsheet includes information on other fishing methods used (i.e. trolling, rod and reel, handline and poling), but the catch data for other fishing methods are not separated by individual method. It would be useful for estimating catch rates for other fishing methods if the catch data were given for each fishing method separately, although it was recognised that this may be difficult due to lack of space.

Australian Tuna Minor Line Daily Fishing Log

12. The logsheet has a column labelled "Fish Retained, No. of Fish caught and kept (kg)". The "(kg)" at the end of the text is a typographical error.

13. It was noted that the three-alpha species codes listed in a table in the instructions are not consistent with the three-alpha codes developed by the Food and Agricultural Organization. The FAO codes are a global standard and are used by all regional fisheries agencies. If FAO codes are not used

by national agencies, then an additional step in data processing is necessary when the data from national agencies are provided to regional agencies.

14. The logsheet records effort data for handline, trolling, rod and reel, and poling, but the catch data are not separated by individual method. In the event that more than one method is used during a day, it would be useful for estimating catch rates for each fishing methods if the catch data were given for each fishing method separately. This could be accomplished by using a separate form for each fishing method used during the day.

Australian Purse Seine And Pole Daily Fishing Log

15. The logsheet does not include information on discards, although it was noted that discards are rare for the Australian purse-seine and pole-and-line fisheries.

16. The logsheet includes two columns for “other” species. The instructions specify that any species not covered in the columns for southern bluefin, skipjack, albacore, yellowfin and jack mackerel should be recorded, although there are no instructions concerning what should be done when more than two other species are caught.

17. Neither the logsheet nor the instructions specify the resolution at which the latitude and longitude of the position should be recorded. This could be resolved by including the desired format of the latitude and longitude under the words “Latitude” and “Longitude”, e.g. “dd-mm” and “ddd-mm” for latitude and longitude respectively, to the nearest minute.

APPENDIX 8. INTERACTIVE SESSION ON ONGOING & PROPOSED MARLIN RESEARCH

General data collection for all marlin species

Data Collection	Previous work	Present work	Proposed work
Commercial	• SPC Catch and effort data back to 1962, Observer data from 1994 (limited), unloading data (from 1993) • Australian observer & port sampling data	• SPC – ongoing • Aust, NZ, US, IATTC - ongoing	• SPC – ongoing • Aust, NZ, US, IATTC – ongoing • Philippines – some data collection
Recreational	• Some holdings within national gamefishing clubs • Some wt data – NZ/Aust • unknown holdings by national fisheries organisations • Aust – game fish data collation	• SPC trying to coordinate holdings onto SPC database (preliminary stages) • Aust collating historical charter boat • Ongoing data collection in Aust, NZ and US.	• SPC and others to coordinate data collection and standardise data – 'log sheet'. • NMFS 'catch card' • IATTC – funding proposal
length-weight data sets	• SPC - length / weight data from 1991 • Australia • US • NZ • IATTC	• SPC – ongoing incl. conversion ratios • NMFS – ongoing • IATTC • Aust/NZ – ongoing • Philippines – processed weights	• SPC – ongoing • NMFS –ongoing • Aust/NZ – ongoing • IATTC

Striped marlin

Biological	Previous work	Present work	Proposed work
Age and growth	• No validated age analyses • Little sexual dimorphism in growth. • Growth slows with age	• SPC - feasibility study for ageing dorsal / anal spines	SPC?
Mortality	• **Unknown**. • Tag recoveries ~1%. • Some analysis carried out from growth curves	?	?
Maturation & spawning	• Egg distribution unknown. • Some larvae work carried out • Seasonal spawning in early summer? • Females reach sexual maturity @ 23-36kg - age • Spawn once per season? • Spawning areas not fully known. • Fecundity?	?	• Batch or multiple spawners needs clarification – histological work • Joint IATTC/Japan GSI study

Stock	Previous work	Present work	Proposed work
Assessment	• Early assessment suggest - MSY of 24,000mt and in good condition	?	• Need for looking more locally • Joint IATTC/Japan study
Structure	• **Still unclear** – possibly single stock or 2 stocks separated at the equator or 'semi-independent subpopulations' • mtDNA identified 3 stocks	Ongoing tagging work by NSWFRI, NIWA and NOAA	• Copepod DNA study – Pepperell Research, awaiting N. Pacific samples.
Stock size – Catch and CPUE trends	• Stock size **unknown**. • Total catch decreased from 40,000 tonnes in 1960's to ~ 15,000 tonnes in 80's and 90's, now fairly stable. • CPUE decrease from 0.18 to.04 fish/100hooks. • altered fishing strategies – more deep fishing	• SPC, IATTC & US – ongoing catch and effort data collection. Aust & NZ – vessels can't keep fish but meant to be recorded in logbooks.	• SPC, Aust, NZ, US, IATTC – ongoing catch and effort data collection

Blue marlin

Biological	Previous work	Present work	Proposed work
Age and growth	• **No validated age work**. • Indications they can live to 30 years • Growth - sexually dimorphic.	• SPC presently carrying out feasibility study for ageing spines and otoliths.	• SPC?
Mortality	• No estimate of mortalities. • Potential to use growth curves	?	
Maturation & spawning	• Spawning unsure - year-around in equatorial waters and during summer periods in the southern and northern hemispheres, • Peak spawning probably occurs around Micronesia and French Polynesia. • Determinate, serial spawners. Females may spawn a number of times during the spawning season. • Preliminary estimates of total reproductive output determined • Size at maturity for females is around 80kg and for males around 31kg – possibly less.	?	• Joint IATTC/Japan GSI study • Larvae study – Uni of Technology Sydney

Stock Status	Previous work	Present work	Proposed work
Assessment	• Earlier assessments suggested stock had been over-fished since the early 1960s. • CPUE has decreased from 0.3 fish per 100 hooks in the 1950's to 0.08 in 1995. • More recent work (IATTC) suggests stock is in a healthy position	• Assessment presently being carried out by IATTC/NRIFSF	• Australia to carry out study including stock assessment in relation to effect of gamefishing on marlin stocks. • Joint IATTC/Japan study
Structure	• **Little known**. • Is the most tropical of the billfish species. • Most assume one stock • Long distance tag recoveries - indicate are wide ranging.	• Ongoing tagging work by NSWFRI and NOAA	
Stock size – Catch and CPUE	• Stock size unknown. • Taken mainly in tropical oceanic waters. • Catch shows some fluctuations and is presently around 16,000 tonnes.	• MSY estimated at around 18,000t • SPC, IATTC & US – ongoing catch and effort data collection. Aust & NZ – vessels can't keep fish but meant to be recorded in logbooks.	• SPC, Aust, NZ, US, IATTC – ongoing catch and effort data collection

Black marlin

Biological	Previous work	Present work	Proposed work
Age and growth	• Some validated ageing carried out by AIMS for small fish. • strong sexual dimorphism • off eastern Australia age-weight relationship: 1-year old - 15-20kg, 2-year-30kg, 3-year-olds - 50-55kg and 4-year olds - 70kg (length frequency analysis) • unvalidated ages of black marlin up to 20 years.	• AIMS – OTC tagging study – results? • Daily ageing of juveniles – Pepperell / NMFS	• Early growth rates derived from length frequency data - NSWFRI
Mortality	• Unknown • Some work carried out using growth rates		
Maturation & spawning (location, period, size & age at maturity, fecundity, sex ratio)	• Spawning area in the Coral Sea during October- December. • Age at maturity remains uncertain though it appears that males mature around 3-4 years (60kg), females around 4-5 years (70kg). • No significant spawning observed in eastern Pacific		• Joint IATTC/Japan GSI study

Stock	Previous work	Present work	Proposed work
Assessment	• Due to uncertainty in total catch figures and stock structure, there have been no attempts to fit production models or estimate MSY. • Catch has been sustained between 1,000-2,000 tonnes since 1980. • AIMS, on their web site, state that the stock is stable or recovering in recent years. This needs to be verified.		• Australia to carry out study including stock assessment in relation to effect of gamefishing on marlin stocks • Joint IATTC/Japan study
Structure	• Suggestions of 3 stocks – SW Pacific, eastern Pacific and Indian Ocean. • Potentially some fish move between the SW Pacific and Indian stock (AIMS 1999) – stocks linked?	• Ongoing tagging work by NSWFRI and NOAA	
Stock size – Catch and CPUE trends	• Catch has decreased slightly since 1980 while CPUE has remained fairly constant.	• SPC, IATTC & US – ongoing catch and effort data collection. Australian vessels can't keep fish but meant to be recorded in logbooks.	• SPC, Aust, NZ, US, IATTC – ongoing catch and effort data collection • Need to look at 'core' areas when carrying out stock work.

APPENDIX 9. SCTB12 – PROMPT REPORT

STANDING COMMITTEE ON TUNA AND BILLFISH

12th MEETING

Papeete, Tahiti
16–23 June 1999

PROMPT REPORT

1. The 12th meeting of the Standing Committee on Tuna and Billfish was held from Wednesday 16th June to Wednesday 23rd June in Tahiti, French Polynesia, at the invitation of the Service des Ressources Marines of French Polynesia. SCTB 12 was attended by participants from American Samoa, Australia, Canada, Cook Islands, Federated States of Micronesia, French Polynesia, Japan, Kiribati, Nauru, New Caledonia, New Zealand, Niue, Northern Marianas, Palau, Papua New Guinea, Philippines, Republic of Korea, Samoa, Taiwan, Tonga, Tuvalu, United States of America, Vanuatu, and Wallis and Futuna. Participants from FFA and IATTC also attended.

2. The meeting agenda, working papers presented at the meeting, and list of participants have been provided separately. The meeting convenes as six working groups – the Statistics Working Group (SWG), the Skipjack Research Group (SRG), the Albacore Research Group (ARG), the Yellowfin Research Group (YRG), the Bigeye Research Group (BRG), and the Billfish and Bycatch Research Group (BBRG). The Bigeye RG and Billfish and Bycatch RG were accorded slight priority in time allocated for deliberations, given existing resource uncertainties.

3. The initial overview of Western and Central Pacific Ocean (WCPO) tuna fisheries noted that the estimated total catch for 1998 for the four main tuna species was the highest on record (1,773,000 mt), with a record catch of skipjack, particularly that taken by purse seine, making up 66% of this total. The yellowfin and bigeye catches were the second highest on record (407,000 and 97,600 mt respectively), and the south Pacific albacore catch (41,100 mt) the highest this decade. National fishery reports provide further details of these catches.

4. Reports on relevant activities of other organizations were received from CSIRO, IATTC, FAO, PFRP and the ISC.

5. The objectives of the SCTB Statistics Working Group (SWG) are to coordinate the collection, compilation and dissemination of tuna fisheries data. In regard to the coordination of data collection, the SWG held a session prior to the main SCTB meeting to establish minimum standards for catch and effort logsheets and to review the logsheets used in New Zealand and Australia. In the future, the SWG will review other logsheets used in the region, including those developed by the SPC/FFA Tuna Fishery Data Collection Forms Committee.

6. During the main SCTB meeting, the SWG Coordinator, reported on the status of data collection, compilation and dissemination. Data that are compiled by the OFP on behalf of the SCTB include annual catch estimates, catch and effort data, length data, and other types of data. Progress in data compilation was achieved, although certain problems remain with some of the catch and effort data provided by Japan and Korea. Concerning the provision of data by Japan, a

participant from the National Research Institute of Far Seas Fisheries stated that while the Fisheries Agency has an agreement with SPC to provide catch and effort data, this agreement may not cover the provision of data compiled by the OFP on behalf of the SCTB. It was also noted that there are two ex-Korean purse seiners and several ex-Taiwanese purse seiners flagged in Vanuatu, but the Vanuatu Department of Fisheries has not established procedures for collecting catch and effort data from these vessels. Regarding the dissemination of data, it was reported that catch and effort data, grouped by 5° latitude and 5° longitude strata and month, for all fishing nations combined, are now available on the SPC website.

7. Other subjects discussed by the SWG included the statistical areas used for compiling annual catch estimates (Figure 1); the adjustment of bigeye and yellowfin catches by purse seiners for the mis-identification of bigeye and yellowfin in catch and effort logsheet data and landings data; and the development of a regional sampling design for port sampling programmes and observer programmes.

8. The five Research Groups considered regional fishery developments, advances in research, stock assessment and research coordination and planning for those species or species groups, with the BBRG concentrating efforts on marlins. Summary statements relating to the status of stocks, where known with any certainty, are appended for each research group. The BRG held a modelling workshop prior to SCTB plenary, to facillitate the collaborative development of an assessment model.

9. The meeting was also provided with an update of the ongoing MHLC process, to develop an arrangement for the conservation and management of highly migratory fish stocks in the WCPO and scheduled for completion in June 2000 (Convention and Commission). It then discussed the implications for SCTB in terms of the provision of scientific advice to the proposed Commission, as well as the proposed Convention area and species to be addressed by the Commission.

10. Following resolution of procedural matters, including arrangements for the meeting report, the appointment of research group coordinators, and an offer to host the next meeting in Vava'u from Tonga, the meeting closed on Wednesday at 1300 hrs.

Attachments:

SKIPJACK RESEARCH GROUP (SRG)– SUMMARY STATEMENT

Skipjack contribute two thirds of the WCPO catch of the four main tuna species. The best available estimates indicate that the 1998 skipjack catch in the WCPO was the highest on record (1.17 million tonnes, just exceeding the 1991 catch), with purse seine fleets providing both the majority of this catch (76%) and the catch increase observed during 1998. Available indicators (purse seine, pole-and-line) show variable catch rates over time in the fishery, but with no suggestion of a downward trend. Recent studies have begun to provide some understanding of environmental influences on fluctuations seen in skipjack availability and productivity of the stock in the WCPO.

Tag-based assessments from the early 1990s found regional exploitation levels to be low to moderate at catch levels similar to those in recent years; combined with the absence of clear trends in fishery indicators, this would suggest that the current catches are certainly sustainable. However, given the importance of the skipjack fishery, there is a need to improve the statistical coverage of the fisheries, which remains poor in some areas (eg Indonesia, Philippines), to develop improved assessment models which would be amenable to reference point-based management, to develop fishery indicators for use in stock assessments, and to continue to develop an understanding of processes affecting stock productivity and recruitment.

ALBACORE RESEARCH GROUP (ARG) – SUMMARY STATEMENT

Albacore occurring in the south Pacific constitute a single stock. The best fishery estimates indicate that the 1998 albacore catch (41,000 tonnes) was the highest annual catch this decade. South Pacific albacore were mainly harvested by the longline fleet (88%) with a lesser amount contributed by the troll fleet (12%). Longline catches have escalated in several domestic longline fisheries, especially Samoa, American Samoa and French Polynesia. In these three countries, the 1998 catch totalled 9,700 t or nearly 25% of the entire south Pacific catch.

The Taiwanese distant-water longline CPUE provides the best long-term indicator for the fishery, and catch rates in 1998 were high (>4 albacore per 100 hooks) compared to fishery performance earlier in the decade. Trolling catch rates of the USA and New Zealand fleets are more variable than those of the longline fishery, possibly due to factors affecting availability rather than changes in stock abundance.

A length-based age-structured stock assessment (MULTIFAN–CL) applied from 1962 to 1993 suggested that current levels of south Pacific albacore catch are sustainable given moderate exploitation rates and recent increases in catch rates of domestic and distant-water longline fisheries. In addition, there was some evidence of ENSO impacts on both catchability and recruitment. A recent production model analysis is also consistent with the good stock condition interpretation.

The MULTIFAN–CL assessment needs updating, and could be improved by updating Taiwanese longline statistics, re-structuring the analysis to better incorporate recent fishery developments, consideration given to the likelihood of localizing the model to smaller scales, incorporating assessment of precautionary reference points and better understanding how fleet behavior or albacore targeting may be related to economic factors.

YELLOWFIN RESEARCH GROUP (YRG) – SUMMARY STATEMENT

The yellowfin tuna catch for the western and central Pacific Ocean (WCPO) has increased since the 1980’s, when purse seine fishing began its significant expansion in the WCPO. Although expansion has slowed in recent years, the catch has reached record high levels. The best estimate of the 1998 catch is about 407,000 mt, which is among the highest on record. This is an increase for the purse seine and other gear catches, and a decrease for the longline and pole-and-line gear catches over 1997 catches.

This level of catch appears to be sustainable and is not adversely impacting the stock. Evidence for this conclusion is based on the time series of purse seine CPUE, which is variable but with no particular trend, and the time series of standardised longline CPUE which is flat, or with a downward trend, depending on fishing area and type of analysis. Other indicators (the MULTIFAN–CL length-based age-structure model and tagging data) show exploitation at low to high levels depending on the yellowfin tuna statistical area, but on a whole and at the stock level, exploitation is at a low to moderate level.

In short, the WCPO yellowfin tuna stock appears to be in good condition and able to safely sustain the current level of catch.

BIGEYE RESEARCH GROUP (BRG) – SUMMARY STATEMENT

Although the catch of bigeye for the total Pacific Ocean accounts for a relatively small portion (8 % of total tuna catch in the Pacific Ocean), its economic value is substantial (approximately 1 billion US $ annually). In 1998, the catch was 100,000 mt and 70,000 mt for the WCPO and EPO, respectively. The catch increased gradually in the WCPO reflecting increases in longline and purse seine catches. On the other hand, the surface fishery catch in the EPO increased markedly beginning in 1994 with decline in the longline fishery catch, and the total catch has stabilized between 70,000 and 90,000 mt. The longline catch in the EPO declined from 83,000 mt to about 35,000 mt in 1998, and has been replaced with large purse seine catch since 1993. The purse seine catch in the EPO increased from about 8,000 mt in 1993 to over 50,000 mt in 1996 and 1997. It declined to 34,000 mt in 1998.

Because a comprehensive stock assessment for this species is hindered by the scarcity of data and the absence or poor estimates for some key biological parameters, the current stock status is uncertain. To overcome this situation, the application of the integrated model (Multifan-CL model), which utilizes all available data and estimates all parameters simultaneously, is planned for the coming year.

The Group, however, noted that preliminary estimates of relative stock abundance from standardized longline CPUE indicate a decline in abundance since the late 1970s in the WCPO and since 1990 in the EPO. Although the estimates require further developments, the preliminary results raise concern of overfishing and decline in adult biomass. Cohort analysis performed by the IATTC for the stock in the EPO also indicated a similar decline in the adult biomass. The Group therefore strongly recommends that directed research efforts supporting the appropriate stock assessment be urgently undertaken, for example, (i) determine better estimates of the bigeye catch by surface fisheries, (ii) determine estimates of mixing rates and movements of fish across the range of the stock, and (iii) determine estimates of biological parameters (growth and size-specific natural mortality rates).

BILLFISH AND BYCATCH RESEARCH GROUP (BBRG) – SUMMARY STATEMENT

Good information is available on marlin stock structure and broad movement patterns. However, BBRG highlighted gaps in other information required for the development of quantitative stock assessments. Major gaps include information on age and growth, mixing rates and natural mortality. Historical catch and effort data are available for several commercial fleets, especially Japanese longliners. But catches of billfishes are often incidental to commercial fishing operations. Consequently, there is uncertainty over the reporting of discarded catches, and catch rates need to be standardised if they are to be used as an index of stock abundance. Size data are also required. Useful catch, effort and size data might also be gathered from gamefishing operations that target billfishes.

BBRG does not yet have a history of stock assessment to draw on. BBRG did not attempt to develop a statement of stock status because of the information gaps mentioned above. In the interim, BBRG's coordinator offered to develop a statement that subsequent meetings of BBRG can consider. Thus it will eventually create an agreed statement on stock status and add to this as results of dedicated research and assessment become available.

APPENDIX 10. SCIENTIFIC NAMES OF SPECIES

ENGLISH NAME	SCIENTIFIC NAME
Tuna and tuna-like species	
Albacore	*Thunnus alalunga*
Bigeye	*Thunnus obesus*
Frigate tuna	*Auxis thazard*
Skipjack	*Katsuwonus pelamis*
Wahoo	*Acanthocybium solandri*
Yellowfin	*Thunnus albacares*
Billfish	
Black marlin	*Makaira indica*
Blue marlin	*Makaira mazara*
Sailfish	*Istiophorus platypterus*
Shortbill spearfish	*Tetrapturus angustirostris*
Striped marlin	*Tetrapturus audax*
Swordfish	*Xiphias gladius*
Sharks	
Blue shark	*Prionace glauca*
Mako shark	*Isurus* spp.
Oceanic whitetip shark	*Carcharhinus longimanus*
Silky shark	*Carcharhinus falciformis*
Thresher shark	*Alopias* spp.
Other species	
Escolar	*Lepidocybium flavobrunneum*
Mahi mahi	*Coryphaena hippurus*
Oceanic triggerfish	*Canthidermis maculatus*
Rainbow runner	*Elagatis bipinnulata*

APPENDIX 11. ACRONYMS AND ABBREVIATIONS

AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
ARG	Albacore Research Group
AusAID	Australian Agency for International Development
BBRG	Billfish and Bycatch Research Group
BRG	Bigeye Research Group
CART	Classification and Regression Tree
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
cm	centimetre
CNMI	Commonwealth of the Northern Mariana Islands
CPUE	catch per unit of effort
CSIRO	Commonwealth Scientific and Industrial Research Organisation
ECOTAP	Etude de Comportement des Thonidés par l'Acoustique et la Pêche
EEZ	exclusive economic zone
ENSO	El Niño Southern Oscillation
EPO	eastern Pacific Ocean
ETP	eastern tropical Pacific
F	the instantaneous rate of fishing mortality
FAD	fish aggregating device
FAO	Food and Agriculture Organization of the United Nations
FFA	South Pacific Forum Fisheries Agency
FSM	Federated States of Micronesia
GAM	general additive model
GLM	general linear model
GRT	gross registered tonnage
HMS	highly mirgratory species
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICES	International Council for the Exploration of the Sea
IFREMER	
in	inch
IOTC	Indian Ocean Tuna Commission
IRD	Institut de la Recherche pour le Développement (formerly ORSTOM)
JIMAR	Joint Institute of Marine and Atmospheric Research
KFC	Kuniyoshi Fishing Company
kg	kilogram
LRP	limit reference point
M	the instantaneous rate of natural mortality
MHLC	Multilateral High-Level Consultation on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean
mi	mile
MMR	Ministry of Marine Resources
MSE	Management Strategy Evaluation
mt	metric tonnes
NAFO	North Atlantic Fisheries Organization
nm	nautical mile
NOAA	National Oceanic and Atmospheric Administration
NRIFSF	National Research Institute of Far Seas Fisheries (Japan)
NAD	non-target, associated and dependant (species)
OFDC	Overseas Fisheries Development Council (Republic of China)
OFP	Oceanic Fisheries Programme
OM	Operational Model
OTC	oxytetracycline
PEAC	Pacific ENSO Application Center
PFRP	Pelagic Fisheries Research Program
PITI	Palau Internation Traders Incorporated
PMIC	Palau Marine Industrial Corporation
PRP	provisional reference point
RP	reference point
SAM	Stock Assessment Model
SCTB	Standing Committee on Tuna and Billfish
SEAFDEC	Southeast Asian Fisheries Development Center
SEM	scanning electron microscope
SOI	southern oscillation index
SPAR	South Pacific Albacore Research (Group)
SPC	Secretariat of the Pacific Community (formerly the South Pacific Commission)
SRG	Skipjack Research Group
SSH	sea surface height

SST	sea surface temperature
STCZ	Sub-tropical Convergent Zone
SWG	Statistics Working Group
TAC	total allowable catch
TAO	Tropical Atmosphere Ocean (Project)
TRP	target reference point
UNIA	Agreement for the Implementation of the Provisions of UNCLOS Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks
UNCLOS	United Nations Convention on the Law of the Sea
WCPO	Western and Central Pacific Ocean
WPRFMC	Western Pacific Regional Fisheries Management Council
WPYR	Western Pacific Yellowfin Research (Group)
VMS	vessel monitoring system
VPA	Virtual Population Analysis
XBT	expendable bathythermograph
YRG	Yellowfin Research Group

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Directory: G:\Info_dbs\SCTB\Sctb_12
Template: C:\Program Files\Microsoft Office\Office\Normal.dot
Title: TECHNICAL CONSULTATION ON THE COLLECTION AND EXCHANGE
Subject:
Author: Tim Lawson
Keywords:
Comments:
Creation Date: 11/02/99 11:51 AM
Change Number: 6
Last Saved On: 11/02/99 2:08 PM
Last Saved By: Peter Williams
Total Editing Time: 18 Minutes
Last Printed On: 11/02/99 3:12 PM
As of Last Complete Printing
Number of Pages: 131
Number of Words: 48,982 (approx.)
Number of Characters: 279,198 (approx.)