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Fourteenth Meeting of the

STANDING COMMITTEE ON TUNA AND BILLFISH

Noumea, New Caledonia

9 – 16 August 2001

EXECUTIVE SUMMARY

The fourteenth meeting of the Standing Committee on Tuna and Billfish (SCTB14) was held from Thursday 9th August to Thursday 16th August in Noumea, New Caledonia, at the invitation of the Chairman, and hosted by the Secretariat of the Pacific Community. SCTB 14 was attended by participants from Australia, Federated States of Micronesia, Fiji, France, French Polynesia, Guam, Kiribati, Korea, New Caledonia, New Zealand, Papua New Guinea, the Peoples Republic of China, Samoa, Solomon Islands, Taiwan, United States of America, and Vanuatu. Representatives from various regional and international organisations also attended the meeting. These included the Food and Agriculture Organisation (FAO) of the United Nations, Inter–American Tropical Tuna Commission (IATTC), and the Forum Fisheries Agency (FFA).

The meeting agenda, working papers presented at the meeting and list of participants are provided in Appendices 1, 2 and 3, respectively. The meeting convened as eight working groups – the Statistics Working Group (SWG), the Fishing Technology Working Group (FTWG), the Methods Working Group (MWG), 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 initial overview of Western and Central Pacific Ocean (WCPO) tuna fisheries noted that the estimated total catch for 2000 for the four main tuna species was 1,862,269 mt, the third highest annual catch on record after 1998 (2,014,106 mt) and 1999 (1,873,042 mt). The 2000 WCPO catch of skipjack (1,163,417 mt) was slightly higher than in 1999, but below the 1998 record catch (1,306,671 mt) and as usual dominated the total catch (62%). The yellowfin catch (426,909 mt) was slightly less than in 1999. South Pacific albacore catches (47,308 mt) were higher than in 1999, and the WCPO bigeye catch (115,264 mt) declined slightly from the record high in 1999 (117,121 mt). National fishery reports provide further details of these catches.

Reports on relevant activities of other organisations were received from Bureau of Rural Sciences (BRS–Australia), Commonwealth Scientific & Industrial Research Organisation (CSIRO–Australia), Inter-American Tropical Tuna Commission (IATTC), the United Nation's Food and Agriculture Organisation (FAO), and the Pelagic Fisheries Research Program (PFRP) of the University of Hawaii.

The directives to the SWG made during SCTB13 were reviewed. These concerned the compilation of annual catch estimates for small-scale fisheries; the compilation of catch estimates for the South China Sea; the availability of data in Indonesia and the Philippines; a review of Japanese logsheets; an OFP project to scan logsheets in member countries to improve the timeliness of data submissions; the availability of tuna and billfish data on sex ratios and length data by gender; the compilation of factors for converting processed weights to whole weights; the compilation of information on illegal, unreported and unregulated (IUU) fishing; the level of predation of longline-

caught fish by sharks and whales; a review of vessel and gear attribute data on the FFA Regional Register; the classification of purse-seine effort by school association; the sampling of yellowfin and bigeye species composition for purse seine; the estimation of bigeye catches by purse seiners using regression trees; the compilation of data covering the American Samoan longline fleet and the Canadian troll fleet; the revision of catch and effort data for the Taiwanese distant-water longline fleet; targeting of albacore by the Taiwanese distant-water longline fleet; sampling of longline-caught albacore in Samoa; the estimation of catches of billfish under mandatory release; the estimation of tagged and released catches in recreational fisheries; the revision of billfish catch estimates; the compilation of annual catch estimates for species of special interest, such as sharks, marine reptiles, marine mammals and sea birds; the availability of data that can be used to estimate catches of non-target species; and the role of SCTB in national and regional observer programmes.

The five Research Groups considered regional fishery developments, advances in research, stock assessment and research co-ordination and planning for those species or species. Summary statements on these matters are provided for each research group. The SCTB14 was presented with applications of the MULTIFAN–CL length-based assessment model to all four target tuna species in the WCPO, and to the North Pacific blue shark (*Prionace glauca*), and Pacific blue marlin (*Makaira mazara).*

Recognising the continuing concern of the SCTB about the status of yellowfin and bigeye tuna stocks in the WCPO, and recognising the increasing catchability of juveniles of these species in surface fisheries, particularly those using FADs, SCTB 14 recommended that there be no increase in fishing mortality in surface fisheries on these species in the WCPO until uncertainty in the current assessments has been resolved.

It also strongly reinforced the value of large scale tagging experiments to provide information on movement, natural mortality and exploitation rates. As this will reduce the uncertainty in existing assessments, SCTB recommended that funding be sought to undertake such work.

The objectives of the SCTB Statistics Working Group (SWG) are to co-ordinate the collection, compilation and dissemination of tuna fisheries data. Data compiled by the OFP on behalf of the SCTB include annual catch estimates, catch and effort data, length data, and other types of data. The SWG Co-ordinator reported that progress in data compilation had been achieved, although no annual catch estimates for 2000 had been provided by Japan, and the most recent estimates covering the domestic fisheries of the Philippines are for 1997. It was reported that the level of coverage of catches in the WCPO in recent years by observer data held by the OFP is only 0.18 percent for longliners and 3.9 percent for purse seiners, so coverage must be increased to obtain reliable catch estimates for non-target species, including those of special interest, such as sharks and rays, marine reptiles, marine mammals and sea birds.

This year, two new Working Groups met in preparatory meetings, just prior to SCTB14, to review and discuss key aspects of fishing technology and analytical methods. The terms of reference and summary of presentations for each working group are given in separate sections.

The objective of the first Fishing Technology Working Group (FTWG) was to discuss the status and direction of this new working group. Ten working group papers were presented to the twenty participants covering the development of the FTWG, comparable programs, technical data holdings and accessibility, country reports, recent entrants and developments in regional fisheries, and the status of regional purse seine management measures and developing bigeye tuna management plan for the WCPO. During the preparatory meeting, the terms of reference were drafted and later approved by the plenary. These TORs and a brief report of the WG are attached to meeting report.

The objectives of the first Methods Working Group (MWG) were to review the terms of reference (drafted at SCTB13), and discuss recent developments concerning the testing of stock-assessment methods. Two papers were presented (MWG-1, YFT-4). The first of these outlined the recent changes made to MULTIFAN-CL to improve its capabilities. The second paper described the features of a new operational model of the WCPO yellowfin fishery that is used specifically to assess the accuracy and precision of MULTIFAN-CL estimates. The group recognised the need to conduct further testing of MULTIFAN-CL under various scenarios, and to compare the reliability of the estimates obtained with alternative models using simulated datasets. Recognising the value of bringing the MULITFAN-CL model into the public domain, in view of its increasing application to stock assessment, the group recommended that funding be sought to make this possible. A report of the WG is attached to the meeting report.

The Second Ocean Atlas Users Workshop was held on August 14, 2001. This workshop was chaired by Dave Foley (Univ. of Hawaii/JIMAR), and open to all SCTB participants. The aim of the workshop was to refine project goals and enhance the utilisation of the end products of this atlas, currently being developed by the NMFS Fisheries Research Laboratory in Honolulu, and the University of Hawaii Pelagic Fisheries Research Laboratory. A report of the workshop is appended to the meeting report.

The meeting was also provided with an update of the Preparatory Conference (PrepCon) process, in particular the expected requests for the provision of interim scientific advice and other information by SCTB. Procedures for providing such information were agreed, and a continuing role for a small working group in co-ordinating the provision of such advice was noted. Some concern was expressed over the reduced role of the SCTB in the provision of scientific advice in this process.

The SCTB Chairman and Working Group and Research Group Co-ordinators for SCTB14 were as follows:

SCTB Chairman :	Mr Bernard Thoulag
Albacore RG :	Dr Talbot Murray
Skipjack RG :	Dr Gary Sakagawa
Yellowfin RG :	Dr Robert Campbell
Bigeye RG :	Dr Chi-Lu Sun
Billfish and Bycatch RG :	Mr Paul Dalzell
Statistics WG :	Mr Tim Lawson
Methods WG :	Dr John Sibert
Fishing Technology WG :	Mr David Itano

The venue and the dates for the 15th SCTB meeting to be held in 2002 were not confirmed, but would be communicated to participants at a later date. The meeting closed on Thursday 16 August at 16:00 hrs.

ALBACORE RESEARCH GROUP (ARG) – SUMMARY STATEMENT

Albacore caught in the South Pacific constitute a single stock. Longline, primarily catching adults, accounts for most albacore catches (88%) in the South Pacific with trolling catching the rest (12%). The total albacore catch, estimated at 47,308 mt in 2000, was greater than in 1999 (10% increase). In 2000 longline catches were 41,436 mt and troll catches were 5,750 mt. Longline catches of several South Pacific island States and territories, particularly Fiji, French Polynesia and Samoa, continue to increase and together contribute substantially to the total albacore catch. The combined albacore longline catch in 2000 by South Pacific Islands (17,171 mt) accounts for 41% of all

albacore longline catches in the South Pacific. A substantial increase in catch to 2,918 mt (81% increase) was also reported for Canadian and USA troll vessels fishing the STCZ in the 1999/00 season relative to 1998/99. Troll caught albacore in the New Zealand EEZ are also estimated to have increased by 83% over the same period to 2,832 mt.

There has been no dedicated field research on albacore since the OFP research programme in 1991/92. Biological data on albacore is regularly collected, however, in observer and port sampling programmes in the region, although some of these data have not been compiled. Length frequency data from port sampling is a critical input to the length-based age-structured stock assessment model (MULTIFAN-CL). This model has been extended to cover the period 1962-2000 and can incorporate tag recovery information. Previous results from this model were believed to have been strongly influenced by a small number of tags recovered (135 recoveries). Model runs conducted with and without tagging data give similar results for recruitment but not for biomass trends or estimates of average fishing mortality. Results of the current MULTIFAN-CL model suggest a marked decline in recruitment and biomass in the mid-late 1970s and 1980s by about 50% that is followed by an increase in the 1990s. Results also suggest that biomass is largely distributed south of 10º S and that biomass may be driven by recruitment. An alternative stock production model using Taiwanese longline catch and effort data, raised to South Pacific wide coverage, gave broadly similar results with respect to trends in biomass, but attributed the change to fluctuations in the fishery. An investigation of the assumptions made in both models would assist in resolving the apparent discrepancies.

A number of areas requiring further work prior to the next SCTB meeting were identified. These areas include: incorporate data from additional fleets; review the adequacy of observer coverage; analyse longline data to determine if retention practices have changed in some fleets; develop extensions to the MULTIFAN-CL model; develop procedures for standardising CPUE; improve estimates of effective effort; evaluate the need for further tagging; evaluate the use of reference points in assessing stock status using MULTIFAN-CL and other models; and work to agree on a standard model structure and diagnostics for evaluating models.

No information was presented to indicate a change in interpretation of stock status of South Pacific albacore. Although model results are considered uncertain, exploitation rates appear to be moderate and current catches are likely to be sustainable.

SKIPJACK RESEARCH GROUP (SRG) – SUMMARY STATEMENT

Skipjack tuna are the most important tuna resource in the WCPO, in terms of contribution by weight to the total catch. In the past decade, skipjack catches have been approximately 1 million mt per year, contributing about 65 % of the total tuna catch in the area. The 2000 catch was about 1.2 million mt, which was only slightly less than the record catch in 1998 of 1.3 million mt. Purse seiners provided the majority of this catch (70 %) with 24% from pole-and-line fleets.

The CPUEs for purse seine and pole and line vessels have been highly variable. Nominal CPUEs for Japanese and USA purse seiners have shown nearly identical increasing trends for FAD sets and a decreasing trend for unassociated sets. Nominal CPUEs for Taiwan purse seiners, in contrast, have shown increasing trends for both unassociated and FAD sets. Korean purse seiners continue to set mostly on unassociated schools. The interpretation of CPUE trends was not possible because their standardisation was incomplete and on going.

Skipjack are concentrated in the tropical waters, but seasonally expand to subtropical waters north and south. Their fast growth, early maturity, high fecundity, spawning year around, relatively short life span, highly variable recruitment and few age classes on which the fishery is dependent makes the species unique among the main tuna species. Ongoing fisheries oceanographic studies have been continuing to provide a better understanding of environmental influences on the availability and productivity of skipjack in WCPO. They suggest a positive impact of El Nino on skipjack recruitment, particularly when followed shortly by La Nina, as occurred in 1998.

Tag based assessments from the early 1990's suggested low to moderate exploitation at catch levels slightly lower than those in recent years. Recent results from MULTIFAN-CL , including tagging and other information from the northern part of the area, were consistent with the tag based assessments, but additionally, indicated that fishing mortality have been increasing since the early 1970s. Nevertheless, estimates of fishing mortality at age have been smaller than those of natural mortality. The impact of fishing on the total biomass of skipjack is estimated to be low, with estimates of recent recruitment and stock biomass being at historically high levels.

Future advances in the basic biology, data collection and stock assessment of skipjack should be encouraged to substantiate the knowledge required for the fisheries management of this economically and ecologically important species.

BIGEYE RESEARCH GROUP (BRG) – SUMMARY STATEMENT

Bigeye tuna account for a relatively small proportion of the total tuna catch in the Pacific Ocean, but their economic value probably exceeds US$ 1 billion annually. Bigeye may comprise a single Pacific-wide stock and this is reflected in data collection and assessment approaches. The year 2000 total Pacific catch of bigeye was an estimated 208,173 mt, an historical high, with 115,264 mt (55%) and 92,909 (45%) mt taken in the WCPO and EPO respectively. The catch in the WCPO declined slightly compared to 1999, while the catch in the EPO increased. Purse seine catches of mostly larger bigeye in the EPO increased to record levels (69,745 mt); no year 2000 data were available on the EPO longline catch, which has however been declining steadily in recent years. The WCPO purse seine catch of bigeye, associated with the increasing use of FADs, remained high (28,843 mt) and combined with the largest longline catch yet recorded (67,792 mt), resulted in the highest bigeye catch on record for the WCPO. The Pacific total bigeye catch continues an upward trend since 1998.

Limited ecological and biological research has lead to improved understanding of some parameters e.g. age and growth, dynamics of aggregations etc. No new information was provided on environmental effects on catchability and stock productivity, although results of archival tagging work in progress are expected to provide useful information on the former and could be utilized in longline effort standardization.

Several nominal and standardized CPUE time series were examined by the group; the purse seine CPUE trends for the main fleets generally reflect the extent to which associated sets, especially drifting FADs (which have produced higher juvenile bigeye catches in recent years), are fished. Longline CPUEs since 1980 for the Japanese fleet, both nominal and standardized according to several habitat models, are relatively flat in the EPO but more variable in the WCPO. Over longer time periods i.e. since the beginning of the fishery, a much greater decline in these CPUEs is evident.

An elaboration of the collaborative Pacific-wide application of the integrated statistical MULTIFAN-CL model was presented, incorporating some new features and considerable additional data. Results should be regarded as preliminary, but indicate that recruitment shows considerable temporal variation, and been has declining, particularly in recent years in both the EPO and WCPO. Biomass also shows a declining trend over time and current levels (total and adult biomass) may be at around 50% of initial levels. The overall impact of fisheries on the population was considered moderate. Given however the importance of some key assumptions to model outputs e.g. standardized longline effort, it was recognized that further investigation regarding the appropriateness of these assumptions is required.

A preliminary application of the A-SCALA method to WCPO bigeye was also presented. The results were indicative of a larger impact of the fisheries on the stock than suggested by the MULTIFAN-CL analysis. The assessment indicated that the average fishing mortality has increased since 1980 due to an expansion of the purse seine fisheries. It further suggested that the decline in relative abundance was due to fishing rather than to a decline in recruitment. Analyses conducted during the meeting suggested that there is no fundamental difference in the MULTIFAN-CL and A-SCALA approaches. The differences in the results appear to be due largely to different assumptions and data used in the analyses. In particular, (i) the tagging data used in the MULTIFAN-CL analysis implies lower estimates of fishing mortality than those obtained in the A-SCALA analysis, which does not use the tagging data; and (ii) the levels of natural mortality assumed in the A-SCALA analysis are lower than those estimated in the MULTIFAN-CL analysis, which causes further divergence in the two sets of results. Further research is required to identify the most appropriate set of assumptions to use in future assessments. In this respect, additional tagging data accompanied by high tag-reporting rates for all fisheries would provide valuable information on bigeye tuna stock dynamics and exploitation.

Given the continuing increase in Pacific bigeye catches in both surface and longline fisheries, indications of recent low recruitment and declining biomass, and possible significant fishery impacts on the stock, the Group reiterated its concern that the condition of the stock be closely monitored and that efforts to develop reliable assessments at Pacific-wide and regional level be regarded as a priority task. It was noted that concerns about bigeye stocks driven by similar factors are common to tuna fisheries in all areas and have already resulted in management interventions in most cases.

Recognising the continuing concern of the SCTB about the status of bigeye tuna stocks in the WCPO, and recognising the increasing catchability of juveniles of this species in surface fisheries, particularly those using FADs, SCTB 14 recommended that there be no increase in fishing mortality in surface fisheries on bigeye in the WCPO until uncertainties in the current assessments have been resolved.

The group recommended that the following research leading to improved stock assessment be continued in the following areas: (i) acquisition of more detailed catch / effort and size composition data from the fisheries of Indonesia and the Philippines (ii) improved/refined estimates of bigeye catches from WCPO purse seine fisheries (iii) improvement to effort standardization utilizing data from archival tagging and other studies providing information on habitat preferences (iv) investigations of key assumptions to stock assessment models and continued elaboration of the MULTIFAN-CL and other models (v) characterization of effective effort on juvenile bigeye taken mostly in association with FADs and (vi) large scale tagging to provide information on key parameters and to assist in discriminating between alternative hypotheses and model assumptions.

YELLOWFIN RESEARCH GROUP (YRG) – SUMMARY STATEMENT

Catches of yellowfin tuna represent the second largest component (23%) of the total catch of the four main target species in the WCPO. Yellowfin tuna are also believed to constitute a single stock in the WCPO.

The catch of yellowfin tuna in the WCPO first exceeded 200,000 mt in 1980. With the expansion of the purse seine fishery during the 1980s catches almost doubled to reach around 350,000 mt by 1990. Since this time yellowfin catches in the WCPO have varied between 320,000 and 480,000 mt with the catches during the last four years being at historical high levels, exceeding 420,000 mt during each year. Purse seine vessels harvest the majority of the yellowfin catch (46% by weight during 2000), while longline and pole-and-line fisheries caught 15% and 4% respectively and various other gears accounted for 35% (mostly eastern Indonesia and the Philippines).

Nominal catch rates of yellowfin for purse seine fleets are characterised by strong inter-annual variability but indicate no clear trend in the available time series of data. While it is suspected that variability in yellowfin catch rates may be associated with variation in environmental conditions associated with the El Nino Southern Oscillation cycle, catch rates for some fleets since the mid-1990s may have may benefited from efficiencies associated with the increased use of drifting FADs.

Nominal catch rates of yellowfin for the Japanese longline fleet show a steady decline during the 1980s while catch rates for the Korean longline fleet displayed high inter-annual variability but no overall trend. However, nominal catch rates for both fleets reached historical lows in 1999 but recovered somewhat during 2000. After accounting for the increased targeting on bigeye tunas since the mid-1970s, standardised catch rates for the major longline fleets in most regions of the WCPO display large inter-annual variability but no overall long-term trend.

Biological research undertaken in recent years has lead to an improved understanding of age and growth and reproductive dynamics. However, further work is required to understand habitat preferences, trophic dynamics and the influences of recent increases in fishing efficiencies (e.g. the increased use of FADs) to help improve the standardisation of catch rates.

Tag-based assessments from the early 1990s found exploitation levels of yellowfin tuna to be low to moderate at catch levels at that time about 10-20 percent below those in recent years. However, more recent assessments of the yellowfin stock using the MULTIFAN-CL model indicate that fishing mortality may have increased significantly since this time, largely as a result of catchability increases in the purse seine fisheries. While the overall estimates of fishing mortality-at-age remain considerably smaller than the corresponding estimates of natural mortality-at-age, the analyses indicate that recent recruitment may have declined significantly. This in turn has produced a significant decline of around 35% in overall stock biomass since 1997. Biomass levels in 2000 are estimated to be the lowest since the mid-1970s. The decline in biomass is most evident in the main catch regions of the western equatorial Pacific where current biomass is estimated to have declined by over 50 percent since the mid-1990s. For the WCPO in total, the current biomass is estimated to be around 30% less than that which would have occurred in the absence of fishing.

Attempts to estimate an MSY for yellowfin are currently hampered by uncertainty in the stock-recruit relationship and the age-specific exploitation patterns as well as other uncertainties in the stock assessment models. Depending on the assumptions used, estimates of MSY vary between 40% above to 40% below current catch levels.

The reasons for the large declines estimated to have occurred in recruitment in recent years remain unknown, though the possibility that the estimated declines in both recruitment and biomass in recent years may be associated with a shift to a lower productivity regime was discussed. Such a shift in productivity may have occurred in the past, as the significant increases in average annual recruitment and biomass estimated to occur after the mid-1970s might have been associated with a regime shift in oceanographic conditions in the Pacific around this time. Although there has been a dominance of La Nina conditions in recent years, it remains unknown at this time whether this is associated with a shift to new regime and whether or not the estimated recent declines in recruitment and biomass may be associated. However, if a shift to a lower productivity regime has occurred, it is possible that present catches may not be able to be maintained.

Due to the short time-series on which they are based, estimates of stock parameters and stock conditions in the most recent years are the most poorly determined. As a result, additional research will be needed to determine the significance of the present results, especially in terms of future stock productivity. Until the uncertainties associated with present stock assessments are resolved, the Group recommends a precautionary approach, and that there be no further increases in fishing mortality (particularly on juvenile yellowfin) in the WCPO, and that the condition of the stock be closely monitored over the next few years.

The Group also recommends that current research on yellowfin stock assessments be continued as a matter of priority. This research will include (i) the acquisition of data required as input into the stock assessment models (particularly from the Philippines and Indonesia); (ii) a greater understanding of the trophic and ecosystem dynamics of yellowfin (particularly in relation to aggregating devices); (iii) a greater understanding of the habitat preferences of yellowfin; (iv) refinement of the methods used to standardise CPUE; and (v) further development of stock assessment models, particularly MULTIFAN-CL. In addition to this work, the Group also saw the need for additional large-scale tagging to provide information on yellowfin movement, natural mortality and exploitation rates to support future stock assessment analyses.

BILLFISH AND BYCATCH RESEARCH GROUP (BBRG) – SUMMARY STATEMENT

The Billfish and Bycatch Research Group (BBRG) has a more varied perspective than the single species research groups. Issues include non-targeted catches in pelagic fisheries, protected species interactions and the catch estimation and stock assessment of billfish. The potential for bycatch issues to have major impacts on pelagic fisheries was noted, citing the closure of the swordfish-targeting sector of the Hawaii longline fishery in 2000/2001. The BBRG reviewed progress on statistical issues since SCTB 13 and during the 14th SCTB dealt with three non-target catches in WCPO pelagic fisheries namely sharks, turtle and “other species”.

Shark bycatch in WCPO pelagic fisheries

The OFP provided an overview of shark catches in WCPO longline fisheries based on observer data collected from the Marshall Islands, PNG and New Caledonia. There was some targeting of sharks for retention of trunks, but the majority of retained sharks were finned. Species composition of longline shark catches depends on latitude. As in the Hawaii longline fishery (HLL) shark catches are greatest in shallow longline sets. Member country participants commented on planned or ongoing data collection and research programs for shark bycatch in domestic and distant water pelagic fisheries.

A collaborative stock assessment of blue shark in the North Pacific, based on a MULTIFAN-CL analysis of US, Taiwan, Korean and Japanese data was presented to the BBRG. The stock assessment suggested that North Pacific blue shark landings are moderate compared to the production potential of the population. There was discussion of the data requirements for the MULTIFAN-CL and the properties of the model. Other simpler approaches such as surplus production models were suggested, but the more complex MULTIFAN-CL model permitted incorporation of operational changes in the fisheries catching blue shark.

Turtle bycatch in WCPO pelagic fisheries

An overview of the status of marine turtle populations in the Pacific noted that populations of leatherbacks, eastern Pacific black and loggerhead turtle populations were in a serious state of decline. Olive Ridley and Hawaiian green turtles were in much better shape and had growing populations. The decline in turtle populations was due to a combination of factors, including harvest of adults and eggs on nesting beaches, loss of nesting habitat, fishery bycatch and marine debris. Some recent population modeling by the NMFS Honolulu Laboratory had noted the importance of protecting nesting females and eggs for leatherback turtle recovery.

The results of a qualitative review of OFP data conducted on behalf of SPREP were presented. There was little information on the nature of fishery interactions with longliners, e.g. tangling or hooking. In general, interactions were more frequent in tropical areas and adjacent to nesting sites. Depth was another major factor in interactions, with shallow set longlines set at night catching an order of magnitude more turtles than deep sets made in the day. Purse seine turtle catches were an order of magnitude lower than those of longliners. Purse seine crews made every effort to release turtles before encountering the power-block. Olive Ridley and green turtles were the most frequently encountered turtles. The review listed recommendations on a variety of improvements including fishery observer coverage, species identification, collection of turtle biometrics, interaction descriptions, crew education and awareness.

Member country participants commented on planned or ongoing data collection and research programs for turtle bycatch in domestic and distant water pelagic fisheries

The BBRG was presented with an account of the recent litigation involving the US federal government and environmental groups through which swordfish fishing by the Hawaii-based longline fishery was banned, north of the equator, and tuna longlining constrained in April and May each year. The BBRG also heard how the NMFS Honolulu Laboratory was coordinating a wide variety of research activities to rehabilitate swordfish longlining and to generally reduce turtle longline interactions. This included gear research, potential new longline methods to catch swordfish during the day and behavioral and physiological research on turtles and target species.

The expansion of longline fishing off the Australian East Coast had likely increased fisher interactions with turtles. The BBRG heard how Australian fishery managers are seeking solutions to the problem and actively involving the fishing industry in finding these solutions. Examples were given of similar work in the Australian northern prawn trawl fishery that successfully used industry volunteers to tag and collect information on captured turtles.

Other species bycatch in WCPO pelagic fisheries

The BBRG discussed a preliminary MULTIFAN-CL stock assessment on Pacific blue marlin. The results of the stock assessment were greatly influenced by whether selectivity in the various fisheries data was constrained or not. Unconstrained selectivity produced an improbably large stock size.

Yield estimates with constrained selectivity would suggest that the stock was fully exploited, which is consistent with previous assessment results presented in other fora. Discussion focused on the effects of data quality and assumptions used in the model

A new OFP project generated through Global Environmental Fund (GEF) funding was aimed at collecting data required for ecosystem based fishery management. The project used fishery observers to collect target catch, bycatch, stomach contents and muscle samples from longline, purse seine and pole and line fisheries in the WCPO. These data will be used to provide inputs for ecosystem models such as ECOPATH, ECOSIM and SEPODYM.

A review of the US fisheries catching blue and striped marlins in the WCPO was presented to the BBRG. The review noted that there were several decades of data covering longline and small scale pelagic fisheries over wide area of the WCPO. The data collected also included weight frequencies, which together with catch could be included in Pacific-wide MULTIFAN-CL analyses of blue and striped marlins.

Recommendations

The BBRG recommends that a strong focus should continue to be maintained on regional billfish catches, both in commercial pelagic fisheries and from recreational fisheries. The reduction in domestic swordfish landings in the USA may represent export opportunities for Pacific Island countries developing their longline industries. However, the BBRG also notes potential competition from expanding longline fishing in East and Southeast Asia, recognizing the need to obtain more in formation on swordfish production from these fisheries. The BBRG recommends that efforts be made to improve the overall level and quality of observer coverage in WCPO pelagic fisheries in order to obtain more reliable statistics on catches. Member countries might begin by initially improving data collection on pelagic sharks caught in domestic and distant pelagic fisheries, using the FAO IPOA framework as a guideline.

The BBRG also recommends that risk analysis be conducted on non-target species to identify those species which may be the most vulnerable, and guide future BBRG priorities.

The BBRG recommends that member countries should also strengthen data collection on turtle interactions in pelagic fisheries in order to refine estimates of the interaction problem, due to concerns regarding the population status of turtles. The BBRG recommends that member countries should also liaise with the appropriate government and regional agencies to compile an inventory on turtle nesting sites, domestic harvests of turtles, habitat destruction and other impacts (e.g. feral pigs).

The BBRG recommends that a watching brief be maintained on other bycatch issues as they arise, e.g. FAO IPOA on seabird-fishery interactions, or a future IPOA on turtle-fishery interactions. The BBRG notes that powerful US environmental legislation may be used to influence seafood exporters to the US to conform with various bycatch mitigation measures.

SUMMARY OF DISCUSSIONS

1. PRELIMINARIES

1. The Fourteenth Meeting of the Standing Committee on Tuna and Billfish (SCTB14) was held from 9-16 August 2001, in Noumea, New Caledonia. The Oceanic Fisheries Programme (OFP) of the Secretariat of the Pacific Community (SPC), New Caledonia, served as Secretariat for the meeting.

2. SCTB14 was attended by participants from Australia, Federated States of Micronesia, Fiji, France, French Polynesia, Guam, Kiribati, Korea, New Caledonia, New Zealand, Papua New Guinea, the Peoples Republic of China, Samoa, Solomon Islands, Taiwan, USA and Vanuatu. Representatives of several regional and international organisations also attended the meeting. These included the Food and Agriculture Organisation (FAO) of the United Nations (UN), Inter–American Tropical Tuna Commission (IATTC), and the Forum Fisheries Agency (FFA).

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. In the absence of the Director-General of the Secretariat of the Pacific Community, an opening address was given by the Deputy Director-General, Mr Yves Corbel (Appendix 4). Mr Corbel outlined the importance of this group in providing scientific advice on the tuna fisheries of the western and central Pacific Ocean. Dr Antony Lewis welcomed the group and provided a brief overview of the expected work and outcomes of the meeting.

1.2 Confirmation of Chairman and Appointment of Rapporteurs

5. Mr Bernard Thoulag assumed his appointed role as Chairman of SCTB14, replacing outgoing Chairman Dr Ziro Suzuki.

6. The appointment of co-ordinators for each SCTB research group was confirmed as follows: Mr Tim Lawson for the Statistics Working Group, Dr Talbot Murray for the Albacore Research Group, Dr Chi-Lu Sun for the Bigeye Research Group, Dr Rob Campbell for the Yellowfin Research Group, and Mr Paul Dalzell for the Billfish and Bycatch Research Group. Following the SCTB13 recommendation, Dr John Sibert chaired the Methods Working Group, and Mr David Itano chaired the Fishing Technology Working Group.

7. The SCTB14 Secretariat (OFP) assumed responsibility for co-ordinating the rapporteuring process and compiling the report of the meeting, with the assistance of participant rapporteurs. Dr Marc Labelle was appointed as co-ordinating rapporteur. SCTB14 Secretariat provided most of the rapporteurs for agenda items 1–3 (Mr Keith Bigelow, Ms Deirdre Brogan, Mr Emmanuel Schneiter, Dr Marc Labelle, Dr Valerie Allain, Mr Peter Williams and Dr Patrick Lehodey). In addition, Dr Jacek Majkowski (FAO), Dr Chien-HsiungWang (IONTU), Dr Pierre Kleiber (NMFS) voluteered to serve as rapporteurs for some of the national tuna fishery report presentations. Rapporteurs for the SCTB working and research groups were appointed as follows:

- Agenda item 4 – Statistics WG: Mr Tim Lawson & Dr Mike Hinton
- Agenda item 5 – Fishing Technology WG Ms Deirdre Brogan

- Agenda item 6 – Methods WG: Dr Robert Skillman, Dr Rob Campbell
- Agenda item 7 – Skipjack RG: Dr Jacek Majkowski
- Agenda item 8 – Bigeye RG: Mr Tim Park
- Agenda item 9 – Yellowfin RG: Ms Carolyn Robins
- Agenda item 10 – Albacore RG: Dr Ray Conser
- Agenda item 11 – Billfish and Bycatch RG: Dr Robert Skillman

1.3 Adoption of the Agenda

8. The agenda was adopted without modifications.

1.4 Adoption of the Report of the Thirteenth Meeting of the SCTB

9. The report of the Thirteenth Meeting of the SCTB, held in Noumea, New Caledonia, from 5-12 July 2000, was adopted.

2. OVERVIEW OF WESTERN AND CENTRAL PACIFIC OCEAN TUNA FISHERIES

2.1 Regional Overview

10. Dr Lewis provided an 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 2000 catches relative to those of recent years.

11. The total WCPO catch of tunas during 2000 was estimated at 1,862,269 mt (Figure 1), the third highest annual catch recorded after 1998 (2,014,106 mt) and 1999 (1,873,042 mt). The purse-seine fishery accounted for an estimated 1,034,209 mt (56% of the total catch), with pole-and-line taking an estimated 359,246 mt (19%), the longline fishery an estimated 217,240 mt (12%), with the remainder (13%) taken by troll gear and a variety of artisanal gears, mostly in eastern Indonesia and the Philippines. The WCPO tuna catch represented 76% of the total estimated Pacific Ocean catch of 2,461,526 mt in 2000, and 48% of the provisional estimate of world tuna catch (3,841,641 mt) of the four species. The EPO catch in 2000 (599,257 mt) was the second highest on record, and the global catch, after two very productive years in the Pacific Ocean, was the highest ever, and has increased by over half a million tonnes since 1996.

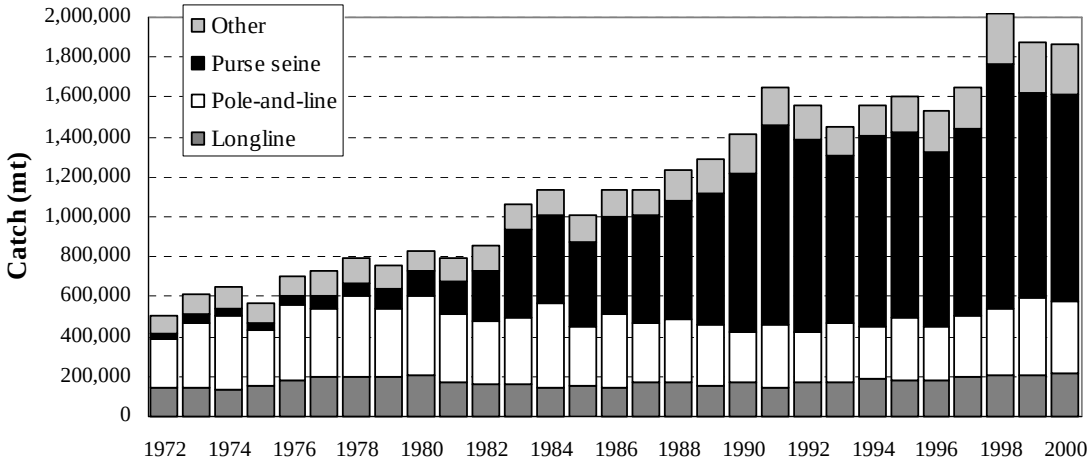


Figure 1. Catch (mt) of albacore, bigeye, skipjack and yellowfin in the WCPO, by longline, pole-and-line, purse seine and other gear types

12. The 2000 catch by species (Figure 2) in the WCPO was dominated as usual by skipjack (1,163,417 mt; 62%), which was slightly higher than 1999, but slightly lower than the record level of 1998 (1,306,671 mt). Yellowfin (426,909 mt; 23%) catches have been above 420,000 mt for the past four years and now comprise over 23% of the catch. The albacore (156,679 mt; 8%) and bigeye (115,264 mt; 6%) catches were the highest and second highest, respectively, on record in the WCPO.

13. The purse-seine catches in recent years have been the highest ever - the WCPO record was taken in 1998 (1,226,722 mt), with the second highest taken in 2000 (1,034,209 mt), this despite the prevailing unfavorable economic conditions in the fishery, with historically low prices for part of the year, and some voluntary effort reduction late in 2000. The purse-seine skipjack catch for 2000 (809,020 mt – 78% of the purse-seine catch) was over 130,000 mt less than the 1998 record catch (942,907 mt), but still much higher than pre-1998 levels, and seems likely to stay at this new elevated level. The purse-seine yellowfin catch for 2000 (196,346 mt – 19%) continued the 1998/99 trend in further declining from the record 1997 catch, but this decrease is understood to be typical of *La Nina* conditions prevailing during 1999-2000. The purse-seine bigeye catch for 2000 (28,843 mt – 3%) was slightly below the record 1999 catch. The catch trends for the four main purse-seine fleets in the past year were generally upwards, with the exception of the US fleet, which experienced significant effort reduction (reduced vessel numbers). The 2000 catch estimates for the Pacific Islands domestic purse-seine fleets are not yet finalized, but it appears they continue to take a significant proportion of the WCPO purse-seine catch, which in 1999 was nearly 10% of the total purse-seine catch (Lawson, 2000). The major Pacific Islands domestic fleets are from FSM, PNG, Solomon Islands, and Vanuatu. The 2000 Solomon Islands catch dropped to a ten-year low as a result of civil unrest, whereas the FSM catch (25,638 mt) was the highest ever recorded.

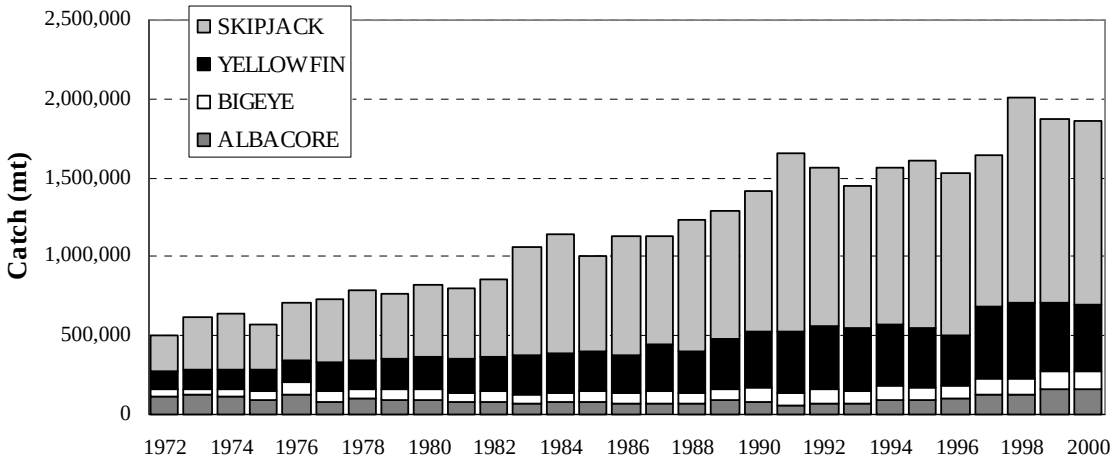


Figure 2. Catch (mt) of albacore, bigeye, skipjack and yellowfin in the WCPO.

14. The percentage of sets on drifting FADs, which showed a significant increase during 1999, decreased for the US and Taiwan fleets during 2000, but increased for the Japanese fleet. The Korean fleet continued its minimal reliance on FAD sets. Typical of La Nina years, the Korean and Taiwanese fleets fished further to the west, and posted record or near record skipjack catches. The skipjack catch by the US fleet was well down on recent years, and fishing on drifting FADs in central Pacific areas appears not to have been as productive as in 1999.

15. The pole-and-line catch estimate for 2000 (359,246 mt) was a slight decrease on the 1999 level (386,831 mt) and represents about 19% of the total WCPO catch. As in previous years,

skipjack accounts for the vast majority of the catch (79%); albacore taken by the Japanese coastal and offshore fleets in the temperate waters of the north Pacific (15%), yellowfin (5%) and a small component of bigeye (1%) make up the remainder of the catch. The Solomon Island fleet accounted for only 2,692 mt during 2000, an order of magnitude less than in recent years and attributable to the prevailing civil unrest.

16. The estimated longline catch in the WCPO in 2000 of 217,240 mt (12% of the total WCPO catch, but rivalling the much larger purse-seine catch in value) represents a record. The next highest catch was taken some 20 years earlier (211,104 mt in 1980), but with a vastly different species composition, comprising mostly yellowfin. The overall species of the 2000 WCPO longline tuna catch was 30% yellowfin, 38% albacore and 31% bigeye. The yellowfin catch (64,735 mt) represented a significant recovery from the lowest recorded catch for nearly 30 years in 1999. The 2000 bigeye catch (67,792 mt) was a record for this fishery, and the albacore catch (83,105 mt) was the second highest recorded. Most of the longline catch continues to be taken by the larger DWFN fleets, but domestic fleet activity continues to increase in the South Pacific, with recent activity by PRC vessels and a reported sharp increase in the catch landed in Vietnam (neither included in figures here).

17. The 2000 troll catch of South Pacific albacore (5,750 mt) was greater than the 1999 catch of 3,156 mt, as a result of the highest catch recorded by US trollers since 1992 and a significant increase in the NZ domestic troll catch, but was slightly less than the 1990–1999 average catch of 5,936 mt. As in previous years, the fleets of New Zealand (operating in their own waters) and the United States (operating in the Sub-tropical Convergence Zone–STCZ) accounted for nearly all of the catch, which in turn consists almost exclusively of albacore tuna.

2.2 National Tuna Fishery Reports

18. Mr Thoulag called for presentations of the latest developments in national tuna fisheries. These presentations provide the meeting with, *inter alia*, a more detailed overview of recent domestic and foreign fleet activity in the region.

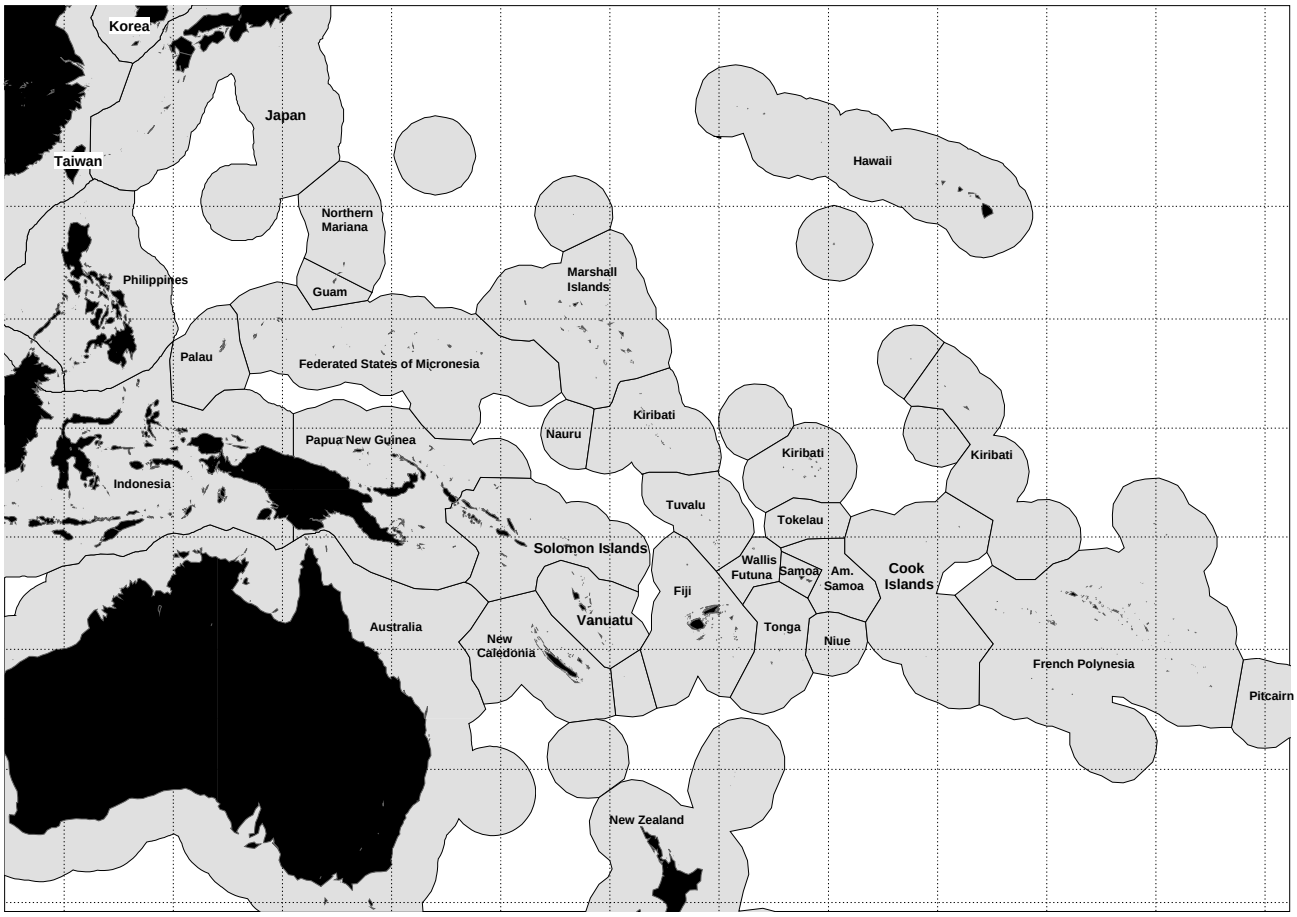


Figure 3. Countries and territories of the western and central Pacific Ocean.

American Samoa

19. Mr Dalzell presented a brief summary of developments in American Samoa's pelagic fisheries since the last SCTB. The main pelagic fishery in American Samoa was the longline fishery, which commenced in 1994. Monitoring of this fishery was conducted both by creel survey intercepts and by federal logbooks. The majority of the longline vessels were outboard powered catamarans using manually deployed longline gear. The total catch of the pelagic fishery in 2000 was 870 mt of which 660 or about 75% was longline caught albacore. Troll caught fish comprises just over 1% of total pelagic landings

20. The albacore is marketed locally to the two canneries in Pago Pago, with the balance of the catch marketed locally. Unlike neighbouring Samoa, there are insufficient airline links for the incidental catches of bigeye and yellowfin to be sent to more lucrative fresh fish markets in Hawaii or Japan. The most notable development in the fishery was the entry of about a dozen large (> 50 ft) longline vessels during the second quarter of 2001. The entry of these new vessels was due to a combination of factors, including local interest in the fishery due to high albacore prices, gearing of North Pacific trollers for longlining to stay beyond the southern surface fishery season, and vessels displaced from the Hawaii fishery by recent new regulations.

21. Mr Dalzell explained that the federal management authority, the Western Pacific Regional Fishery Management Council (WPRFMC), had tried to implement a 50 nm area closure for large longline vessels around the American Samoa archipelago in 1998, but this measure was disapproved by the US National Marine Fisheries Service in 1999. The measure had been resubmitted in 2000, but was now being revised due to the rapid build-up of many large longliners in 2001, which would

be displaced 50 nm offshore by this measure. The Council was also developing a limited entry program for the longline fishery in American Samoa. The fishing community in the territory had requested both measures.

Australia

22. Ms Carolyn Robins summarised WP NFR–2. Historically, bilaterally licensed longliners from Japan had taken most of the tuna catch in the north–eastern Australian fishing zone (AFZ). Bilateral access ceased in November 1997 and Australia's longline fishery has expanded to equal or exceed Japan's fishery since this time.

23. Activity by Australia's longliners increased substantially during the late 1990s, with many operators purchasing larger vessels, thereby extending the range of longline activities further offshore. In addition to the new vessels joining the fleet, existing longliners were more active. Fishing effort, for example, doubled from 4 million hooks in 1996 to 9 million in 1998. Vessels continued to move further offshore into international waters during 2000 with around 15% of effort occurring in these waters.

24. Expansion of Australia's longline fishery slowed in 1999 and 2000 with fishing effort stabilising at around 10 million hooks. The 2000 landings of yellowfin (1,492 mt) and bigeye (666 mt) tuna were down on the previous year's catches (1,577 mt and 791 mt, respectively). In the 1996 and 1997, many longliners had relocated from New South Wales to southern Queensland where they used night–set squid baits to target broadbill swordfish and bigeye. Landings of swordfish in 2000 (1,699 mt) showed a slight decrease on 1999 landings (1,884 mt), but there was a slight increase in the striped marlin catches over this period (490 mt to 505 mt).

25. Pole-and-line and purse seine vessels also 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 6000 mt in 1992 then fell below 1500 mt a year. In 2000, around 4,000 mt of skipjack were caught.

26. The fishery has been managed as a limited entry fishery since 1989, with a range of secondary controls, such as boat replacement regulations and area restrictions. Over the last few years, management has been examining alternative arrangements including those based on input controls, such as gear units, and output controls, such as individual transferable quotas (ITQs). It has been decided, however, that the input control of hook-days be implemented in this fishery. The allocation process is currently underway.

Canada

27. No delegates from Canada attended SCTB14. However, Mr William Shaw (Fisheries and Oceans Canada) provided WP NFR–2. Commercial fishing for tunas, principally trolling for albacore, is an important and growing fishery by vessels based on Canada's west coast. The Department of Fisheries and Ocean (DFO) has recently embarked on a program to document and control the west-coast albacore fishery to ensure its long-term sustainability. Based on a variety of information sources (sales slips, logbooks, phone-in records and interviews of vessel masters), DFO has revised recent albacore catch and effort statistics based on sales slips compilation and logbook submissions. This program continues and data for 1998–99 should be finalised by the end of 2001.

28. The preliminary catch estimate for north Pacific albacore in 2000 is 4,486 mt, substantially higher than in 1999. Most of the catch is taken during the summer in the Pacific northwest (FOA

Statistical Area 67) between California and the Queen Charlotte Islands, by 10-20 m jigboats fishing along the coast, and by larger vessels fishing west of the dateline. For south Pacific albacore, Canadian vessels caught 289 mt during 1999-2000, compared to 162 mt during the 1998-99 season. Canadian vessels (2 to 5) operate mainly in the area of 130–165°W by 35–40°S during November to March. Canadian albacore vessels have acquired licences to longline tuna and billfish in 2000.

China

29. Mr Dai Xiao Jie summarised WP NFR–3. China's tuna fishing fleet began operating in 1988. The number of fishing vessels increased since. During 2000, 106 longliners operated in the WCPO. Most of these are in the 24-30 m size range. Total Chinese longline effort in 2000 was about 25 million hooks. Total catch of tuna and billfish in 2000 was about 7,300 mt, with almost equal amounts of albacore, yellowfin and bigeye making up 86% of the total catch. China's purse seine fleet in 2000 consisted of 2 vessels. These operated mainly during January-April in the area of 75–85°W by 2–7°N (i.e. in the EPO). Total purse seine effort in 2000 amounted to 209 fishing days. The total catch of billfish, yellowfin and skipjack in 2000 was about 2,200 mt.

Federated States of Micronesia (FSM)

30. Mr Tim Park summarised WP NFR–4. Due to the late submission of some year 2000 logsheets, only preliminary figures were reported and include data from outside FSM's zone. A current estimate of the total catch for 2000 is 184,121 mt. The Taiwanese purse seiners generated 96,160 mt of the catch, the Japanese vessels 36,247 mt, while the Koreans had a catch of 26,835 mt, and finally the domestic fleet recorded only 5,802 mt of fish - although fishing company records indicate that this might be higher at 18,628 mt. An outline of the longline catches was also given. Total catches include yellowfin, bigeye billfish, shark and others. The Japanese longline vessels declared 6,495 mt, the Taiwanese effort resulted in 2,226 mt, the Chinese 1,080 mt and the domestic fleets had a catch of 681 mt, while other vessels produced 135mt. The pole and line fleet comprised exclusively of Japanese vessels and took 7,053 mt of tuna.

31. The volume of purse seine transhipments, involving the Taiwanese and to a lesser extent the Korean fleet, was lower in 2000, at 34,967 mt. Chinese longline vessels generated the most volume and the most longline transhipments within the zone. A large volume of the domestic longline fleet was also transhipped in Guam. MFA's observer programme made 57 trips in 2000, covering the three main gear types and attaining an overall coverage of 2.7 %. The lowest coverage was for the Japanese fleet, as a restrictive MOU curtails the number of placements.

Fiji

32. Dr Lewis summarised WP NFR–5. Preliminary catch estimates for 2000 indicate that the total catch was at least 5,700 mt, with 55 domestic longline vessels licensed to fish. Almost all longline caught fish caught (tunas and other species) are landed for the domestic or export market. Species composition in the 2000 fishery was 37% albacore, 28% yellowfin, 6% bigeye and 29% other species. There was little seasonal variability in the catch rates of the main longline species. The pole-and-line fishery started in the 1980s, but has declined substantially from seven vessels landing 3,200 mt in 1996 to only one vessel that landed 351 mt in 2000.

33. The Fisheries Division allocates 20 licences for foreign longliners to unload their catch at the PAFCO cannery. There were 27 Taiwanese and two Korean vessels active during the year 2000 that landed a total of 4,600 mt, which was primarily albacore. Suva has become a major transhipment centre in recent years as vessels offload their catches to motherships destined for Japan, Korea,

Taiwan or Pago Pago. Over 12,000 mt was transhipped in 2000, an increase from 1999 (10,000 mt). There have been some infrastructure improvements in recent years and the Fisheries Division is committed to developing a new National Tuna Management Plan.

French Polynesia

34. Mr Christophe Misselis summarised WP NFR–6. Since the beginning of the 1990s, the fishery has evolved with the development of a domestic longline fleet using monofilament gear. In 2000, there were 57 active vessels, of which 11 were converted "bonitiers". Originally, these bonitiers (~12 m long) targeted mainly skipjack with pole-and-line and trolling, but are now decreasing in number, unlike the now important fleet of multi-purpose "poti marara" (5-7 m long) which are more adaptable and can be used for different types of fishing.

35. In 2000, the total catch for all species was estimated at 11,000 mt, of which 2,000 were taken by a Korean fleet (71 vessels) operating in the French Polynesian EEZ under access agreements. Albacore was the main catch of the domestic fleets, comprising 40% of the total catch. Eighty-eight percent of the exported albacore is frozen, of which 60% is loins prepared aboard freezer vessels. The Government of French Polynesia intends to increase production to 22,000 mt by 2006, by building at least 56 extra vessels, 50% of which will be freezer vessels.

Kiribati

36. Mr Johnny Kirata provided a brief overview of the domestic fleets of Kiribati. Kiribati does not have a well-developed domestic tuna fleet, with one joint-venture (with Japan) purse seiner in operation. A government-owned fishing company, established initially for pole-and-line operations, was liquidated last year. Two of the four vessels from this company have been decommissioned, with the other two remaining inactive. Recent efforts have been directed towards the development of a domestic prototype longline vessel, as reported to SCTB13. Trials of the prototype have been ongoing since 2000.

37. The joint-venture Kiribati purse-seine vessel caught an estimated 4,973 mt during 2000. This is a decrease on the estimated catch for 1999. This vessel operates under the FSM Arrangement and the main areas fished during 2000 were in and around FSM and PNG waters.

38. Foreign purse-seine transhipment activity recommenced in Tarawa during in May 2001. Most purse seine activity in the zone during recent La Nina conditions has been by US and Japanese vessels.

Korea

39. Dr Jungrak Koh presented WP NFR–8, a summary of Korean tuna fisheries in the western Pacific Ocean. During 2000, a total of 202 vessels were active (176 longline and 26 purse seine) with the number of longliners increasing by five and purse seiners staying the same from the previous year. The total catch of tuna and tuna-like species was estimated at around 213,549 mt, an increase of 17.6% on the previous year. The total catch was 170,025 mt (79.6%) and 43,524 mt (20.4%) respectively, by purse seine and longline.

40. The longline catch composition was 59.1%, 29.8%, 1.9% and 9.2% for bigeye, yellowfin, albacore and other species (including billfish) respectively. The catch of bigeye (the predominant species caught) increased by 5.7% compared to 1999, and the catch of yellowfin by 4.2%, but there

was a noticeable drop in the albacore catch, thought to be primarily due to changes in targeting and area of operation.

41. The purse seine catch during 2000 was estimated to be 170,025 mt, an increase of 19.7% on the 1999 catch. As in previous years, skipjack was the main species caught (84.1%) followed by yellowfin (15.8%). There was a 30.3% increase and 16.1% decrease in the catch of skipjack and yellowfin tuna, respectively.

42. As reported during SCTB13, biological sampling of the purse-seine catch continues to be carried out at domestic landing sites once a month, although it was noted that the sample size remains relatively small for this fleet.

New Caledonia

43. Mr Régis Etaix-Bonnin summarized WP NFR–9. Major changes occurred in the New Caledonia tuna longline fleet during year 2000. The last freezer longliner stopped fishing early in the year. The domestic fleet is now only composed of fresh fish longliners that target bigeye and yellowfin tuna for the Japanese sashimi market. Thirteen of these boats were active last year. Ten more boats are likely to start fishing in 2001 since a new company was established recently in the Northern Province of New Caledonia (port of Koumac). These 20 metre longliners are originally from French Polynesia and it is expected that some fish from these vessels could be exported to Europe.

44. A port sampling programme was initiated in Koumac in collaboration with the OFP at the very beginning of the fishing operations. Observer trips on these boats will be conducted, so as to compare their catch with the one from the fleet based in Noumea where it was reported that up to 2/3 of the total catch may represent bycatch. It is expected that a couple of new fishing companies will be established in the coming years. In this regard, a local policy has been recently established by the New Caledonia parliament relating to licenses of all kinds of vessels operating in the EEZ. Some extra provisions may also be adopted later in regard to control of fishing effort.

New Zealand

45. Dr Murray summarized WP NFR–10. Tuna fisheries are an important component of New Zealand's fishing industry, comprising a mixture of seasonal and year-round fisheries primarily using troll, purse seine and surface longline methods. Tuna fishing began in the 1960s and has continued to develop since then. The trend in vessel numbers varies with gear type.

46. The least significant fleet is the pole-and-line fishery in which 3–15 vessels have reported using this method at some time during the year since 1989. Pole-and-line fishing is an occasional method and the amount of fish caught by this method is insignificant. Purse seine fishing targets skipjack, with occasional catches of yellowfin tuna; 5 to 7 mostly small vessels have reported using this method each year since 1989. The most significant development in purse seine fishing in New Zealand was the entry last year of a New Zealand flagged super seiner (formerly US owned and flagged) which fishes part of the year in the EEZ and part of the year in the equatorial western and central Pacific Ocean. In the past few months, another New Zealand company announced that they have purchased two super seiners and has similar fishing plans. The number of troll vessels gradually increased from 200 vessels in 1991 to a maximum of 490 in 1994; since then troll vessel numbers have declined to 285 vessels in 2000. Another new development in New Zealand tuna fishing, especially in northern waters, has been the expansion of tuna longlining since 1989. This fleet has grown from a single domestic vessel longlining in 1989 to 115 vessels in 2000. The target

species are primarily southern bluefin and bigeye tunas, but about 25% of longline sets report targeting albacore.

47. The trend in skipjack catches has been variable during the late 1980s to mid-1990s ranging from about 1,000 to 5,000 mt. Since the mid-1990s, skipjack catches have increased from about 4,000 to nearly 10,000 mt. Albacore catches have also been variable since the late 1980s at 2,000 to nearly 7,000 mt. Bigeye catches, less than 100 mt prior to 1996, have increased in recent years to about 400 mt. Yellowfin catches, less than 100 mt prior to 1994, have ranged from 100-200 mt since then. Southern bluefin tuna, restricted by a national catch allocation of 420 mt, has only exceeded that quota in 4 of the past 15 years (average annual catch over last 10 years = 281 mt). When the catch has exceeded quota, the national allocation has been reduced in subsequent years. In recent years northern Pacific bluefin tuna have been caught with increasing frequency. While catches are small, about 20 mt currently, this change appears to be due to an increased ability to distinguish northern Pacific bluefin tunas from southern bluefin tunas in the catch and increased longline effort in waters north of 40º S. Another significant change in the New Zealand catch by longline has been the increase in swordfish catches. Swordfish can only be retained if it is a bycatch of tuna targeting and coincident with increased longline effort in northern waters has been a rapid increase in swordfish landings. Swordfish landings prior to 1995 were less than 100 mt, since then the catch has steadily increased and in the past two years was about 1,000 mt. No billfish species other than swordfish can be retained and all catches of marlin, sailfish and short-billed spearfish must be released whether alive or dead.

Papua New Guinea

48. Mr Ludwig Kumoru summarized WP NFR–11. Commercial fishing operations commenced during the 1950s with foreign fleets exploiting the fishery in its early stages. In 1995, a domestication policy reserved the longline fishery for PNG citizens and restricted purse seining in archipelago waters to PNG-based vessels. The preliminary total catch by all vessels in the PNG EEZ was estimated to be 158,601 mt in 2000, a significant increase on the 1999 catch (112,147 mt). The total catch of domestic vessels for 2000 was not available but is expected to be similar to the 1999 level, although on average only about 7% of the catch in PNG is taken by PNG registered vessels. The number of licensed, domestic longline vessels has risen to 47 (38 active) compared to 38 in 1999. The number of domestic purse seiners is also higher at 13 vessels, an increase of one compared to 1999.

49. The longline nominal CPUE for yellowfin (14.62 kg per thousand hooks) is much lower than for previous years, but thought to be mainly due to shark-targeting practices by certain longline vessels. The National Fisheries Authority (NFA) has now instituted restrictions on commercial shark targeting in PNG and hopes instead to develop a community-based project involving shark that will result in less wastage.

50. The tuna cannery in Madang tripled production from 30 mt/day in 2000 to 100 mt/day during 2001. The construction of a new cannery in Wewak is planned. There are around 10–15 transhipments per month in most of the six designated ports in PNG, but one almost every day in the busy port of Madang.

51. The future of PNG tuna fisheries remains very promising. Both the government and commercial sector are pursuing a number of projects. One project involves the development of two fishery wharves in Manus, and another involves airfreight trials from the northern part of the country. Other industry projects include the construction of fish storage and processing facility by Frabelle (PNG), which manages a domestic purse-seine fleet.

Samoa

52. Mr Tanielu Su'a summarized WP NFR–12. The tuna longline fishery is now the major export earner for Samoa with exports of 4,505 mt in 2000, worth an estimated SAT$39 million. Although a Tuna Management plan exists, it is under considerable pressure from industry to expand, noting that available on-shore infrastructure is also deemed to be limited and under strain. In 2000, the total catch was reported to be 5,895 mt., including 4,067 mt of albacore, 177 mt of bigeye and 1,120 mt of yellowfin, as well as 530 mt of other bycatch species.

53. There were 154 active vessels in Samoa in 2000. The majority of the fleet is made up of 119 alias, with an additional 20 'larger alias'. There are also 15 longline vessel greater than 12.5 metres. The CPUE for the fleet ranged from 50.8 kg/100 hooks for the alia fleet, up to 71.2 kg /100 hook for the vessels greater than 12.5 m. The dominant species was albacore, at 68 % of the landed catch. The majority of the catch was exported to the canneries in Pago Pago, while a significant amount was air freighted, mostly to Hawaii and the US mainland. Future developments include; an increase in ice production, the construction of a new marina for the commercial fleet, a review of vessel numbers, the implementation of improved quality control and an examination of the possibilities of a reciprocal fishing agreements with neighbouring EEZs.

Solomon Islands

54. Mr Eddie Oreihaka summarized WP NFR–14. During 2000 there was a large downturn in the Solomon Islands fishery, due to the social unrest in the country. Solomon Taiyo Ltd, a veteran local tuna company suffered the departure of its main shareholder and is now 100% owned by the Solomon Island Government. The current domestic fleet includes pole and line, purse seine and longline vessels. In addition to this there are Japanese (PL, LL and PS), Taiwanese (LL and PS) as well as Korean purse seine vessels, fishing under bilateral agreements.

55. An overview of the historical catches from 1971 to 2000 was presented. The table showed that the total catch dropped from an average in excess of 100,000 mt, to a historical low in 2000, of only 7,496 mt. While historically, the domestic pole and line fleet catches were around 20,000 mt, they decreased to only 2,694 mt in 2000. The domestic single purse seiner fleet also recorded a similar drop from 20,111 mt to just 2,365 mt in 2000, and the domestic group purse seine decreased from 4,186 mt to 1,040 mt. The domestic longline catch was the least affected, reducing its catch from 1,212 mt to 1,057 mt.

56. In total, 201 fishing vessels were licensed to fish in Solomon Islands waters during 2000. This included 35 tuna longliners, 54 pole and liners, 91 purse seiners and 13 shark longliners. Canning and export of fresh fish continued on a reduced scale in 2001. The observer programme that had been temporarily suspended, was re-activated in mid 2001. The Solomon Island fishery, previous managed by a quota system is now restricted through licence limitations and area restrictions.

Taiwan

57. Dr Shyh-Bin Wang summarized WP NFR–13. The number of distant water longline (DWLL) vessels operating in the Pacific Ocean in 2000 was estimated to be about 78. Most of them targeted on albacore for canning. The major fishing ground of DWLL vessels located in the South Pacific and the tropical region. However, in recent years, the North Pacific has become increasingly important. The average catch in the most recent 5 years (1996-2000) was about 19,000 mt for albacore, 1,500 mt for bigeye, and 1,200 mt for yellowfin tuna. The total number of purse seine vessels in 2000 remained the same as the previous year, at 42. Skipjack (79%) was the dominant

species caught in this fishery, followed by the yellowfin tuna (20%); bigeye tuna only accounted for 1% of the total catch. Average catch during this period was about 165,000 mt for skipjack, 43,000 mt for yellowfin and 1,200 mt for bigeye tuna. The major fishing ground of distant water purse seine (DWPS) fishery was mainly located in the western and central part of the tropical Pacific (135-175^{o}E, 8^{o}N-8^{o}S). The major catch of this fleet was from the "free or unassociated schools" and to a lesser extent from the log-associated schools. This pattern was consistent for all years between 1996 and 2000. Number of registered offshore longline (OSLL) vessels was similar during 1996-2000 period, and estimated to be about 1700 (including vessels operating in both the Pacific and the Indian Oceans). The total catch of tuna and tuna-like species landed in Taiwan by this fleet was stable and averaged around 46,000 mt during 1996-2000 period. The dominant species caught included yellowfin, bigeye, billfishes, skipjack and other tuna species. In addition to catches landed at domestic ports, catches of bigeye and yellowfin tunas were unloaded in foreign base ports in the Pacific and Indian Oceans, were estimated to be about 12,000 to 15,000 mt and about 14,000 to 22,000 mt, respectively during 1996-2000 period. The vessel monitoring system was implemented for distant water fleets operated in the Pacific Ocean through an incentive program since 1996, and an experimental observer program also was launched in 2001 to understand bycatches of sharks, seabirds, sea turtles, discards etc.

58. In the ensuing discussion, it was noted that the percentages of log sets undertaken by the Taiwanese purse-seine fleet, presented in Table 4 of WP NFR–19, includes sets on drifting FADs. The difference in catch estimates of billfish by the offshore longline fleet presented in the paper with statistics available elsewhere was noted. Dr Wang indicated that the estimates presented in the paper included an unknown component of Indian Ocean catches, and hence were larger than estimates available elsewhere.

United States of America

59. Dr Sakagawa summarized WP NFR–15. The US fisheries operation in the central and western Pacific consist principally of purse seine, longline and troll fleets plus some small, localised fleets such as handline, various sport fleets and a few pole-and-line vessels. The total landings of principal target species (yellowfin, skipjack, bigeye, albacore and swordfish) by the US fisheries in 2000 was 140,300 mt, a decrease of 28% from the 195,900 mt landed in 1999. This decrease was largely the result of reduced fishing effort by the US purse seine fishery in response to falling prices for yellowfin and skipjack tunas used for canning, which were as low as $400 US/mt at the end of the year. Break-even price for purse seine operations is reckoned to be about $700 per tonne, but the prevailing price in year 2000 was around $400 per tonne. . The purse seine fleet consisted of 33 vessels in the year 2000, down from earlier years and well below the 55 allotted by treaty. Though effort in the purse seine fleet has declined, the catch per effort has remained high, and the fleet was able to produce 125,000 mt of tuna in year 2000. Data from observers and port samplers indicate that approximately 1900 mt of small tuna were discarded in year 2000. The outlook for year 2001 is for further decline in effort.

60. The Hawaii and California based longline fleets consisted of 137 vessels in year 2000 divided into two principal sectors: those targeting tunas, and those targeting swordfish. In American Samoa 37 longliners operated in year 2000, targeting principally albacore, and a small number of U.S. longliners operated in Micronesia. The Hawaii based longline fleet was heavily affected by law court actions severely limiting targeting of swordfish and placing additional restrictions on targeting tuna. As a result some vessels have moved to other regions, and more are expected to follow. Overall, the U.S. longline fishery landings were relatively stable for the last two years.

61. The U.S. albacore troll fleet operates in the south Pacific to the east of New Zealand. In the 1999-2000 season, the fleet consisted of 36 vessels. Some of these vessels are being refitted as longline vessels. Landings of south Pacific albacore by the U.S. albacore troll fishery increased significantly (98%) to 2,700 mt during the 1999-2000 season from 1,400 mt in the 1998-1999 season.

62. Recent survey data indicate that several species are caught by purse seine and longline gears as bycatch. In the purse seine fishery, rainbow runner is a common bycatch species, In 2000, the U.S. fleet had an estimated 500 mt of bycatch that was largely discarded at sea. The fleet also discarded approximately 1,900 mt of tuna of little value. For vessels in the U.S. longline fishery that target swordfish or bigeye tuna, blue shark is the principal bycatch species. In 2000, the estimated blue shark bycatch for these vessels was 1,250 mt.

Vanuatu

63. Mr William Naviti provided an overview of Vanuatu tuna fisheries. There are several foreign fleets operating in the EEZ outside the 12-mile zone, but all catches are currently landed in other countries. There was an increase in the number of vessels registered to fish in Vanuatu waters from 35 vessels in 1999 to 64 vessels in 2000. Most of these are Taiwanese longline vessels targeting albacore, but there has been an increase in the number of Fiji-based vessels during the past year. In recent months, there has been three additional fishing companies expressing interest in access to Vanuatu waters. Vanuatu currently has the maximum number of vessels allowing in their EEZ set at 100 vessels.

64. Albacore catches in the Vanuatu zone were approximately 950 mt during 2000, a threefold increase over the 1999 catch (300 mt) but only half of the catch during 1998 (2,000 mt). Yellowfin catch for 2000 was only 40 mt, with catches in 2001 (174 mt), already well in excess of this figure. Most of the catch is taken by the Taiwanese distant-water longline vessels based out of Pago Pago and Fiji-based vessels.

65. The national tuna management plan has now been approved in principle and will inform future policies on Vanuatu fisheries. The plan covers both national and regional requirements and issues with regard to tuna fisheries.

2.3 Economic Condition of the Fishery

66. Mr Les Clark presented WP GEN–2. A key feature of the economic performance of the fishery in 2000 had been the low level of prices for skipjack and yellowfin for canning that had prevailed throughout 2000. The representative skipjack price had fallen from over US$1,000 per tonne in 1998 to a low of under US$400 per tonne in late 2000. The low prices had resulted in action by purse seine owners through the World Tuna Purse Seine Organisation to reduce skipjack supplies. Following this action, prices had recovered from late 2000. At July 2001, the representative skipjack price at Bangkok was around US$700-750, with higher prices reported in other regions.

67. As a result of the fairly constant level of purse seine catches and the low prices, the value of the WCPO purse seine catch in 2000 was estimated to have declined by around 32 per cent in ex-vessel terms. The progress in loining that had been noted in recent years was continuing, and US canneries were receiving an increasing share of the fish they received in the form of loins.

68. The Japanese sashimi market for bigeye and yellowfin was generally depressed in 2000. Domestic supplies fell slightly, but imports increased by around 14 per cent, resulting in an increase of around 5 per cent in overall supplies. Average prices for fresh and frozen bigeye and yellowfin all declined. Imports of fresh bigeye and yellowfin from the South Pacific increased in 2001 after declining since 1995, and preliminary data for 2001 showed further large increases.

69. Prices for albacore had been firm in 2000. In the US market, import volumes fell by 20 per cent, and prices increased by around 13 per cent to nearly US$2,500 per tonne. The US is also an important market for exports of fresh longline tuna from the region. In 2000, the value of fresh albacore exports to the US from countries such as Fiji and Samoa had increased moderately, and there had been large increases in the volume and value of fresh yellowfin shipped from Fiji, Samoa and Tonga.

3. REPORTS BY ORGANISATIONS

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

70. Dr Campbell gave a brief presentation on behalf of the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The CSIRO Division of Marine Research, employing around 300 people, undertakes a diverse range of research on fisheries and oceanography. The Pelagic Ecosystems sub-program currently consists of around 21 scientists. About 25 percent of the research undertaken within the Pelagic sub-program is directed at tropical tunas and billfish with the remainder largely directed at research on southern bluefin tuna. Most of the research on tropical tuna and billfish is focused on the domestic fisheries off eastern and western Australia, though aspects of this work also feed into the larger regional assessments in both the Pacific and Indian Oceans.

71. Several projects are presently ongoing on tropical tunas and billfish, some of which are described in WP NFR–1. Two of these projects – the origin of yellowfin recruits to the eastern Australian Fishing Zone and a study on the reproduction dynamics of swordfish off eastern Australia – have recently been completed and final reports should be available around the end of the year. Other projects underway include i) a study of swordfish movement and migration through an industry based tagged study (~140 fish tagged with one recovery to date), iii) the development of an operational model for the swordfish fishery off eastern Australia, iv) a tagging study of the seasonal and long-term migration patterns and habitat preferences of bigeye tuna (~100 archival tags and several conventional tags released to date), v) determination of the age and growth of bigeye tuna occurring off eastern and western Australia, and vi) the archiving of hard parts for the routine ageing of tuna and billfish.

Inter–American Tropical Tuna Commission (IATTC)

72. Dr Hinton summarized the report of the Inter-American Tropical Tuna Commission (IATTC) (WP SWG–2). IATTC reports tuna catches in the eastern tropical Pacific (ETP) in year 2000 as follows: yellowfin 281,000 mt (276,000 mt by purse seine), bigeye 93,000 mt (68,000 mt by purse seine), skipjack 210,000 mt (almost all by purse seine), all tuna 600,000 mt.

73. IATTC has been making further developments in A-SCALA, an integrated stock assessment model. A new growth model has been added as well as Beverton-Holt stock recruitment. A new fecundity schedule was added and also new criteria for model selection. Assessment results for yellowfin showed that spawning biomass ratio (SBR) is above the level consistent with average maximum sustainable yield (AMSY). Recent recruitment is less than in 1998–1999 leading to

declining biomass during year 2000. Effort is currently about 84% of effort at AMSY. IATTC staff recommended that current levels of effort should not be exceeded. A resolution was adopted establishing a yellowfin quota of 250,000 mt, with options for increasing the quota by three increments of 60,000 mt.

74. Bigeye showed large increases in catchability since 1993 resulting from expanded use of FADs. Average size in the catch is below the critical weight for maximum yield per recruit, but the disparity is less in year 2000 than in earlier years. Recruitment in 1999-2000 was the lowest since 1981. Recruitment variations appear to be driven to a large extent by environmental variations, as are the estimates of AMSY. IATTC staff recommended no increase in effort. A resolution established a rule closing FAD fishing any time after November 1 in the event that catch of bigeye smaller than 60 cm exceeds the 1999 catch level.

75. Skipjack are estimated to have a large biomass with a low exploitation rate. Biomass and recruitment are highly variable and appear to be driven by environmental variations. Most skipjack are taken by floating object, FAD, or free-swimming school sets. Given the evidently low exploitation rate, there was no recommendation to limit skipjack fishing effort.

76. IATTC examined the status of swordfish under several stock hypotheses using a GLM approach to standardise CPUE. Contrast in the data was insufficient to get meaningful results from stock dynamic models. This is consistent with low exploitation levels and previous analyses indicated that effort levels were less than those that would result in AMSY, implying that the fishery continues to be operating well below AMSY.

77. IATTC has continued development of pelagic ecosystem models using ECOSIM and ECOPATH. Results are giving insights into system behaviour in the presence of physical forcing effects. At present the approach is deemed to be useful in understanding ecosystem behaviour and guiding future research but it is not yet considered suitable for providing management advice.

78. Other resolutions and actions by IATTC include:

1. Bycatch: A continued requirement to retain and land all tunas, i.e. no discarding and "high-grading", and a requirement for fishermen to release non-target species unharmed when ever possible.

2. Vessel registry and Unauthorised Fishing: Developed vessel registry, and adopted a resolution to identify and notify non-member flag-States of their vessels operating in the area in manners inconsistent with the management and conservation actions adopted by the IATTC, and to request whether the State has authorised such vessels to operate in the EPO and whether they are prepared to cooperate with and participate in IATTC management and programs.

3. Established at-sea catch reporting system for tuna catches and fishing effort to enhance abilities to meet management objectives.

4. Catch certification: Established a program to track and verify tuna from capture to retail sale, and established a "Dolphin Safe" certificate under the authority and auspices of the International Dolphin Conservation Program.

79. Full details on these and other programs are available in English and Spanish on the IATTC website at http://www.iattc.org.

Food and Agriculture Organisation (FAO) of the United Nations (UN)

80. Dr Majkowski reported on recent activities of the FAO Fisheries Department. He pointed out that some participants in the meeting and some institutions represented at the meeting significantly contributed to these activities, thanking them for this contribution. He noted that in July 2001, FAO and its sub-regional office in Apia, Western Samoa organised, at SPC, the FAO Pacific Island Regional Workshop on Fishery Statistics to discuss ways of improving statistics, referring to a draft of its report tabled at the Meeting. He noted that in June 2001 at the meeting of the FAO Council held in Rome, Italy, the report of an earlier meeting of the FAO Committee on Fisheries (COFI) was reviewed. The Council recognised, as very timely, the International Plan of Action (IPOA) to prevent, deter and eliminate Illegal, Unreported & Unregulated (IUU) Fishing, which Dr Majkowski outlined. He also mentioned plans for FAO's activities to assist in the implementation of the Plan.

81. Dr Majkowski mentioned areas of FAO's present and future activities recognized by the FAO Council as of priority, particularly those of interest to SCTB such as:

- the implementation of the Code of Conduct of Responsible Fisheries and IPOAs and, in general,
- the promotion of improvements in global fisheries management, particularly of small-scale fisheries, ecosystem-based management, trade aspects of management, fishing gear selectivity, waste reduction, resource assessment and monitoring and special requirement of Small Island Developing States (SIDS).

82. In regards to COFI, Dr Majkowski outlined also FAO's plans to organise Technical Consultations on (i) improving fishery status and trend reporting and (ii) CITES criteria. He also mentioned a request of some countries for FAO's involvement in addressing the tuna fishing capacity on the global scale in relation to tuna resources and socio-economic considerations. He pointed out that before COFI, a Meeting of Regional Fishery Bodies was organised in Rome, the outcome of which was discussed at COFI.

83. Dr Majkowski outlined the progress made by FAO in the development of FAO's Fishery Global Information System (FIGIS) and particularly, its tuna segment, pointing out that:

- pre-agreements of cooperation of FAO with SPC & some tuna fishery bodies have been reached,
- info on the status on tuna stocks from SPC & the tuna bodies is being included in FIGIS,
- overviews on tuna ecology & fishing methods are being incorporated to FIGIS,
- after the transfer of FAO's Atlas of Tuna & Billfish Catches to FIGIS, the Atlas will be updated and extended to include the presentation of not only catch weight, but also its value on maps with an overview of historical development of tuna fisheries
- nominal tuna catches by fishing gear have been collated & they are being included to FIGIS in addition to official national statistics without fishing gear classification, which have always been available always from FAO.

84. Concluding his statement, Dr Majkowski mentioned that the outcome of the Expert Consultation on Implications of the Precautionary Approach for Tuna Fisheries Management has been printed and distributed according to guidelines of its Steering Committee.

Bureau of Rural Sciences (BRS)

85. Since 1993, Australia's Bureau of Rural Sciences (BRS), a scientific establishment of Australia's Commonwealth Department of Agriculture, Fisheries and Forestry has produced annual reviews of the status of fisheries managed by a Commonwealth Statutory Authority, the Australian Fisheries Management Authority. An expertise-based board that includes government and industry members controls the Authority.

86. The annual BRS reviews provide an independent audit of the Authority's management performance, as reflected by the status of the stocks on which the fisheries depend. The reports classify stocks as underfished, fully fished, overfished or uncertain. Trends in classifications will provide a means of monitoring whether management strategies are succeeding in sustaining the resources on which each fishery is based.

87. The BRS has been reviewing the format and approach of the status reports, so is keen to compare them with other approaches to national and regional fishery status and ESD reporting. Standing Committee's national fishery reviews, stock reviews, and regional fishery reviews, provide one such example. Another is the annual United States report to Congress on the status of United States fisheries. The format and approach adopted for such reporting have relevance in relation to Standing Committee's discussions about the need for adopting a more standard template for its reporting. The BRS would be keen to participate in such considerations.

88. A pdf file of the most recent BRS fishery status reports publication is available from the BRS web page at (http://www.brs.gov.au/fish/status99/1999 fishery status.pdf).

National Marine Fisheries Service (NMFS)

89. The Honolulu Laboratory is mounting major research efforts related to the reduction of bycatch of Pacific sea turtles by longline fisheries. The rationale for this research is related to the critical need to develop longline fishing gear technologies and fishing strategies for reducing sea turtle capture rates throughout the Pacific. The potential long-term benefits to Pacific sea turtle stocks of developing new fishing strategies that may be adopted by domestic longline fisheries as well as potentially being exportable to other longline fishing nations far outweigh the minimal harm to sea turtle population status caused by the experiments.

90. The research topics related to longline sea turtle bycatch issues include: 1) research to reduce longline fishery bycatch of sea turtles, 2) research to reduce mortality of sea turtles caught in longline fishing, and 3) research to improve sea turtle population estimates and evaluate management alternatives.

91. There is a need to enhance international co-operation and collaboration in studies to reduce sea turtle bycatch and mortality resulting from longline fishing operations. This includes the necessity for research on gear, fishing strategies, and fishing tactics to avoid catching sea turtles as well as the need to determine the best ways to safely release turtles caught incidental to longline fishing. In addition, international collaboration is needed on research on sea turtle biology and oceanic habitats and on the development of sea turtle population assessment models.

Pelagic Fisheries Research Program (PFRP)

92. The Pelagic Fisheries Research Program (PFRP) makes competitive awards for research in support of management of pelagic fisheries in the WCPO. Approximately 50 different research

projects have been implemented in the fields of economics, oceanography, biology and statistics since 1993. A detailed listing of these projects and resulting publication can be found on the PFRP web site, www.soest.hawaii.edu/PFRP/ The PFRP will circulate a request for proposals (RFP) in December 2001. In addition to the usual broad range of research topics, the 2001 RFP will emphasise research in support of ecosystem-based management of pelagic fisheries, the dynamics of tuna aggregation, and models of protected species population dynamics. A workshop on protected species population dynamics will be convened in November 2001. The PFRP principal investigators workshop will be held in December 2001 and will emphasise research in support of ecosystem-based management of pelagic fisheries. The proceedings of these workshops will be used to refine the 2001 RFP. Interested SCTB participants are welcome at these workshops and to compete for PFRP research grants.

4. STATISTICS WORKING GROUP (SWG)

4.1 Co-ordinator's Report on Data Collection, Compilation and Dissemination

93. The objectives of the Statistics Working Group are to co-ordinate the collection, compilation and dissemination of tuna fisheries data. Mr Lawson presented WP SWG–1, 'Status of data collection, compilation and dissemination'.

Data Collection

94. Regarding the Statistics Working Group objective of co-ordinating data collection, the procedures that were 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 Japanese logsheets had been reviewed by Dr Shui-Kai Chang (Taiwan), Mr Al Coan (United States), Dr Michael Hinton (IATTC) and Mr Lawson (SPC). Problems were noted with the use of activity codes and lack of information on most major non-target species, but otherwise the Japanese logsheets were considered to have been well designed. It was agreed that the catch and effort logsheets used by the Taiwanese longline and purse-seine fleets would be reviewed by a small group following SCTB14 and OFDC agreed to provide translated versions of those logsheets.

Data Compilation

95. The procedures for co-ordinating data compilation include reviewing the compilation of annual catch estimates, the number of vessels by size category, catch and effort data, and length data. Details on the compilation of data are given for each fishing nation in WP SWG–1, 'Estimates of annual catches of target species in tuna fisheries of the western and central Pacific Ocean', and in the OFP Data Catalogue, which is available on the OFP website at www.spc.int/oceanfish.

96. In regards to the compilation of annual catch estimates, estimates of catches during 2000 were requested from most fishing nations prior to SCTB14. All those fishing nations provided estimates of annual catches, except for Japan, the Philippines and Tonga. The OFP obtained an industry estimate of the Japanese purse-seine catch during 2000, but industry estimates of the Japanese longline and pole-and-line catches were not available.

97. The meeting was reminded that in 1998, the tables of annual catch estimates compiled for SCTB (see Working Paper SWG–2) were extended from 1970 back to 1950. In 1999, prior to SCTB12, many historical estimates were provided. However, the time series for total bigeye and

yellowfin catches in the WCPO area, and hence estimates of the total catch of the four target species in the WCPO area, as well as estimates of global catches, will not be complete until estimates for Japanese longliners for 1950–1961 have been determined.

98. In regards to the compilation of statistics on the number of vessels by size category, information was provided prior to SCTB by two fishing nations (New Caledonia and New Zealand) and information was also presented in several SCTB13 national fishery reports. Information is also available for several fleets from data held by the OFP. However, in general, the coverage of the statistics on the number of vessels by size category remains poor.

99. In regards to the compilation of catch and effort data, logsheet data covering the fleets of SPC member countries and territories are provided on a regular basis, although coverage varies. A backlog of catch and effort data covering the Solomon Islands domestic pole-and-line and purse seine fleets was recently provided by the Fisheries Division. Logsheet data for the United States purse-seine fleet, with full coverage, are provided to the OFP by NMFS through FFA.

100. 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 data for the Japanese fleets do not cover the high seas and coverage of the longline fleets of Korea and Taiwan is incomplete. Therefore catch and effort data grouped by time-area strata are requested from Japan, Korea and Taiwan. In February 2001, NRIFSF provided data covering the Japanese fleets, i.e. longliners during 1998–1999, pole-and-line vessels during 1998, and purse seiners during 1967–1999. The whole time series of Japanese purse-seine data was stratified by school association. No new data were provided by NFRDI during the inter-sessional period; the most recent data for Korean longliners, covering 1994–1997, were provided in February 2000. In April 2001, OFDC provided distant-water longline data covering 1997–1998.

101. There continue to be significant 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 kilograms. The unit of time for Korean longline data for 1988-1993 is year, instead of month. The units of catch for Korean longline data for 1994–1997 are kilograms only and not numbers of fish. The 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’. The usefulness of these data for stock assessment will be greatly enhanced when these problems are resolved.

Data Dissemination

102. The procedures for co-ordinating the dissemination of data by the Statistics Working Group includes reviewing instances of dissemination on an annual basis. It was reported that 11 releases of data occurred in 2000 and 8 during January-July 2001. Details of each of the releases are presented in WP SWG–1. 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 available on the SPC website. The data are available in FoxPro DBF files, together with text files containing database formats and notes on the sources of data.

4.2 Review of SCTB13 Directives to the Statistics Working Group

103. The directives to the SWG that were made at SCTB13 were reviewed. The directives were grouped under the following categories: general, vessel and gear attributes, bigeye and yellowfin, albacore, and billfish and bycatch.

General

1. Compile estimates of annual catches of tuna and billfish in small-scale fisheries (commercial, artisanal, subsistence, recreational) (OFP)

104. It was reported that annual catch estimates have been compiled by the OFP for the following small-scale fisheries:

- Australian recreational fisheries, 1981–1995;
- French Polynesia poti marara, 1990–1999;
- Small-scale fisheries in the Gilbert group of Kiribati, 1988;
- Troll and handline fisheries in American Samoa, 1982–2000; Guam, 1980–2000; and the Northern Marianas, 1983–2000.

105. Statistics for small-scale fisheries were considered at the FAO Pacific Islands Regional Workshop on Fishery Statistics, which was held during 16-18 July 2001 in Noumea with 40 participants, including 17 from Pacific island countries. The current status of fishery and aquaculture statistical systems in the participating countries was presented, which ranged from systems covering only exports and industrial tuna fisheries to systems covering all production, including subsistence catches. However, small-scale fisheries are generally poorly covered. The workshop made 16 recommendations for the improvement of fisheries statistics, including the establishment of a regional forum for discussion of issues concerning fishery statistics; training in data collection, processing and analysis; assistance in survey design; increased coverage of non-target species through observer programmes; funding support; etc.

106. The compilation of catch estimates for small-scale fisheries will continue as a regular activity of the SWG.

2. Compile annual catch estimates for tuna, billfish and tuna-like species in the South China Sea, for consideration by MHLC (OFP)

107. Mr Williams presented SWG–4, A review of catches of tuna and tuna-like species in the South China Sea. This paper was originally developed as an OFP Internal report prepared as background material for MHLC7. It has been recently updated with new information that has only become available in the past six months. The original report provides distinction between oceanic and neritic tuna and tuna-like species in the South China Sea, since there have been relatively larger catches of neritic tuna species in this area and it is important to ensure these are distinct from the oceanic species (skipjack, yellowfin and bigeye) catch.

108. The South China Sea is bounded by Philippines (Palawan, Luzon) in the east, Taiwan to the north, China, Vietnam, Cambodia, in the west and Malaysia, Indonesia and Brunei in the south. Several sources of tuna fishery data are available to estimate the catch of oceanic tuna species in this area. The fleets for which historic catch information are currently available are (i) Taiwanese domestic offshore longline fleet, Japanese distant-water longline fleet, (iii) the Philippine purse seine fleet, and (iv) the Vietnamese LL fleet. The paper provides brief background on the sources of data for each fleet.

109. Information from the FAO web site and the Vietnam Ministry of Fisheries web site indicates that exports for the Vietnamese LL fleet have increased significantly in recent years. Informal communications with contacts in Vietnam also suggest that there are purse seine, pole-and-line,

ringnet and gillnet fleets also operating out of Vietnam, although the extent of oceanic tuna catch is currently unknown. The exports for the Vietnamese longline fleet so far this year suggest that the projected 2001 catch could be in excess of 20,000 mt, a significant proportion of the WCPO longline catch. It was therefore suggested that efforts be made to obtain more information on this fleet.

3. Investigate the availability of annual catch estimates, catch and effort data, and sampling data in Indonesia and the Philippines (OFP)

110. Mr Williams reported on his duty travel to Indonesia and the Philippines during two weeks in November 2000. A detailed trip report was produced, including tables showing the availability, provisions and coverage of tuna fishery data by year and gear for each country. It is acknowledged that the domestic fisheries of these countries are important contributors to total tuna catch in the WCPO and the basis of this directive arose from the lack of annual catch estimates for recent years, and the fact that very little catch and effort data and size composition data have been made available from these countries.

111. Indonesia has been involved in a major restructuring of government fisheries bodies in recent years, the results of which may require some time to stabilise. The Directorate General of Capture Fisheries (DGF) is responsible for the compilation of annual catch estimates and Mr Suharyadi Salim, Director of Resources, DGF, recently provided estimates of the annual catches of skipjack and 'tuna' (yellowfin and bigeye) for 1997–1999. However, these estimates were not provided by gear type. The estimate of the 'tuna' catch in 1998 represents an increase of 44,178 tonnes, or 44 percent, compared to 1997. Mr Salim advised that the increases were due to mechanisation of the fleets and increased demand for tuna.

112. Annual catch estimates are compiled through the collection of landings data at the district level (221 districts), which feed up through the provinces (26) and which are then provided to the DGF. Statistics are available at the district level by gear for skipjack and tuna/billfish combined, but have not been provided to OFP at this level, although these data were requested during the visit. It appears that catches in the Pacific Ocean can be clearly differentiated from catches in the Indian Ocean based on district landings. The OFP have requested a breakdown of catch by species and gear for each district to provide a better indication of where fishing is taking place and a better understanding of the sources of the annual estimates.

113. Annual catch estimates for the Philippines domestic tuna fisheries are compiled and provided by Bureau of Agricultural Statistics (BAS). The collection of information on fisheries in general is acknowledged to be poor compared to agriculture and has suffered in recent years due to budget restrictions. This has no doubt also had some effect on the reliability and resolution of the statistics gathered in recent years. Annual catch estimates were last provided for 1997, but estimates for recent years are not likely to be provided in the short term. An recent executive order requires that BAS have a closer working relationship with the Bureau of Fisheries and Aquatic Resources (BFAR), the government bureau primarily responsible for tuna research in the Philippines.

114. Catch and effort data and size data has been historically been collected and compiled by BFAR through port sampling at strategic sites throughout the Philippines. During the visit, the OFP was provided with substantial historic port sampling data, including size data, for the 1980s. Port sampling data for period 1993–1994 were provided previously, leaving the periods 1990–1992 and 1996–2000 outstanding; no sampling occurred during 1995.

115. A recent development has seen the research section of BFAR become the National Fisheries Research and Development Institute, leaving BFAR to look after management, regulatory and training duties only. BFAR has been occupied with a major project, the National Stock Assessment Project (NSAP), since 1998. This is an ambitious project, which has seen the coverage of port sampling increase significantly to approximately 168 sampling sites in 2000.

116. In summary, there appears to be sufficient ancillary information to further review annual catch estimates in both countries, but any work in this area will take substantial time and effort. Both countries basically suffer similar problems in having limited resources to deal with large diverse domestic fisheries, which contribute a significant proportion of the total WCPO tuna catch.

4. Review Japanese longline, pole-and-line and purse-seine logsheets, and possibly other logsheets (Chang, Coan, Hinton, Lawson, Miyabe, Ogura, Skillman)

117. The Japanese logsheets were sent to the group, with checklists of minimum standards, on 23 August 2000. The comments were incorporated into Working Paper SWG–5, Review of Japanese catch and effort logsheets, and are presented below in Appendix 5.

5. Develop a strategy for improving the timeliness of longline catch and effort data (NFRDI, NRIFSF, OFDC, with all other fleets to be covered by the OFP)

118. An OFP project to test the provision by SPC member countries and territories of scanned logsheets to SPC will be implemented at the Micronesian Fisheries Authority later in 2001. A Canon CD–4050 scanner will be used to scan the logsheets, which will then be sent via email to the OFP.

119. It was suggested that there would always be at least a one-year delay in the provision of longline catch and effort data because of the time it takes to verify logsheets with landings data. However, it was also suggested that it should be possible to provide preliminary annual catch estimates for distant-water longline fleets with a much briefer delay.

6. Review the availability of data on sex ratios and length data by gender, for tuna and billfish, from port sampling and observer data (OFP)

120. In general, no data on sex ratios and length by gender are available from port sampling as fish are usually processed onboard; hence, the only data available are observer records from longline vessels. The availability of the current data held by the OFP are given below:

Table 1. Available sex ratio and length data by species

Species	Observations	Observations where sex and length are available	%
Albacore	131,412	19,925	15.2%
Bigeye	25,079	19,615	78.2%
Yellowfin	53,638	34,467	64.3%
Black marlin	880	374	42.5%
Blue marlin	2,486	940	37.8%
Striped Marlin	3,182	2,027	63.7%
Swordfish	10,422	6,204	59.5%

121. It was noted that the geographic coverage of the observer data held by the OFP, and hence the data on sex ratios and length by gender, is limited primarily to the waters of Australia, New Zealand and the tropical WCPO. There is almost no observer coverage in the WCPO north of 20°N and on the high seas in the eastern and southern WCPO.

122. Some data on sex rations and length by gender covering Taiwanese longliners are available from OFDC. During 2000, eight to ten monthly samples of about 500 yellowfin and bigeye were taken. No data are available for earlier years or for other species.

7. Compile information on factors for converting processed weights to whole weights (OFP)

123. It was reported that Australia uses conversion factors of 1.131 for BET and 1.166 for YFT, while Japan uses single conversion factors for each species (although the factors have not been provided). New Caledonia suggests that BET and YFT estimates be raised by 1.120. A request for information concerning conversion factors was sent to fishing nations prior to SCTB14; however, no new information has yet been received. The conversion factors currently used by the OFP are given below:

Species processed to whole weight formulae (Whole weight = Processed weight * σ)

Species	Processed weight	Parameter σ	Sample size	R^2	Source
Albacore	Gilled and gutted	N/A			
Bigeye	Gilled and gutted	1.1018	92	0.9948	Regional Observer data
Yellowfin	Gilled and gutted	1.0896	116	0.9940	Regional Observer data
Black marlin	Headed, Tailed and gutted	1.2005	19	0.7357	Regional Observer data
Blue marlin	Headed, Tailed and gutted	1.2605	103	0.9855	Regional Observer data
Striped marlin	Headed, Tailed and gutted	1.2314	12	0.9378	Regional Observer data
Swordfish	Headed, Tailed and gutted	1.2551	10	0.9834	Regional Observer data
Swordfish	Filleted	1.5269	682	0.9650	Regional Observer data

124. It was noted that conversion factors can vary over time-area strata, as suggested by recent work done by NMFS on swordfish. Hence in order that estimates of annual average weights be reliable, conversion factor data should be collected from time-area strata that are representative of the fishery.

8. Compile information on illegal, unreported and unregulated (IUU) fishing in the WCPO (OFP)

125. An extract from the FFA Violations and Prosecutions (VAP) database was provided to the OFP on 21 July 2000; however, the VAP database does not contain information that can be used to estimate the extent of IUU fishing in the WCPO.

126. It was considered that catch certification schemes might be necessary to determine the extent of unreported catches in the WCPO and it was noted that FAO will hold a expert consultation on the harmonisation of catch certification schemes in December 2001.

127. It was noted that the CCSBT catch certification scheme was only finalised after several years and that it was implemented in order to monitor catch quotas. Implementation of a catch certification scheme for the WCPO will be an even more complex task. It was therefore suggested that the feasibility of using import data to determine first order approximations of the extent of unreported catches in the WCPO be examined, before further considering catch certification schemes.

128. It was reported that during the 19th session of the Co-ordinating Working Party on Fishery Statistics, which was held in Noumea from 9 to 13 July 2001, there was discussion concerning the desirability of generalising trade documentation for all fresh and frozen primary fishery commodities so as to record, for example, the convention area from which the fish were caught and the vessel which took the catch. Such extension of generalised trade documentation could facilitate estimation of total catch and routine comparisons for catch data validation and would be extremely useful. CWP considered that the feasibility of such an extension needs to be investigated in consultation with appropriate trade agencies. Furthermore, CWP recognised that catch certification schemes have proved effective in detecting unreported catches for certain species. Implementation of such schemes has so far been very limited and CWP agreed that there is considerable potential for estimation of further unreported catches by extending them to additional selected species. CWP further agreed that there could be merit in harmonising catch certification used by different regional fishery management bodies, but the full implications of this need to be investigated.

129. IATTC's experience has been that import and export statistics for tuna are not usually accompanied with information identifying the region or even the ocean where the fish were caught; hence these data are frequently unusable.

9. Compile information concerning predation of longline-caught fish by marine mammals (OFP)

130. Mr Lawson presented Working Paper SWG–6, Predation of longline-caught fish by whales and sharks in the western and central Pacific Ocean. Shark predation determined from observer data collected in the tropical WCPO during 1995–2000 was 2.6 percent, compared to 10 percent in the Pacific, 14 percent in the EPO, 6 percent in the South China Sea, 5 percent adjacent to Japan and 5 percent in the Coral Sea reported by Hirayama (1975)[1]. The percentage of shark- and whale-damaged catches are presented by species group below:

[1] Hirayama, N. 1976. Study on predation damages to hooked tuna by shark in longline fishery. Journal of the Tokyo University of Fisheries 62(2): 125–136.

SPECIES GROUP	TOTAL	SHARK DAMAGE		WHALE DAMAGE	
	OBSERVED	N	%	N	%
TUNA	35,323	919	2.6	440	1.2
TUNA-LIKE SPP	1,117	65	5.8	3	0.3
BILLFISH	3,502	127	3.6	19	0.5
OTHER FISH	5,913	95	1.6	6	0.1
SHARKS AND RAYS	12,696	25	0.2	2	0.0
MARINE REPTILES	36	0	0.0	0	0.0
BIRDS	1	0	0.0	0	0.0
MARINE MAMMALS	4	0	0.0	0	0.0
UNSPECIFIED	499	5	1.0	0	0.0
TOTAL	59,091	1,236	2.1	470	0.8

131. Longliners based in Réunion in the Indian Ocean sometimes experience whale damage to the extent that almost all tuna in the longline set are damaged. In the WCPO, there have only been 4 out of 2,243 observed sets for which five or more tuna were caught and for which whales damaged more than 80 percent of the tuna.

132. It was noted that Japan is currently undertaking a large study of predation, with a significant proportion of Japanese longliners participating. It was reported that historical data indicate that Japanese longliners have experienced up to 30 percent predation in certain times and places. It was also reported that Australian longliners on the east coast have reported 20–30 percent predation.

Vessel and Gear Attributes

10. Review data on the FFA Regional Register concerning vessel and gear attributes (OFP, FFA)

133. Mr Colin Millar presented Working Paper FT–1, Review of vessel attributes in the FFA Regional Register, during the session of the Fishing Technology Working Group on Wednesday, 8 August 2001.

11. Compile information on purse-seine vessel and gear attributes and fishing operations, including moored and drifting FADs (Itano)

134. This directive was discussed by the Fishing Technology Working Group.

12. Examine the classification of purse-seine effort by school association (OFP)

135. Mr Millar presented Working paper SWG–7, Classification of purse-seine effort by school association. The paper describes the extent of missing data by time/area strata, the current procedures used to apportion set types to missing data, and reviews the homogeneity of set types by time/area strata. Over 90% of missing data are estimated using the 3 most coarse strata used in the procedure. The purse seine data were examined for homogeneity of set type by the same 8 strata defined by the estimation method. The homogeneity for the finest strata is between 62 and 78% for the major fleets. This gradually decreases until there is virtually no homogeneity for the data stratified by month alone. There are no definite trends within strata. In summary, the results show that there is always a certain degree of heterogeneity in set types and the heterogeneity increases as the strata become coarser.

Bigeye and Yellowfin

13. Evaluate sampling of yellowfin and bigeye species composition for purse-seine (NMFS, NRIFSF, OFDC)

136. NMFS reported that port sampling data covering US purse seiners are representative of sampling strata (e.g. sampling area and quarter), but they are not representative of individual sets.

137. It was noted that sampling of Taiwanese and Korean purse seiners was hampered by well mixing, such that it was difficult for port samplers to identify wells containing the catch from a single set. The problem is most prevalent for Taiwanese vessels, which use dry lockers to sort the catch.

138. It was reported that whole well sampling conducted by IATTC gave results for time-area strata that were not significantly different from previous results based on the usual sampling protocols. Previous studies by the IATTC have shown that directed sampling within wells cannot be used to obtain representative samples for time-area strata.

14. Improve estimation of bigeye catches by purse seiners (NFRDI, NMFS, NRIFSF, OFDC, OFP).

139. Mr Keith Bigelow presented Working Paper SWG–8, Estimation of bigeye catches by purse seiners. Bigeye catch estimates are determined for the Japanese and US 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 US fleet, though the procedure may be biased because bigeye proportions in sets conducted by the other fleets may differ due to various factors (e.g. time and space variability, fleet behaviour, gear modifications).

140. The main objectives were to: 1) compare the composition of bigeye in the yellowfin and bigeye estimates from port and at-sea observer sampling programmes and 2) provide an update of bigeye catches using regression approaches that considers all available port and at-sea observer data.

141. There were 4,599 observer and 1,241 port samples of the bigeye in the bigeye and yellowfin estimates for analysis. For unassociated sets, annual bigeye composition was relatively low compared to associated sets. For associated sets (drifting logs and FADs), there were differences between the annual estimates based on sampling programs for a given fleet. The composition of bigeye was consistently higher in port samples compared to observer samples for both the Japanese and US fleets. The differences in annual estimates between sampling programs could be related to vessel differences, spatial or temporal effects or reflect the high variability in bigeye composition in associated sets. There is a need to further compare the two sampling programs for sources of bias.

142. Tree-based regression models are used in classification problems and six predictor variables were used in the regression. The order of relative importance in the regression was 1) set type, 2) year, 3) month, 4) fleet, 5) longitude and 6) latitude. Predictions from the tree results were applied to the entire fishery dataset in order to predict total bigeye catch by fleet. Estimates from 1988 to 1999 were 31% higher for the US fleet based on the extrapolation of port-sampling data than the regression technique. The discrepancy results from the inclusion of observer data in the regression estimation that has a lower proportion of bigeye than the port-sampling results. Annual estimates for the WCPO range from 7 to 36 thousand tonnes based on extrapolation of port-sampling data and 9 to 37 thousand tonnes based on the regression. Contrary to the US fleet estimates, the regression estimates for the entire WCPO were greater than the extrapolation method in all years except 1996.

Since 1988, annual regression estimates averaged 20% greater than estimates made by extrapolation.

143. The discussion primarily concerned the discrepancies in the proportion of bigeye sampled by port samplers, on the one hand, and observers, on the other. Species composition sampling by observers on purse seiners in the Atlantic and Indian Ocean are not used because the accuracy of species identification is low. The accuracy of the observers was tested by examining their species identification during port sampling.

144. It was suggested that the discrepancies may be the result of the different sampling protocols and that these need to be examined. Port samplers chose wells in which the set type and time and place of capture can be identified and then measure a certain number of fish, whereas observers measure about five fish selected randomly from each brail.

145. The recent introduction of Spanish-style brailing might be affecting the work of observers. The rapid movement of fish makes it difficult to obtain samples.

146. It was agreed that prior to the adoption of the regression estimates of bigeye catches, the discrepancies in the proportion of bigeye determined from data collected by port samplers and observers should be examined by (1) verifying the accuracy of observers through testing during port sampling; (2) examining the port sampling and observer protocols; and (3) examining the effect of Spanish-style brailing on observer sampling.

Albacore

15. Compile catch and effort data for the American Samoa longline fleet and the Canadian troll fleet (OFP, NMFS, DFO)

147. American Samoa longline catch and effort data, grouped by 5x5 and month, for 1996-1999, were provided by NMFS on 3 October 2000. Annual catch estimates for the Canadian troll fleet targeting South Pacific albacore, for 1988-2000, were provided by DFO in July 2001; however, no catch and effort data by time-area strata have been provided.

16. Examine discarding of albacore by Japanese longliners (BRS, NRIFSF)

148. This directive was discussed by the Albacore Research Group.

17. Compile revised Taiwanese distant-water longline catch and effort data, and examine the feasibility of stratifying the catch and effort data by target species (OFDC, OFP)

149. This directive was discussed by the Albacore Research Group. Mr Millar presented Working Paper SWG–11, Taiwanese distant-water longline catch characteristics with regard to albacore targeting. The aim of the paper is to identify trends in targeting by Taiwanese distant water longliners, especially trends for species other than albacore. The sources of data were logsheets provided to SPC member countries by Taiwanese distant-water longliners and aggregated data provided by Taiwan, which have been aggregated by month and 5x5 degree grid. Targeting of species other than albacore could not be identified with albacore dominating the catch in almost all strata. Higher proportions of yellowfin are caught closer to the equator, however Taiwanese effort is low in this area.

18. Examine longline operations in Samoa (e.g. use of shallow sets) in order to explain catches of large albacore (Mulipola)

150. This directive was discussed by the Albacore Research Group.

Billfish and Bycatch

19. Estimate the billfish catch by commercial fleets for species under mandatory release (CSIRO, MOF, NIWA, OFP)

151. Regulations requiring the mandatory release of billfish are currently in force in two countries, Australia and New Zealand. Commercial longline fleets have been required to release dead or alive marlin species in New Zealand since 1988. Logbooks have provision for reporting released billfish, but observer coverage is not considered sufficient to provide reliable annual estimates. However, some work has been undertaken to estimate the released marlin catch for certain discrete periods where observer coverage is considered acceptable (e.g. SCTB12 NFR–13 NZ national tuna fisheries report). The retention of black marlin and blue marlin (dead or alive) in Australian fisheries has been prohibited since 1998. As in New Zealand, logbooks have provision for reporting released billfish, but there is no observer coverage for the domestic fleet, making it difficult to verify what is considered under-estimates of catches. Some analyses have been undertaken by CSIRO using observer-reported catch rates for specific periods.

20. Estimate the tagged-and-released catch in recreational fisheries (Pepperell, OFP)

152. Tables showing tagged-and-release billfish in recreational fisheries by species and source of data have been included in WP SWG–3. Efforts will be made in the coming year to add other sources that have not yet been included, for example, information from gamefishing clubs in Hawaii.

21. Review and revise billfish catch data; document data processing, e.g. conversion of processed weights to whole weights; correct catch data for species miss-identification and species grouping (OFP)

153. This is an ongoing activity. During the past year, procedures have been built into post-entry error checking of logsheets to identify obvious problems in billfish species reporting. For example, a few Korean distant-water longline trips recently reported substantial black marlin with no blue marlin catch in an area where other vessels of the same and other fleets were reporting relatively large catches of blue marlin. This was clearly a problem of misidentification and the data were corrected.

154. The OFP are currently reviewing procedures to estimate billfish average weights by species, time and area using available port sampling and observer data. This will provide the necessary information to estimate billfish catch in weight where billfish catch, in numbers only have been provided. This situation exists with the aggregate Japanese longline data (1962–1999) and for certain years with the aggregate Korean longline data.

22. Compile sex-specific size data for billfish (NFRDI, NRIFSF, OFDC, OFP)

155. This directive was discussed under directive 6 above.

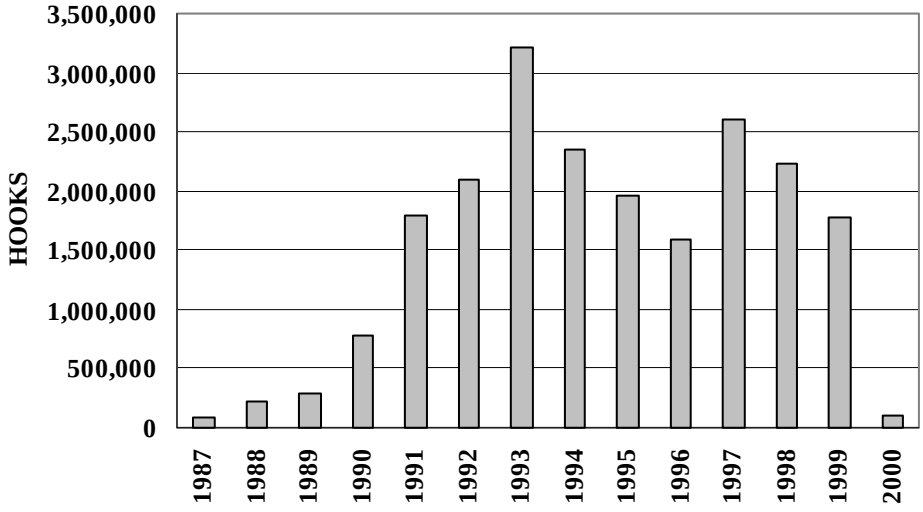
23. Compile annual catch estimates for sharks and rays, marine reptiles, marine mammals and birds (OFP)

156. It was reported that estimates of annual catches of five species of shark are available for Japanese and New Zealand longliners in the New Zealand EEZ and that observed catches of 20 shark species taken by Japanese longliners in the Australian Fishing Zone have been reported, but not annual catch estimates. Estimates of catches of turtles and other species of special interest are available for the Hawaiian longline fleet. Estimates of shark catches, by major species, are available from Japanese longline logsheet data and shark catches, not broken down by species, are available for other longline fleets. It was noted that except for the examples above, the estimation of catches of species of special interest would depend on increasing observer coverage in the WCPO.

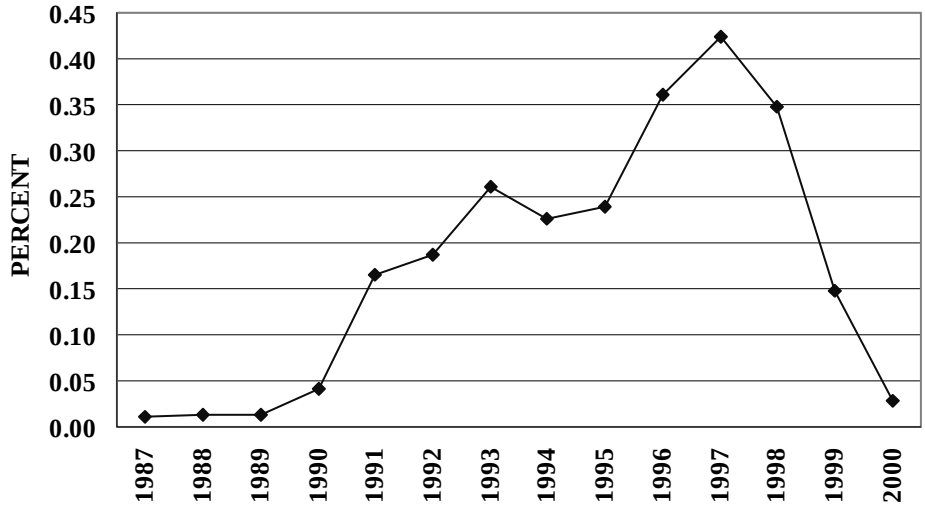
24. Document the data that are available to estimate bycatches, by type of data (logbooks, port sampling, observers), species groups covered, and annual levels of coverage (NFRDI, NMFS, NRIFSF, OFDC, with other fleets to be covered by the OFP)

157. Mr Lawson presented Working Paper SWG–9, 'Observer data held by the Oceanic Fisheries Programme covering tuna fishery bycatches in the western and central Pacific Ocean'. The OFP holds observer data collected from longliners by the national observer programmes of Australia, Federated States of Micronesia, Marshall Islands, New Zealand, Palau, Papua New Guinea and Solomon Islands and the regional programme of SPC. Most of the longline observer data were provided by Australia (43 percent) and New Zealand (38 percent). Observer data covering the Hawaii-based longline fleet are not held by the OFP.

158. Observer coverage of longliners in the WCPO during 1987–2000 represents 0.2 percent of the catch of tuna. Observer coverage of longliners, in number of hooks covered and the percentage of the catch of tuna covered, is presented in the figures below. (The statistics for 2000 are incomplete.)

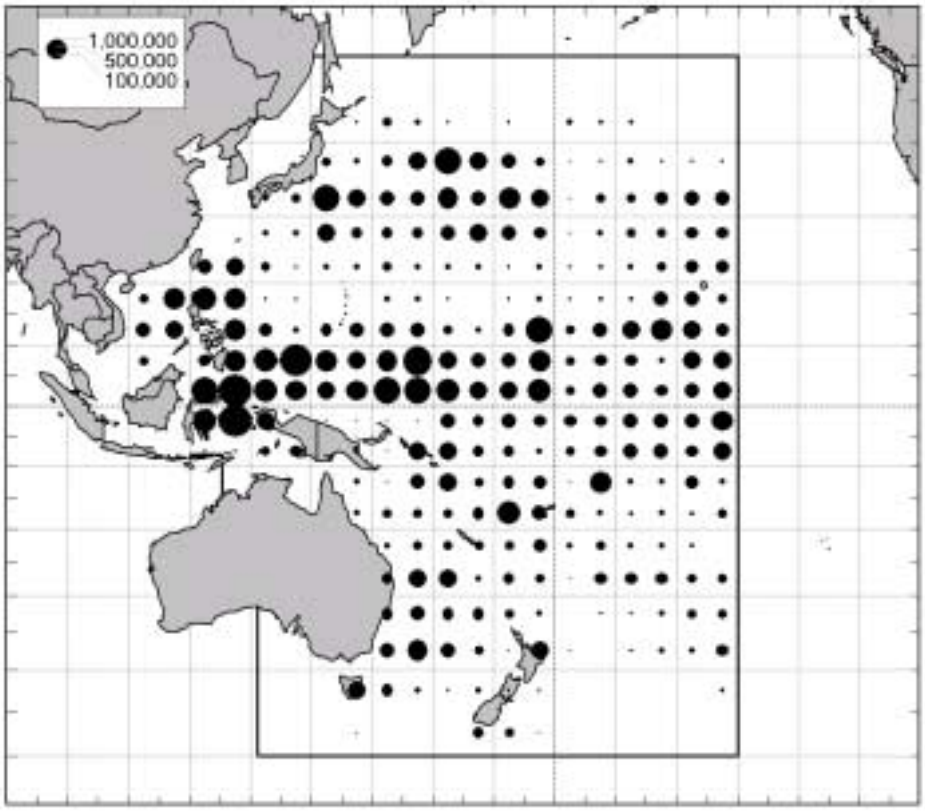


Observer coverage (hooks) of longliners in the WCPO Area

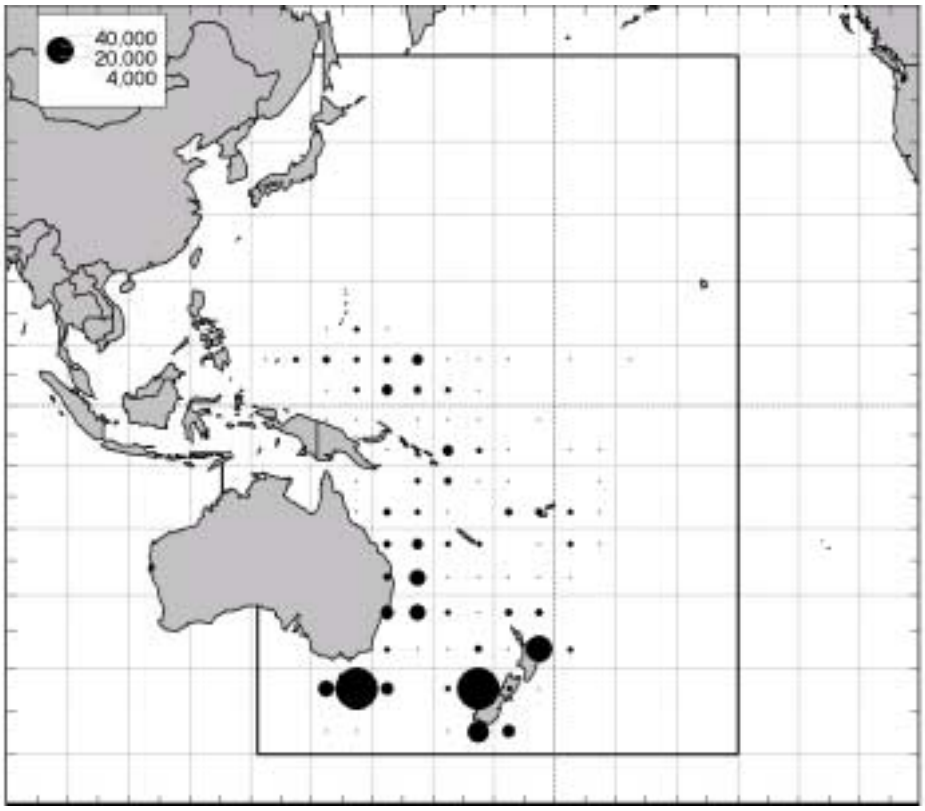


Observer coverage (percentage of total catch of target

159. The geographic area covered by the longline observer data is not representative of the fishing effort, as can be seen in the figures below, with the observer coverage concentrated in the waters of Australia and New Zealand and the tropical WCPO, but no coverage in the northern and eastern WCPO.



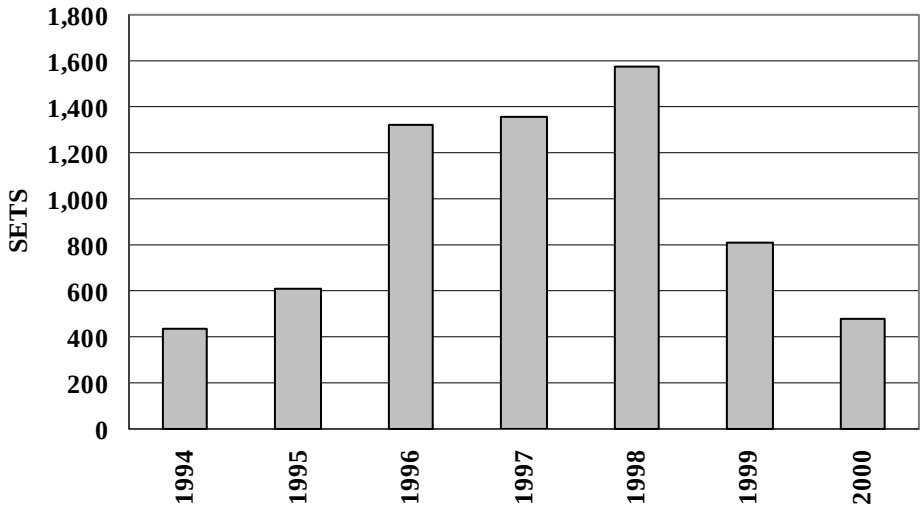
Total longline effort (hundred hooks) in the WCPO Area during 1987–1999



Observed longline effort (hundred hooks) in the WCPO during 1987–2000 determined from data held by the OFP

160. The OFP holds observer data collected from purse seiners by the national observer programmes of Federated States of Micronesia, Nauru, Papua New Guinea and Solomon Islands and the regional programmes of FFA and SPC. Most of the purse-seine observer data cover the US fleet (67 percent).

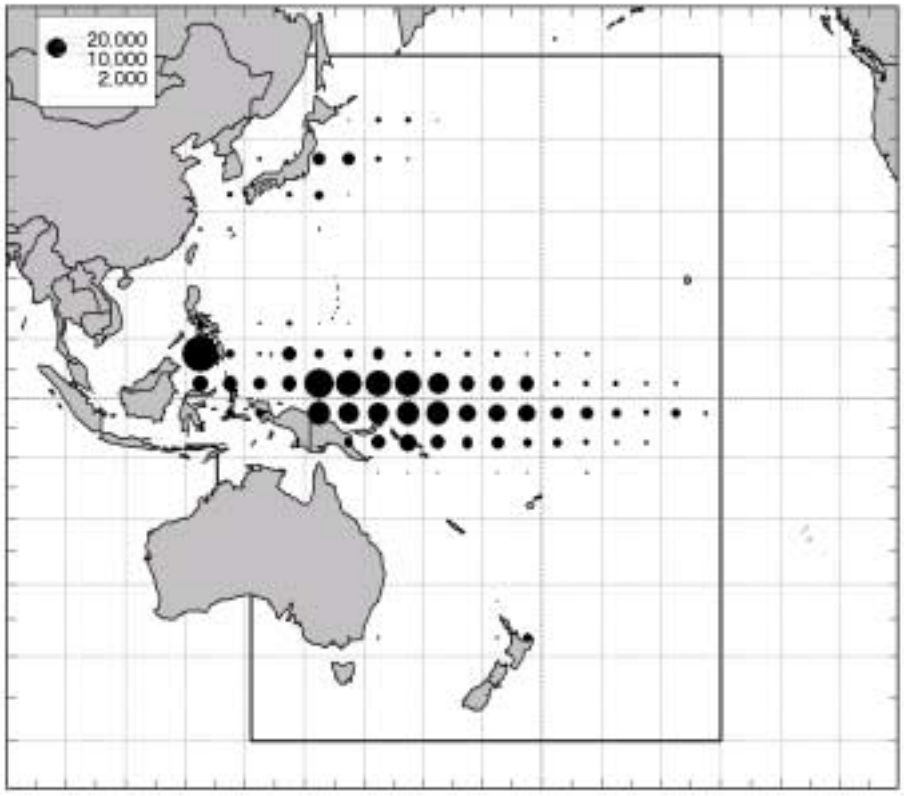
161. Observer coverage of purse seiners in the WCPO during 1994–2000 represents 3.9 percent percent of the catch of tuna. Observer coverage of purse seiners, in number of sets covered and the percentage of the catch of tuna covered, is presented in the figures below. (The statistics for 2000 are incomplete.)



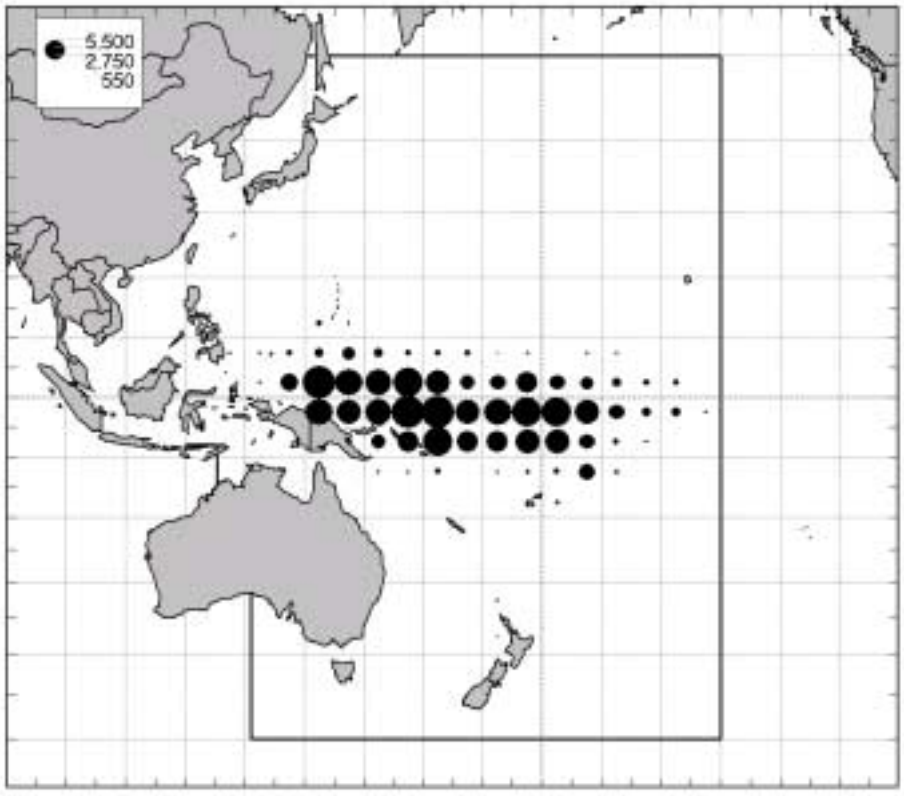
Observer coverage (number of sets) of purse seiners in the WCPO Area

Observer coverage (percentage of total catch of target species) of purse seiners in the WCPO Area

162. The geographic area covered by the purse-seine observer data is representative of the fishing effort, with the exception of the waters of Philippines and Japan, as can be seen in the figures below.



**Total purse-seine effort (days fished or searched)
in the WCPO during 1994–1999**



**Observed purse-seine effort (days fished or searched) in the WCPO during 1994–2000
determined from data held by the OFP**

163. It was reported that Taiwan will undertake a pilot observer programme, with a small number of observer trips aboard longliners and purse seiners. The objective of the programme is primarily to collect biological data.

25. Develop a strategy for increasing observer coverage of longline fleets in order to improve the reporting of bycatches (NFRDI, NRIFSF, OFDC, with other fleets to be covered by the OFP)

164. Ms Brogan reported on the status of observer programmes in the WCPO. New Zealand currently has 100 percent coverage on their joint-venture longliners, with considerably lower coverage on their domestic fleet. The coverage levels for the Hawaiian observer programme are presently running at 20 percent coverage, as are the USMLT and FSM Treaty programmes run by FFA. The FSM observer programme, one of the longest running and most productive national observer programmes, had 2.7 percent coverage during 2000. PNG have recently restructured their programme and are hoping to achieve 5 percent coverage of all foreign vessels in 2001. Kiribati, which has recently had in-country observer training, is actively arranging for the placement of observers on vessels. While the Solomon Islands did have a good observer programme previously, it was temporarily suspended with the civil unrest, but has recently re-started albeit at a much lower rate. Currently Marshalls Islands observers are only used as port samplers, but it is hoped to place observers on a number of longline vessels that have recently been licensed to fish in their zone. Palau and Fiji both have had in-country observer training, but they have no observer programme at present. Samoa and Vanuatu have requested observer training. Finally, American Samoa, French Polynesia, New Caledonia and Australia have all signalled their intention to start an observer programme, on their domestic tuna longline fleets, within the next 12 months.

165. The role of the SCTB in regard to national and regional observer programmes was then discussed, noting that Article 28 of the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean specifies that "the Commission shall develop a regional observer programme to collect verified catch data, other scientific data and additional information related to the fishery from the Convention Area and to monitor the implementation of the conservation and management measures adopted by the Commission". It was suggested that the possible roles of the SCTB could be to:

- establish minimum data standards for observer programmes (as has already been done by the SWG for logsheets);

- determine coverage rates required for scientific purposes, i.e. the "sufficient level of coverage to ensure that the Commission receives appropriate data and information on catch levels and related matters"; and

- review methods for estimating catches of non-target species using observer data (see, for example, Working Paper SWG–10, 'Methods for analysing bycatches with observer data').

166. It was proposed that the Statistics Working Group (a) convene a workshop to determine minimum standards for research data collected by observers and (b) establish a sub-group to examine coverage rates and statistical methods.

167. Regarding the establishment of minimum standards for observer data, it was recognised that observer programmes can have various research objectives; therefore, data standards should be associated with the different objectives. On the other hand, most observer programmes are expected

to have certain common objectives, such as the collection of species composition data and/or the collection of length samples.

168. It was suggested that the OFP could advise regional and national observer programmes on the allocation of observer effort in order to collect the appropriate data required to improve stock assessments and for other research purposes that may be identified by the SCTB species research groups.

4.3 SCTB14 Directives to the Statistics Working Group

1. Compile annual catch estimates, catch and effort data and length data from Indonesia and the Philippines and examine the availability of data for Vietnam. (OFP)
2. Evaluate methods to determine the extent of unreported catches in the WCPO, including trade statistics and catch certification schemes. (OFP)
3. Examine the discrepancies between bigeye and yellowfin sampling by observers and port samplers by considering (a) sampling protocols, (b) the accuracy of species identification and (c) the effects of Spanish-style brailing on sampling by observers. (OFP, FFA, NMFS, FTWG)
4. Convene a workshop to determine minimum standards for research data collected by observers. (OFP)

169. Other directives to the Statistics Working Group are included in the workplans of the other working groups and research groups.

5. FISHING TECHNOLOGY WORKING GROUP (FTWG)

170. A preparatory meeting for the Fishing Technology Working Group was held on 8 August 2001 immediately prior to 14th meeting of the Standing Committee on Tuna and Billfish. During that meeting the working papers and the terms of reference for the group were discussed.

5.1 Introduction

171. Mr Itano, as Chairman, opened the session. He outlined the work that had been done by the group during the preparatory meeting. His paper WP FTWG-4 summarised the justification, the main objectives, concepts, participation and gave preliminary task list from SCTB 13.

172. The Yellowfin Research Group of the 13th Standing Committee on Tuna and Billfish, Statistics, research and coordination planning section recommended the following: "*Organize a working group to document current status and recent developments in purse seine technology with particular emphasis on those developments with significant potential to impact sampling programs, catch and effort analyses and other data sources necessary for management related research. The Working Group will also monitor developments in the use of moored and drifting FADs and work in collaboration with appropriate members of the Skipjack and Bigeye Working Groups through e-mail correspondence, and meet one day prior to the next SCTB meeting.*"

173. Through email correspondence, the FTWG was established and produced several working papers for discussion. The paper concludes with a request to SCTB for guidance on what types and areas of data collection and analysis should be pursued by the FTWG that would be most useful toward SCTB goals.

5.2 Compatible programs and recent initiatives relevant to the FTWG

174. Groups compatible with the FTWG already exist, and one of the main peers is the European ESTHER programme, that has been working to document historical and current gear technology in the European tuna purse seine fleet.

175. Mr Julio Morón, a major player in that project, travelled a considerable distance to share some of his knowledge with SCTB. Julio directed people to WP FTWG-6 describing the EU funded project "*Efficiency of the tuna purse seiners and effective efforts* (ESTHER)", which is a cooperative effort of IRD and IEO that began in 1999 to examine the impact of increasing effective fishing effort of EU tuna purse seiners operating in the Eastern Atlantic and Indian Oceans. The effort consists of collaboration of ten scientists from several organizations under the direction of Mr Daniel Gaertner, IRD. The main objectives of ESTHER are to; define the main technical factors related to increasing effective effort; establish a system of data collection to develop a database, and conduct statistical and simulation studies. The program will run for a 24-month period using data from commercial logsheet sources, interviews with fishing captains, written surveys and at-sea observer trips. The similarity of mission and objectives between the ESTHER and FTWG goals were noted and close collaboration with ESTHER scientists and Daniel Gaertner was encouraged. Unfortunately, Mr Gaertner could not attend SCTB 14 due to flight scheduling problems but it should be noted that he was willing to finance his attendance to this meeting and is willing to cooperate and assist fully with the FTWG.

176. Mr Morón then went on to present WP FTWG–9, "The Management Measures for the European Tuna Purse Seine Fleet". The main components of the European tuna fleet are the Spanish and French vessels. The EU is already a member of ICCAT and IOTC and has applied to be a member of IATTC. The relationship between the EU fleet and these organisations, whether through monetary funding or applied research is well established and beneficial to all parties. The EU has observer status with the MHLC. Since 1999, all EU vessels have been obliged to use VMS, with Immarsat C the chosen system. A concern in the Atlantic Ocean regarding the high level of capture of juvenile bigeye led to a voluntary moratorium on log fishing there. The area, results and the eventual formal adoption of that moratorium by ICCAT were outlined, as was the support by industry for non-traumatic management solutions.

177. In the absence of Dr Alan Fonteneau, Mr Itano presented WP FTWG–2, "An overview of problems in the catch per unit of effort and abundance relationship for the tropical purse seine fisheries". This paper was originally submitted to ICCAT in 1999 and the authors generously agreed to resubmit the paper to the FTWG/SCTB 14 meeting. The paper concisely summarizes several problems that may be encountered in CPUE analyses if certain factors are not accounted for. In summary some of these problems are: basic data problems and inconsistencies, non-documented changes in time/area strata of fishery, non-random distribution of the analysis – and the need to capture this in analyses, uncorrected increase in effective fishing effort, or fishing power, lack of relationship between local CPUE and biomass, changes in fishing mode or introductions of new methods, undocumented influence of cooperative searching and information sharing, changes in price structure of target species and new markets, changes in local abundance and vulnerability, ageing of vessels. The paper also contains a discussion on different abundance indices and analytical methods to examine standardization of purse seine effort given rapidly increasing effective fishing effort. The paper was seen by the group as a valuable reference document useful for planning the work plan and objectives of the FTWG.

178. Mr Honda presented WP FTWG-7, a status report of the World Tuna Purse Seine Organisation (WTPO). The most recent meeting of the WTPO was in July 2001. A number of resolutions were adopted at the meeting. The WTPO stated that vessels from Japan, Korea, Taiwan and the US would stop fishing for 45 days within the next 90 days, that the Phillippine members would reduce their number of vessels by one in three, and that all WTPO members would make a strong commitment not to sell skipjack below the current price level. They recognised the need to; consider the end to the growth of the worldwide fleet, to establish a price before sailing, to reduce the fishing effort, to ascertain a global target level, and to promote in regional organisations the concepts of resource management and economic sustainable yield. The WTPO made a final commitment to react immediately if further action was required, to urge non-members to join and to promote and to encourage the consumption of tuna.

5.3 Technical data holdings, database status and accessibility.

179. Mr Karl Staisch gave a review of the status of FFA's technical observer data and accessibility. Between 1994 and 2001 approximately 280 trips were carried out on USMLT purse-seiners by observers. Observer data since 1996 have been collected under the regional harmonised format and is readily available on the database. Data collected before this date, back as far as 1987, are currently being transcribed. Good technical gear data are available from 1994. Access to the data, for the purpose of research or study will be considered, with a formal request to the Director of FFA.

180. Mr Millar presented WP FTWG–1 a "Review of Vessel Attributes in the FFA Regional Register". The paper examines the data values for vessel attributes in the FFA Regional Register in terms of integrity and completeness. In summary, there were a number of problems with the data that would need to be resolved before certain fields could be used in analyses. The main problems are: duplicate vessels, high percentages of missing data, different spellings of the same item in text descriptions, a mixture of units used for some numeric fields, no unique value with the meaning 'no information', and some possible entry errors. Most of these types of errors can be avoided by adding integrity checks to the database itself and/or to the data entry programs, for example checks could be set up to reject certain criteria such as null values or values outside of a reasonable range.

181. Ms Brogan presented WP FTWG–8, "The status of SPC's observer data collection, standardisation and accessibility with regard to gear and vessel attributes". SPC observer database currently holds over 1,500 observer trips, with substantial holdings from Australia, New Zealand the USMLT observer programmes. Over 600 of these are trips are on purse seine trips. Vessel and gear attributes have recently been added to the database and data on 78 different purse seiners are now available. These vessel numbers will be considerably increased when data from the MFA programme and USMLT are entered and imported. Output reports for this data are available by request and will eventually be incorporated into the database.

182. FFA's regional register was a good source of information on vessel attributes. A small sub-group met after the preparatory meeting to discuss the regional register. Les Clarke commented on the three proposals that were made at that meeting. The proposals were: (i) FFA should improve the management of vessel attributes in the regional register including the rehabilitation of the historical data, (ii) FTWG should prepare a list of vessel characteristics that need to be collected, and (iii) SWG would look at the compilations of these characteristics once they have been identified.

5.4 Country Reports

183. Mr Kumoru presented WP FTWG–13, "Purse Seine Operations in Papua New Guinea". He explained that of the 139 purse seine vessels licensed to fish in PNG, 24 fish exclusively on anchored FADs. The total number of anchored FADs is said to be 700, although in reality the numbers are probably closer to 2000. Vessels are allowed to deploy 50 FADs each. The catcher vessels work with approximately three tender boats, surveying an average of 10 FADs each per day. FADs are surveyed using side sonar, divers, or handlining. A light boat will stay with the selected FAD to aggregate fish from 21.00 hrs until the 03.00 hrs set. Most of the FADs in PNG are in the Bismarck Sea and at least 12 miles from any known reef or island.

184. When asked to comment on the Solomon Islands, Mr Oreihaka referred people to his country report WP NFR–14. He highlighted the operational difficulties faced by the fishing companies due to civil unrest. Many companies had reduced their operations considerably and contact with them was difficult.

185. Mr Ran-Fen Wu presented WP FTWG-12, "A brief overview in recent development of purse seine fishery in Taiwan". Purse seine fishing technology was introduced in early 1980s. Since then, it grew rapidly, and the annual production has reached about 200,000 mt accounting for about 15% of the overall fisheries production in 1999. Currently, there are 41 purse seine vessels in Taiwan, 80% of which have the capacity of carrying a helicopter, although use may be limited by the high rental costs. In addition, there are 10 different sizes of net used by Taiwanese purse seiners. The most popular sizes are 1,650 m by 300 m and 1,720 m by 300 m. All Taiwanese purse seine vessels are equipped with seabird radar and sonar. In the 1980s and the early 1990s, the fish aggregation devices (FADs) used by skippers were mostly logs. However, at present, more and more skippers use bound coconut or banana leaves as FAD. To better manage the fishing fleet and to meet the requirements of access agreements, 100% of the purse seiners have installed the Inmarsat-C vessel monitoring system. The fishing grounds of the fleet have also changed dynamically over the years, along with the environmental changes. The recent depression in international tuna market has caused large financial losses to the major fishing companies in Taiwan. Thus, boat owners have decided to suspend fishing operations voluntarily to reduce the supply of skipjack.

186. Mr Park presented a Vessel Operating Profile for Micronesia. The vessel details, fishing habits, temporal pattern and spatial patterns of effort were outlined. An overview of the relative ages, GRT, and engine power to length of the fleets was given. Fishing habits which characterised the fleets included trip duration, base port and consequently fishing location. The predominant set types employed among purse seine fleets differed. The Taiwanese had the highest proportion of FAD sets, Japanese purse seiners had the highest proportion of logs sets while the Korean vessels most frequently did free school sets over the period.

187. The longline fleets were bipolar in set and haul times with the offshore small Japanese longliners, domestic and Guam based US flagged longliners setting during the day, whereas the Chinese and Taiwanese longliners set at night. Associated with this bipolarity of fleets, the fleets were also characterised in terms of the number of hooks set, number of hooks per basket and relative minimum hook depth.

188. Temporal patterns of activity were noticed. Monthly fishing effort of the Chinese longliners peaked in the boreal summer and was lowest in February during the Chinese New Year. The Pacific based offshore Japanese fleet had the opposite pattern with a lull in activity in summer. Chinese longliners had the clearest lunar cycle of effort. The fleet fished the full moon period.

189. Spatial patterns of catch of the longline fleets appeared to be determined by their base port and their range, which in turn was related to storage technology and the capacity of the vessels. The Chinese faced the most restricted, while the offshore Japanese and Taiwanese longliners, based in Guam were less restricted and fished in the central and western longitudes of the EEZ, from Guam to the southern High Seas. The least restricted were the distant water Japanese longliners that fished across the entire southern end of the EEZ.

190. With regard to other major purse seine or FAD countries, not otherwise covered, Mr Itano mentioned the possible extent and concentration of the Indonesian and Philippine fleet fishing on FADs. SCTB recognises the need to collect more information from these countries and for that reason contact has been made, and participants invited to this year's meeting. Unfortunately no one was able to attend, but contact will be maintained and hopefully improved. New Zealand informed the floor of two new purse seine vessels (formerly part of the American tuna fleet) that were recently purchased and will commence fishing in the Pacific under the New Zealand flag.

5.5 Recent developments and entrants to the WCPO purse seine fishery

191. Mr Morón presented WP FTWG–11, "Statistics and technical information about the Spanish purse seine fleet in the Pacific". The paper gives an overview of the catch figures for the Spanish fleet in the EPO and the WCPO, outlines the final markets destination of the fish and expands on the various logbook systems that the Spanish use including the SPC/FFA regional logsheet.

192. Vessel technical information, and its associated impact, as analysed under the ESTHER project, was also summarised. The introduction and evolution of the various models of sonar, radar and net design was shown. Radio buoy development was seen as one of the most important technological advances in recent years. Vessels have moved from old style radio buoys with low range, limited battery power through to Sel-call buoy with ranges of up to 700 miles. A breakthrough in buoy technology came around 1996 when the GPS buoys became available. Finally in the late 1990's a buoy that could show position, SST battery level and a triggered light became available. The ultimate buoy is now one with an unlimited range, communicating via Immarsat, reading the position, SST and battery power.

193. Mr Steve Beverly presented WP FTWG–10, "Longline fishing perspectives: Techniques, gear, boats, bait and recent trends." There are two styles of longline gear - the traditional basket gear or the more recent monofilament gear. Basket gear was disadvantaged by fixed branchline intervals, heavy mainline rope, resistant to retrieval from a depth, and the effort and knowledge required to maintain and set this gear. Monofilament gear is easier to use and can be deployed to greater depth with ease. Developments with monofilament gear include twin reels, new fishing lights (Electralume™) which effectively replace lightsticks and the use of temperature depth recorders. Advances in chart plotters which allow sea-bed mapping to be integrated into the plotter are also a new feature of longline fishing, as are remote sensing applications which show temperature fronts and plankton concentrations, thus reducing searching time. Another option is satellite radar altimeter which is not affected by cloud cover. A longline fishing simulator is being developed. The growth in the domestic longline fishing in the Pacific was outlined.

5.6 General discussion topics

194. Mr Itano presented WP FTWG–3 "Factors that may have affected U.S. purse seine catch rates in the central-western Pacific Ocean: an examination of fishing strategy and effective fishing effort".

195. This analysis utilized observer and logsheet data collected on US purse seine vessels operating in the WCPO that was collected under conditions of the USMLT. Fifteen vessels that had made at least one trip per year during 1988-2000 were examined. Due to incomplete data in 1988 and anomalous fishing activity in 2000 due to self-imposed reductions in effort, the 1989-99 period was examined. The period up to 1996 was characterized as a period of free school setting for the US fleet, while the period 1997-99 was described as a period of high drifting FAD setting. These fifteen vessels are considered to well represent the entire US western Pacific fleet, comprising 38 % of the fleet (numbers of vessels) and 39% of the catch.

196. During the 11 year period, it was seen that vessels shifted significantly in fishing mode from free school to associated seining after 1996, to a high seen in 1999 when 94% of all sets were made on drifting FADs. During the period of high drifting FAD use, an increase in the number of trips made per year was noted through a reduction in no catch days and a significant increase in average catch per set and catch per day. However, catch rates of bigeye and small target tropical tunas was also noted to increase significantly with a presumed increase in FAD associated bycatch.

197. Mr Clark presented WP FTWG–5 "Review of the Palau Arrangement and Work on Options for Bigeye Management". Based on previous analysis, the Parties to the Arrangement have decided in principle to shift the basis of the Arrangement from a limit on purse seine vessel numbers allocated by fleet (the total is currently set at 205 vessels) to limit on purse seine vessel fishing days allocated by zone. Mr Clark noted that two particular issues relating to fishing technology which needed to be addressed in revising the Arrangement are managing the impact of increasing vessel fishing power over time which would be accentuated by an effective capacity limit, and deciding on how to classify vessels according to fishing power.

198. Mr Clark also informed the Group of the work that was being done within the FFA on analysing options for the management of bigeye, particularly in the light of the possible impact on the stock of increasing catches of juvenile bigeye by purse seine fishing on FADs. After a broad review of possible management options, including management options that had been applied or considered in other regions, further work was being undertaken on six options - time and area limits; limits on the use of tender vessels; limits on FAD numbers or FAD sets per vessel; compulsory retention/no discards of juvenile tuna; limits on net depth; and overall (holistic) bigeye management, covering both surface and longline fisheries.

5.7 Research co-ordination and planning

199. One of the main tasks of the preparatory FTWG meeting, was to draw up a Terms of Reference document for the newly developing group. Mr Itano presented a draft of the TOR that was compiled as a result of the prepatory meeting and solicted comments from SCTB. A number of comments were made and they have been included in the final version of the TOR, where appropriate.

Terms of Reference of the FTWG

1. The primary region of focus for the FTWG is the WCPO, currently monitored by the SCTB. However, advance in fishing technology move rapidly between ocean basins, reinforcing the need for the FTWG to work closely with research and monitoring organisations from the Atlantic, Indian and Eastern Pacific Oceans.

2. Participation: as with the SCTB and its affiliated Research and Working Parties, membership to the FTWG is open to all scientists or other parties with an interest in tuna fisheries of the WCPO.

    a. Promote membership and participation with national fisheries organisations and regional tuna management and research bodies.

    b. Promote membership and participation with key DWFN entities with purse seine and longline fleets operating in the region.

    c. Promote membership and participation with tuna industry sectors, i.e. vessel owners, fishing masters, vessel/gear manufacturers, processors, etc.

    d. Foster close collaboration with the IRD/IEO research project ESTHER and SCTB species working groups on issues related to FTWG concerns.

    e. Promote collaboration with regional tuna industry organisations, such as the World Tuna Purse Seine Organisation (WTPSO) and regional longline associations.

3. Emphasis of FTWG will be prioritised toward fisheries, gear types or recent developments in regional fisheries considered of high management concern by the FTWG and SCTB members. FTWG data collection, research and analysis will be on developments in regional fisheries with potential to significantly influence sampling programs, catch and effort analyses and any data sources useful to management related research. However, new developments in any surface fishery world-wide may be examined and reported.

4. Promote and conduct research and analyses on innovative fishing methods and technology to reduce bycatch levels.

5. Promote and conduct and research and analyses of an innovative nature to estimate increases and impacts of advancing effective fishing effort that do not require the collection of detailed technical data on gear and methods.

6. Document current status and recent innovations (previous SCTB to current SCTB) in fishing technology in categories to include but not be limited to:

    a. Fishing gear and methods, catch loading, storage, freezing, unloading and processing technologies;

    b. Drifting FADs (design, electronics, utilisation, quantities etc);

    c. Fish detection, communication and marine electronics;

    d. Remote sensing technologies.

7. Monitor and summarise recent expansions or contraction of fishing effort (vessels and fleets) in the region.

8. Examine socio-economic and other factors that may influence fishing power; i.e. experience of captain, crew composition and remuneration, vessel age, changes in vessel flag and registry, effort restrictions imposed by vessel flag state, price structure fluctuations, market shifts, etc.

9. Monitor the status of large-scaled moored FAD arrays used by industrial fishing gears.

10. Conduct analyses of existing technical data relevant to changes in effective fishing effort.

Research tasks arising from the FTWG for SCTB15

200. A draft task list was also submitted to SCTB for consideration and although a number of comments were made, for the sake of compiling a thoughtful and a cohesive list, the coordinator requested that the task list could be finalised post-SCTB via email, which was approved by SCTB. After consideration the final task list reads;

1. Compile a reference list and electronic library of documents of interest to the FTWG that would be useful to address FTWG Terms of Reference. (Itano, Gaertner, Park, OFP, FFA, others)

2. Compile and translate ICCAT, ESTHER and other documents useful to the FTWG to English language versions for inclusion in the electronic reference library. Summarize particularly useful documents for FTWG members. (Gaertner, Pallares, Morón Ayala, Areso, Honda)

3. Establish contact with commercial tuna fishing associations and industry related organizations to advance cooperative studies and information sharing. (FFA, DWFN and PIN representatives to FTWG)

4. Compile descriptions of the development of WCPO purse seine and longline fisheries by fleet, describing a timeline of significant advances in fishing technology and shifts in fishing methods. Document a "state of the art" purse seine and longline vessel as an example of where fishing technology may be headed in the future. (OFP, FFA, Itano, Brogan, Staisch, Beverly, Morón Ayala , Areso, Coan, Park, Dai, Koh, Wang, Wu).

5. Coordinate with FFA as the FFA improves its management of data on vessel and gear attributes in the Regional Register, including trying to rehabilitate the historical data. (FFA, OFP).

6. Evaluate the data that needs to be collected by the Regional Register on vessel and gear attributes with a view to identifying data that is "essential" and data that is "desirable". Request the SWG and OFP that they encourage the provision of this data from flag states not required to report on the Regional Register (OFP, FFA).

7. Compile information on the status of anchored FAD arrays for use by industrial fisheries within the WCPO. (Kumoru, Oreihaka, Opnai, OFP, Philippines representation, Indonesian representation).

8. Investigate size and species composition of target catch and bycatch taken by purse seine sets on anchored FADs with emphasis on bigeye tuna. (Itano, Brogan, Staisch, Kumoru, Oreihaka, Opnai).

9. Define current state of drifting FAD technology, i.e. FAD design(s), numbers of FADs per vessel, use of tender vessels, use of telesounding radio buoys, chumming, artificial light, etc. in consultation with industry experts and observer data whenever possible. (Brogan, Staisch, Coan, Areso, Itano, Morón Ayala, Pallares).

10. Investigate the role of sonar to purse seine fishing power and extent to which sonar is currently useful for species and size discrimination of target species and bycatch. (Coan, Brogan, Areso, Itano, Staisch, Gaertner, Morón Ayala).

11. Investigate the impact of new fishing technologies, i.e. Spanish style brailing, on length frequency and species composition sampling at sea. (Staisch, Park, Itano, Kumoru, Brogan)

6. METHODS WORKING GROUP (MWG)

201. The SCTB Methods Working Group (MWG) held a first meeting on 8 August 2001 at the Secretariat of the Pacific Community, Noumea, prior to 14th meeting of the Standing Committee on Tuna and Billfish. The first meeting was attended by Mr Bigelow, Dr Campbell, Dr Conser, Dr Dave Foley, Dr John Hampton, Dr Hinton, Dr Pierre Kleiber, Dr Labelle, Dr Mike Laurs, Dr Lehodey, Dr Majkowski, Dr Murray, Dr Sibert, Dr Skillman, Mr Neville Smith, Dr Chi-Lu Sun, and Dr Chien-Hsiung Wang.

6.1 Review of the terms of reference

202. As this was the first meeting of the MWG, the Terms of Reference were reviewed in the order as listed originally. The original terms of reference were

1. Develop criteria for evaluating the performance of stock assessment methods applicable to the tuna fisheries of the western and central Pacific Ocean tuna fishery.

2. Investigate the statistical properties and performance of selected stock assessment methods using simulation analysis and other appropriate methods and, on the basis of studies undertaken, make recommendations to SCTB regarding the most appropriate methods to be used for the assessment of target tuna stocks and important bycatch species of the western and central Pacific Ocean tuna fishery.

3. Provide ongoing review of the application of stock assessment models to the various species of interest and, where necessary, make recommendations to SCTB regarding enhancements to the models to improve their performance or to address deficiencies with regards to specific applications.

4. Co-ordinate research to determine appropriate biological reference points for target tuna stocks and important bycatch species of the western and central Pacific Ocean tuna fishery and make recommendations to SCTB on the basis of this research.

5. Advise SCTB on appropriate methods of formulating scientific advice for management.

6. Advise SCTB on methods that might be used to monitor and assess the ecosystem impacts of tuna fishing in the western and central Pacific Ocean.

7. Advise SCTB on stock assessment research needs.

Re: TORs 1-3.

203. These were discussed together. It was acknowledged by the MWG that in recent years MULTIFAN-CL (MFCL) has become the principal stock assessment method used to undertake stock assessments for the principal target species within the Western and Central Pacific Ocean (WCPO). It was explained that development of MFCL was promoted by the Western Pacific Yellowfin Research Group in response to a perceived lack of existing models appropriate to the data for the fisheries in this region. In particular, the lack of data in many regions and years would have required a large amount of data substitution if traditional methods had been adopted. Instead of

crafting data to fit existing models, it had been deemed more appropriate to craft a new model to fit the existing data. This was the genesis of MFCL.

204. While the general concepts underlying MFCL are generally well accepted, it was nevertheless acknowledged by some that there exists a reticence to fully accept all the model results at this stage. To a large extent, this is due to the fact that the model is relatively new and that its general statistical properties and limitations are not well understood compared to older models. While the use of diagnostics was seen as being important in evaluating the utility of different methods, it was also acknowledged that diagnostics were often case specific. As such, the use of simulated data was seen as the most appropriate manner to test the properties of MFCL and other methods. Fitting the model to a range of simulated data sets with known stock trajectories would indicate how well MFCL is able to correctly infer, for example, trends in stock biomass and fishing mortality. By fitting the model to data sets with increasingly perverse statistical properties, the limitations of the model would emerge and be understood.

205. While not forgetting the work undertaken in recent years to develop MFCL, it was also seen as desirable to apply a suite of stock assessment models to the WPCO data. A range of models from relatively simple models such as GLMs, GAMs, and production models, to more complex integrated models such as A-SCALA methods should, where possible, be evaluated. The use of alternative methods would help test the consistency and robustness of model results to a range of model assumptions. Where different methods give different results, the reasons for the adoption of one method over another could then be made more explicit. Again, the use of generic sets of simulated data could be used to compare and contrast the properties of different models.

206. In providing a review of generic stock assessment methods, participants did not see the role of the MWG as reviewing each stock assessment undertaken for SCTB. Such reviews would be best undertaken by each species research group.

Re: TOR 4 – Biological Reference Points (BRPs)

207. The MWG was informed that no specific work has yet been undertaken to determine BRPs appropriate for the target stocks in the WCPO. However, the MSG noted that much work on the determination of BRPs had already been undertaken in other fisheries and that the report of the FAO Expert Consultation on Implications of the Precautionary Approach to Tuna Fisheries Management reviews available information on BRPs through 2000.

208. Maximum sustainable yield (MSY) is cited in the context of BRPs in some fisheries management jurisdictions. The MHLC convention requires that stocks should be maintained at levels capable of producing MSY. Managers in some nations, including the USA and New Zealand have found it difficult to estimate MSY for all but the main target species in their fisheries. Estimation of MSY in the context of MFCL depends heavily on assumptions about the shape of the spawner-recruit relationship. Practical application of the MSY concept as a basis for BRPs will probably require the development and use of “proxies”.

209. Given the current status of stock assessment on target species in the WCPO, it was seen as premature at this stage to be calculating and providing BRPs to managers. However, work on developing methods for the calculation of BRPs for the target stocks in the WCPO in the future is being undertaken by scientists in the OFP and elsewhere.

Re: TOR 5 – Appropriate methods of formulating scientific advice for management.

210. It was generally acknowledged that scientific advice needs to be formulated in a manner that helps to achieve management objectives. However, as there are currently no specific management objectives for the tuna and billfish fisheries in the WCPO, it remains difficult to know exactly how to formulate such advice. The MHLC Convention states the general concept of managing the fisheries in a sustainable manner, but it presently remains uncertain exactly what is meant by this concept other than by reference to MSY.

211. Despite the limitations of the present framework there was a general discussion on the types of scientific advice that may be deemed appropriate in future. For example, a range of concepts from simple to complex will probably be needed to convey scientific information to managers and lay persons with an interest in the fishery. Simple point estimate concepts, such as MSY or ratios involving estimates of parental biomass, were seen as being well understood and as such would most likely continue to play an important role when framing scientific advice. Statements indicating the present status of the stock in relation to conditions in the past (e.g. at the start of the fishery) were also seen as useful in summarising information as were the present trends in indicators such as standing stock, spawning biomass, recruitment and fishing mortality. However, simple means of conveying the uncertainty in such estimates also need to be developed. The development of alternative scenarios and the use of projections were seen as possible means of conveying risk. Where detailed stock assessment advice is not possible, advice could still be framed in terms of the productivity of the stock and the susceptibility to over-fishing given life-history parameters.

212. Finally, lessons can be learned from other fisheries to understand appropriate means of formulating and conveying scientific advice for managers. The present framework used by the IATTC was seen as one such example.

Re: TOR 6 – Methods for assessing ecosystem impacts

213. While ecosystem impacts are currently receiving much interest in the resource management community, means of implementing ecosystem concepts in fishery management are not well understood. Nevertheless, the MWG will maintain an active interest in work progressing in other fisheries. The MWG considers ecosystem based fisheries management to be an important but poorly understood topic and that the development of ecosystem-based policies requires considerable research. The MWG was encouraged to take an active interest in work in progress on the development of ecosystem models in other fisheries. The development of specific hypotheses linking different components of the general WCPO ecosystem (as presently being undertaken by Patrick Lehodey and Dave Foley), and which can be explored within a modelling framework, was also encouraged. It was noted that ecosystem modelling could be used to design surveys to test specific hypotheses.

Re: TOR 7 – Providing advice on stock assessment research needs.

214. This topic was seen as being best addressed through the provision of a work plan which would prioritise stock assessment research needs.

6.2 OFP operational model

215. Dr Labelle presented a summary of the work undertaken to develop an operational model of the yellowfin tuna fishery in the WCPO (see WP YFT-4). A number of features of the model (such as size of error terms, environmentally driven movement regimes) can be controlled through the use

of input parameters. The model also uses a number of techniques to help mimic specific perversities that may exist in the real data sets collected from the fisheries. For example, when generating length frequency samples, only 10-percent of the randomly generated data is used with this sample then pro-rated up to the numbers actually reported in the fishery to mimic measurement error and non-randomness in sampling catches.

216. Data generated from this model is to be used to evaluate the performance of MFCL and other stock assessment models. Data sets can be generated with a range of observational and process error and with specified trends in stock abundance. During the discussion it was seen as important to minimise the similarities in the structural assumptions of the operational model and the assessment models to be tested.

6.3 Recent developments to MFCL

217. Dr Hampton outlined the changes that had been made to the MFCL assessment model since SCTB 13 (WP MWG-1). In response to a question as to why only the Beverton-Holt stock-recruitment model was used, it was pointed out that it is a simple two parameter model and that since there very little information in the data for estimating the parameters, it is unlikely that more complex spawner-recruit relationships could be applied. Even for this model, the priors placed on the "steepness" parameter play an important role on determining the spawner-recruit relationship.

6.4. Workplan for future activities

218. There was general consensus in the MWG that the highest priority activity before SCTB 15 is the comparison of assessment models using simulated data sets with known properties. There was a lengthy discussion on the manner in which this might best be achieved. In particular, much of the discussion focused on the need to carry out a "blind" test, i.e. the analyst should not know the underlying nature of the data that is to be analysed (e.g. the stock biomass history, the actual perversities used to generate the data, etc.). The following protocol was eventually agreed upon:

- The operational model developed by Marc Labelle contains the essential components needed and will serve as basis for generation of test data.

- The documentation of the operational model describing options now included and capability of including alternative error structures will be sent to interested parties.

- Seek feedback on what features should be included in the 'final' model in order to generate the necessary data sets.

- Synthesise the feedback and make the appropriate adjustments to the model so that the recommendations can be included.

- Generate a set of standardised data sets that encompass the necessary range of perversities in stock histories and data generation.

- Send out generated data sets to interested parties (or post on SCTB web site), together with general information on the nature of the fishery, requesting analysis of each set of data be undertaken within a reasonable time frame (2-3 months).

- Convene a meeting of analysts to discuss results and summarise performance of each model.

- Make recommendations to improve methods and report conclusions to SCTB 15.

7. SKIPJACK RESEARCH GROUP (SRG)

219. The Co-ordinator, Dr Gary Sakagawa, led the session of the Skipjack Research Group.

7.1 Regional fishery developments

220. Dr Lewis presented an overview of the skipjack fishery, referring to papers WP GEN–1 and WP SWG–2. The skipjack catch, the dominant component of the WCPO tuna catch by weight, is taken primarily in the surface fisheries (purse seine 70%, pole-and-line 24%), and has been in excess of one million tonnes during much of the 1990s. The estimated 2000 catch (1,163,417 mt) was the second highest on record, maintaining the elevated catches taken since 1998.

221. Figure (to be added) shows the average spatial distribution of skipjack catch in the WCPO for the period 1989–1999, with the great majority of the catch taken in equatorial areas, and a lesser amount in the seasonal home-water fishery of Japan. The distribution of skipjack in equatorial areas east of PNG is strongly influenced by ENSO events, as noted earlier.

222. Nominal skipjack purse seine CPUE, variable but relatively flat for most fleets over time, has shown some increase in recent years associated with the increased use of drifting FADs. The pole-and-line CPUE for the Japanese pole-and-line fleet has tended to increase over time.

223. In response to a question about the likelihood of catches falling below yields in excess of a million tons recently because of economic conditions, Dr Lewis suggested that catch levels might be expected to remain about the same. While some vessels had tied up for various lengths of time, the overall fishing effort appears to have remained at high levels. Figures 2 and 7 in WP GEN–2 illustrate the decline in prices for skipjack.

224. Recently, new products have been appearing with less oil or water and a greater fish content. As a consequence, the demand for raw product may increase to meet regulatory requirements and consumer expectations for constant package weight. In addition, it was noted that pressure to increase skipjack production may occur because the other major tuna species are fully utilised or nearly so. Some concern was voiced about the adverse effect on the stock of an apparent decline in the size of first entry into the fishery due to increased dependence on FAD sets. Changes in the catch per effective effort (CPUE) for unassociated sets, log sets, and drifting FADs can be seen in Figs. 22, 23, and 24 in WP GEN–1. It was also noted that the substantial biomass of skipjack is an important component of the ecosystem involved.

7.2 Biological and ecological research

225. Dr Lehodey presented new developments in his ecosystem model SEPODYM (spatial environmental population dynamics model) with an application to the skipjack population and fisheries (see WP SKJ–2). A new set of predicted environmental data (temperature, currents and primary production) provided by a Nutrient-Phyto-Zooplankton (NPZ) model has been used. Despite some limitations in the prediction of temperature in high latitudes, this has considerably extended the analysis, both in time (1955-92) and space (all the Pacific Basin from 65^{o}N to 45^{o}S). After the coupling between density of forage and density of tuna presented at the SCTB last year, Dr Lehodey indicated that new developments in the modelling were focused on recruitment mechanisms. He has introduced a spawning habitat index (H_s) to constrain the recruitment by environmental conditions. In addition to temperature and advection that were already considered in

the model, the primary production over forage ratio (P/F) has been used as a proxy for testing the effects of food availability and predation of larvae.

226. Simulations produced good correlations between observed and predicted catch. Recruitment and biomass estimated from environmental constraints by SEPODYM were compared with those estimated by the stock assessment model MULTIFAN-CL. Dr Lehodey stressed that these comparisons are very encouraging since these independent estimates show similar fluctuations. These fluctuations appear to be related to the ENSO (El Niño Southern Oscillation) events. During El Niño events the recruitment of juvenile increases dramatically with a spatial extension to the central Pacific, while during La Niña it is contracted in the western Pacific and decreases to a lower level. A large proportion of these recruits moves either to Japan following the Kuroshio or to the central Pacific in the convergence zone between the warm pool and the cold tongue. Dr Lehodey concluded that these results confirm the impact of the ENSO variability with a positive (negative) effect of El Niño (La Niña) events on the recruitment that is propagated into the stock in the following 2-3 years. Therefore, after the 1997-98 El Niño event and the associated high record of skipjack catch in 1998-2000, the last La Niña episode of 1998-2001 should lead to a decrease of the skipjack stock biomass in the next two years.

227. During the discussion of WP SKJ–2, it was explained that the catchability coefficient was introduced to match the magnitude of simulated production to that observed. It was recommended that size or age differences in habitat preferences of skipjack be included in the simulation model to make the model more realistic. In response to an observation regarding the values of the coefficient $\propto$ between 0.7 and 1.0, Dr Lehodey indicated that some effort may be put into changing the movement of fish in the simulation to better handle fragmentation of habitat. Archival tags were suggested as a potential way of obtaining information on vertical movement of fish. It was noted that the model must be validated before it can be used to test fishery hypotheses. It was suggested that the model, possibly after modification, should be used to evaluate the synchronisation between eastern and western components of the fishery.

7.3 Stock assessment

228. Dr Sun presented an application of the general linear modelling (GLM) procedure to estimate annual indices of abundance from Taiwanese distant-water tuna purse seine data for 1983 to 2000 (WP SKJ–3). Results showed a decreasing trend of standardised CPUE to 1990, then CPUE increased to a maximum of 20.2 mt/day in 1996. In 1997, CPUE decreased to 8.5 mt/day and increased to 17 mt/day in 1998.

229. It was noted that the 1993 ban on at-sea transhipment of catches probably resulted in an incremental decline in their under-reporting and therefore possibly caused some of the observed increases in CPUE; it was therefore recommended that its impact on CPUE trends and their standardisation be investigated. Since the regions used in this analysis differ from those in the stock assessment paper (WP SKJ–1), it was recommended that the authors harmonise the regions used. Lastly, it was recommended that an interaction term for year and region be incorporated into the GLM to better handle shifts caused by events like El Nino.

230. Dr Hampton presented the results of an assessment of skipjack tuna in the WCPO using the MULTIFAN-CL model (WP SKJ–1). The analysis has been considerably extended compared to the analysis presented at SCTB 13. The spatial coverage of the analysis has been extended to include the full range of the stock and has thus included the various Japanese fisheries that target skipjack in the sub-tropical North Pacific. It was therefore possible to include a large amount of additional

tagging data from skipjack tagging programmes in the North Pacific carried out by Japanese scientists. The main stock assessment conclusions of the analysis were:

1. Recruitment showed an upward shift in the late 1980s and has been at a high level since that time. Particularly high recruitment occurred in 1997−1998. The strong El Niño at around that time and the high frequency of such events during the 1990s is suspected to have had a positive effect on skipjack recruitment. The possible mechanisms involved in this relation are an area of further research.

2. The biomass trends are driven largely by recruitment, with the highest biomass estimates for the model period being those in 1998−1999. The model results suggest that the skipjack population in the WCPO in recent years has been at an all-time (over the past 30 years) high.

3. Fishing mortality has increased throughout the time-series for all age-classes; however the recent age-specific fishing mortality remains considerably lower than the respective age-specific natural mortality. The impact of fishing is relatively slight in the tropical regions where the majority of the population and catches occur. However, local impacts are higher in the northern regions where catchability may be very high seasonally.

231. An equilibrium yield analysis confirms that skipjack is currently exploited at a modest level relative to its biological potential. In this case, the fairly extreme extrapolations required to estimate MSY and related quantities would make such an exercise pointless.

232. It was noted that stock sizes for initial years may be poorly estimated. They may be improved when the relationship of recruitment and environmental conditions is better known and it can be used to infer the levels of recruitment in this period. The boundaries of six areas used in MULTIFAN–CL are based on an analysis of the distribution of fishing grounds in the Western and central Pacific. It was suggested that Dr Lehodey's simulation model might be used to further rationalise their definition. The use, in MULTIFAN–CL, of nominal rather than effective fishing effort was noted. It was also noted that the adoption of the precautionary approach may make it difficult to determine the stock recruitment relationship for skipjack because the spawning has never been low enough to significantly lower recruitment.

233. Further discussion revolved around developing biological reference points. In particular, it was noted that the use of MSY as a reference point and equilibrium assumptions may not be appropriate for skipjack, a species with an ecological characteristic more similar to a small pelagic species rather than that of tuna. Higher estimates of its biomass during more recent years when catches increased were noted. A point was also raised about setting biological reference points for the entire stock, which effectively could only be implemented for the tropical regions because recruitment basically occurs only in these areas. Noting that age and growth characteristics might vary between regions, it was suggested that a relaxation of constant parameters across regions in MULTIFAN–CL might improve fit. There was also discussion on the desirability and practicality of relaxing the movement constraints in the assessment model.

7.4 Research co-ordination and planning

234. SCTB13 identified the work that should continue and expand (see the bulleted items below). That work was reviewed at SCTB14, as per the comments below.

- Apply the MULTIFAN CL assessment method to examine the stock status and to determine reference points.

Comments: Significant progress has been achieved and further refinements planned with the exception of the determination of reference points.

- Critically examine data inputs to MULTIFAN-CL.

Comments: Significant progress has been achieved, but some problems remain including those with Indonesian and Philippines data. Scientists from these countries should be encouraged to participate in the work of SCTB.

- Examine the skipjack abundance and movement in relation to environmental influences like El Nino and La Nina.

Comments: Significant progress has been achieved and further work is underway.

- Continue to refine CPUE analyses especially for purse seiners.

Comments: Significant progress has been achieved with Taiwanese vessels, but much more work is required.

- Examine growth and mortality through the life history.

Comments: The work progresses in Japan and Taiwan.

- Validate daily growth in early life history stages.

Comments: The work needs to be advanced.

- Collect and examine more detailed information on the use of moored and drifting FAD and in general, on technological improvements in regional purse-seine fisheries and determine their influences on CPUE.

Comments: See papers associated with FTRG.

- Study schooling and aggregation behaviour as this may strongly influence CPUE.

Comments: Similar work is in progress for mostly bigeye and yellowfin off Hawaii, but it needs to be advanced for skipjack.

- Encourage increased observer coverage to:
    - improve the knowledge and data on the FAD technology,
    - obtain better length-frequency data for MULTIFAN-CL and
    - examine means to implement large scale tagging to improve the assessment of stock in a regional scale.

Comments: This work should be undertaken by SRG.

235. It was noted that more time is required at the next meeting of SCTB to discuss research priorities in depth and ways of achieving them.

7.5 Summary statement

236. 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

Skijack tuna are the most important tuna resource in the WCPO, in terms of contribution by weight to the total catch . In the past decade, skipjack catches have been approximately 1 million mt per year, contributing about 65% of the total tuna catch in the area. The 2000 catch was about 1.2 million mt, which was only slightly less than the record catch in 1998. Purse seiners provided the majority of this catch (70%) with 24% from pole-and-line fleets.

The CPUEs for purse seine and pole and line vessels have been highly variable. Nominal CPUEs for Japanese and USA purse seiners have shown nearly identical increasing trends for FAD sets and a decreasing trend for unassociated sets. Nominal CPUEs for Taiwan purse seiners, in contrast, have shown increasing trends for both unassociated and FAD sets. Korean purse seiners continue to set mostly on unassociated schools. The interpretation of CPUE trends was not possible because their standardisation was incomplete and on going.

Skipjack are concentrated in the tropical waters, but seasonally expand to subtropical waters north and south. Their fast growth, early maturity, high fecundity, spawning year around, relatively short life span, highly variable recruitment and few age classes on which the fishery is dependent makes the species unique among the main tuna species. Ongoing fisheries oceanographic studies have been continuing to provide a better understanding of environmental influences on the availability and productivity of skipjack in WCPO. They suggest a positive impact of El Nino on skipjack recruitment, particularly when followed shortly by La Nina, as occurred in 1998.

Tag based assessments from the early 1990's suggested low to moderate exploitation at catch levels slightly lower than those in recent years. Recent results from MULTIFAN-CL, including tagging and other information from the northern part of the area, were consistent with the tag based assessments, but additionally, indicated that fishing mortality have been increasing since the early 1970s. Nevertheless, estimates of fishing mortality at age have been smaller than those of natural mortality. The impact of fishing on the total biomass of skipjack is estimated to be low, with estimates of recent recruitment and stock biomass being at historically high levels.

Future advances in the basic biology, data collection and stock assessment of skipjack should be encouraged to substantiate the knowledge required for the fisheries management of this economically and ecologically important species.

8. BIGEYE RESEARCH GROUP (BRG)

237. The Coordinator, Dr Chi-Lu Sun, led the session of the Bigeye Research Group.

8.1 Regional fishery developments

238. Following the Chairman's introduction, Dr Lewis provided a fishery overview, referring to WP GEN–1. He noted that bigeye were generally assumed to be a single pan-Pacific stock and so data from the EPO were generally included in any consideration of the species. Bigeye are taken by purse seiners primarily as juveniles, and as adults by longline vessels. Because they are the most

valuable of the tropical tunas, bigeye are targeted for sashimi markets and represent a cornerstone species of the longline fishery.

238. The total pan-Pacific catch of bigeye during the 1990s varied between 160,000 and 200,000 mt. The estimated 2000 catch of 208,173 mt was the highest on record, and included record annual catches in both the EPO purse seine fishery and the WCPO longline fishery.

239. The longline catch shows considerable geographic variation. Catches in the EPO, formerly the main longline fishing ground, have been at historic lows in recent years (23,164 mt in 1999), whereas the estimated 67,792 mt caught in the WCPO during 2000 was a record.

240. Since 1994 in the EPO, and since 1996 (and to a lesser extent) in the WCPO, purse seine catches have been increasing. The increases correspond to increasing use of drifting FADs; catches peaked in the EPO in 2000 at 69,745 mt, and in the WCPO in 1999 at 33,744 mt. The surface fishery now takes approximately 60% of the total catch. There has been a resultant increase in the proportion of smaller bigeye in the total catch, notably in the WCPO.

241. The nominal bigeye CPUE of the WCPO purse seine fleet was largely stable until 1995, when the significant increase in the use of drifting FADs and technological changes resulted in corresponding increases in bigeye CPUE by several fleets. The increase was most evident in the Japanese and US fleets in recent years. The time series since the increased use of FADs is, however, still short.

242. Two hypotheses used for standardising the longline CPUE of bigeye, based on habitat studies done in Hawaii and Tahiti, were outlined. The standardised CPUE of either method using Japanese distant-water longline data showed no obvious trends after 1980. The CPUE in the WCPO oscillated in certain years and that of the EPO was more stable, especially during the past decade. Over a longer time series, the overall decline has been more marked.

243. The spatial distribution of the bigeye catch, both surface and longline fisheries, is primarily tropical, but with significant longline catch slightly polewards of the subtropical gyre in the northern WCPO. The majority of the catch comes from between 10^0 N-10^0 S in the WCPO and 5^0 N-15^0 S in the EPO.

244. The length frequencies from port sampling over time indicates there are between 1-3 age classes in the surface fishery, with gradual recruitment into the longline fishery. Bigeye tuna caught in the longline fishery were predominantly older adults averaging 130 cm FL.

245. During discussion, it was suggested that the reduction in the longline catch in the EPO may be due to a reduction in fleet size. It was noted that the standardised LL CPUE was for the Japanese fleet only (this was the longest time series of data), which shows decreased effort in the EPO. Other fleets, however (e.g. the Korean longline fleet), might not have decreased effort in the EPO. In addition, there was some evidence the Japanese fleet may have focussed their effort on the most productive areas. So, while there was a reduction in overall effort, there may have been an increase in effective CPUE. It appears that there may be similar information for other fleets in the EPO.

246. IATTC was asked if a decrease in the Japanese longline effort in the EPO was expected. They responded that a such a decline was expected, but thus far it had not been as significant as anticipated. Asked if catch data were collected for other fleets in the EPO, IATTC responded that data were collected for the Mexican, U.S., Japanese, Taiwanese, Korean and Spanish industrial

fleets as well as the artisanal fleets of Ecuador and Costa Rica. These data were fairly compatible with that presented but IATTC were now pursuing finer detail in the data.

247. The Chairman asked Taiwan to comment about their longline data, to which the response was that Taiwan collected such data, and duly supplied it to IATTC and SPC; the Taiwanese effort was lower in the EPO.

248. It was pointed out that very few small bigeye were evident in the purse-seine catch in the EPO, unlike the WCPO. However, that had changed with a strong recruitment in 1998. This was confirmed by IATTC, which also pointed out that the catch of small bigeye on FADs should not be thought of as bycatch because they were targeted; their catchability had increased by 750% as a result of the introduction of drifting FADs.

8.2 Biological and ecological research

Stock structure

249. Dr Hampton outlined the results of the 1998 genetics project with CSIRO. Bigeye were sampled from across the Pacific from the Philippines to Ecuador. CSRIO looked at several loci using mitochondrial DNA and microsatellite DNA analysis to detect heterogeneity of the stocks. However, he noted that the data could not statistically refute the null hypothesis of one stock. The sampling may not have been on a scale that could detect the restricted level of mixing that might occur, but which may be important from a management perspective. The limited tagging data indicated that although there was some low level of long-distance movement, considerable short distance nett movement has occurred over both long and short term periods.

250. The Chairman asked if any further genetic studies were underway. The delegate from CSIRO noted that his organization had participated in this study, but nothing additional was currently planned. IATTC noted that they too had participated in the study and were now undertaking a billfish genetic study.

Age and growth

251. Mr James Cushing of the Guam Department of Commerce presented the results of a study by Bert Kikkawa of NMFS (WP BET–2). Monthly weight frequency distributions of bigeye tuna landed by Japanese coastal longliners in the Guam fresh tuna transhipment fishery were used in a modal progression analysis. Instead of relative age, real age was calculated using the modified von Bertalanffy model. The advantages of real age were that it allowed the calculation of actual hatching and it could be associated with oceanographic conditions. This could then be used to relate growth to physical conditions.

252. Recruitment was highly defined and occurred during the first quarter of the year. Seven year classes (1989-95) were tracked over a span of 4 or 5 years. The growth coefficient, k, for each year class ranged from a low of 0.201 to a high of 0.465 per year. Except for 1990 and 1993 year classes, high growth (> 0.3 per year) was associated with El Niño conditions and conversely low growth (< 0.3) with La Niña events. $L_{\S}$ extended from 157.9 to 204.9 cm FL. The values of t_0 for each year class ranged from -0.0061 to -0.0034. Age at the recruitment size of 80 cm FL ranged from 1.52 to 2.5 years and averaged 1.8 years. Cohort-related total mortality (Z) ranged from 0.324 to 0.901 and averaged 0.612 per year. Variations in mortality were attributed to changes in the catchability coefficient, q. In summary strong year classes appeared related to El Niño conditions and weak year classes with La Niña conditions.

253. During discussion, it was noted that the modes in the weight frequency tables appeared particularly clear for bigeye and clearer than, for example, those in SPC length frequency data. It would be useful to investigate the use of weight rather than length data in stock assessment models. The unloadings data were associated with logsheets submitted for the unloadings, which may allow some estimates of area fished. Asked if lengths were collected, the response was that this was not the case although the Micronesian delegate noted that a Port Sampling Program in Guam had begun collecting length data.

254. It was noted that 1989 was a particularly strong El Niño year and yet the growth estimates were low for that year.

255. Mr Bruno Leroy from SPC/OFP presented WP BET–3, "The determination of annulus formation in otoliths of bigeye tuna by counting daily growth rings". Using 10 otoliths from each of four locations, it was possible to count daily rings and match the Y1, Y2 and Y3 positions to counts of 365, 730 and 1,095 daily rings. These counts corresponded to distances of 1,135, 1631, and 1,976 microns from the nucleus. Older fish were not sampled as the maximum size of the bigeye sampled was 120 cm FL. Mr Leroy concluded that micro-increments were an appropriate method to determine the location of the second and third annuli along the transverse section. While the small sample sizes did not permit analysis of differences among samples, he noted that the samples from Geraldton (Indian Ocean), the site of the highest latitude, had the lowest distance values.

256. Asked about the method of preparation, Mr Leroy stated it was the same as that developed for yellowfin where a transverse section of the otolith was polished to a thin section. Asked about the ease of determining the first annulus, Mr Leroy replied that it was at the 365th daily ring. Regarding validation/corroboration, the reply was that there was consistency among readers and with the positions of the annuli relative to the number of daily rings. Asked if annuli were evident on all otoliths or only those from subtropical regions, Mr Leroy replied there was a very low proportion of annuli evident on otoliths from tropical fish. Paul Dalzell asked if anyone had looked at spines or vertebrae of bigeye. Mr Leroy replied that he did not think so. The Australian delegate noted there was a bigeye ageing study underway in Australia.

257. Details were provided on a joint CSIRO/SPC archival tagging study, where 100 tags had been deployed in the Coral Sea. To date, there have been 4 recaptures. Of these, two tags had malfunctioned and the other two fish were in the 15-30 kg range. It was also noted that IATTC had done some OTC otolith marking in collaboration with PFRP, and had validated daily growth in bigeye tuna from the Hawaii region.

Tagging

258. Mr Itano and Dr John Sibert jointly presented WP YFT–6, "Size specific tag attrition in bulk transfer models: Analysis of the Hawaiian Tuna Tagging Project Data". Mr Itano explained that the Hawaiian commercial tuna fishery is composed of three main elements

- an inshore handline and troll fishery that operate around the main islands and on the inshore FADs;

- a longline fishery which is regulated to operate more than 50 nm from shore; and

- an offshore handline fishery which operates on the Cross Seamount and at four meteorological buoys that act as fish aggregation devices.

259. The development of the offshore handline fishery which targets juvenile yellowfin and bigeye tuna led to some conflicts with the other fisheries. The main arguments concerned the increased vulnerability of juvenile tuna as well as the cropping of relatively low grade small tuna before they grew and became more valuable as sashimi tuna for the inshore handliners and longliners. The Pelagic Fisheries Research Program responded to these perceived concerns by undertaking a tagging study to investigate the interactions amongst the fisheries, residence times, migration, exploitation rates, and aggregation effects of the tuna. The Seamount Tagging Project and the Hawaiian Tuna Tagging Project produced over 17,000 releases with a recapture rate of 12.5%.

260. About 95% of the recaptures were from the seamount or buoys. Transfer rates between the offshore buoys and seamount to the offshore region were high, whereas those between offshore and inshore areas were low. Bigeye were found to be more persistent in the offshore sites. Global attrition rates were found to be similar for both species. However bigeye tuna were found to have twice the residence time of that of yellowfin tuna.

261. Over four size classes, natural mortality was found to be higher in the small and large size classes but relatively low in the middle size classes. Fishing mortality for both species at the Cross Seamount was found to be moderate at current fishing levels. Emigration was found to be the greatest source of loss from the seamount. The current fishery at the seamount was concluded not to be adversely affecting the populations of bigeye and yellowfin, nor their recruitment to inshore areas.

262. It was noted that natural mortality was high for yellowfin but lower for bigeye. Dr Sibert replied that the data contained few large fish, which made it hard to extrapolate. Mr. Itano noted that the >56 cm category included all the large yellowfin, with a considerable number being larger than 85 cm.

263. Asked if they had any tagging projects planned, SPC replied that various fora, including SCTB, had underlined the value of undertaking further tagging projects, especially large scale bigeye tagging. Bigeye posed a challenge since they normally comprised a small percentage of surface catches and aggregation situations were not common. The Capricorn Seamount in Tonga may, however, provide a similar opportunity as the Cross Seamount for tagging bigeye in the South Pacific. SPC was also looking at securing funds to do additional archival tag work.

8.3 Stock assessment

CPUE Trends

264. Dr Sun presented an update of the standardised CPUE series presented at SCTB13. GLM techniques were applied to estimate annual CPUEs of the Taiwanese distant-water and offshore longline data for 1967-1999 and 1980-1999, respectively. The distant-water longline fishery standardised CPUE was consistently higher than the nominal CPUE for the time series, though both

showed similar trends. The distant-water longline fishery CPUE declined from 2.53 to 0.26 fish per 1,000 hooks during the time period.

265. The offshore longline fishery standardised CPUE was also consistently higher than the nominal CPUE. The standardised CPUE increased from 0.57 fish per 1,000 hooks in 1986 to the maximum of 3.68 fish per 1,000 hooks in 1993 and then declined to 1.5 fish per 1,000 hooks in 1999.

266. Dr Sun explained that the CPUE of the offshore longline fishery was much higher than that of the distant-water fishery because it targets bigeye tuna, whereas the distant water fleet targets albacore.

Assessment model results

267. Dr Hampton presented WP BET–1, "The results of an assessment of bigeye tuna in the Pacific Ocean using the MULTIFAN-CL model". The bigeye tuna model represents a preliminary attempt to integrate available catch, effort, length-frequency and tagging data for the entire Pacific Ocean into a single integrated analysis. Additional work is needed to reconcile the results of this analysis with similar analyses conducted for the eastern Pacific Ocean only. To date, the major stock assessment conclusions of the analysis are:

1. The growth estimates are consistent with estimates of length-at-age of tagged bigeye, but tend to underestimate length-at-age relative to daily increment counts on otoliths.

2. Estimates of natural mortality show some age-specific variation, with higher rates estimated for older bigeye tuna. The basal rate is reasonably consistent with the expectation for a moderately long-lived tuna species.

3. Recruitment shows considerable variation at several different time scales. A slight declining trend in recruitment is estimated overall. Recent recruitment appears to have been relatively low in the tropical regions on both sides of the Pacific.

4. The main feature of both the total and adult biomass estimates is a declining trend over time since the early 1960s. Both total and adult biomass are estimated to be currently at around 50% of the levels of the early 1960s.

5. Fishing mortality has greatly increased in recent years, due mainly to catchability increases in the purse seine fisheries and the decline in the incidence of school sets, which have very low bigeye tuna catchability. However, the overall impact of the fisheries on the population is moderate, resulting in about a 30% reduction in biomass in the eastern tropical Pacific relative to what would have occurred with no fishing, but with lesser impacts elsewhere.

6. Some examples of yield analysis were presented. As with yellowfin tuna, the extent to which the results of these analyses are driven by various assumptions suggests that more robust alternatives are required for developing reference points for fisheries management.

268. It was noted that trends in biomass and other related aspects of the results are conditioned to a large extent by the catch and standardised effort estimates for the longline fisheries in the four regions. In estimating standardised effort, certain assumptions were made regarding bigeye tuna habitat preferences. By necessity, these assumptions were based on limited data. Tests using different assumptions have demonstrated that the analysis is sensitive to these assumptions.

Therefore, it is essential that estimates of standardised effort continue to be refined as additional data, mainly from bigeye tuna archival tagging experiments, become available.

269. It was noted the trends had a saw-toothed appearance and the question was asked if this was an effect of seasonality. Dr Hampton agreed that the trends were due to seasonality of recruitment. Later it was observed that seasonal recruitment would only explain the inclining edges of the saw-teeth, not the declining edges. Dr Hampton postulated that this may be due to migration, particularly for the very young fish, which may produce a sharp decline in biomass.

270. Though the biomass had declined by half in the time series, there did not appear to be an impact on fishing. Dr Hampton agreed that the decline appeared to be mostly driven by reduced recruitment.

271. A Taiwanese delegate asked whether ENSO effects were included in the model, particularly as they appear to affect growth, etc. Dr Hampton agreed that ENSO does play a role but it was not included as there were no environmental correlates to recruitment. Asked why that recruitment had declined, Dr Hampton stated it was not known.

272. The IATTC delegate noted that nine of the lowest ten years of recruitment have occurred since 1988. He noted that recruitment in 2001 is predicted to be the lowest ever. The IATTC anticipates seeing a declining biomass until 2002 then an increase for a few years. However the rate of increase will be determined by the level of constraints on the purse seine fishery. He noted that in the EPO there was a significant impact from fishing and a significant gear impact.

273. It was noted that the MULTIFAN–CL results were good for explaining biomass sensitivities but that tagging data were not strong. Effort had not been examined in a systematic way, but the effort data were standardised. However, in future, there would be more data from archival tagging. When this was available to be incorporated into the model, it would stabilise CPUE and improve the model.

274. Observing that purse seine FAD fishing was becoming increasingly significant, this was exemplified in the EPO where the catchability of bigeye had increased by 750%.

275. Asked if the model could be pushed back to before 1960, Dr Hampton said that the data went back as far 1962.

276. Dr Sun presented WP BET–4, ‘A preliminary application of the A-SCALA method to WCPO bigeye’. The assessment indicated that the average fishing mortality has increased since 1980 due to an expansion of purse seine fisheries. The recruitment estimates tended to be comparable that of the virgin stock recruitment. However, in recent years there have been some high recruitment events that may be environmentally related. Average weights of bigeye have declined steadily over the time series. Longline fisheries were found to catch bigeye tuna above the critical weight while average size of bigeye from the purse seine fisheries was well below critical weight. The spawning biomass ratio dropped from 0.82 of the virgin stock in 1962 to an historic low of 0.38 in 1996; it has been between 0.48 and 0.52 in the subsequent years. Yield per recruit estimates were satisfactory from 1962 to 1980, although after 1981 the performance appears to be sub-optimal.

277. If fishing mortality is proportional to fishing effort and the current patterns of age-specific selectivity are maintained, then a 1.53 increase in fishing effort would produce MSY. Increasing effort by 1.53 times would increase the average yield by 5% but would decrease the spawning potential by 38%. Catch projections for the longline fleet predict an initial increase in catches then a

decrease to 1999 levels. Other than the longline fishery, an initial decline then a stabilisation at lower levels is predicted for the fisheries.

278. This is a preliminary assessment of WCPO bigeye tuna. These results should be compared with the results of the Pacific-wide assessment using the MULTIFAN-CL model. The main differences between models are that the A-SCALA model does not include spatial structure in the population dynamics and does not include tagging data. Differences in assessment between the A-SCALA and the MULTIFAN-CL models were also found when applied to the EPO bigeye tuna fisheries. Differences in the assumptions between A-SCALA and the MULTIFAN-CL require examination to help determine what assumptions are most appropriate for analysing this stock given the available data.

279. SPC noted that since year 2000 catches of bigeye are even greater than they were in 1999, and as used in the model, the picture may be even more negative. It was also stated that the catchability in this model appears stable whereas MULTIFAN-CL suggests an increase in catchability. It was suggested that the recruitment peaks in recent years might be an artefact. It was clarified that natural mortality in the model had been fixed.

280. The main difference relative to MULTIFAN-CL was that A-SCALA indicated that recruitment stayed stable but fishing mortality was driving down biomass. If there was no stock recruitment relationship, it was not clear how the model was fitted. Dr Sun stated that there was insufficient data for an SRR, and these results were still preliminary and under discussion. It was noted that the lengths at age were different to those used in the MULTIFAN-CL model but these differences had not been examined. The catchability assumptions were also different. The veracity of the observed decline in average weight in the A-SCALA analysis was queried.

281. A NMFS representative stated that it was easy to compare this paper with Dr Hampton's (WP BET-1) using MULTIFAN-CL, however there were fundamental differences in assumptions. In this paper, mortality is held constant. He noted that it would be interesting to free up some parameters; if catchability is increasing, this would lead to a more optimistic view as in Hampton's paper. He said the mathematics of SRR limits the size of ratios and hence the limits the model.

Related management issues

282. Mr Clark of FFA initiated discussion of FFA's proposed options for bigeye management in the WCPO. FFA was looking for some direction from FFC, which in turn was wanting some assessment of bigeye. He noted that this may be the only region in the world without some management measures in place for bigeye tuna. This may be the first issue that comes up in regional management. FFC had been given a list of 16 possible management options, which had been culled to six by the FFA Species Working Group.

1. Time and area limits.

2. Limits on the use of tender vessels.

3. Limits on FAD numbers or FAD sets per vessel.

4. Compulsory retention/no discards of juvenile tuna.

5. Limits on net depth.

6. Overall (holistic) bigeye management, covering both surface and longline fisheries.

283. Mr Clark stated that FFA needed to rationalise the best option(s) before the next PrepCon, if at all possible.

284. IATTC stated they introduced management measures where the fishery was closed when the catch of small bigeye (<60cm) reached the 1999 level. There was also consideration given to closing or limiting associated sets.

285. Dr Lewis noted that this issue has arisen from concern expressed by FFC following on concerns raised at SCTB12 and SCTB13. Dr Sibert suggested that the recommendations of those meetings be examined. After these recommendations were read, it was agreed that a carefully worded consensual statement was required to address the group's concerns regarding the bigeye stock.

286. Other concerns were raised about exceeding the MSY by the current fishing levels. In fact, bigeye catches had reached record levels in 2000. There were some suggestions to recommend a catch limit or prevent discarding. Mr Clark pointed out the limitations in the region's capacity to monitor these options.

287. There were several suggestions for an improvement of the standardisation of CPUE to verify the model predictions.

8.4 Research co-ordination and planning

288. The Chairman introduced this section by stating the urgent need for further bigeye research. He proposed that the collection of catch and effort data from Indonesian and Philippine waters was of premier concern. He also suggested that representatives from these countries be further encouraged to participate. It was agreed that priority be given to the refining of the MULTIFAN-CL model and examining the differences with the developing A-SCALA model. The levels of uncertainty of the parameters should be defined. In refining the models further work on archival tagging was agreed as necessary for better habitat definition. Also further development of the standardised CPUE using the habitat model was necessary for verification of the stock assessment models

289. Another concern needing to be addressed was the accurate identification of bigeye catch. Mr Bigelow pointed out that differences in port sampling and observer estimates were of concern. Dr Lewis suggested the continued urging of all fleets for accurate reporting. Dr Hampton asked which data set are used for catch estimations; Mr Lawson stated the port sampling estimates are used.

290. A large scale tagging study was agreed as desirable, although funding was the limiting factor.

8.5 Summary statement

BIGEYE RESEARCH GROUP (BRG) – SUMMARY STATEMENT

Bigeye tuna account for a relatively small proportion of the total tuna catch in the Pacific Ocean, but their economic value probably exceeds US$ 1 billion annually. Bigeye may comprise a single Pacific-wide stock and this is reflected in data collection and assessment approaches. The year 2000 total Pacific catch of bigeye was an estimated 208,173 mt, an historical high, with 115,264 mt and 92,909 mt taken in the WCPO and EPO respectively. Both regions recorded increased catches over

1999. Purse seine catches of mostly larger bigeye in the EPO increased to record levels (69,745 mt); no year 2000 data were available on the EPO longline catch, which has however been declining steadily in recent years. The WCPO purse seine catch of bigeye, associated with the increasing use of FADs, remained high (28,843 mt) and combined with the largest longline catch yet recorded (67,792 mt), resulted in the highest bigeye catch on record for the WCPO. The Pacific total bigeye catch continues an upward trend since 1998.

Limited ecological and biological research has lead to improved understanding of some parameters e.g. age and growth, dynamics of aggregations etc. No new information was provided on environmental effects on catchability and stock productivity, although results of archival tagging work in progress are expected to provide useful information on the former and could be utilized in longline effort standardization.

Several nominal and standardized CPUE time series were examined by the group; the purse seine CPUE trends for the main fleets generally reflect the extent to which associated sets, especially drifting FADs (which have produced higher juvenile bigeye catches in recent years), are fished. Longline CPUEs since 1980 for the Japanese fleet, both nominal and standardized according to several habitat models, are relatively flat in the EPO but more variable in the WCPO. Over longer time periods i.e. since the beginning of the fishery, a much greater decline in these CPUEs is evident.

An elaboration of the collaborative Pacific-wide application of the integrated statistical MULTIFAN-CL model was presented, incorporating some new features and considerable additional data. Results should be regarded as preliminary, but indicate that recruitment shows considerable temporal variation, and been has declining, particularly in recent years in both the EPO and WCPO. Biomass also shows a declining trend over time and current levels (total and adult biomass) may be at around 50% of initial levels. The overall impact of fisheries on the population was considered moderate. Given however the importance of some key assumptions to model outputs e.g. standardized longline effort, it was recognized that further investigation regarding the appropriateness of these assumptions is required.

A preliminary application of the A-SCALA method to WCPO bigeye was also presented. The results were indicative of a larger impact of the fisheries on the stock than suggested by the MULTIFAN-CL analysis. The assessment indicated that the average fishing mortality has increased since 1980 due to an expansion of the purse seine fisheries. It further suggested that the decline in relative abundance was due to fishing rather than to a decline in recruitment. Analyses conducted during the meeting suggested that there is no fundamental difference in the MULTIFAN-CL and A-SCALA approaches. The differences in the results appear to be due to different assumptions and data used in the analyses. In particular, (i) the tagging data used in the MULTIFAN-CL analysis implies lower estimates of fishing mortality than those obtained in the A-SCALA analysis, which does not use the tagging data; and (ii) the levels of natural mortality assumed in the A-SCALA analysis are lower than those estimated in the MULTIFAN-CL analysis, which causes further divergence in the two sets of results. Further research is required to identify the most appropriate set of assumptions to use in future assessments. In this respect, additional tagging data accompanied by high tag-reporting rates for all fisheries would provide valuable information on bigeye tuna stock dynamics and exploitation.

Given the continuing increase in Pacific bigeye catches in both surface and longline fisheries, indications of recent low recruitment and declining biomass, and possible significant fishery impacts on the stock, the Group reiterated its concern that the condition of the stock be closely

monitored and that efforts to develop reliable assessments at Pacific-wide and regional level be regarded as a priority task. It was noted that concerns about bigeye stocks driven by similar factors are common to tuna fisheries in all areas and have already resulted in management interventions in most cases.

Recognising the continuing concern of the SCTB about the status of bigeye tuna stocks in the WCPO, and recognising the increasing catchability of juveniles of this species in surface fisheries, particularly those using FADs, SCTB 14 recommended that there be no increase in fishing mortality in surface fisheries on bigeye in the WCPO until uncertainties in the current assessments have been resolved.

The group recommended that the following research leading to improved stock assessment be continued in the following areas: (i) acquisition of more detailed catch / effort and size composition data from the fisheries of Indonesia and the Philippines (ii) improved/refined estimates of bigeye catches from WCPO purse seine fisheries (iii) improvement to effort standardization utilizing data from archival tagging and other studies providing information on habitat preferences (iv) investigations of key assumptions to stock assessment models and continued elaboration of the MULTIFAN-CL and other models (v) characterization of effective effort on juvenile bigeye taken mostly in association with FADs and (vi) large scale tagging to provide information on key parameters and to assist in discriminating between alternative hypotheses and model assumptions.

9. YELLOWFIN RESEARCH GROUP (YRG)

291. The Co-ordinator, Dr Campbell led the session of the Yellowfin Research Group.

9.1 Regional fishery developments

292. Dr Lewis presented an overview of the yellowfin fisheries referring to WP GEN–1. Yellowfin tuna are harvested with a range of gear types, from small-scale artisanal fisheries in Pacific Island and south-east Asian waters to large ‘distant-water’ longliners and purse seiners that operate widely in equatorial/tropical waters. Purse seiners take a wide size range of yellowfin, whereas the longline fishery targets mostly adult fish. Yellowfin usually represent ~20–25% of the overall purse seine catch and may contribute a higher percentage of the catch in individual sets. Yellowfin may also be directly targetted by purse seiners, especially as unassociated schools.

293. The annual WCPO yellowfin catch over the past decade has varied between 320,000–485,000 mt, with the largest on record (484,594 mt) being attained during 1998. The estimated catch for 2000 was 426,909 mt, a slight decrease on the 1999 level, and a result of reduced purse seine catches. Purse seine harvests the majority of the yellowfin catch (46% by weight during 2000), while longline and pole-and-line fisheries account for 15% and 4%, respectively. Various assorted gears mostly from eastern Indonesia and the Philippines account for 35%.

294. The longline catch in recent years (53,000–74,000 mt) has been well below annual catches in the late 1970s/early1980s (90,000–120,000 mt), presumably related to changes in targeting practices by some of the large fleets and the gradual reduction in the number of distant-water vessels. The 1999 yellowfin catch of 56,195 was the lowest for nearly 30 years, but recovered during 2000 (to 64,735 mt).

295. Purse seine yellowfin CPUE is characterised by strong inter-annual variability and differences amongst the fleets, and that much of this variability is due to environmental conditions associated with the El Niño Southern Oscillation (ENSO) cycle. There was significant decline then recovery in

the purse seine yellowfin CPUE during 1996 and 1997, and a similar trend observed in the longline CPUE during 1999 and 2000, perhaps reflecting the growth and relative abundance of the main age class fished in each case. However, it was noted that these were preliminary interpretations of nominal CPUE data and that further review was no doubt required.

296. The importance of the yellowfin fisheries in the Western and Central Pacific was noted by the chairman. He explained that Australian catches and catch rates of yellowfin had dropped over the last few years. It was generally accepted that this was due to increased targeting on other species. Anecdotal information from fishers suggests that there has been an absence of small yellowfin in the Australian waters that may indicate poor recruitment during 2000, although in recent months, some fishers have reported seeing an increase in juvenile yellowfin. It was also noted that catches of yellowfin had increased in Fijian waters in 2000.

297. It was reported that yellowfin catches in American Samoa were minor compared with other species, show strong inter-annual variability and were typically sold on the domestic market. Nevertheless data from the US troll and longline fleets cover a large area of the fishery over a long timeframe and may be useful to consider when studying regional abundancies of yellowfin tuna.

298. The issue of scarcity of length data from the Philippines and Indonesia was discussed. It was reported that the former had provided data over the past year and that these data had been incorporated into the stock assessment models. The latter data existed but at this stage had not been obtained. It was acknowledged that SPC would continue to pursue the matter. Another further data issue discussed was the lack of recent data from Korea longliners. Dr Jungrak Koh agreed to look into the problem.

9.2 Biological and ecological research

Age and Growth

299. There was no update on the age and growth research presented at SCTB13.

Stock structure

300. Dr Campbell presented some of the results from work led by Dr John Gunn at CSIRO on the origin of yellowfin recruits to the fisheries off eastern Australia. The main fisheries in this region occur outside the main spawning areas for yellowfin tuna, though seasonal spawning is known to occur within the Coral Sea off northeastern Australia. To assist in the management of these fisheries, it is important to understand whether recruitment of yellowfin tuna is limited to spawning events in the Coral Sea or whether fish also recruit from spawning within the larger equatorial regions. In the latter case, it is important to estimate the proportion of fish recruiting from outside the Australian zone.

301. The study was based on the analysis of the micro-chemical composition of the primordium region of the otoliths. It is hypothesised that the chemical composition of the primordium provides a fingerprint of the region in which the fish was spawned. Therefore, variations in otolith microchemistry allow discrimination between the different regions from which fish originate. For fish sampled off NSW during 1994, it was estimated that 73 percent had originated from the Coral Sea whilst 14% and 13% had originated from the Philippines and Fiji respectively. For fish sampled off NSW during 1995, it was estimated that 69% had originated from the Coral Sea whilst 27% and 4% had originated from the Indonesia and Solomon Islands respectively. The study concluded that it is possible to determine regional and/or temporal 'finger-prints' from otoliths even if genetic

differences cannot be detected. For the two years studied, around 70-75% of fish sampled off NSW were seen as recruiting from the Coral Sea region, with the remainder originating from other regions within the WCPO.

Reproductive Biology

302. Mr Itano presented WP YFT–2. This report describes the large-scale investigation on the reproductive biology of yellowfin tuna in the WCPO, funded by the Pelagic Fisheries Research Program of the University of Hawaii. The project objectives were to:

- Define spatio-temporal and size related reproductive parameters (length at maturity, spawning frequencies, batch fecundity, peak areas of spawning, peak times of spawning);

- Investigate differences in reproductive parameters in relation to capture depth and fishing gear type, with their influence on vulnerability to fisheries and interaction rates; and

- Compare and contrast the main region of yellowfin spawning (within 10 degrees of the Equator) with a representational region of seasonal yellowfin spawning (Hawaii).

303. The study depended on the collection of over 10,000 yellowfin ovaries from a variety of gear types and fleets throughout the WCPO that were histologically interpreted to achieve project objectives. The results of this study are currently available in a PFRP report (SOEST Publication 00-01, JIMAR Contribution 00-328) that is fully downloadable from the PFRP website (http://www.soest.hawaii.edu/PFRP/biology/itano.html). Additionally, full colour graphics of histological preparations of yellowfin ovaries in all stages of maturity are viewable from the same site. The following comments summarise the presentation provided to the meeting.

304. The reproductive biology of yellowfin tuna (*Thunnus albacares*) was examined in relation to seasonality, their vulnerability to capture, and fisheries interaction in the central and western Pacific Ocean. Reproductive parameters were determined by the examination of 10,898 yellowfin ovary samples collected from surface and sub-surface fisheries operating in the central and western tropical Pacific and from Hawaii based fisheries, between May 1994 and April 1996. Histological criteria were used to assess maturity stage, spawning periodicity, spawning frequency and spatio-temporal patterns in spawning distributions.

305. Spawning occurs primarily at night, at sea surface temperatures above 24–25^{o} C and was estimated to peak between 2200 and 0300 hours. Mean batch fecundity estimates from counts of migratory nucleus or hydrated oocytes from yellowfin tuna in the equatorial western Pacific and Hawaii region were 2.160 and 3.455 million oocytes or 54.7 and 63.5 oocytes per gram of body weight respectively. Continuous spawning of yellowfin within 10 degrees latitude of the equator was histologically confirmed, with a mean spawning interval of 1.99 days from fish taken by surface and sub-surface gear types.

306. Length at 50% maturity for equatorial samples was estimated at 104.6 cm with no significant difference in length at maturity estimates between samples taken by surface and sub-surface gears. However, spawning frequency estimates varied according to school and harvest gear type. Reproductively active fish are vulnerable to troll, shallow handline, shallow-set longline and purse seine gear. Mature, but reproductively inactive fish are predominant in the catches of deep-set longline gear. Histological evidence suggests alternating periods of near daily spawning interspersed with non-spawning periods, with rapid development into and out of spawning condition.

307. Equatorial areas subject to strongly reversing monsoon weather patterns may experience related seasonal patterns in yellowfin spawning. However, yellowfin spawning in the oceanic regions of the tropical central and western Pacific takes place throughout the year, while peak areas and times were noted that varied between sampled years. A positive relationship was noted between intense feeding activity of mature yellowfin, a high reproductive condition of the fish and an increased vulnerability to surface fisheries. Localised areas of elevated forage abundance that vary both seasonally and by area may help to explain spatio-temporal variations in spawning activity. In particular, the ocean anchovy (*Encrasicholina punctifer*) appears to be a major forage source for western Pacific yellowfin, occupying a significant ecological role in the region. The spawning season for yellowfin in Hawaiian waters occurs from April through September/October, peaking in June, July and August when daily or near-daily spawning rates were noted. Hawaii-based fisheries that target large yellowfin also peak during the northern summer and appear to be based on an inshore spawning run when the highest potential for gear conflict and interaction occurs.

308. One participant drew attention to the possible connection between the phase of spawning and grade of meat. This was possibly due to the energy expended by the tuna when spawning. It was noted that an important implication of this work to the modelling research might be the necessity of considering differences in the spawning processes between fish targeted by difference gears and by area. It was noted that these differences are not considered in the current MULTIFAN-CL model, but changes may be made in future versions.

Environmental effects

309. There has been no further research in this area since SCTB13. It was felt, however, that the results presented at that meeting still applied.

Food habits and trophic dynamics

310. Mr Itano presented WP YFT–3. This report describes ongoing work in Hawaii that is being conducted by Dr K. Holland and Dr D. Grubbs to investigate the size and species related aspects of feeding and trophic biology in relation to different aggregation types (WP YFT–3: Food habits and trophic dynamics of structure-associated aggregations of yellowfin and bigeye tuna (*Thunnus albacares and Thunnus obesus*) in the Hawaiian Islands Project description, rationale and preliminary results). The PFRP has funded this project which is a multi-disciplinary examination of tuna ecology and association related behaviour (Trophic Ecology and Structure-Associated Aggregation Behavior in Bigeye and Yellowfin Tuna in Hawaiian Waters, PIs K. Holland, R. Brill, R. Young, L. Dagorn) The first phase of the project will concentrate on gut sample analysis of bigeye and yellowfin tuna found in mixed species aggregations within the Hawaii EEZ. Hawaii offers an ideal setting in which to investigate tuna aggregation and vulnerability to a variety of gear types, having an open water longline fishery; a seamount associated mixed gear fishery as well as tuna exploitation on offshore FADs, inshore FADs and natural tuna aggregation sites surrounding the main islands. The project will emphasise the comparative aspects of feeding by bigeye and yellowfin over a broad size range including fine scale information on the time, location and seasonality of feeding. Field work will examine whole gut contents collected through field sampling and at-sea collection trips on board research and commercial fishing vessels.

311. Sampling for the project has recently been initiated, but very preliminary results have indicated interesting differences in diet contents between similar sized tuna species. Analysis of gut contents indicates that offshore FAD associated bigeye were found to be feeding on mesopelagic fishes, while yellowfin remained highly opportunistic on a variety of small fishes and crustaceans, primarily crab megalopae and stomatopod larvae. Seamount associated bigeye were found to be

feeding heavily on oplophorid decapod shrimp while yellowfin remained classically opportunistic on a variety of fishes, crustaceans and cephalopods. Sampling from unassociated tuna taken by pelagic longline gear indicated that bigeye were feeding on a mixture of mesopelagic fishes while yellowfin were feeding on a mixture of small fishes, crustaceans, cephalopods and thaliaceans (salps).

312. Provided further funding is made available, this project will expand to include a finer scale examination of trophic relationships in tuna diet as determined by stable isotope (carbon and nitrogen) analysis. Further aspects of the project will examine the role of local productivity on feeding ecology and movement of tuna in the Hawaii region. A full description of this project is available on the PFRP website at: http://www.soest.hawaii.edu/PFRP/biology/dagorn.html.

313. The importance of research on yellowfin tuna aggregations was noted by the Chairman. It was reported that SPC was conducting food web research and that results would be presented to the Billfish and Bycatch Research Group. PFRP intend to conduct a study using stable isotopes.

9.3 Stock assessment

CPUE analyses

314. Dr Sun presented WP YFT–5, a paper that provides an update of GLM-standardized CPUE trends for yellowfin caught by purse-seine and longline fleets of Taiwan. For the distant-water purse-seine fleets, the standardized CPUE in the WCPO decreased six-fold over the period 1969–77, but then more slowly to 1999. The broad trend in nominal CPUE was similar. For the distant-water longline fishery, standardized CPUE trends declined progressively over the period 1984–90, then increased to 3–6 times this level in almost all years after, except 1996. As with the purtse seine fishery, the nominal CPUE trend was similar, although with less pronounced variation. By contrast, standardized and nominal CPUE trends for the offshore longline fishery have varied about the mean of 4 fish per 1000 hooks since 1985, with 1999 showing average catch rates. Recent catch rates for the distant-water longline fleet are now higher than those of the offshore fleet.

315. It was noted that changes in the way Taiwanese fishery statistics are compiled might account for the apparent changes. The increase in purse seine catches after 1992, interpreted as an actual increase, could be due to the ban of at-sea transhipment after this date, which had the effect of reducing the under-reporting of catches on logsheets. The consideration of alternative areas that better align with the different fisheries was also suggested, in particular, it was noted that that the Taiwanese distant-water longline fleet targets albacore, not yellowfin and bigeye as some of the other fisheries do.

316. The Chairman discussed the possibility of conducting CPUE standardization across fleets to develop regional indices of abundance. Collectively these 'snap shots' could build up a picture across the WCPO. It was also noted that no evidence had been presented to indicate that standardized CPUE trends were reliable indicators of abundance trends, and more work needed to be done in this area.

MULTIFAN–CL

317. Dr Hampton presented the results of an assessment of yellowfin tuna in the WCPO using the MULTIFAN-CL model (WP YFT–1). The model has integrated catch, effort, length-frequency and tagging data into a coherent analysis that is broadly consistent with other information on the biology and fisheries. Since the analysis presented at SCTB 13, a significant amount of historical length

frequency data for the Philippines fisheries has been added, as well as an additional year of data for all other fisheries. These additions appear to have resulted in some changes to specific estimates, although the overall patterns are similar. The major stock assessment conclusions of the analysis are:

1. Recruitment shows considerable variation at several different time scales. Recruitment is estimated to have been relatively low during the last two years of the analysis, but the precision of these estimates is also low. Relatively low recruitment seems to have persisted in region 4 for the past several years.

2. The main feature of both the total and adult biomass estimates is a strong increase in the late 1970s and a decline in the past 2–3 years. These declines would appear to be driven by the lower recruitment that have occurred in recent years.

3. Fishing mortality has increased strongly in recent years, partly as a result of catchability increases in the purse seine fisheries. The increases have been particularly strong for age 0–1 yellowfin in region 3. However, these most recent estimates are associated with large uncertainty. Also, the fact that the estimates of high *F* are mainly attributable to fisheries (Philippines and Indonesian fisheries) with the weakest catch, effort and size data is of continuing concern. There has been recent progress made in the acquisition of a large amount of historical length frequency data from the Philippines (which appears to have had an impact on the analysis). Data for the Indonesian fishery, which are known to exist, would be extremely valuable in helping to resolve some of the ongoing uncertainties in the analysis.

318. Various examples of yield analysis were presented. The extent to which the results of these analyses are driven by assumptions regarding the stock-recruitment relationship and the age-specific exploitation pattern suggests that more robust alternatives are required for developing reference points for fisheries management.

319. It was noted that the lack of data from region 3 would have had an impact on the results so their interpretation should be carefully considered. Consequently, there was a discussion on what advice should be provided to managers in the face of uncertainty. It was noted that there was a need to explore options such as reverting back to surplus production models before giving up on equilibrium yield models. The discussion also focused on the reliability of the relationship between yellowfin fisheries and oceanography phenomena such as El Niño and La Niña. It could be assumed that a similar relationship to that seen with skipjack would occur. However, it was not demonstrated with this model. It was suggested that these issues indicate the need to consider further retrospective analysis.

Operational Model

320. Dr Labelle presented WP YFT–4, describing the features of an operational model that simulate key aspects of the dynamics of the WCPO yellowfin fishery. The model includes key elements of age-structures, length-based models. The latest version accounts for recruitment, growth, natural mortality, spawning, fish movement, and exploitation by 16 fisheries with different gear types and selectivity patterns. All commercial effort series available to SPC are used to represent the historical and spatial trends in exploitation patterns. The model makes use of data from tagging programs conducted by SPC staff in the WCPO, and predicts tag recovery patterns in various time/area/fishery strata. The model can generate a wide variety of outputs on key components of the fisheries or the stock, given user specified levels of process and observation

errors. Current plans are to progressively add new features to the model as required testing the reliability of estimates of biological reference points obtained with MULTIFAN-CL. The importance of an operational model in testing other models was acknowledged by the participants.

9.4 Research co-ordination and planning

321. The YRG identified the following specific tasks to be addressed prior to SCTB 15. Organisations assigned to take a lead in the completion of each task are shown in parentheses.

1. Identify the gaps in the information currently available for the MULTIFAN-CL model for yellowfin tuna and where possible obtain data where information is lacking. In particular, obtain catch, effort and size frequency data for the most recent years from Taiwan, Korea and Japan (OFP, OFDC, NFRDI, others) and from Indonesia (length frequency data in particular), the Philippines and Vietnam. (OFP)

2. Where appropriate, add additional information to National Fisheries Reports on the fishing conditions for yellowfin tuna in the most recent years and assess the possibility of constructing an annual index of 'yellowfin availability'. (All)

3. Continue feeding habits studies in order to understand trophic and ecosystem dynamics of yellowfin tuna, particularly in relation to aggregating devices. (PFRP, OFP)

4. Continue to refine analyses on the standardisation of catch and effort data. In particular, undertake analyses which utilise the data being complied by the FTWG.

5. Conduct studies and examine existing data (i.e. archival tags) to better understand the temperature, depth and oxygen preferences of yellowfin tuna for the further development of habitat models used for standardising CPUE data.

6. Continue the development of the MULTIFAN-CL assessment model to examine stock status of yellowfin tuna in the WCPO. Where possible, conduct sensitivity tests to model inputs and assumptions and identify critical input parameters and assumptions. (OFP and others)

7. Develop appropriate biological reference points for yellowfin tuna. In particular, apply biomass dynamics models to the results of MULTIFAN-CL to estimate productivity parameters for this species. (OFP and others)

8. Undertake retrospective analyses using the MULTIFAN-CL assessment model to better understand possible biases inherent in the estimates of recent recruitment and biomass trends. (OFP)

9. Identify the benefits of conducting a further tagging programme on yellowfin tuna, especially with respect to providing corroboration of existing views of stock status. (OFP, others)

322. The chair called for comments/suggestions on the technical synopsis to be provided out of session.

General

323. General tasks related to the YRG are:

1. Develop research ideas and plans for obtaining fishery-independent or semi-independent data for indexing stock abundance and/or for critical parameters of the new assessment models

9.5 Summary statement

324. 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

Catches of yellowfin tuna represent the second largest component (23%) of the total catch of the four main target species in the WCPO. Yellowfin tuna are also believed to constitute a single stock in the WCPO. The catch of yellowfin tuna in the WCPO first exceeded 200,000 mt in 1980. With the expansion of the purse seine fishery during the 1980s catches almost doubled to reach around 350,000 mt by 1990. Since this time yellowfin catches in the WCPO have varied between 320,000 and 480,000 mt with the catches during the last four years being at historical high levels, exceeding 420,000 mt during each year. Purse seine vessels harvest the majority of the yellowfin catch (46% by weight during 2000), while longline and pole-and-line fisheries caught 15% and 4% respectively and various other gears accounted for 35% (mostly eastern Indonesia and the Philippines).

Nominal catch rates of yellowfin for purse seine fleets are characterised by strong inter-annual variability but indicate no clear trend in the available time series of data. While it is suspected that variability in yellowfin catch rates may be associated with variation in environmental conditions associated with the El Nino Southern Oscillation cycle, catch rates for some fleets since the mid-1990s may have may benefited from efficiencies associated with the increased use of drifting FADs.

Nominal catch rates of yellowfin for the Japanese longline fleet show a steady decline during the 1980s while catch rates for the Korean longline fleet displayed high inter-annual variability but no overall trend. However, nominal catch rates for both fleets reached historical lows in 1999 but recovered somewhat during 2000. After accounting for the increased targeting on bigeye tunas since the mid-1970s, standardised catch rates for the major longline fleets in most regions of the WCPO display large inter-annual variability but no overall long term trend.

Biological research undertaken in recent years has lead to an improved understanding of age and growth and reproductive dynamics. However, further work is required to understand habitat preferences, trophic dynamics and the influences of recent increases in fishing efficiencies (e.g. the increased used of drifting FADs) to help improve the standardisation of catch rates.

Tag-based assessments from the early 1990s found exploitation levels of yellowfin tuna to be low to moderate at catch levels at that time about 10-20 percent below those in recent years. However, more recent assessments of the yellowfin stock using the MULTIFAN-CL model indicate that fishing mortality may have increased significantly since this time, largely as a result of catchability increases in the purse seine fisheries. While the overall estimates of fishing mortality-at-age remain considerably smaller than the corresponding estimates of natural mortality-at-age, the analyses indicate that recent recruitment may have declined significantly. This in turn has produced a significant decline of around 35% in overall stock biomass since 1997. Biomass levels in 2000 are estimated to be the lowest since the mid-1970s. The decline in biomass is most evident in the main catch regions of the western equatorial Pacific where current biomass is estimated to have declined

by over 50 percent since the mid-1990s. For the WCPO in total, the current biomass is estimated to be around 30% less than that which would have occurred in the absence of fishing.

Attempts to estimate an MSY for yellowfin are currently hampered by uncertainty in the stock-recruitment relation and the age-specific exploitation patterns as well as other uncertainties in the stock assessment models. Depending on the assumptions used, estimates of MSY vary between 40% above to 40% below current catch levels.

The reasons for the large declines estimated to have occurred in recruitment in recent years remain unknown, though the possibility that the estimated declines in both recruitment and biomass in recent years may be associated with a shift to a lower productivity regime was discussed. Such a shift in productivity may have occurred in the past, as the significant increases in average annual recruitment and biomass estimated to have occurred after the mid-1970s may have been associated with a regime shift in oceanographic conditions in the Pacific around this time. Although there has been a dominance of La Nina conditions in recent years, it remains unknown at this time whether this is associated with a shift to new regime and whether or not the estimated recent declines in recruitment and biomass may be associated. However, if a shift to a lower productivity regime has occurred, it is possible that present catches may not be able to be maintained.

Due to the short time-series on which they are based, estimates of stock parameters and stock conditions in the most recent years are the most poorly determined. As a result, additional research will be needed to determine the significance of the present results, especially in terms of future stock productivity. Until the uncertainties associated with present stock assessments are resolved, the Group recommends a precautionary approach, and that there be no further increases in fishing effort (particularly to surface fisheries) in the WCPO, and that the condition of the stock be closely monitored over the next few years.

The Group also recommends that current research on yellowfin stock assessments be continued as a matter of priority. This research will include (i) the acquisition of data required as input into the stock assessment models (particularly from the Philippines and Indonesia); (ii) a greater understanding of the trophic and ecosystem dynamics of yellowfin (particularly in relation to aggregating devices); (iii) a greater understanding of the habitat preferences of yellowfin; (iv) refinement of the methods used to standardise CPUE; and (v) further development of stock assessment models, particularly MULTIFAN-CL. In addition to this work, the Group also saw the need for additional large-scale tagging to provide information on yellowfin movement, natural mortality and exploitation rates to support future stock assessment analyses.

10. ALBACORE RESEARCH GROUP (ARG)

325. The ARG Co-ordinator, Dr Murray, led the session of the Albacore Research Group.

10.1 Overview of Fishery and Review of Inter-sessional Work

326. Dr Lewis provided an overview of the South Pacific albacore fishery with reference to WP GEN-1. This fishery provides about 25% of the total Pacific catch of albacore tuna. Around 97% of the South Pacific catch is taken west of 110°W, and was estimated to be 47,308 mt in 2000. The fishery includes widely distributed DWFN longline vessels, US troll vessels that operate along the sub-tropical conversion zone east of New Zealand, NZ troll vessels that operate within their EEZ, and several domestic longline fleets that operate within Pacific Island states EEZs (Fiji, Samoa, French Polynesia, New Caledonia). Chinese longliners have been active in high seas areas since 1999, but the associated statistics have not yet been included in catch estimates.

327. Longline CPUE trends show significant difference between tropical and sub-tropical latitudes within years. The NZ troll CPUE has been relatively stable except for the most recent two years. The US troll CPUE has been more variable, with peaks in 1988 and 2000. Catch samples indicate that the longline catches consists mainly of adult fish, with juveniles taken in temperate waters in surface fisheries.

Albacore targeting in the Taiwanese distant water longline fishery

328. Mr Millar presented WP SWG–11, which investigates the possibility of using Taiwanese data to develop an index of abundance for South Pacific albacore after removing sets targeting other species.

329. With the data available it proved difficult to identify trends in targeting of species other than South Pacific albacore, particularly at low latitudes. Targeting of other species occurs to a lesser extent than previously thought and may be restricted to specific areas and seasons. Consequently, it is not possible to separate out such sets at this time.

330. It was noted that the Taiwanese CPUE rates are twice those of other fleets and are more variable (see ALB Template p. 5, Fig. 7). Perhaps data from other fleets could be used to develop an index of abundance. Suggestions on how this could be done were sought from the participants, especially with regards to the method used to identify the target species for specific sets.

331. One participant said he tried use the number of hooks per basket as an indicator of targeting, but the results were inconclusive. It was noted that other investigators had shown similar albacore catch rates on both deep and shallow sets, so the number of hooks per basket was unlikely to prove useful.

332. One participant suggested that it might be useful to look at the type of bait used, since albacore is almost exclusively targeted with saury.

333. Nearly all longline fishing in the South Pacific has targetted albacore. However, the recent use of low temperature freezer vessels had meant that Pacific bigeye tuna and Pacific yellowfin tuna were being targeted at least part of the year. Consequently, targetting practices could possibly be determined by examining temporal changes in fishing practices.

334. One participant noted that seasonal changes had been looked into, but the results had not been informative.

335. It was suggested that one way to detect targeting changes might be to explore Taiwanese data north of 25°S using a cluster analysis on an area-by-area basis. The data from south of 25°S are unlikely to be of use due to the near exclusive fishing for South Pacific albacore in these higher latitudes.

Possible changes in albacore retention by Japanese longline vessels in the Australian EEZ

336. The Chair noted that BRS had looked into this matter inter-sessionally, but Ms Robins (BRS) noted that further exploration was not planned.

337. It was noted that the South Pacific albacore catch rate for Japanese vessels had nearly doubled between the 1970s and 1980s in the Australian EEZ. One hypothesis was that Japanese longline vessels used to make long trips (up to two years) with only the last portion of fishing taking place in

the Australian EEZ. By then freezer space was limited and only the most valuable species were kept, with most albacore being discarded. By the mid-1980s, trips were shorter and more albacore were kept. This operational change would explain the increase in catch rate.

338. One participant confirmed this practice through personal experience as an observer in the fishery in the 1980s. He noted that the introduction of catch quotas for Southern bluefin tuna also lead to greater retention of albacore.

339. Dr Hampton noted that the catchability as estimated by the MULTIFAN-CL model for South Pacific albacore supported this hypothesis (see WP ALB–1, Fig.10).

340. Dr Campbell agreed to use Australian observer data to attempt to verify and quantify this practice inter-sessionally.

Samoan Port Sampling

341. Ms Brogan (OFP) reported that the apparent anomalies in some length frequency measurements from Samoa had been investigated inter-sessionally. Some measurements were found to be in error due to the sampling method used, and would not be used in future analyses. Callipers are now being used for port sampling in Samoa, and data quality is expected to improve.

Possibility of incorporating recovered Taiwanese logbook data into database

342. Dr S-B Wang presented a paper on the possibility of adding the 1964-94 longline logbook data from American Samoa to the Taiwanese longline database of the Pacific region to facilitate future analyses (WP SWG-12).

343. The corresponding CPUE for major species is similar to the current summary data (Task II) except for the earlier years, and the area covered by both data sets does not match perfectly. Plans are to conduct further work to identify differences between them, including discussing data with fishermen that were active at the time. Different weighting options for using the two data sets will be explored.

344. In the ensuing discussion, it was suggested that the presence of duplicate records might explain some differences. Dr Wang replied that duplicates had already been removed.

345. The ALB-RG agreed that further investigations would be worthwhile and that the ability to include the new data set in future assessments would be helpful.

10.2 Regional fishery developments

Developments in Samoa

346. Catch data in Samoa are collected through port sampling and logbooks. Large vessels (12 m or longer) must carry logbooks. It is a condition of fishing licences that logbooks be submitted to the Fisheries Division within five days after returning to port. Catch sampling covers all fishing vessels because they all unload at a single port. The Fisheries Division research vessel also collects biological information regarding gut/gill weight that will help determine conversion factors in future. CPUE estimates for year 2000 were computed for large vessels to help conduct comparisons with other fleets.

American Samoan Data

347. The availability of longline catch and effort data from American Samoa was discussed. It was noted that time series of catches in weight were available, but no length data and no effort data had been provided to OFP. The later were collected, and their non-availability was due to confidentiality issues.

10.3 Biological and ecological research

348. Dr Murray presented WP ALB–3, which describes the monitoring of commercial catches of albacore in New Zealand during the 2000-01 season. Samples from individual vessels and port sampling operations were used to determine the length composition of catches and length-weight relations. Albacore caught in the NZ troll fishery in coastal areas were smaller than those caught by US troll vessels in the sub-tropical convergence zone. Albacore caught by NZ longline vessels were larger than those from the troll vessels. Further monitoring of catches of juveniles in NZ waters was considered to be necessary.

10.4 Stock assessment

349. Mr Bigelow presented WP ALB–1, the results of an updated stock assessment of South Pacific albacore using the MULTIFAN-CL model The data employed cover the period 1962-00 using quarterly time stratification. The spatial coverage of the model is the entire Pacific Ocean south of the equator and east of 140^{o}E. Within this area, albacore tend to segregate by latitude with the smallest fish caught in the south. The model uses catch, effort, and size data from 14 fisheries (11 longline, 2 troll, and 1 drift gillnet), with the data stratified into three regions delimited by latitudinal bands of 0-10^{o}S, 10-30^{o}S, and 30-50^{o}S. No effort standardisation was done, so the analysis was based on nominal effort series. Some tagging data are available for South Pacific albacore, and were used in the model.

350. Predicted size frequencies were consistent with the observed data. Growth estimates were similar to those based on analysis of vertebral rings. Trends in catchability estimates were apparent in many fisheries (WP ALB–1, Fig. 10). Recruitment estimates were similar those from the MULTIFAN-CL assessment presented at SCTB13. Although year-to-year variability is apparent, a marked decline in recruitment occurred in the mid-to-late 1970s and generally continued at lower levels through to the present (WP ALB–1, Fig. 14). The most recent recruitment estimates are greater than the long-term average, but these tend to be less precise than those of earlier years. Stock biomass was estimated to have declined to historically low levels in the late 1980's, then stabilised and recovered somewhat during the 1990s (WP ALB–1, Fig. 15). The biomass trend is largely driven by recruitment. Trends in fishing and natural mortality are similar to those presented at SCTB13.

351. The participants discussed the possibility that the estimated catchability trends for some fisheries were masking a recent decline in stock biomass. As noted previously, changes in fishing practices (e.g. Japanese longliners off Australia) are consistent with increases in catchability of albacore. It was suggested that another model run be done where catchability for all fisheries is held constant over time to better gauge the possible confounding of catchability and biomass in recent years.

352. The sensitivity of the model results to estimates of tag reporting rates was discussed. The authors noted that a run had been made with tagging data excluded. Estimates of recruitment, biomass, fishing mortality and natural mortality were virtually identical to those presented in WP ALB–1. As currently configured for South Pacific albacore, the MULTIFAN-CL model does not

appear to be largely influenced by the tagging data. This is a somewhat different conclusion than was drawn at SCTB-13. It was noted that the analysis might benefit from some standardisation, i.e. fixing the model configuration so that year-to-year changes in outcomes are minimised. Ideally, this could be done in collaboration with those conducting MULTIFAN-CL analyses on North Pacific albacore.

353. It was noted that biomass estimates near the beginning of the time series (1962) are relatively low, and are highly dependent on the assumption of equilibrium age composition since the age composition is not estimable at that point. Presently there are no practical alternatives other than assuming equilibrium in 1962. However, if a reliable predictive relation can be developed for recruitment (e.g. based on ENSO events), then recruitment could be estimated prior to 1962, alleviating the need for the equilibrium assumption.

354. Dr Wang presented an updated stock assessment of South Pacific albacore using surplus production modelling (ALB-2). Based on Taiwanese longline catch and effort data (1967-98), the surplus production model was used to estimate carrying capacity (K), intrinsic rate of growth (r), and catchability (q). The three estimates were 167,211 mt, 1.89, and 9.62E-09 respectively. A unique "equivalent" point (where theoretical catch = surplus production) was estimated to be at F = 0.63 per yr, biomass = 55,737 mt, and catch = 36,786 mt. The results suggest that the albacore population is near this point, and population size is currently stable (as of 1998, the final year in the analysis). The parameter a_t (ratio of stock biomass in year t to the virgin biomass) indicates a sharp decline in the early years (1967-75), followed by a fairly stable biomass with some year-to-year variation (WP ALB–2, Fig. 2).

355. Discussion following the paper presentation focused mainly on the input data that was used in WP ALB–2. The Taiwanese albacore catch shown in Table 1 of WP ALB–2 appear to be at variance with the Taiwanese longline data reported in Table 1 of WP NFR–13. This discrepancy could not be resolved during the discussion period. The impact of this on the result of WP ALB–2 is not clear.

356. Although the albacore biomass trends estimated in WP ALB–1 and ALB-2 both show a decline from the late 1960's to present, the absolute levels of biomass and fishing mortality differ greatly. The interpretation drawn from WP ALB–1 is that the biomass decline is due to lower recruitment. While the one drawn from WP ALB–2 is that the decline is due to fishing.

357. Different interpretations may result from differing modelling approaches, but before this issue is explored, it was suggested that the Taiwanese catch and CPUE data used in the both models be examined for discrepancies.

10.5 Research co-ordination and planning

358. The research tasks arising from the ARG for SCTB15 are:

1. Compile summary tables of catch and effort by gear types as in the "Tuna Yearbook" for the South Pacific population for distribution to ARG correspondents (OFP).

2. Analyse Australian observer data to clarify reported changes in the retention of albacore on Japanese longline vessels (CSIRO).

3. Develop a list of ways to enhance observer coverage and improve transhipment information, especially on distant water longliners from Taiwan (OFP, OFDC, FFA, etc.).

4. Improve estimates of effective effort for use as model input (OFP).

5. Explore ways in which historical Korean, Japanese and Taiwanese longline data could be improved by distinguishing albacore target and non-target sets, especially during the period of increased targeting of bigeye and yellowfin (OFP, NFRDI, OFDC).

6. Identify the benefits of conducting a further albacore tagging and other complementary activities that would help corroborate the differing views on stock status (OFP).

7. Explore the utility of reference points derived from the MULTIFAN-CL and other model assessments of stock trends for summarising stock status conditions (OFP).

8. Confirm the availability of catch and effort data from American Samoan and Guam based USA longline vessels to the ARG (NMFS – Hawaii).

9. Review and summarise the availability of length frequency data available for the analysis of South Pacific albacore (OFP).

10. Standardise the approach for MULITIFAN-CL assessment of South Pacific albacore through agreement on the model structure and diagnostics used evaluation (OFP, NMFS - La Jolla).

10.6 Summary statement

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

360. Regis Etaix-Bonnin was proposed and accepted as the incoming ARG co-ordinator.

ALBACORE RESEARCH GROUP (ARG) – SUMMARY STATEMENT

Albacore caught in the South Pacific constitute a single stock. The longline fishery accounts for most albacore catches (88%) in the South Pacific, with the remainder caught by trollers (12%). Total albacore catch, estimated at 47,308 mt in 2000, was 10% higher than in 1999. In 2000, longline catches were 41,436 mt and troll catches 5,750 mt. Longline catches of several South Pacific island States and territories, particularly Fiji, French Polynesia and Samoa, continue to increase and together contribute substantially to the total catch. The combined albacore longline catch in 2000 by South Pacific Islands (17,171 mt) accounts for 41% of all albacore longline catches in the South Pacific. A substantial increase in catch to 2,918 mt (81% increase) was also reported for Canadian and USA troll vessels fishing the STCZ in the 1999/00 season relative to 1998-99. Troll caught albacore in the NZ EEZ are estimated to have increased by 83% over the same period to 2,832 mt.

There has been no field research on albacore since the OFP research programme in 1991-92. Biological data on albacore is regularly collected, however, in observer and port sampling programmes in the region, although some of these data have not yet been compiled. Length frequency data are crucial input to the primary assessment model (MULTIFAN-CL). Previous results from this model may have been strongly influenced by a small number of tags recovered (135 recoveries). Model runs conducted with and without tagging data give similar results for recruitment but not for trends in biomass and fishing mortality. Results from the latest analyses indicate a 50% decline in recruitment and biomass in the mid-late 1970s and 1980s, followed by an increase in the 1990s. The results suggest that biomass is largely distributed south of 10º S, and may

be driven by recruitment. An alternative stock production model using Taiwanese longline catch and effort data, raised to South Pacific wide coverage, gave broadly similar results in biomass trends, but attributed the change to fluctuations in the fishery. An investigation of the assumptions made in both models would assist in resolving the apparent discrepancies.

A number of areas requiring further work prior to the next SCTB meeting were identified. These include adding data from additional fleets; review the adequacy of observer coverage; analyse longline data to determine if retention practices changed in some fleets; develop extensions to the MULTIFAN-CL model; develop procedures for standardising CPUE; improve estimates of effective effort; evaluate the need for further tagging; evaluate the use of reference points in assessing stock status using MULTIFAN-CL and other models; and collaborate on identifying a standard model structure and set of diagnostics for evaluating the models. No information was presented to indicate a change in interpretation of stock status of South Pacific albacore. Although model results are considered uncertain, exploitation rates appear to be moderate and current catches are likely to be sustainable.

11. BILLFISH AND BYCATCH RESEARCH GROUP (BBRG)

361. Mr Paul Dalzell assumed the role of Co-ordinator of the Billfish and Bycatch Research Group (BBRG) from the previous Co-ordinator, Peter Ward.

362. The BBRG reviewed the progress to date on statistical issues since SCTB 13, and dealt with three main topic areas during the 14th SCTB; shark bycatch in the WCPO pelagic fisheries; turtle bycatch in the WCPO pelagic fisheries; and other bycatch species in the WCPO pelagic fisheries. The potential for bycatch issues to have both major impacts on some fisheries and potential benefits to others was noted. The closure of the swordfish (*Xiphias gladius*) fishery in Hawaii in 2000 was due to marine turtle bycatch issues and this may provide an opportunity for regional domestic and distant-water longline fleets to export swordfish to Hawaii. Such developments could change the nature of some regional domestic fisheries as a consequence. However, it was pointed out that such environmental regulatory actions have, in the past, also impacted the importation of product into the USA, for example dolphin-safe requirements. Co-ordinator Dalzell also quickly reviewed the regulation, both State of Hawaii and USA federal, effectively ending the finning of sharks in USA waters and even the transhipment of shark fins in the unincorporated territories of American Samoa, Guam, and Northern Mariana Islands.

11.1 Review of progress on the SCTB 13 task list

363. The BBRG reviewed progress made on the task list developed during SCTB 13, and addressed the catches of three non-target species assemblages in the WCPO pelagic fisheries namely sharks, turtles, and other species.

11.2 Shark bycatch in WCPO pelagic fisheries

Overview of pelagic fisheries catching sharks in the WCPO

364. Ms Brogan provided an OFP overview of shark catches in the WCPO longline fisheries. Longline vessels targeting sharks currently operate in the Solomon and Marshalls Islands, while similar operations in PNG have recently ceased. Sharks are also targeted by Chinese and Taiwanese tuna longliners by using supplementary branchlines attached to the floats. Elsewhere, sharks are caught as a regular bycatch component of the tuna longline fishery. The longline fisheries targeting

sharks normally use basket gear, with four hooks per basket, set at night, and electrocute the hooked sharks to minimize the dangers during handling.

365. Nominal CPUEs (observer data for tropical waters only) were outlined. The CPUE for blue sharks (*Prionace glauca*) is highest for the Taiwanese and Chinese fleets, and lower for the Japanese and shark targeting fleets. The CPUE for silky shark (*Carcharhinus falciformis*) was highest on the shark targeting vessels, and the lowest on Japanese vessels. The Chinese and Taiwanese tuna vessels have similar CPUE values – this was as expected as they fished in a similar manner. The low catch rates for Japanese boats were attributed to the depth of the setting.

366. Retention rates of both trunks and fins varied (between zero to 60%) for incidental catches of oceanic white-tip (*Carcharhinus longimanus*) and silky sharks in tropical waters. Most blue sharks were finned only (≈80%). This was also evident on shark targeting longliners. Blue sharks have exceptionally large concentrations of urea in their blood and require considerable at sea processing to achieve a quality product. Shark harvesting, particularly for fins is being driven by an expanding and increasingly affluent Chinese middle class. Fins are normally harvested in *sets* comprising: two pectoral fins, the dorsal fin and lower caudal fin (the anal fins, known as chips, may also be retained). Other shark parts are periodically retained including: the liver, spinal chord, skin and teeth.

367. The species composition of longline shark catches are latitude dependant. Blue sharks, however, are dominant across the range of pelagic longline fishing. Blue shark, silky shark and oceanic white-tip dominate the tropical (15°N - 10°S) WCPO shark catches, while in the sub-tropics (10°S - 30°S), makos displace silky sharks in the catch composition. In temperate WCPO waters (30°S - 50°S) porbeagles (*Lamna nasus*)) feature strongly. Shark catch rates are depth dependent, with the highest catch rates from the shallowest sets. There was some discussion on CPUE values, and whether these were biased downwards, as some sharks species may be cut before landing on longliners. Since shark species have different degrees of vulnerability to harvesting, it was suggested that the OFP could undertake a study on this topic.

Country reports on shark bycatch

368. Member country participants commented on planned or ongoing data collection and research programs for shark bycatch in their domestic and distant water pelagic fisheries. In Australia, shark catches in longline fishing are collected through logbooks, but there are concerns about data reliability. Shortfin makos (*Isurus oxyrhinchus*) and blue sharks dominate the domestic longline catches. Finning is banned and a limit of 20 sharks per boat per trip will be introduced for the retention of whole shark. Wire traces are also banned to reduce bycatch rates. The shark fin ban has been subject to legal challenge from East Coast fisheries. CSIRO carried out a number of shark surveys in the Coral sea which have been reported at a previous SCTB meetings. A pelagic longline vessel set 20,000 hooks during the survey. The catch composition was 13.5% sharks. Approximately 76% of the shark catch was retained and finned, comprising mainly threshers, oceanic white-tips, dusky sharks (*Carcharhinus obscurus*) and blue sharks. CSIRO researcher John Stevens has conducted a stock assessment of ocean sharks. Other CSIRO shark research includes satellite tagging of white sharks, between Victoria and Tasmania, and risk assessments on shark bycatch.

369. Taiwan is developing an action plan for sharks, which are taken by its longline vessels in the Pacific. Recent improvements to logbooks will ensure shark catches can be recorded. From 2001 onwards, the Taiwanese observer program will collect detailed information on more than ten pelagic

shark species. China reported that they have a shark data collection plan in place for the Atlantic in response to ICCAT reporting requirements. A comparable plan for the Pacific does not currently exist. Data from the Atlantic suggests that a Chinese longline vessel could retain up to 800 kg of shark fins per trip. The shark fin trade is a long established business in Fiji. About 80-85% of fins are landed by local fishing vessels. Fiji Fisheries Division are currently contemplating a ban on finning and the means to collect more detailed data. Meetings between shark fin traders and fishery managers had explored the potential for value added processing of shark fins and shark carcasses, with the objective of establishing a shark meat export fishery. The French Polynesian longline fishery comprises mainly blue and oceanic white-tip sharks, which were mainly finned. Trunk landings averaged 500 mt per annum. Some mako sharks are also landed but the local market price was lower. In New Caledonia, mako trunks are retained. Other species are discarded after finning.

370. Commercial shark catches were permitted in PNG from 1996 until early 2001 using bottom set longline gear, with nylon mainline and anchors, set adjacent to reefs. This method has since being prohibited. Unfortunately some DWFN tuna longliners were targeting sharks and this is currently an enforcement problem. NFA is currently developing a shark management plan. Artisanal fishing, with bottom longline gear targeting reef sharks, primarily for their fins, is carried out in some villages.

371. Shark catches in Kiribati are not a major commercial fishery. Catches were small and there were few observations or data available. Sharks have a traditional significance in Samoa. The longline fishery was previously catching sharks and finning was common. This lead to objections from local people about the waste of discarded carcasses. However, there was no finning legislation in place as yet. Good prices are still being offered for fins and there is a local demand for shark meat. In the Solomon Islands longline vessels are not allowed to operate within 3 nautical miles and are required to report all shark catches. Licences to target sharks have been granted to two longline fishing companies in the Solomon Islands. The recent civil unrest has eventuated in no fishing operations. Recently however, six longline vessels have re-commenced operating, but there were no details about these fishing operations. Between 1996 and 1998, the average shark catch in the Solomon Islands was around 18 mt per year.

372. In the Hawaiian longline fishery federally enforced longline logbooks requires shark reporting. The species listed has been amended over time. Detailed data on shark takes are collected in the longline observer program, with coverage of 3-5% and now mandated to be 20% by court order. A draft federal fishery management plan amendment for the pelagic fishery would have limited blue shark catches for finning to 50,000 animals per annum, plus one other shark species landed whole per trip. However, a State of Hawaii ban on the landing of shark fins and the federal ban on shark finning replaces this amendment. It was noted that a directed commercial and sport fishery on sharks on the USA east coast, led to over-harvesting of the resource, and probably contributed to the recent shark regulations. The NMFS Honolulu laboratory has conducted various research projects on blue sharks, including pop-up archival tagging to obtain data on ecology, movement patterns and post-release survival. Of the fourteen blues tagged in April 2001, one died after four days and the tag was jettisoned. Between 1998 and 1999, there was a demersal longline fishery for coastal sharks in Hawaii, through the arrival of one displaced Gulf of Mexico shark longliner. The vessel was able to fish with impunity in state and federal waters through loopholes in the law which meant that pelagic longline regulations did not apply. It is targeting mainly sandbar sharks for fillets and fins. An observer was deployed on the vessel during a trip to the Northwestern Hawaiian Islands.

373. In the Eastern Tropical Pacific Ocean, IATTC collects data on shark catches in purse-seine and longline tuna fisheries. Log books, observer data and trip ticket or market data were all used to

monitor shark longline catches. Mexico has domestic market for sharks, although some shark was also exported. Data collection on purse seine shark catches was augmented through a high level of observer coverage. Shark catches made by other American fleets are not well documented by IATTC. Japanese longline logbook data provide catches for some shark species. The aggregated data from Taiwan and Korea does not contain data on shark catches. Historically, Taiwan statistics have reported shark catches in aggregate. In 2001, the ability to report to the individual shark species level was included in the longline logbook.

374. Observers deployed by FFA on US purse seiners have reported that purse-seiners were catching a substantial volume of sharks, including at one time setting shark lines. Other purse-seine fleets were also setting shark lines to catch sharks. Virtually all the shark catch was finned, with the income going to the crew.

375. Shark fin incomes were initially for crew beer money only, in the Hawaii longline fishery. Buyers would meet vessels with cash-in-hand. As the volume and value of finning increased the vessel skippers and owners became involved. In the summer period when fish prices were low, fin revenues supplemented crew incomes. Finning activity died away to insignificant levels when the State of Hawaii passed a bill banning finning in August 2001. This was followed by a comprehensive federal bill banning finning in December 2001.

376. It was noted that fishermen's attitudes to sharks were generally negative, due to the damage they could inflict on catches and gear. FSM had tried to protect sharks in artisinal fisheries, but fishermen always wanted to fish shark stocks down. FSM regulations does not permit shark targeting, although some logsheet data suggests that this may have been occurring where 80-90% of the catch comprises sharks. A longline vessel had been licensed to fish for shark with 100% observer coverage. However, during the permitted period the vessel had fished beyond FSM's EEZ. Some small-scale, artisanal fishing directed toward sharks also occurs in the FSM. These trips generally last only a few hours.

377. New Zealand had no directed shark longline fishery, but there was also no ban on finning, as long as sharks were humanely killed under the provisions of the Animal Protection Act. NZ was developing a NPOA for sharks in line with the FAO IPOA, as well as a fishing industry code of conduct for the safe handling of sharks, based on observer data for the southern bluefin longline fishery between 1998 and 2000. Not enough observer data was available for small vessel coastal fisheries in New Zealand. In Vanuatu there were no major shark fisheries, although there were two vessels targeting sharks but there was no information on species being captured. Similarly, there is little information on shark catches by longliners licensed to fish in Vanuatu's EEZ. There is one buyer of shark fins in Vanuatu.

11.3 Pacific Blue Shark stock assessment

378. Dr Pierre Kleiber presented WP BBRG-1 "The estimation of maximum sustainable yield (MSY) levels for blue shark in the North Pacific" which was done in collaboration with Yukio Takeuchi and Hideki Nakano of the National Research Institute of Far Seas Fisheries, Japan. The estimates were based on an extension of collaborative stock assessment work. The assessment is based on catch, fishing effort, and size composition data for 1971-1998 and uses the integrated statistical model MULTIFAN-CL. Structural components used in the model include: two regions (one north of 25° N and one from the equator to 25° N), ten longline and drift net fisheries, fifteen age-classes, one recruitment episode per year, and maturity at age 6-7 years. Only length composition data representing the Japanese fishery were used, and most of these were from

Japanese high school training ships. Several scenarios were tried in the model, and those involving the structural parameters which control the variability of catchability over time showed the greatest effect. Predicted abundance trends from four catchability scenarios were presented, ranging from little impact of the fishery to substantial impact, or the least optimistic in assessing the status of the resource.

379. To estimate MSY, density dependence was introduced into the model by incorporating a Beverton and Holt stock recruitment model. Relative yield or production curves resulting from the four catchability scenarios suggest that that landings of blue shark in the North Pacific are moderate compared to the production potential of the population. BBRG participants discussed the difficulty of obtaining complete and reliable catch estimates for sharks, noted that catch rate trends would likely vary between fleets, and that it was desirable to include size composition data from other components of the fishery, and to have tagging results available. As with several other assessments presented at the SCTB, it was suggested that results from alternative assessment models, including simpler ones, be compared to possibly provide a different perspective on the impact of the fishery on the resource.

11.4 Turtle Bycatch in WCPO Pelagic Fisheries

Overview of the status Pacific turtle populations

380. Mr Dalzell presented an overview of the status of marine turtle populations in the Pacific. This included beach counts where available, how harvested turtles have been utilised, whether they are carnivorous or herbivorous, and their designation under the IUCN. It was noted that populations of leatherbacks (*Dermochelys coriacea*), the Eastern Pacific black (*Chelonia agassizii*) and the loggerhead turtle (*Caretta caretta*) are in a serious state of decline. The Olive ridley (*Lepidochelys olivacea*) and Hawaiian green (*Chelonia mydas*) were in much better shape and had growing populations. The decline in turtle populations was due to a combination of factors: including harvesting of adults and eggs on nesting beaches, loss of nesting habitat, fishery bycatch and marine debris. A turtle simulation model (TURTSIM) developed by Jerry Wetherall at the NMFS, Honolulu Laboratory, noted the importance of protecting nesting adult females and eggs for the recovery of leatherback turtles.

Country reports on turtle bycatch

381. Mr Williams presented the results of a recent review of marine turtle encounters in WCPO tuna fisheries, an OFP study contracted to the South Pacific Regional Environment Programme (SPREP). Since logbook data contained no useful information, observer data were used. The observer coverage was <1% of longline activity and <5% of the purse seine activity throughout the WCPO, although coverage of the FSM waters by their national observer programme ranges from 2–5%, and USA purse seine coverage through the FFA-managed regional observer programme targets around 20%. The review found that there was little information on the exact nature of fishery interactions with longliners, e.g. whether entangled or hooked, except for the observer data from Hawaii. In general, interactions were more common in tropical areas and adjacent to nesting sites. Depth of the longline gear (contrasting the shallow 4–6 hook-gear with the deep 15–20 hook gear) was found to be a major factor associated with interactions, while the day/night (diel) effect and bait type did not seem to be as important. Shallow sets made at night caught an order of magnitude more turtles than deep sets made in the day. The Olive ridley turtle was the most frequently encountered species, followed by the green turtle in the tropical waters. There were no observed interactions with black turtle or flatback (*Natator depressus*) turtle. Between 60 and 80% of the turtles on longline vessels were released alive. Purse seine interactions with turtles were an order of magnitude lower

than those of longliners. Purse seine crews made every effort to release turtles before encountering the power-block. Log-associated purse seine sets accounted for most of the interactions. The review recommended a number of improvements: increased observer coverage, turtle species identification training for the observers, measuring of carapace length, more detailed data on the nature of the interaction (e.g. whether hooked and where, or whether entangled and how), training for vessel operators and crew to heighten awareness of requirements for care and release of turtles and to provide guidelines for resuscitation, unhooking, etc. The report of this review provides annual estimates, with confidence intervals, of marine turtle encounters in WCPO fisheries, but this presentation was restricted to a qualitative overview until the report has been cleared for release by SPREP.

382. Member country participants commented on planned or ongoing data collection and research programs for turtle bycatch in domestic and distant water pelagic fisheries. In Fiji reports from captains and crew of domestic longline vessels suggested that turtle interactions were low. Turtles were still taken by coastal villages, but adults rather than juveniles. Australian observers were collecting information on turtle interactions in domestic longline fisheries. In the FSM, observers have recorded turtle interactions with longliners since 1994. Since 1994, with 2% coverage, a total of 16 interactions had been recorded. Observers have not recorded any interactions with turtles in the French Polynesian longline fishery. A similar observation was noted for Kiribati. In New Caledonia, observers would be collecting information on longline-turtle interactions in the near future. There was a permitted cultural take of turtles in New Caledonia.

383. Turtles were still very important culturally in PNG and are regularly taken by coastal villagers around the coast of PNG. Turtles were seasonally available in the markets of Western Province. Information on China's longline vessels operating in the Pacific was unavailable, but some information was given on vessels operating in Mediterranean, where loggerhead turtles were taken seasonally in May. There were no extensive records for turtle-longline interactions in Samoa, but there are indications that some interactions with green and hawksbill turtles occur. There was no major concerns over interaction rates and interest in subsistence use of turtles is declining.

384. In the Solomon Islands there was no information on turtle bycatch. Since the 1970s there has been a monitoring program on turtles nesting in the Solomon Islands. Results to date indicate that populations had been increasing. Turtle harvesting is permitted between July-September, with a year round ban on taking leatherbacks, but enforcement was problematic. In Taiwan, the green turtle is protected and the subject of study. The new observer program on Taiwanese vessels will collect data on turtle interactions. No information was available for the Spanish purse seine fleet in the Pacific, but interaction rates were well documented. Cultural takes by purse seine crews in the ETPO are regulated and observer data collected on turtle interactions within the longline and purse seine fisheries.

385. Estimates of around 700-800 interactions between longliners and turtles occur in the Hawaii the longline fishery were given. About 140 these are killed. New regulation banning swordfish fishing had greatly reduced turtle-longline interactions. With 20% observer coverage, there had been two reported interactions since the new regulations were implemented.

11.5 Effects of Litigation on US Fisheries in the Western Pacific

386. Mr Charles Karnella presented WP BBRG-6 "Status and Impacts of Litigation on the Hawaii Longline Fishery for Swordfish and Tunas". The paper outlined the development of the Hawaii based longline fishery, previous management actions, and recent litigation involving the US NMFS and environmental groups. The wooden sampan-style longline fishery declined through the 1970s

until a turnaround occurred in the 1980s with the entry of modern, larger boats targeting swordfish and somewhat later tunas. The rapid expansion of the fishery led to concerns about local depletion and a limited entry management plan was put into effect capping the fishery at 164 boats, as many as 120 boats have operated in recent years. Mandatory submission of logbooks was also implemented to adequately monitor the fishery. Conflicts between the longliners and inshore commercial and sport trolling boats led to a 50 nautical mile closure around the main Hawaiian Islands. Reported interactions with the endangered Hawaiian monk seal resulted in a 100 nautical mile closure around the Northwestern Hawaiian Islands. With these closures, the vessels were required to carry vessel monitoring systems (VMS). Recorded interactions on the mandatory logbooks resulted in NMFS issuing a Biological Opinion that required NMFS itself to establish an observer program to accurately measure the take of turtles in the fishery. The coverage of this program varied from 3-5%, as budgets allowed. In 1999, a lawsuit was filed against the NMFS asserting that the agency was in violation of the Endangered Species Act (ESA), namely the process leading to the issuing of the Biological Opinion, and the National Environmental Policy Act (NEPA), because the current environmental impact statement (EIS) was not current with the existing Fishery Management Plan for the fishery. In late November 1999, the Federal court ruled that the NMFS was in compliance with the ESA but ordered NMFS to prepare a new EIS and to put into place temporary time and area closures and other measures to minimise the take of sea turtles. During this period, it was found that the fishery had exceeded the take of Olive ridley turtles, thus requiring a new ESA consultation and reissuing of a Biological Opinion. With the submission of a new EIS and Biological Opinion in April 2001, the court closed all shallow-set swordfish fishing in the North Pacific and closed a large area south of 15° N during April and May for the Hawaii-based fleet, prevented transfer of Hawaii-based boats between this regulated and other unregulated longline fisheries, increased observer coverage to 20%, as well as several other actions.

A fishing experiment to develop turtle-friendly swordfish longlining

387. Dr Laurs explained that the NMFS Honolulu Laboratory was coordinating a wide variety of research activities including: rehabilitating swordfish longlining, reducing turtle longline interactions and moralities, improving sea turtle population estimates and evaluating management alternatives. Areas of study will consist of gear research, investigations into new longline methods to catch swordfish during the day, as well as behavioral and physiological research on turtles and target species. A fishing experiment has been conducted by the NMFS Honolulu Laboratory over 3 years, involving a total of 1,370 longline sets per year, to test various mitigation techniques and strategies.

11.6 Longline-Turtle Interactions in the Australian Longline Fishery

388. Ms Carolyn Robins presented WP BBRG-3 " Longline-turtle interactions in Australia's pelagic longline fishery". The expansion of longline fishing off the Australian East Coast had possibly increased fishery interactions with turtles. Four turtle species nest along the Queensland coast, namely loggerheads, greens, hawksbills and flatbacks. Observer data from Japanese longliners previously fishing in Australian waters and logbook data from domestic longliners indicated that turtles interactions occurred but as yet the scale of the problem could not be accurately evaluated. The Bureau of Rural Sciences has commissioned the Department of Agriculture, Fisheries and Forestry, Australia to investigate this problem between July-December 2001 with the following objectives: 1) identify the extent of longline turtle bycatch in Australia, 2) outline legal frameworks and policy responses, 3) review turtle interaction literature, 4) assess the utility of overseas management actions for Australia, and 5) establish a set of monitoring and mitigation measures. The project will consist of a review of scientific, policy and legal information

concerning turtle-longline interactions, and consult with the Australian longline fishing industry on potential mitigation actions.

Using fishermen to collect scientific information on turtle-fishery interactions

389. Ms Robins then went on to present WP BBRG–4 "Using fishermen to collect scientific information". Excellent co-operation with fishers made it possible to establish a voluntary observer program in collaboration with the northern prawn fishery in Australia. This fishery has some 150 vessels participating and as many as 5,500 interactions with turtles estimated in a 1990 study. In this fishery, a turtle program has been developed with volunteer crew. They found it important to identify fishers interested in turtle conservation and to involve the industry in the design of the program. Turtle species identification has been a problem, and they found providing cameras for taking photographs a viable solution. Training in resuscitation has been provided the results encouraging. Some volunteers have continued their tagging efforts even when they move to other fisheries.

11.7 Other Bycatch Issues in WCPO Pelagic Fisheries

Pacific blue marlin stock assessment

390. Dr Kleiber also presented a preliminary assessment of blue marlin stock dynamics using MULTIFAN-CL to the BBRG. The structural components of the model included: the use of four quadrants divided at 15° N and 165° W, twenty age-classes, maturity at age six, eight longline fleets and six purse seine fleets, and selectivity either monotone non-decreasing or not. Japanese and Mexican longline catch and effort data were standardised using a habitat model and information on blue marlin biology and physiology. Size composition data were included for the Japanese longline fishery, primarily collected on the high school training ships. When selectivity was constrained to be monotone non-decreasing, estimated total biomass trends suggested a fairly large impact of the fishery with a significant decline of the adult stock. Recruitment declined initially and flattened out for the remaining years, and catchability trends for the Japan/Mexico longline fleets were generally flat but slightly increasing. When selectivity was not constrained, estimated total biomass trends suggested almost no impact of the fishery, implausibly large stock biomass and flatter catchability trends. Estimated growth was impacted by whether standardised or nominal fishing effort was used: larger variability in length-at-age was obtained with nominal effort than with standardised effort. Estimated yield curves using standardised effort data and selectivity monotone non-decreasing suggested that the stock is either slightly below or slightly above the stock size at MSY, depending on the reference period used to calculate the base fishing mortality rates. These results are not inconsistent with results presented in earlier fora. The discussion focused on the effects of data quality and structural assumptions used in the model.

OFP food web study of the WCPO pelagic ecosystem

391. Dr Valerie Allain presented WP BBRG-2 "Food web study in the tuna ecosystem of the Western and Central Pacific Ocean". In collaboration with national and regional observer programs stomach and muscle samples will be taken from tuna and bycatch species on longline and purse-seine fleets across the WCPO, to determine diet composition and N and C stable isotope ratios. These data will be used to model the pelagic ecosystem using such models as ECOPATH/ECOSYM and SEPODYM. The study has been funded by the United Nation's Global Environmental Facility.

Pelagic fisheries catching marlins in the Western Pacific

392. Mr Dazell gave a review of the US fisheries catching blue and striped marlins in the WCPO. The review noted that there were several decades of data covering longline and small-scale pelagic fisheries over a wide range of the WCPO. The data collected also included weight frequencies, which together with catch could be included in Pacific-wide MULTIFAN-CL analyses of blue and striped marlins.

11.8 Recommendations

393. The BBRG recommends that a strong focus should continue to be maintained on regional billfish catches, both from commercial pelagic fisheries and recreational fisheries. The reduction in domestic swordfish landings in the USA may represent opportunities for the Pacific Island longline industry to develop. However, the BBRG also notes the potential competition from expanding longline fishing in East and Southeast Asia and recognizes the need to obtain more information on swordfish catches from these fisheries.

394. The BBRG recommends that efforts be made to improve the overall level and quality of observer coverage in WCPO pelagic fisheries in order to obtain more reliable statistics on bycatch, and to permit risk analysis on bycatch species. Member countries might begin by initially improving data collection on pelagic sharks, caught in domestic and distant pelagic fisheries, using the FAO IPOA framework as a guideline.

395. The BBRG recommends that member countries should also strengthen data collection on turtle interactions in pelagic fisheries in order to refine estimates of the interaction problem, due to concerns regarding the population status of turtles. The BBRG recommends that member countries should also liaise with the appropriate government and regional agencies to compile an inventory on turtle nesting sites, domestic harvests of turtles, habitat destruction and other impacts (e.g. feral pigs).

396. The BBRG recommends that a watching brief be maintained on other bycatch issues as they arise, e.g. the FAO IPOA on seabird-fishery interactions, or a future IPOA on turtle-fishery interactions. The BBRG also notes that powerful US environmental legislation may be used to influence seafood export to the US, and require vessels to conform to various bycatch mitigation measures.

BILLFISH AND BYCATCH RESEARCH GROUP (BBRG)
SUMMARY STATEMENT

The Billfish and Bycatch Research Group (BBRG) has a more varied perspective than the single species research groups. Issues include non-targeted catches in pelagic fisheries, protected species interactions and the catch estimation and stock assessment of billfish. The potential for bycatch issues to have major impacts on pelagic fisheries were noted, citing the closure of the swordfish-targeting sector of the Hawaii longline fishery during 2000/2001 The BBRG reviewed progress on statistical issues since SCTB 13, and during the 14th SCTB dealt with three non-target catches in WCPO pelagic fisheries namely sharks, turtle and other species.

Shark bycatch in WCPO pelagic fisheries

The OFP provided an overview of shark catches in WCPO longline fisheries. There was some targeting of sharks for retention of trunks, but the majority of retained sharks were finned only. Composition of longline shark catches depends on latitude. As in the Hawaii longline fishery (HLL) shark catches are greatest for shallow longline sets. Member country participants commented on planned or ongoing data collection and research programs for shark bycatch in domestic and distant water pelagic fisheries.

A collaborative stock assessment of blue shark in the North Pacific, based on a MULTIFAN-CL analysis of US, Taiwan, Korean and Japanese data was presented to the BBRG. The stock assessment suggested that North Pacific blue shark landings are moderate compared to the production potential of the population. There was discussion of the data requirements for the MULTIFAN-CL and the properties of the model. Other simpler approaches such as surplus production models were suggested, but the more complex MULTIFAN-CL model permitted incorporation of operational changes in the fisheries catching blue shark.

Turtle bycatch in WCPO pelagic fisheries

An overview of the status of marine turtles in the Pacific noted that populations of leatherbacks, eastern Pacific black and loggerheads were in a serious state of decline. Olive ridley and Hawaiian green turtles were in much better shape and were growing. The decline of some turtle populations was due to a combination of factors, including harvest of adults and eggs on nesting beaches, loss of nesting habitat, fishery bycatch and marine debris. Some recent population modeling by the NMFS Honolulu Laboratory staff highlighted the importance of protecting nesting females and eggs for leatherback turtle recovery.

The results of a qualitative review of OFP data conducted on behalf of SPREP were presented. There was little information on the nature of fishery interactions with longliners, e.g. tangling or hooking. In general, interactions were more frequent in tropical areas and adjacent to nesting sites. Depth was another major factor in interactions, with shallow set longlines set at night, catching an order of magnitude more turtles than deep sets made in the day. Purse seine turtle catches were an order of magnitude lower than those of longliners. Purse-seine crews made every effort to release turtles before encountering the power-block. Olive ridley and green turtles were the most frequently encountered turtles. The review listed recommendations from a variety of improvements including: fishery observer coverage, species identification, collection of turtle biometrics, interaction descriptions, crew education and awareness.

Member country participants commented on planned or ongoing data collection and research programs for turtle bycatch in domestic and distant water pelagic fisheries.

The BBRG was presented with an account of the recent litigation involving the US federal government and environmental groups through which swordfish fishing by the Hawaii-based longline fishery was banned, north of the equator, and tuna longlining constrained in April and May each year. The BBRG also heard how the NMFS Honolulu Laboratory was coordinating a wide variety of research activities to rehabilitate swordfish longlining and to generally reduce turtle longline interactions. This included gear research, potential new longline methods to catch swordfish during the day and behavioral and physiological research on turtles and target species.

The expansion of longline fishing off the Australian East Coast had likely increased fisher interactions with turtles. The BBRG heard how Australian fishery managers are seeking solutions to the problem and actively involving the fishing industry in finding these solutions. Examples were

given of similar work in the Australian northern prawn trawl fishery that successfully used industry volunteers to tag and collect information on captured turtles.

Other species bycatch in WCPO pelagic fisheries

The BBRG discussed a preliminary MULTIFAN-CL stock assessment on Pacific blue marlin. The results of the stock assessment were greatly influenced by whether selectivity in the various fisheries data was constrained or not. Unconstrained selectivity produced an improbably large stock size. Yield estimates with constrained selectivity would suggest that the stock be fully exploited, which is consistent with previous assessment results presented in other fora. Discussion focused on the effects of data quality and assumptions used in the model.

A new OFP project generated through Global Environmental Facility (GEF) funding was aimed at collecting data required for ecosystem based fishery management. The project will use fishery observers to collect, stomach contents and muscle samples from target and bycatch species on longline, purse-seine and pole and line fisheries in the WCPO. These data will be used to provide inputs for ecosystem models such as ECOPATH, and with ECOSIM and SEPODYM.

A review of the US fisheries catching blue and striped marlins in the WCPO was presented to the BBRG. The review noted that there were several decades of data covering longline and small-scale pelagic fisheries over wide area of the WCPO. The data collected also included weight frequencies, which together with catch could be included in Pacific-wide MULTIFAN-CL analyses of blue and striped marlins.

Recommendations

The BBRG recommends that a strong focus should continue to be maintained on regional billfish catches, both from commercial pelagic fisheries and recreational fisheries. It notes that the reduction in domestic swordfish landings in the USA may represent export opportunities for Pacific Island countries, to develop their longline industries. However, the BBRG also notes the potential competition from the expanding longline fishing in East and Southeast Asia, and recognizes the need to obtain more information on swordfish catches in these fisheries. The BBRG recommends that efforts be made to improve the overall level and quality of observer coverage in WCPO pelagic fisheries in order to obtain more reliable statistics on catches. Member countries might begin by initially improving data collection on pelagic sharks, caught in domestic and distant pelagic fisheries, using the FAO IPOA framework as a guideline.

The BBRG also recommends that risk analysis be conducted on non-target species to identify those species which may be most vulnerable, and subsequently guide future BBRG priorities.

The BBRG recommends that member countries should also strengthen data collection on turtle interactions in pelagic fisheries in order to refine estimates of the interaction problem, due to concerns regarding the population status of turtles. The BBRG recommends that member countries should also liaise with the appropriate government and regional agencies to compile an inventory on turtle nesting sites, domestic harvests of turtles, habitat destruction and other impacts (e.g. feral pigs).

The BBRG recommends that a watching brief be maintained on other bycatch issues as they arise, e.g. the FAO IPOA on seabird-fishery interactions, or a future IPOA on turtle-fishery interactions. The BBRG notes that powerful US environmental legislation may be used to influence seafood exports to the US, and require vessels to conform with various bycatch mitigation measures.

12. DISCUSSION ON PREPCON ISSUES

397. Dr Lewis drew attention to Information Paper 2, which provides an account for the recent developments concerning the "Preparatory Conference for the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the WCPO" (PrepCon). He noted that the terms of reference of one of its two working group was to focus on the provision of interim scientific advice to the Commission, both in the long and short term. The working group met for three days, and recommended that in the long term, existing regional organisations and agencies (ISC, IATTC, SCTB etc.) be involved in the identification of scientific needs, ongoing activities, and the provision of such advice. In the short term, it was recommended that provisional advice on stock status be made solicited from such agencies and be made available for the next PrepCon meeting.

398. However, since this group met, SCTB has not yet received any request for short term or long term assistance for reasons that are not known. At this stage, guidance from the SCTB was required to determine how to deal with PrepCon requests for information in the future. Dr Sibert noted that the provision of SCTB reports, which are public documents, would benefit PrepCon considerably. Some participants noted that the periodical submission of executive summaries, individual species summary and miscellaneous tables from the SCTB report would be helpful. Dr Lewis noted that the procedure used to deal with the long-term requirements still needed to be elucidated, ideally before the next PrepCon meeting.

399. Dr Lewis noted that over the last two years, SCTB has gone from being the primary provider of scientific advice to the Commission, to being one of several advice providers. In addition, Japan has now declined to participate to SCTB, and is apparently opposed to having SCTB being the main provider of advice to the Commission. At the end of SCTB13, the meeting recommended that a small working group be formed to determine how to provide advice to PrepCon in the future, and this group was to report to SCTB14. The group was established by the outgoing chairman (Dr Z. Suzuki), and consisted of the current SCTB chairman, Dr M. Laurs, and Dr Tony Lewis. There was some discussion on how to proceed since but little was accomplished since. Some participants noted the concern over the latest developments concerning the role of the SCTB with regards to PrepCon activities, and the progressive marginalisation of its role. Dr Lewis noted that a useful role for SCTB scientists in the future might be to assist in the co-ordination of PrepCon activities dealing with scientific issues, and perhaps a small group of SCTB scientists could be formed to fulfil this role.

13. OTHER BUSINESS

400. The Chairman drew attention to other issues that needed to be discussed. The Chairman asked if there were any country that would like to host the next meeting. One participant from New-Caledonia suggested that the SCTB send a letter to the government of New-Caledonia through SPC to request some funding for the next meeting in case it was held here again next year. Dr Sibert noted that he and Dr Laurs had explored the possibility of hosting the next meeting in Honolulu, but further discussions with local authorities were required before an official proposition could be made. For the next meeting, the first week of July was proposed as an acceptable period for holding the next meeting.

13.1 Consideration of summary statements from the Species Research Groups

401. 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 in the Executive Summary, and at the end of each Species Research Group section in this report.

14. CLOSE

402. The Chairman thanked all the participants for their assistance, and the SPC for hosting this meeting. He noted that all had done an excellent job, and that the venue for the next meeting would be announced at a later date.

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	-	...	-	-	-	16,740	12,863	32,746	5,835	68,184	68,184
1951	-	...	-	-	-	11,408	14,500	15,629	6,577	48,114	48,114
1952	154	...	-	-	154	26,733	41,787	23,914	1,764	94,198	94,352
1953	803	...	-	-	803	27,800	32,921	15,745	341	76,807	77,610
1954	9,578	...	-	-	9,578	20,971	28,069	12,246	208	61,494	71,072
1955	8,625	...	-	-	8,625	16,286	24,236	13,264	721	54,507	63,132
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	773	63,407	85,700
1961	23,742	0	-	-	23,742	17,442	21,476	12,059	1,636	52,613	76,355
1962	35,219	0	-	-	35,219	15,771	9,814	19,753	1,933	47,271	82,490
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	25,329	24,430	15,377	1,293	66,429	105,542
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	24,670	21,503	21,462	2,337	69,972	99,037
1969	24,360	0	0	-	24,360	18,654	34,908	20,192	1,826	75,580	99,940
1970	32,590	100	50	-	32,740	16,897	28,679	21,422	1,604	68,602	101,342
1971	34,708	100	0	-	34,808	12,805	55,028	22,272	2,396	92,501	127,309
1972	33,842	122	268	-	34,232	15,748	64,341	27,521	1,646	109,256	143,488
1973	37,649	141	484	-	38,274	16,201	71,044	17,053	1,985	106,283	144,557
1974	30,985	809	898	-	32,692	13,632	78,353	21,509	1,368	114,862	147,554
1975	26,131	100	646	-	26,877	14,050	55,400	19,043	1,237	89,730	116,607
1976	24,106	100	25	-	24,231	18,029	88,036	16,183	3,227	125,475	149,706
1977	34,849	100	621	-	35,570	17,439	33,431	10,022	2,285	63,177	98,747
1978	34,858	100	1,686	-	36,644	13,627	60,827	16,636	8,102	99,192	135,836
1979	28,739	100	814	-	29,653	14,695	44,965	7,302	4,213	71,175	100,828
1980	31,027	101	1,468	-	32,596	15,658	47,125	7,768	4,723	75,274	107,870
1981	32,632	0	2,085	5	34,722	18,843	28,174	12,837	11,542	71,396	106,118
1982	28,339	1	2,434	6	30,780	17,802	30,040	6,713	13,973	68,528	99,308
1983	24,303	0	744	39	25,086	16,083	21,705	9,584	7,886	55,258	80,344
1984	20,340	2	2,773	1,589	24,704	15,720	27,045	9,354	18,801	70,920	95,624
1985	27,138	0	3,253	1,937	32,328	14,720	22,212	6,471	14,928	58,331	90,659
1986	32,641	0	2,003	1,946	36,590	13,186	16,528	4,738	11,015	45,467	82,057
1987	26,877	9	2,049	930	29,865	14,960	19,249	2,870	11,611	48,690	78,555
1988	31,530	0	4,214	5,283	41,027	14,369	6,814	4,367	19,233	44,783	85,810
1989	22,237	0	8,208	21,968	52,413	14,091	8,683	2,000	20,162	44,936	97,349
1990	23,045	3	6,661	7,494	37,203	16,417	8,647	2,905	26,332	54,301	91,504
1991	24,963	5	7,553	1,474	33,995	17,712	7,103	1,984	11,104	37,903	71,898
1992	30,316	5	6,521	58	36,900	19,824	13,888	4,935	16,909	55,556	92,456
1993	30,589	14	3,820	59	34,482	30,593	12,809	6,748	4,410	54,560	89,042
1994	34,187	5	6,523	78	40,793	30,787	26,391	12,976	3,950	74,104	114,897
1995	26,450	3	7,024	94	33,571	32,506	21,060	9,446	2,555	65,567	99,138
1996	24,487	4	7,375	105	31,971	39,051	20,296	21,011	1,832	82,190	114,161
1997	33,014	21	4,545	94	37,674	47,701	32,323	16,942	4,269	101,235	138,909
1998	39,239	35	6,180	55	45,509	46,873	23,032	18,617	4,359	92,881	138,390
1999	39,666	38	3,156	48	42,908	47,654	55,904	13,319	11,978	128,855	171,763
2000	41,436	8	5,750	114	47,308	(47,654)	55,850	12,738	10,036	126,278	173,586

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	...	...	1,095	...	...	...	...	...	...	...	...	...
1952	...	2,100	1,039	...	...	...	...	...	...	...	...	...
1953	...	2,400	619	...	...	...	...	...	...	...	...	...
1954	...	2,100	360	...	...	...	...	...	...	...	...	...
1955	...	4,000	285	...	...	...	...	...	...	...	...	...
1956	...	4,400	908	...	...	...	...	...	...	...	...	...
1957	...	5,200	49	...	...	...	...	...	...	...	...	...
1958	...	4,200	48	...	...	...	...	...	...	...	...	...
1959	...	1,700	36	...	...	...	...	...	...	...	...	...
1960	...	1,500	58	...	...	...	...	...	...	...	...	...
1961	...	1,800	63	...	...	...	57	156	-	-	...	...
1962	34,206	800	173	...	35,179	44,200	168	160	-	-	44,528	79,707
1963	40,727	1,800	6	...	42,533	65,300	75	-	-	-	65,375	107,908
1964	29,316	1,100	231	...	30,647	45,400	68	-	-	-	45,468	76,115
1965	28,318	1,300	201	...	29,819	28,600	117	-	-	-	28,717	58,536
1966	30,761	1,100	9	...	31,870	34,100	157	109	-	-	34,366	66,236
1967	30,353	2,800	60	...	33,213	35,035	748	916	-	-	36,699	69,912
1968	23,528	2,300	183	...	26,011	34,216	63	2,496	-	-	36,775	62,786
1969	28,904	1,700	48	...	30,652	50,938	-	576	-	-	51,514	82,166
1970	33,987	1,600	726	2,820	39,133	31,800	-	1,332	-	-	33,132	72,265
1971	34,659	900	877	3,060	39,496	29,900	58	2,494	-	14	32,466	71,962
1972	45,329	1,762	865	3,498	51,454	36,400	66	2,172	-	-	38,638	90,092
1973	35,478	1,258	1,078	4,218	42,032	53,400	131	1,848	-	-	55,379	97,411
1974	39,029	1,039	1,389	4,719	46,176	36,500	-	890	-	-	37,390	83,566
1975	52,779	1,334	1,328	4,943	60,384	41,764	28	3,695	-	-	45,487	105,871
1976	64,513	3,423	1,312	4,138	73,386	54,239	45	10,136	1	4	64,425	137,811
1977	62,934	3,325	1,587	5,637	73,483	73,702	2	7,053	-	-	80,757	154,240
1978	49,394	3,337	1,146	4,243	58,120	70,411	-	11,714	-	-	82,125	140,245
1979	56,748	2,419	2,033	4,662	65,862	55,342	-	7,531	-	1	62,874	128,736
1980	54,045	2,243	2,162	4,142	62,592	64,695	-	15,318	-	103	80,116	142,708
1981	41,239	2,596	4,315	4,919	53,069	53,366	-	10,090	-	1	63,457	116,526
1982	44,739	4,108	5,150	4,738	58,735	53,270	23	4,079	-	-	57,372	116,107
1983	41,144	4,055	9,388	4,987	59,574	59,883	21	3,144	-	95	63,143	122,717
1984	46,156	3,465	8,556	5,176	63,353	46,245	1	5,919	-	16	52,181	115,534
1985	51,064	4,326	7,311	6,120	68,821	66,176	17	4,497	-	18	70,708	139,529
1986	46,486	2,865	7,509	6,480	63,340	102,245	-	1,939	-	-	104,184	167,524
1987	60,647	3,134	11,395	5,563	80,739	97,972	-	771	-	5	98,748	179,487
1988	50,167	4,112	7,305	6,439	68,023	68,003	2	1,051	-	-	69,056	137,079
1989	51,182	4,272	12,651	7,137	75,242	69,113	-	1,470	-	-	70,583	145,825
1990	66,800	3,868	12,143	8,851	91,662	90,699	-	4,701	-	11	95,411	187,073
1991	51,259	1,909	13,406	10,225	76,799	89,783	25	3,702	-	13	93,523	170,322
1992	63,157	1,631	19,384	7,274	91,446	77,073	-	5,488	-	9	82,570	174,016
1993	57,066	2,360	14,286	7,347	81,059	74,147	-	8,043	-	26	82,216	163,275
1994	64,827	2,805	11,178	8,560	87,370	69,142	-	28,683	692	-	98,517	185,887
1995	52,923	3,807	14,209	10,340	81,279	55,736	-	36,155	1,154	-	93,045	174,324
1996	47,530	3,861	17,571	11,612	80,574	42,344	-	50,728	-	625	93,697	174,271
1997	57,086	3,731	30,457	11,847	103,121	47,780	-	51,617	-	2	99,399	202,520
1998	63,483	2,933	18,234	15,125	99,775	44,233	-	35,143	-	12	79,388	179,163
1999	64,753	3,135	33,744	15,489	117,121	23,164	-	41,118	-	42	64,324	181,445
2000	67,792	3,031	28,843	15,598	115,264	(23,164)	-	69,745	-	-	92,909	208,173

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	34	...	...	6,483	...	49,534	5,741	1,299	56,574	...
1951	12	96,214	1,748	8,602	106,576	45,617	5,790	1,109	52,516	159,092
1952	54	78,518	3,716	10,014	92,302	32,724	4,806	905	38,435	130,737
1953	1	65,546	3,371	11,403	80,321	50,812	5,171	0	55,983	136,304
1954	0	88,073	4,534	11,554	104,161	61,221	8,519	1	69,741	173,902
1955	157	92,524	2,906	12,664	108,252	51,558	6,503	1	58,062	166,314
1956	0	91,950	2,145	13,094	107,189	64,971	3,204	0	68,175	175,364
1957	17	92,156	2,813	11,955	106,941	54,414	873	10	55,297	162,238
1958	0	131,441	10,698	15,244	157,383	67,594	5,481	23	73,098	230,481
1959	33	145,447	16,941	14,853	177,274	69,495	9,477	24	78,996	256,270
1960	0	70,428	3,728	15,782	89,938	34,900	11,820	21	46,741	136,679
1961	0	127,011	11,693	18,032	156,736	27,497	40,614	384	68,495	225,231
1962	4	152,387	11,674	17,559	181,624	16,153	52,572	34	68,759	250,383
1963	0	94,757	9,592	18,354	122,703	16,549	76,829	2,318	95,696	218,399
1964	0	137,106	25,064	20,739	182,909	9,783	46,006	3,545	59,334	242,243
1965	0	129,933	4,670	20,601	155,204	19,137	58,246	999	78,382	233,586
1966	0	215,600	10,968	22,890	249,458	13,666	45,119	1,875	60,660	310,118
1967	0	168,846	10,954	24,864	204,664	17,871	97,962	4,906	120,739	325,403
1968	1	162,379	7,485	24,891	194,756	7,008	54,362	9,896	71,266	266,022
1969	53	168,084	4,400	30,031	202,568	6,591	40,879	11,763	59,233	261,801
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	172,827	19,691	41,777	235,712	6,081	26,434	1,070	33,585	269,297
1973	1,608	253,065	21,547	50,326	326,546	8,789	34,737	569	44,095	370,641
1974	2,007	289,202	14,742	49,410	355,361	7,150	71,255	461	78,866	434,227
1975	1,827	218,271	18,237	50,176	288,511	13,366	110,083	487	123,936	412,447
1976	1,964	276,581	28,148	51,206	357,899	10,846	114,715	684	126,245	484,144
1977	3,049	294,641	40,122	66,420	404,232	7,218	77,228	1,968	86,414	490,646
1978	3,265	331,401	42,186	73,621	450,473	5,603	162,915	1,369	169,887	620,360
1979	2,286	283,494	65,124	60,400	411,304	5,931	124,673	1,446	132,050	543,354
1980	651	332,465	82,536	42,767	458,419	5,040	123,687	1,963	130,690	589,109
1981	857	294,187	94,931	48,203	438,178	5,780	112,948	906	119,634	557,812
1982	1,120	262,233	174,693	53,007	491,053	3,676	94,681	429	98,786	589,839
1983	2,226	299,762	324,603	56,813	683,404	4,112	53,150	903	58,165	741,569
1984	893	379,474	327,058	44,187	751,612	2,770	56,948	857	60,575	812,187
1985	1,104	250,010	309,469	43,524	604,107	918	48,375	200	49,493	653,600
1986	1,427	336,694	369,609	49,089	756,819	1,939	61,486	169	63,594	820,413
1987	2,317	262,467	373,331	47,802	685,917	2,230	59,941	197	62,368	748,285
1988	1,915	295,691	489,505	49,049	836,160	4,278	80,445	663	85,386	921,546
1989	2,510	285,780	477,572	48,395	814,257	2,892	88,468	1,033	92,393	906,650
1990	1,292	224,130	604,549	60,728	890,699	835	69,927	1,883	72,645	963,344
1991	1,541	288,401	773,655	65,280	1,128,878	1,670	59,707	1,900	63,277	1,192,155
1992	1,063	224,295	706,496	75,976	1,007,830	1,860	81,026	1,092	83,978	1,091,808
1993	940	269,785	580,699	55,589	907,013	3,633	81,500	2,256	87,389	994,402
1994	1,793	220,960	720,377	48,050	991,179	3,110	71,449	898	75,457	1,066,636
1995	1,390	269,564	727,727	60,585	1,059,266	5,237	130,974	2,038	138,249	1,197,515
1996	1,112	232,503	738,952	57,297	1,029,864	2,583	108,444	1,328	112,355	1,142,219
1997	1,411	253,890	643,856	59,040	958,197	3,292	158,398	119	161,809	1,120,006
1998	1,572	294,368	942,907	67,824	1,306,671	1,642	143,160	198	145,000	1,451,671
1999	1,656	309,438	782,507	69,743	1,163,344	2,106	264,643	1,353	268,102	1,431,446
2000	1,607	283,174	809,020	69,616	1,163,417	231	209,910	67	210,208	1,373,625

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 estimates of purse-seine catches of yellowfin and bigeye.

YEAR	WCPO					EPO					TOTAL
	LONGLINE	POLE-AND-LINE	PURSE SEINE	OTHER	SUB-TOTAL	LONGLINE	POLE-AND-LINE	PURSE SEINE	OTHER	SUB-TOTAL	
1950	...	...	...	8,919	8,919	-	65,921	15,856	879	82,656	91,575
1951	...	...	938	10,415	11,353	-	65,499	6,598	727	72,824	84,177
1952	23,443	2,595	2,565	10,539	39,142	-	66,108	13,735	1,067	80,910	120,052
1953	33,501	5,228	1,260	10,871	50,860	-	43,920	16,120	-	60,040	110,900
1954	36,067	4,268	4,001	11,763	56,099	-	46,541	7,625	-	54,166	110,265
1955	31,362	3,983	2,944	12,633	50,922	665	50,811	13,086	...	64,562	115,484
1956	23,612	4,399	724	12,818	41,553	1,578	58,828	21,470	...	81,876	123,429
1957	54,527	1,669	1,496	13,481	71,173	9,365	58,402	15,544	...	83,311	154,484
1958	55,097	2,934	3,338	14,682	76,051	7,803	46,776	20,560	...	75,139	151,190
1959	53,113	4,119	4,316	15,673	77,221	4,497	30,053	28,126	...	62,676	139,897
1960	62,839	1,872	1,438	15,919	82,068	7,629	26,199	79,976	...	113,804	195,872
1961	71,281	3,259	2,777	17,044	94,361	16,640	16,762	84,897	984	119,283	213,644
1962	58,049	4,225	6,975	18,150	87,399	14,118	11,855	59,597	0	85,570	172,969
1963	55,673	2,071	2,277	18,676	78,697	22,941	7,678	53,624	726	84,969	163,666
1964	47,985	5,073	3,647	20,183	76,888	20,002	4,327	83,547	776	108,652	185,540
1965	49,295	3,434	3,752	20,958	77,439	18,315	7,417	71,160	321	97,213	174,652
1966	66,240	2,192	5,844	23,409	97,685	10,906	5,852	74,228	531	91,517	189,202
1967	35,334	3,125	3,395	26,303	68,157	11,065	5,214	73,188	1,557	91,024	159,181
1968	42,921	2,706	6,888	26,084	78,599	16,500	4,698	93,942	3,376	118,516	197,115
1969	46,834	2,714	3,857	26,609	80,014	18,000	7,560	119,322	1,976	146,858	226,872
1970	53,080	2,025	9,299	29,422	93,826	14,000	4,688	145,867	5,071	169,626	263,452
1971	49,674	2,667	10,847	31,204	94,392	8,000	5,469	114,416	2,954	130,839	225,231
1972	51,090	7,465	11,765	35,749	106,069	16,300	6,149	169,467	1,512	193,428	299,497
1973	56,828	7,457	16,900	41,726	122,911	12,900	4,355	200,204	694	218,153	341,064
1974	54,102	6,582	19,574	46,997	127,255	10,000	8,659	200,451	1,254	220,364	347,619
1975	60,554	7,801	15,209	48,536	132,100	10,761	6,114	195,442	586	212,903	345,003
1976	70,735	17,186	16,826	40,666	145,413	15,607	3,688	232,266	373	251,934	397,347
1977	87,974	15,257	18,509	55,092	176,832	12,161	2,093	196,427	297	210,978	387,810
1978	109,384	12,767	13,863	38,491	174,505	10,138	4,172	175,747	615	190,672	365,177
1979	104,950	11,463	31,362	46,375	194,150	11,439	5,191	184,236	247	201,113	395,263
1980	117,423	13,132	35,614	43,906	210,075	13,588	1,649	156,878	898	173,013	383,088
1981	92,541	19,268	62,877	50,623	225,309	7,952	1,595	179,371	847	189,765	415,074
1982	83,824	13,835	73,542	48,191	219,392	10,943	1,605	123,272	206	136,026	355,418
1983	83,588	13,266	106,103	50,836	253,793	10,900	4,271	88,779	1,206	105,156	358,949
1984	69,752	13,558	109,681	53,700	246,691	10,309	3,090	141,635	336	155,370	402,061
1985	73,558	18,156	105,367	61,079	258,160	13,161	1,081	215,610	301	230,153	488,313
1986	62,079	13,074	104,719	64,663	244,535	22,748	2,519	265,473	282	291,022	535,557
1987	73,999	13,243	156,647	58,037	301,926	18,071	5,110	266,800	336	290,317	592,243
1988	81,080	12,500	99,244	65,681	258,505	13,267	3,743	283,318	973	301,301	559,806
1989	64,030	13,823	164,335	69,850	312,038	15,820	4,189	284,621	565	305,195	617,233
1990	72,290	13,062	175,239	90,222	350,813	30,402	2,664	268,871	1,751	303,688	654,501
1991	59,423	12,186	211,043	101,591	384,243	25,844	2,909	234,974	1,069	264,796	649,039
1992	69,003	14,048	240,852	67,978	391,881	16,250	3,885	232,811	3,153	256,099	647,980
1993	64,389	12,956	243,108	71,947	392,400	24,257	5,089	223,519	3,463	256,328	648,728
1994	67,060	12,599	223,584	84,588	387,831	29,345	3,755	213,177	1,455	247,732	635,563
1995	73,196	15,749	188,292	102,052	379,289	19,808	1,284	220,486	2,047	243,625	622,914
1996	69,516	16,038	123,018	110,927	319,499	15,042	3,733	245,313	1,056	265,144	584,643
1997	67,738	14,573	261,878	114,062	458,251	20,182	4,386	252,214	1,231	278,013	736,264
1998	57,699	17,635	265,581	143,679	484,594	15,009	5,126	260,261	330	280,726	765,320
1999	56,195	18,367	214,319	148,840	437,720	9,035	1,734	293,889	1,214	305,872	743,592
2000	64,735	17,234	196,346	148,594	426,909	(9,035)	2,418	269,532	384	281,369	708,278

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	35,438		...		...		8,919		...
1951	32,485		...		106,576		11,353		...
1952	69,136		...		92,302		38,820		...
1953	61,853		...		80,321		50,860		...
1954	58,679		...		104,161		55,844		...
1955	49,291		...		108,252		51,433		...
1956	64,512		...		107,189		43,131		...
1957	79,556		...		106,941		80,185		...
1958	59,456		...		157,383		83,677		...
1959	48,179		...		177,274		81,391		...
1960	65,039		...		89,938		89,443		...
1961	60,102		...		156,736		110,706		...
1962	52,162	15	35,179	10	181,624	51	87,399	25	356,364
1963	59,373	20	42,533	14	122,703	40	78,697	26	303,306
1964	56,838	16	30,647	9	182,909	53	76,888	22	347,282
1965	77,726	23	29,819	9	155,204	46	77,439	23	340,188
1966	84,312	18	31,870	7	249,458	54	97,685	21	463,325
1967	93,459	23	33,213	8	204,664	51	68,157	17	399,493
1968	68,102	19	26,011	7	194,756	53	78,599	21	367,468
1969	75,716	19	30,652	8	202,568	52	80,014	21	388,950
1970	70,285	16	39,133	9	242,082	54	93,826	21	445,326
1971	98,270	21	39,496	9	226,371	49	94,392	21	458,529
1972	111,055	22	51,454	10	235,712	47	106,069	21	504,290
1973	120,358	20	42,032	7	326,546	53	122,911	20	611,847
1974	115,531	18	46,176	7	355,361	55	127,255	20	644,323
1975	89,219	16	60,384	11	288,511	51	132,100	23	570,214
1976	126,714	18	73,386	10	357,899	51	145,413	21	703,412
1977	76,735	10	73,483	10	404,232	55	176,832	24	731,282
1978	106,466	13	58,120	7	450,473	57	174,505	22	789,564
1979	88,737	12	65,862	9	411,304	54	194,150	26	760,053
1980	94,591	11	62,592	8	458,419	56	210,075	25	825,677
1981	79,462	10	53,069	7	438,178	55	225,309	28	796,018
1982	84,128	10	58,735	7	491,053	58	219,392	26	853,308
1983	64,309	6	59,574	6	683,404	64	253,793	24	1,061,080
1984	74,345	7	63,353	6	751,612	66	246,691	22	1,136,001
1985	74,326	7	68,821	7	604,107	60	258,160	26	1,005,414
1986	68,556	6	63,340	6	756,819	67	244,535	22	1,133,250
1987	66,599	6	80,739	7	685,917	60	301,926	27	1,135,181
1988	70,535	6	68,023	6	836,160	68	258,505	21	1,233,222
1989	89,989	7	75,242	6	814,257	63	312,038	24	1,291,526
1990	82,203	6	91,662	6	890,699	63	350,813	25	1,415,377
1991	62,351	4	76,799	5	1,128,878	68	384,243	23	1,652,271
1992	71,871	5	91,446	6	1,007,830	64	391,881	25	1,563,028
1993	71,783	5	81,059	6	907,013	62	392,400	27	1,452,255
1994	95,007	6	87,370	6	991,179	63	387,831	25	1,561,387
1995	87,832	5	81,279	5	1,059,266	66	379,289	24	1,607,666
1996	102,895	7	80,574	5	1,029,864	67	319,499	21	1,532,833
1997	125,380	8	103,121	6	958,197	58	458,251	28	1,644,949
1998	123,065	6	99,775	5	1,306,671	65	484,594	24	2,014,106
1999	154,856	8	117,121	6	1,163,344	62	437,720	23	1,873,042
2000	156,679	8	115,264	6	1,163,417	62	426,909	23	1,862,269

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	...		...		6,483		21,237		...
1951	...		110,714		3,780		25,594		...
1952	...		125,000		7,320		21,014		...
1953	...		106,095		5,250		22,603		...
1954	...		122,510		8,895		23,378		...
1955	...		124,743		6,135		25,441		...
1956	...		143,559		3,776		25,985		...
1957	...		148,525		4,358		25,678		...
1958	...		160,750		14,084		30,132		...
1959	...		165,518		21,293		30,805		...
1960	...		99,001		5,224		31,918		...
1961	...		150,709		14,533		35,355		...
1962	135,447	38	166,141	47	18,822	5	35,954	10	356,364
1963	129,055	43	125,064	41	11,875	4	37,312	12	303,306
1964	109,831	32	167,137	48	28,942	8	41,372	12	347,282
1965	113,701	33	176,158	52	8,623	3	41,706	12	340,188
1966	157,743	34	241,722	52	16,821	4	47,039	10	463,325
1967	127,890	32	205,252	51	14,409	4	51,942	13	399,493
1968	115,537	31	183,982	50	14,556	4	53,393	15	367,468
1969	116,774	30	204,410	53	8,305	2	59,461	15	388,950
1970	133,241	30	225,861	51	20,611	5	65,613	15	445,326
1971	127,881	28	237,569	52	26,711	6	66,368	14	458,529
1972	142,988	28	242,767	48	32,321	6	86,214	17	504,290
1973	141,552	23	330,729	54	39,525	6	100,041	16	611,847
1974	132,790	21	371,208	58	35,705	6	104,620	16	644,323
1975	150,057	26	279,663	49	34,774	6	105,720	19	570,214
1976	175,700	25	382,626	54	46,286	7	98,800	14	703,412
1977	196,272	27	345,257	47	60,218	8	129,535	18	731,282
1978	199,600	25	407,482	52	57,195	7	125,287	16	789,564
1979	200,268	26	342,441	45	98,519	13	118,825	16	760,053
1980	211,104	26	395,066	48	120,312	15	99,195	12	825,677
1981	171,459	22	344,225	43	162,123	20	118,211	15	796,018
1982	163,850	19	310,217	36	253,385	30	125,856	15	853,308
1983	158,649	15	338,788	32	440,094	41	123,549	12	1,061,080
1984	143,831	13	423,544	37	445,295	39	123,331	11	1,136,001
1985	156,566	16	294,704	29	422,147	42	131,997	13	1,005,414
1986	146,597	13	369,161	33	481,837	43	135,655	12	1,133,250
1987	169,311	15	298,102	26	541,373	48	126,395	11	1,135,181
1988	169,264	14	319,117	26	596,054	48	148,788	12	1,233,222
1989	149,076	12	312,558	24	654,558	51	175,334	14	1,291,526
1990	174,279	12	249,710	18	791,931	56	199,457	14	1,415,377
1991	147,971	9	309,604	19	998,104	60	196,591	12	1,652,271
1992	168,490	11	253,867	16	966,732	62	173,939	11	1,563,028
1993	170,820	12	297,924	21	838,093	58	145,418	10	1,452,255
1994	188,373	12	262,760	17	955,139	61	155,116	10	1,561,387
1995	180,827	11	310,183	19	930,228	58	186,428	12	1,607,666
1996	175,777	11	272,702	18	879,541	57	204,813	13	1,532,833
1997	199,116	12	304,538	19	936,191	57	205,104	12	1,644,949
1998	202,881	10	337,998	17	1,226,722	61	246,505	12	2,014,106
1999	203,939	11	386,831	21	1,030,570	55	251,702	13	1,873,042
2000	217,240	12	359,246	19	1,034,209	56	251,575	14	1,862,269

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	32,746		...		56,574		82,656		...
1951	15,629		...		52,516		72,824		...
1952	25,216		...		38,435		80,910		...
1953	15,757		...		55,983		60,040		...
1954	12,393		...		69,741		54,166		...
1955	13,841		...		58,062		64,562		...
1956	19,233		...		68,175		81,876		...
1957	21,469		...		55,297		83,311		...
1958	14,903		...		73,098		75,139		...
1959	20,995		...		78,996		62,676		...
1960	20,661		...		46,741		113,804		...
1961	16,253		...		68,495		119,283		...
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	118,516	46	257,492
1969	24,224	9	51,514	18	59,233	21	146,858	52	281,829
1970	31,057	11	33,132	11	56,130	19	169,626	59	289,945
1971	29,039	10	32,466	11	104,823	35	130,839	44	297,167
1972	32,433	11	38,638	13	33,585	11	193,428	65	298,084
1973	24,199	7	55,379	16	44,095	13	218,153	64	341,826
1974	32,023	9	37,390	10	78,866	21	220,364	60	368,643
1975	27,388	7	45,487	11	123,936	30	212,903	52	409,714
1976	22,992	5	64,425	14	126,245	27	251,934	54	465,596
1977	22,012	6	80,757	20	86,414	22	210,978	53	400,161
1978	29,370	6	82,125	17	169,887	36	190,672	40	472,054
1979	12,091	3	62,874	15	132,050	32	201,113	49	408,128
1980	13,279	3	80,116	20	130,690	33	173,013	44	397,098
1981	26,656	7	63,457	16	119,634	30	189,765	47	399,512
1982	15,180	5	57,372	19	98,786	32	136,026	44	307,364
1983	16,035	7	63,143	26	58,165	24	105,156	43	242,499
1984	17,369	6	52,181	18	60,575	21	155,370	54	285,495
1985	16,333	4	70,708	19	49,493	13	230,153	63	366,687
1986	13,501	3	104,184	22	63,594	13	291,022	62	472,301
1987	11,956	3	98,748	21	62,368	13	290,317	63	463,389
1988	15,275	3	69,056	15	85,386	18	301,301	64	471,018
1989	7,360	2	70,583	15	92,393	19	305,195	64	475,531
1990	9,301	2	95,411	20	72,645	15	303,688	63	481,045
1991	9,547	2	93,523	22	63,277	15	264,796	61	431,143
1992	20,585	5	82,570	19	83,978	19	256,099	58	443,232
1993	17,259	4	82,216	19	87,389	20	256,328	58	443,192
1994	19,890	5	98,517	22	75,457	17	247,732	56	441,596
1995	11,306	2	93,045	19	138,249	28	243,625	50	486,225
1996	11,266	2	93,697	19	112,355	23	265,144	55	482,462
1997	12,745	2	99,399	18	161,809	29	278,013	50	551,966
1998	14,053	3	79,388	15	145,000	28	280,726	54	519,167
1999	14,771	2	64,324	10	268,102	41	305,872	47	653,069
2000	14,771	2	92,909	16	210,208	35	281,369	47	599,257

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	68,184		...		...		91,575		...
1951	48,114		...		159,092		84,177		...
1952	94,352		...		130,737		120,052		...
1953	77,610		...		136,304		110,900		...
1954	71,072		...		173,902		110,265		...
1955	63,132		...		166,314		115,484		...
1956	83,745		...		175,364		123,429		...
1957	101,025		...		162,238		154,484		...
1958	74,359		...		230,481		151,190		...
1959	69,174		...		256,270		139,897		...
1960	85,700		...		136,679		195,872		...
1961	76,355		...		225,231		213,644		...
1962	82,490	14	79,707	14	250,383	43	172,969	30	585,549
1963	100,024	17	107,908	18	218,399	37	163,666	28	589,997
1964	85,353	14	76,115	13	242,243	41	185,540	31	589,251
1965	99,134	18	58,536	10	233,586	41	174,652	31	565,908
1966	105,542	16	66,236	10	310,118	46	189,202	28	671,098
1967	123,736	18	69,912	10	325,403	48	159,181	23	678,232
1968	99,037	16	62,786	10	266,022	43	197,115	32	624,960
1969	99,940	15	82,166	12	261,801	39	226,872	34	670,779
1970	101,342	14	72,265	10	298,212	41	263,452	36	735,271
1971	127,309	17	71,962	10	331,194	44	225,231	30	755,696
1972	143,488	18	90,092	11	269,297	34	299,497	37	802,374
1973	144,557	15	97,411	10	370,641	39	341,064	36	953,673
1974	147,554	15	83,566	8	434,227	43	347,619	34	1,012,966
1975	116,607	12	105,871	11	412,447	42	345,003	35	979,928
1976	149,706	13	137,811	12	484,144	41	397,347	34	1,169,008
1977	98,747	9	154,240	14	490,646	43	387,810	34	1,131,443
1978	135,836	11	140,245	11	620,360	49	365,177	29	1,261,618
1979	100,828	9	128,736	11	543,354	47	395,263	34	1,168,181
1980	107,870	9	142,708	12	589,109	48	383,088	31	1,222,775
1981	106,118	9	116,526	10	557,812	47	415,074	35	1,195,530
1982	99,308	9	116,107	10	589,839	51	355,418	31	1,160,672
1983	80,344	6	122,717	9	741,569	57	358,949	28	1,303,579
1984	91,714	6	115,534	8	812,187	57	402,061	28	1,421,496
1985	90,659	7	139,529	10	653,600	48	488,313	36	1,372,101
1986	82,057	5	167,524	10	820,413	51	535,557	33	1,605,551
1987	78,555	5	179,487	11	748,285	47	592,243	37	1,598,570
1988	85,810	5	137,079	8	921,546	54	559,806	33	1,704,240
1989	97,349	6	145,825	8	906,650	51	617,233	35	1,767,057
1990	91,504	5	187,073	10	963,344	51	654,501	35	1,896,422
1991	71,898	3	170,322	8	1,192,155	57	649,039	31	2,083,414
1992	92,456	5	174,016	9	1,091,808	54	647,980	32	2,006,260
1993	89,042	5	163,275	9	994,402	52	648,728	34	1,895,447
1994	114,897	6	185,887	9	1,066,636	53	635,563	32	2,002,983
1995	99,138	5	174,324	8	1,197,515	57	622,914	30	2,093,891
1996	114,161	6	174,271	9	1,142,219	57	584,643	29	2,015,295
1997	138,125	6	202,520	9	1,120,006	51	736,264	34	2,196,915
1998	137,118	5	179,163	7	1,451,671	57	765,320	30	2,533,273
1999	169,627	7	181,445	7	1,431,446	57	743,592	29	2,526,111
2000	171,450	7	208,173	8	1,373,625	56	708,278	29	2,461,526

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	...		...		42,335		15,230		...
1951	...		...		37,617		9,130		...
1952	...		...		39,012		24,227		...
1953	...		...		38,735		27,516		...
1954	...		...		48,408		39,194		...
1955	...		...		43,120		54,127		...
1956	...		...		52,942		70,381		...
1957	...		...		77,396		59,604		...
1958	...		...		100,474		52,650		...
1959	...		...		122,384		56,985		...
1960	...		...		145,384		69,839		...
1961	...		...		135,231		75,446		...
1962	356,364	42	229,185	27	169,697	20	92,642	11	847,888
1963	303,306	35	286,691	34	188,394	22	76,761	9	855,152
1964	347,282	40	241,969	28	201,987	23	81,632	9	872,870
1965	340,188	39	225,720	26	222,199	25	92,131	10	880,238
1966	463,325	48	207,773	22	181,817	19	110,437	11	963,352
1967	399,493	40	278,739	28	184,929	18	141,346	14	1,004,507
1968	367,468	36	257,492	25	228,018	22	177,884	17	1,030,862
1969	388,950	36	281,829	26	236,695	22	159,481	15	1,066,955
1970	445,326	40	289,945	26	237,191	22	127,358	12	1,099,820
1971	458,529	39	297,167	26	290,960	25	118,180	10	1,164,836
1972	504,290	41	298,084	24	301,937	25	112,922	9	1,217,233
1973	611,847	44	341,826	25	306,180	22	115,112	8	1,374,965
1974	644,323	42	368,643	24	360,996	24	146,507	10	1,520,469
1975	570,214	41	409,714	29	301,679	21	124,245	9	1,405,852
1976	703,412	44	465,596	29	316,953	20	121,155	8	1,607,116
1977	731,282	45	400,161	24	372,569	23	137,798	8	1,641,810
1978	789,564	44	472,054	27	368,658	21	145,946	8	1,776,222
1979	760,053	46	408,128	25	338,014	21	131,282	8	1,637,477
1980	825,677	48	397,098	23	368,051	21	131,887	8	1,722,713
1981	796,018	46	399,512	23	414,702	24	137,219	8	1,747,451
1982	853,308	47	307,364	17	467,019	26	173,121	10	1,800,812
1983	1,061,080	55	242,499	13	427,438	22	193,669	10	1,924,686
1984	1,136,001	55	285,495	14	371,658	18	264,697	13	2,057,851
1985	1,005,414	48	366,687	17	429,526	20	313,951	15	2,115,578
1986	1,133,250	47	472,301	20	422,654	18	374,617	16	2,402,822
1987	1,135,181	47	463,389	19	397,706	17	410,888	17	2,407,164
1988	1,233,222	47	471,018	18	409,025	16	511,166	19	2,624,431
1989	1,291,526	47	475,531	17	418,847	15	546,552	20	2,732,456
1990	1,415,377	48	481,045	16	482,617	16	591,420	20	2,970,459
1991	1,652,271	52	431,143	13	532,591	17	585,208	18	3,201,213
1992	1,563,028	49	443,232	14	493,999	16	668,995	21	3,169,254
1993	1,452,255	45	443,192	14	538,415	17	791,217	25	3,225,079
1994	1,561,387	47	441,596	13	549,397	17	746,666	23	3,299,047
1995	1,607,666	48	486,225	14	507,553	15	768,288	23	3,369,732
1996	1,532,833	47	482,462	15	481,921	15	742,421	23	3,239,637
1997	1,644,949	49	551,966	16	445,443	13	732,765	22	3,375,123
1998	2,014,106	54	519,167	14	460,408	12	763,558	20	3,757,239
1999	1,873,042	48	653,069	17	494,777	13	885,338	23	3,906,226
2000	1,862,269	48	599,257	16	(494,777)	13	(885,338)	23	3,841,641

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 13th meeting of the SCTB

2. Overview of Western and Central Pacific Ocean (WCPO) Tuna Fisheries
   - 2.1 Introduction
   - 2.2 National Tuna Fishery Reports
   - 2.3 Economic Condition of the Fishery

3. Reports by Organisations

4. Statistics Working Group
   - 4.1 Co-ordinator's report on data collection, compilation and dissemination
   - 4.2 Review of SCTB13 Directives to the Statistic Working Group
   - 4.3 SCTB14 Directives to the Statistic Working Group

5. Fishing Technology Working Group
   - 5.1 Preliminaries
   - 5.2 Programs and initiatives relevant to FTWG
   - 5.3 Data availability
   - 5.4 Country reports
   - 5.5 Recent developments in the WCPO purse seine fishery

6. Methods Working Group
   - 6.1 Preliminaries
   - 6.2 Review of terms of reference
   - 6.3 Discussion of model evaluation procedures
   - 6.4 Content of report to SCTB
   - 6.5 OFP operational model
   - 6.6 Recent developments to MFCL
   - 6.7 Orientation of future developments

7. Skipjack Research Group
   - 7.1 Overview
   - 7.2 Regional fishery developments
   - 7.3 Biological and ecological research
   - 7.4 Stock assessment
   - 7.5 Research co-ordination and planning

8. Albacore Research Group
   - 8.1 Overview
   - 8.2 Regional fishery developments
   - 8.3 Biological and ecological research
   - 8.4 Stock assessment
   - 8.5 Research co-ordination and planning

9. Yellowfin Research Group
   - 9.1 Overview
   - 9.2 Regional fishery developments
   - 9.3 Biological and ecological research
   - 9.3 Stock assessment
   - 9.4 Research co-ordination and planning
10. Bigeye Research Group
   - 10.1 Overview
   - 10.2 Regional fishery developments
   - 10.3 Biological and ecological research
   - 10.4 Stock assessment
   - 10.5 Research co-ordination and planning
11. Billfish and Bycatch Research Group
   - 11.1 Overview
   - 11.2 Regional fishery developments
   - 11.3 Biological and ecological research
   - 11.4 Stock assessment
   - 11.5 Research co-ordination and planning
12. PrepCon Issues
13. Other Business
14. Close

APPENDIX 2. LIST OF WORKING PAPERS

Information Reports

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APPENDIX 4. OPENING ADDRESS BY THE DEPUTY DIRECTOR GENERAL OF THE SECRETARIAT OF THE PACIFIC COMMUNITY

Distinguished colleagues, ladies and gentlemen, Good morning.

It is my pleasure to welcome you here to Nouméa for this 14th consecutive meeting of the Standing Committee on Tuna and Billfish. It is good to see a large number of familiar faces from our international fishery family - including our SPC member countries, fishing nation partners and tuna fishery organizations from all parts of the world. On behalf of my SPC executive colleagues, Director General Lou Pangelinan, Deputy Directors General Dr Jimmie Rodgers, and the leaders of our SPC Fisheries Programme, Dr Tim Adams and Dr Tony Lewis, I welcome you al to the SPC headquarters in this excellent conference setting. I extend a particular welcome to those attending SCTB for the first time.

La CPS est une organisation bilingue qui a l'anglais et le français comme langues de travail. Je tiens donc à souhaiter la bienvenue dans cette langue aux participants francophones. Je suis heureux de vous accueillir à Nouméa pour cette conférence importante, et je vous souhaite un agréable séjour et un travail fructueux. Je me réjouis toujours d'avoir l'occasion de m'exprimer en français, mais si vous le permettez, je poursuivrai en anglais.

Since SCTB met for the first time in 1988 as a small advisory group to SPC's Regional Technical Meeting on Fisheries, it has undergone significant changes in its structure, mandate and stature. SCTB was formed initially to provide review of the work of the SPC's Oceanic Fisheries Programme, to assist with the acquisition of relevant data to the programme, and to foster a collaborative approach to regional tuna research.

Although it has gradually evolved to become an important vehicle for scientific cooperation in the region, there was recognition that it needed to become more inclusive, i.e., moving beyond being an essentially SPC Committee, that there were more effective means of providing peer review of the OFP's work, and that existing regional arrangements for regional scientific cooperation needed to be streamlined. In 1998 SCTB became a stand-alone body with revised terms of reference, without formal links to SPC, though with SPC/OFP continuing to provide secretariat services to the Committee. In some respects, these changes came in anticipation of the development of a regional management body and its need for interim scientific advice.

SCTB meets here today for the fourth time in this format, as an overall coordinating body and series of working or research groups. It has evolved from a group of 20 participants at its first meeting - 10 SPC member countries plus various agencies - to a much wider and more inclusive grouping of more than three times that size in recent years, involving full and effective participation by all of the parties. Its stature has continued to grow, and it is generally regarded as an authoritative source of information on the tuna stocks and tuna fishery in the WCPO.

Since the last SCTB meeting, some significant events have occurred. The Multilateral High Level Conference process, to develop an effective conservation and management arrangement for the highly migratory fish stocks of the WCPO, concluded in September last year with the adoption of the Convention. As it will likely be some time before entry into force, the Preparatory Conference process, to establish the organisational and financial framework for the new Commission for the Conservation and Management of the Highly Migratory Fish Stocks in the WCPO, is underway, meeting in Christchurch in April of this year. One of the key issues to be addressed is the scientific structure needed to deliver scientific advice to the Commission and the provision of interim

scientific advice to the Preparatory Conference. A Working Group has been formed to address this need. SCTB will be requested to provide information to this working group as it has already done so on several occasions to the MHLC process and indeed confirms its status as a creadible and respected provider of scientific advice.

These matters aside and to return to the focus of SCTB work, the fishery and resource issues themselves - recent years have been seen dynamic times in the regional fishery. A record catch of two million tonnes of the main target species of tuna was recorded in the western and central Pacific in 1998, and has been followed by two years of high catches despite less time spent fishing by some fleets. Production seems now established at a new higher level, with implications for both stocks and for the markets supplied by these catches. The WCPO now supplies half of the global supply of the main market species of tuna, nearly 60% of the skipjack, 55% of the albacore, and over a third of the yellowfin. One often hears of our tuna stocks spoken of as the last great underexploited ocean resource - and more eyes are turning to the region seeking fishery access. Whilst the Western and Central Pacific Ocean is still thought to be relatively well endowed in tuna resource terms, there have been some concerns expressed about the resilience of valuable bigeye stocks in the face of increased catches of smaller fish and more effective targeting on adult stocks. Bigeye catches last year reached a record high in the region.

Associated with this increased supply of tuna (and not just in the Western and Central Pacific Ocean), have come difficult times for some sectors of the industry; with cannery fish prices at historically low levels in the past two years. Industry itself has got together in an unprecedented attempt to exert some control over prices and fleet capacity. There is some evidence that this is bearing fruit and such interventions may become more forceful.

Awareness is also increasing of possible fishery impacts on species other than tunas taken in the course of tuna fishing. We have seen fisheries effectively shut down as a result of environmental concerns over bycatch species taken in the fishery, albeit in small numbers in some cases.

Whether we like it or not, such concerns will need to be addressed in fora such as the SCTB. If your task was challenging enough with tuna stock assessment, the application of the precautionary approach to management, the variety of international legal instruments applying, emerging International Plans of Action, and increasing numbers of more vocal user groups to deal with - then you might think ahead to the more daunting challenges which await and which may require the development of different strategic approaches. I have every confidence that SCTB will be able to meet this challenge. SCTB's future role remains to be determined, but your presence here provides strong evidence that it has a future, and on that basis will continue to work in discharging its responsibility to coordinate collaborative research leading to stock assessments of exploited oceanic species and general provision of scientific advice.

As you know, meetings such as the Standing Committee on Tuna and Billfish do not just happen, and the challenge for us is to ensure full participation in this important but essentially self-funded forum by all interested parties. This is particularly the case with our Pacific Island member countries. This year has been a difficult one. No supplementary funding has been available as has been the case in recent years, hence there are a few more gaps around the table than usual.

My congratulations as well to the organisers of this. We, in the SPC, are very happy to contribute to this important gathering by providing logistical support and venue for your sessions, and the participation of our Programme officers in the sessions. My felicitations as well to all the participants from the various Pacific Island countries and territories, and members of the scientific community who are here with us this week.

I would like to acknowledge the continuing support for the work of the OFP by the Governments of Australia, France, New Zealand, the European Union and Taiwan, among many others.

In closing, it remains just to wish you well with your demanding agenda over the next seven days, and in developing outcomes from your deliberations which will be paid great heed in many quarters. I do hope you are able to take some time out to enjoy the hospitality of New Caledonia and our organisation. May wisdom be with you in your deliberations and since you have now realised that English is not my mother language, and as an acknowledgement of the presence of a few French speakers in the assembly, let me tell you “Merci et bon courage”.

APPENDIX 5. REVIEW OF JAPANESE CATCH AND EFFORT LOGSHEETS

INTRODUCTION

The objectives of the Statistics Working Group (SWG) of the Standing Committee on Tuna and Billfish (SCTB) is to coordinate the collection, compilation and dissemination of data on tuna fisheries in the western and central Pacific Ocean. In regard to the coordination of data collection, it was agreed at the eleventh meeting of the SCTB, which was held from 28 May to 6 June 1998 in Honolulu, United States of America, to establish minimum standards for data collection forms and to review data collection forms that are in use in the region (Anon 1998). The SWG established minimum standards for catch and effort logsheets at the twelfth meeting of the SCTB, which was held from 16 to 23 June 1999 in Tahiti, French Polynesia (Anon 1999). The minimum standards are presented in SCTB14 Working Paper SWG–5, Appendix I.

Catch and effort logsheets developed by the New Zealand Ministry of Fisheries and the Australian Fisheries Management Authority were reviewed at the first SWG Session on Data Collection Forms, which was held from 14 to 15 June 1999, immediately prior to SCTB12. Logsheets developed by the SPC/FFA Tuna Fishery Data Collection Forms Committee were reviewed at the second SWG Session on Data Collection Forms, which was held on 3 July 2000, immediately prior to SCTB13. During the second session, it was agreed that a small group would conduct an review of the Japanese logsheets and possibly other logsheets, and report their findings to SCTB14. Members of the group included Dr Shui-Kai Chang, Mr Al Coan, Dr Michael Hinton, Mr Tim Lawson, Mr Naozumi Miyabe, Dr Miki Ogura and Dr Robert Skillman. Translations of the Japanese longline, pole-and-line and purse-seine logsheets are presented in SCTB14 Working Paper SWG–5, Appendix II.

COMPARISON OF JAPANESE LOGSHEETS AND MINIMUM STANDARDS

SCTB14 Working Paper SWG–5, Appendix III, presents a comparison of the Japanese logsheets and the minimum standards established by the SWG. The following points are of interest:

- The forms are used only by vessels registered in Japan; therefore, there is no field for the country of registration. Also, there is no field for the registration number. The call sign and license number are recorded, however, which, together with the vessel name, should be sufficient for identifying the vessel.

- There is no activity code for longline and pole-and-line, which could be used to monitor the vessel's position when in transit or not fishing due to breakdown or bad weather. The purse-seine logsheet has activity codes for searching and fishing, but not for transit, nor for not fishing due to breakdown or bad weather.

- The longline form has fields to record the catches of tuna, billfish and sharks, but all other species are recorded under "other fishes". Hence, it is not possible to separately record the catches of other major non-target species, such as wahoo, opah, escolar, lancetfish, etc., nor species of special interest, such as marine turtles. There are also no fields for discards of target species.

- The purse-seine form has fields to record six species of tuna, but all other species are recorded under "others". Hence, it is not possible to separately record the catches of other major non-target species, such as rainbow runner, shark species, decapturus, etc., nor species of special

interest, such as marine mammals or marine turtles. There are also no fields for discards of target species.

COMMENTS BY REVIEWERS

Mr Shui-Kai (Eric) Chang, Fisheries Administration, Council of Agriculture, Taipei, Taiwan

"We saw that all of the essential items except for the country of registration and registration number. But considering that these logsheets all contain the license number of the boat, and that they are designed for domestic use only, we think the license number can be a substitute for the missing two items and most of the desirable items were included in the logsheets, which meets the basic standards of the SCTB Statistics Working Group. Therefore we consider these logsheets quite satisfactory.

"We agree with you that in the purse-seine logsheet only two kinds of fishing activities might not be enough; more activity types should be included. In the catch report of longliners, it was very considerable to record the primary target species, the material and length of both main and branch lines, which provide the information of target effect. We also noted that a total of 19 fish species were listed which includes a lot more species than other logsheets, especially sharks. The intention of putting bycatch species into detail is very good. From our experience of poor reporting rate on bycatch information, we are quite interested in knowing how much the report rate on these items are! As to the pole-and-line logbook, because we don't have this type of fishery in our country so we could only say that we think it is complete since it has combined most of the standards.

"To sum up, we consider these Japanese logsheets are well designed and are able to provide most of the information needed in the fishery industry."

Mr Al Coan, Leader, Multipsecies Data Collection and Evaluation Program, La Jolla Laboratory, National Marine Fisheries Service, La Jolla, United States of America

Purse seine

"I found that all of the essential data are supplied on the logsheet except for country of registration and registration number. I am assuming though that the country of registration can be assumed Japan as this form is used for only Japanese vessels and that the registration number may be their license number. Other comments are that the dates and times are not specified GMT/UTC/local; there should be more activity codes such as drifting, in port, transiting, setting FADs, etc.; and it is not clear whether discards are to be included in the catch estimates (there is no space for recording them separately)."

Pole-and-line

"I found that all essential data are supplied on the logsheet except for country of registration, registration number, gross registered tonnage, and activity. Again, we can probably assume that country is Japan and registration number is license number. However, activity is needed. Other comments are that in the date for the daily fishing they specify Japan era date, whereas in all other places the type of date is not specified; noon positions are to the degree not to the minute; and it is unclear whether discards are to be included in the catch estimates (there is no space for recording them separately)."

Longline

"All essential data are supplied on the logsheet except for country of registration, registration number, time of set and position of set (only noon position). Also it is unclear as to whether the arrival port is the port of unloading and the arrival date is the date of arrival in the unloading port. Again, we can probably assume that country is Japan and registration number is license number. Other general comments are that the dates and times are not specified as local/GMT/UTC; positions are specified in degree only, not minutes; placement of catch in number and weight may lead to errors; it is unclear whether discards are to be included in the catch estimates (there is no space for recording them separately); and it is not clear whether processed weights or whole weights are used."

Dr Michael Hinton, Inter-American Tropical Tuna Commission

Vessel Identification, all gear types:

Registration number. "It does not seem clear to me that the registration number referred to in this section is one of the numbers being requested as 'license number' on the various forms. I took 'license number' to refer to the *Vessel Identification*, *All gear types*, *Desirable*: 'fishing permit or license number'.

Longline logbook:

"There should be a provision for recording '*Activity*' as is the case for purse seine and baitboat vessels. Other activities that are of interest in judging fishing power are transit times, break downs, and time searching for places to fish vs. fishing."

"The *essential* set information on date, time and position are not requested, rather the noon position is requested. The section should be set like that in the purse-seine logs, i.e. Set Position (Noon position when searching/elsewise)."

Target: 1 – Swordfish, 2 – Shark, 3 – Others: "This applies to the set level, not the trip level. I would recommend that it be placed adjacent to the 'HPB' and 'Number of Hooks' columns."

Hooks between floats: "The instructions say 'select most representative' if different numbers were used in a set. This could lead to confusion – I think it would be better to make this the 'select the most frequent'."

Purse-seine logbook

"The *essential* information includes *Activity*, but the form includes notes and only two codes, searching (1) and fishing (2). Since the fact that a set is made identifies fishing, I would think the code currently assigned thereto should be for '*Other*', with a note to provide additional related comments."

"It is not clear how discards will be recorded, either as the difference between the total of catches and weight unloaded, or with individual records/lines used to indicate discards. Another way to say this is that it is not clear in the logbook instructions that *Catch* means whatever was in the net, whether retained or not."

Pole-and-line logbook

“There does not appear to be a clear instruction or coding for *Activity*. This should include, as with seines and longline, break downs, transit, rough weather, etc.”

“It is not clear that the species of category ‘*Other’* will be known. There should be codes/comments required for identification of other species.”

APPENDIX 6. REPORT OF THE 2nd OCEAN ATLAS USERS WORKSHOP

Noumea, New Caledonia, August 14th 2001

Background

The Pelagic Fisheries Research Program and the NOAA Fisheries Honolulu Laboratory are developing an oceanographic atlas for pelagic and insular fisheries in the central and western pacific basin. The 1st Ocean Atlas workshop, held just prior to the 13th SCTB in July 2000, generated comments and suggestions from potential data users that were immensely helpful in the planning and initial stages of production of the atlas. The second workshop was convened to keep interested parties apprised of progress made in the first year of the project. Additionally it is anticipated that input from data users at this time will help further refine the project goals and enhance the utility of the end products.

Presentations

Dave Foley (UH/JIMAR) presented an update on the status of the Atlas project with particular emphasis on the technical infrastructure now developed and in place for production of the various Atlas data sets. Significant progress has been made in developing the highly derived products identified as high priority by the 1st Ocean Atlas workshop. Also discussed were examples of data sets acquired and of several fisheries applications already undertaken. The failures associated with one such application provided an excellent learning experience, illustrating the need for effective two-way communication between the atlas staff and the data user. In an effort to encourage more learning experiences, the Atlas staff is soliciting fisheries applications projects to be performed in partnership with regional experts with a variety of infrastructure levels and differing fisheries issues. Ideally such applications would include both pelagic and insular (Island) fisheries, though clearly the interests of SCTB participants favour pelagic studies.

Mike Hinton (IATTC) presented a summary of the ARGO project, an international program to deploy a 3 degree by 3 degree grid of profiling oceanic drifters (ALACE floats) during the next 4 years. While the primary goal of this project is to better understand large-scale ocean circulation, the ARGO project is apparently interested in fisheries-related needs. Mike is the fisheries representative to the ARGO science team and is soliciting suggestions from fisheries researchers and managers for placement suggestions. It is worth noting that the ARGO project will not change the mission of the floats (drifting at 2000 meters depth with a profile to the surface and transmission of data every 10 days). However, instrument additions such as dissolved oxygen sensors are of interest to physical oceanographers and hence may be possible within the next year.

Patrick Lehodey and Fabrice Bouyé (both SPC) presented a software interface for visualising output data from the SEPODYM model and the coupled biological/physical oceanic general circulation model used to drive it. In addition to providing a fairly straightforward diagnostic tool, the interface allows extraction of actual data files for more analytical applications. Foley observed that this approach would allow a complete software and data package that would fit on a present-day standard CD-ROM. Because such a tool allows for data transfer and viewing virtually independent of infrastructure level, the Atlas staff will likely include it in their data distribution suite.

APPENDIX 7. PROPOSED TEMPLATE FOR SCTB WORKING GROUP REPORTS

This template is a device for summarizing and regularly updating information relevant to stock assessment and highlighting areas where more information is required. It is intended that this or a similar template would be ready for preparing the reports of the Species Working Groups from SCTB–14 and that it should serve as a "living" document to guide the work of these groups intersessionally.

I. Working Group Title — Year

II. Description of fisheries (including recent developments)

- Changes in gear and/or fleets
- Targeting practices
- Data availability

III. Trends in catch

- Catch by gear type
- overview
- recent developments
- data adequacy
- Catch composition (other major species)
- Distribution of catches by gear type

IV. Trends in effort

- Effort by gear type
- overview
- recent developments
- data adequacy
- Distribution of effort by gear type

V. CPUE

- Nominal CPUE trends by gear type

VI. Biological information

- Stock structure
- Size composition by gear type
- Size/age at maturity
- Sex ratios
- Growth rates
- Mortality (F, Z, M, other sources)
- Conversion factors

VII. Stock assessment

- Tagging
- Abundance indices
- Population dynamic models
- Environmental models
- Other modeling approaches
- Fisheries independent indicators
- Factors influencing stock assessment
- Reference points

VIII. Research requirements and work plan for next assessment cycle

IX. Status of stock summary

APPENDIX 8. 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 9. 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
ESTHER	*Efficacité des Senneurs Thoniers et Efforts Réels*, or Efficiency of Tuna Purse Seiners and Effective Effort
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
IEO	Instituto Español de Oceanografía
IFREMER	*Institut français de recherche pour l'exploitation de la mer*
IMO	International Maritime Organization of the United Nations
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
Kt	one thousand metric tons
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
NMFS	National Marine Fisheries Service
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 International 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)
WTPO	World Tuna Purse Seine Organization
VMS	vessel monitoring system
VPA	Virtual Population Analysis
XBT	expendable bathythermograph
YRG	Yellowfin Research Group