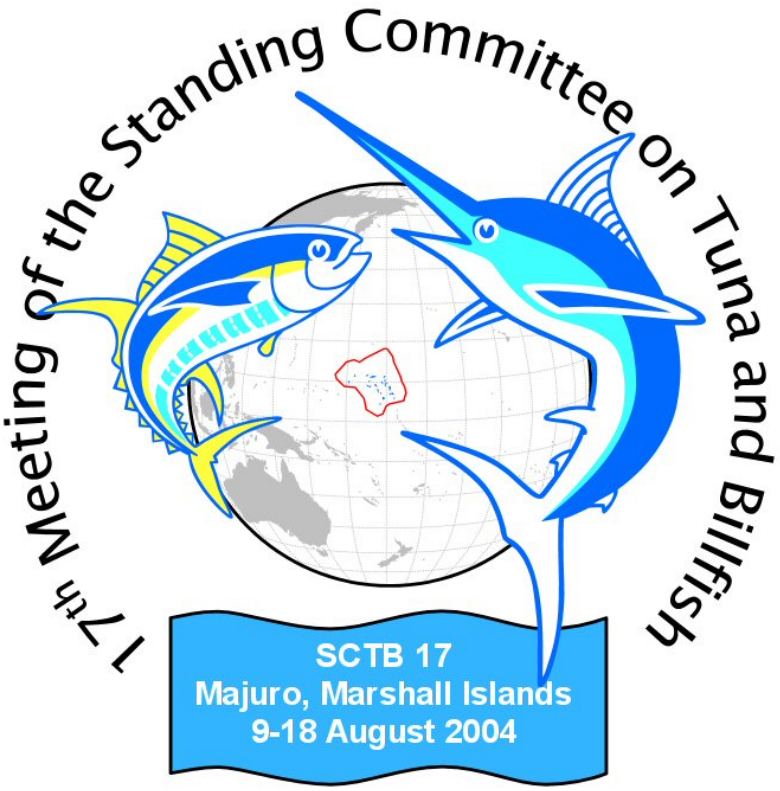

REPORT OF THE SEVENTEENTH MEETING OF THE STANDING COMMITTEE ON TUNA AND BILLFISH

9–18 August 2004

Majuro

Republic of the Marshall Islands

November 2004

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Seventeenth Meeting of the

STANDING COMMITTEE ON TUNA AND BILLFISH

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EXECUTIVE SUMMARY

The seventeenth meeting of the Standing Committee on Tuna and Billfish (SCTB 17) was held on 9-18 August 2004 in Majuro, Republic of the Marshall Islands. SCTB 17 was attended by participants from Australia, Canada, Commonwealth of the Northern Marianas, Cook Islands, European Union, Federated States of Micronesia, Fiji, French Polynesia, Japan, Kiribati, Korea, Marshall Islands, Nauru, New Caledonia, New Zealand, Palau, Papua New Guinea, the Peoples Republic of China, Samoa, Solomon Islands, Taiwan, Tonga, Tuvalu, United States of America and Vanuatu. Participants from various regional and international organizations also attended the meeting. These included the Forum Fisheries Agency (FFA), the Inter-American Tropical Tuna Commission (IATTC), the Secretariat of the Pacific Community (SPC) and the Food and Agricultural Organisation of the United Nations (FAO).

The SCTB provides a forum for scientists and others with an interest in the tuna and billfish stocks of the western and central Pacific Ocean (WCPO) to meet to discuss scientific issues related to data, research, and stock assessment. Its aims are to:

1. coordinate fisheries data collection, compilation and dissemination according to agreed principles and procedures;
2. review research on the biology, ecology, environment and fisheries for tunas and associated species in the WCPO;
3. identify research needs and provide a means of coordination, including the fostering of collaborative research, to most efficiently and effectively meet those needs;
4. review information pertaining to the status of the stocks of tunas and associated species in the WCPO, and to provide statements on stock status where appropriate, and;
5. provide opinions on various scientific issues related to data, research and stock assessment of WCPO tuna fisheries.

The SCTB Chairman and Working Group Coordinators for SCTB 17 were as follows.

SCTB Chairman:	Dr Sung Kwon Soh
Biology WG:	Dr Talbot Murray
Ecosystem & Bycatch WG:	Mr Paul Dalzell
Fishing Technology WG:	Mr David Itano
Methods WG:	Dr John Sibert
Statistics WG:	Mr Tim Lawson
Stock Assessment WG:	Dr Naozumi Miyabe and Dr Max Stocker

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 six working groups: the Statistics Working Group, the Highly Migratory Species (HMS) Biology Working Group, the Ecosystem & Bycatch Working Group, Fishing Technology Working Group, the Methods Working Group and the HMS Stock Assessment Working Group. This 'thematic' working group structure differed from the species-based approach used at previous SCTBs.

The Statistics, Methods and Fishing Technology Working Groups held a series of meeting in the two days prior to the SCTB 17 plenary session. They considered a range of issues relevant to their respective terms of reference. Summaries of these meetings were presented to SCTB 17 and summary statements for each Working Group are provided.

The HMS Biology, HMS Stock Assessment and Ecosystem & Bycatch Working groups were convened during the main SCTB 17 session. Summary reports of these Working Groups are provided. The report of the HMS Stock Assessment Working Group incorporates statements on the status of bigeye, yellowfin, skipjack, and South Pacific albacore tuna.

The initial overview of Western and Central Pacific Ocean (WCPO) tuna fisheries provided details of recent and historical fishery developments. A summary of this information is presented in the report of the HMS Stock Assessment Working Group. Further details of fisheries at the national level were elaborated in a series of National Fisheries Reports presented by national representatives. Reports on relevant activities of other organizations were received from FAO, IATTC and the Pelagic Fisheries Research Program of the University of Hawaii.

SCTB 17 discussed a range of research and fishery statistics needs for the WCPO (Appendix 4). The priority needs identified by SCTB 16 and adopted by the 2nd meeting of the Scientific Coordinating Group were again discussed and progress noted (items 1 to 6 below). Also, SCTB 17 suggested two additional issues (Items 7 and 8 below) that it felt needed to be highlighted.

1. Better estimation of current catch and catch composition from Indonesia, Philippines and Vietnam

A 'Proposal for monitoring the catches of highly migratory species in the Philippines and the Pacific Ocean waters of Indonesia' was presented at PrepCon VI (Bali, April 2004). Under this project, a review of the tuna fisheries and the current statistical system was conducted in the Philippines in July 2004, with funding from Australia. This review highlighted significant problems with the collation of fisheries statistics in the Philippines. One year of port sampling will commence later in 2004, with funding from the United States and another donor. SCTB strongly encouraged potential donors to contribute funds for the balance of the project, i.e. a second year of port sampling in the Philippines and two years of port sampling in Indonesia. There is also a continuing need to compile information on the longline fishery in Vietnam, including estimates of annual catches.

2. Reconstruction of early catch history (catch, effort, size composition) for all fisheries

The incorporation of complete time series of significant industrial fishing into stock assessments generally allows a fuller understanding of population abundance variability over a range of environmental regimes. Significant progress has been made, e.g. the incorporation of pre-1965 Japanese longline size data into bigeye and yellowfin tuna stock assessments. Current work is examining pre-1972 skipjack data for the Japanese pole-and-line fisheries. Further efforts in this area will be important to further reduce uncertainties in the stock assessment.

3. Further development of methods to standardise effort, including the better use of vessel operational details, environmental data and archival tagging data

This work has been ongoing and improvements in effort standardisation for both longline and purse-seine fisheries were presented to SCTB 17. There is a need for finer scale data on the environment and on habitat preferences, as well as information on vessel, gear and operational details, for example, better information to estimate hook depths. Additional variables may be included in the standardisation of effort and more flexible use of standardized effort made in assessment models. There is a forthcoming IATTC meeting on purse seine effort standardization and its deliberations will be considered. The use of 'Longhurst'-type Large Marine Ecosystems as regions for stock assessments will be explored.

4. Ongoing efforts to reduce uncertainty in assessments, through improved data inputs, sensitivity analysis and simulations

There is a need for better species composition data, especially on improved discrimination between small yellowfin and bigeye. Statistical relations among observer, logbook, and port sampling and landing data need to be established. WPFC databases should provide for general biological data, particularly for parameters relevant to stock assessment. Assessment models should refine the parameterization of catchability between regions and explore the estimation of mortality at age. The use of simple production models may also be explored. Bigeye assessments should be compared for the EPO, WCPO, Pacific-wide and with other oceans. Fishing power and effort needs to be characterized and quantified, and there is a broad range of issues related to FADs.

5. Evaluation of possible regime shifts/changes in productivity and development of improved/alternative estimates of recruitment where possible

In response to the SCG 2 recommendations, a project proposal was developed by OFP in collaboration with NRIFSF and NIWA. The project has been funded by the Pelagic Fisheries Research Program of the University of Hawaii and preliminary results were presented at SCTB 17. This work will continue through the collection of empirical data and simulation studies to characterise long-term variability in catch histories and physical/biological time series from the WCPO. Operational metrics to detect changes in productivity and recruitment will be developed. These and other ecosystem indicators may then be used in stock assessments. SCTB 17 also recommends the development of empirical recruitment indicators to compare with model estimations.

6. Large-scale tagging experiments for the main target tuna species in the WCPO.

This has been recommended by successive SCTBs as the highest research priority for the region. Such a project will provide better estimates of movement, mortality and other important parameters for stock assessment. Previous work undertaken more than 10 years ago has underpinned stock assessments but there is a need for regular if not continuous tagging studies of all species of interest. This work could be considered analogous to trawl surveys for demersal fisheries as the data provided are quasi-independent of the fisheries themselves. A large-scale tagging experiment would also permit further scientific research relevant to WCPO fisheries, including biology, ecology and oceanography. Various options for conducting tagging of tropical tunas were presented to SCTB 17 and the likely costs of a two-year tag release programme estimated. The meeting agreed to establish a small group to further develop a concept paper that might be made available to the Commission at its December 2004 meeting.

7. Assessing impacts of fishing and the environment on the pelagic ecosystem

The WCPFC Convention (Article 5d) requires members 'to assess the impacts of fishing, other human activities and environmental factors on target stocks, non-target species, and species belonging to the same ecosystem or dependent upon or associated with the target stocks'. This can be achieved through studies of forage species by in situ sampling and/or diet analysis, the continued development of modelling methodologies, the definition and identification of habitats of special concern, and the mitigation of bycatch. Biological/ecological studies should be carried out for species of special concern.

8. Regional Observer Programme

Article 28 of the Convention requires the Commission to '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'. The data needed for scientific purposes includes size and species composition, bycatch and discards. There needs to be coordination with national observer programmes, particularly regarding species of special concern. Additionally, there is a need for sub-regional coordinators for supervision of port samplers and observers. Data collection needs to be expanded to all fleets, in particular distant water longline fleets, and information should be collected on IUU (Illegal, Unregulated, Unreported) fishing activities.

Consideration of issues requested by PrepCon WG-II

PrepCon WG-II recommended several tasks for consideration by SCTB 17 and SCG, among them data standards and advice on analyses of management options respectively. SCTB 17 considered these issues and reviewed the legal basis for data requirements and standards of the new WCPFC as well as existing standards that could be adopted by that Commission. The meeting also discussed requisites for management options analyses, specifically reference points and decision rules. The meeting concluded that the topic is much too broad to be properly reviewed in the time that was available. It was noted that SCTB11 held a workshop on the precautionary approach that is relevant to these issues. The meeting further concluded that the topic should be reviewed and discussed in the future at a meeting for that purpose and that fishery managers of the new Commission should also be involved. The meeting also considered the working group structure that was used for SCTB 17. This new structure generally functioned more smoothly; it is recommended that this or a similar structure be adopted for the Specialist Working Groups of the Scientific Committee of the Western and Central Pacific Fisheries Commission (WCPFC) when it is established.

Closing remarks

At the end of SCTB 17, Chairman Sung Kwon Soh (Korea) asked participants to share their personal experiences of the SCTB. Apolosi Turaganivalu (Fiji, on behalf of the Pacific Island countries), John Hampton (OFP), John Sibert (PFRP, USA), Chung-Hai Kwoh (Taiwan), Ziro Suzuki (NRIFSF, Japan), Talbot Murray (New Zealand), Jacek Majkowski (FAO), and Chairman Soh himself all spoke fondly of the achievements of the SCTB throughout the years.

All speakers were in agreement that the SCTB had achieved far more than its original modest goals, that the data collection, compilation and analyses have evolved dramatically, and that the stock assessments are now world class. Notwithstanding the concerns expressed by SCTB 17, stock conditions remain healthier in our region than for other oceans and participants expressed the hope that sustainability of the resources would be ensured by quick and wise management.

One of the most important achievements of SCTB has been to bring together representatives of the Distant Water Fishing Nations and the Pacific Island Countries and Territories on an equal footing. Colleagues have become friends and from friendships grew understanding. This has assisted the development of Pacific Island Countries and Territories and of WCPO fisheries. SCTB has provided a unique experience and learning process and participants at SCTB 17 hope that the collegiality and cooperative spirit of SCTB will continue through into the SC.

All speakers highlighted the critical role played by the SPC, and in particular the OFP and its present and previous leaders, in providing support for SCTB meetings and technical assistance to SPC members and other parties. Views were expressed that the critical role of the OFP be retained and its capabilities expanded within the context of the new Commission.

Thanks were extended to our Chair, Sung Kwon Soh, to all the Working Group Chairs, to the rapporteurs, and a special thanks to Glen Joseph and all the MIMRA team for hosting this last meeting of SCTB. Glen Joseph thanked the Honourable Minister John M. Silk, all the MIMRA staff, the participants at STCB17, the staff of OFP and the Marshall Island Resort staff.

Our Chair then formally closed the last meeting of SCTB, bidding farewell to SCTB and welcome to the SC.

STATISTICS WORKING GROUP

The objective of the Statistics Working Group is to coordinate the collection, compilation and dissemination of tuna fishery data. The following were the major issues discussed:

Coverage of tuna fisheries in the WCPO by data held by the OFP

The coverage of tuna fisheries in the WCPO during 2002 by operational catch and effort (logsheet) data held by the OFP is 50.5%, the highest level ever achieved. Coverage by port sampling data for 2002 is 11.1% and coverage by observer data is 3.9%. The principal gaps in coverage by operational catch and effort data include the domestic fisheries of the Philippines and Indonesia, the distant-water longline fleets of Korea and Taiwan, and the longline, pole-and-line and purse-seine fleets of Japan on the high seas. Figure 1 illustrates the trends in coverage from 1970 to 2002; the coverage for recent years may increase as more data become available.

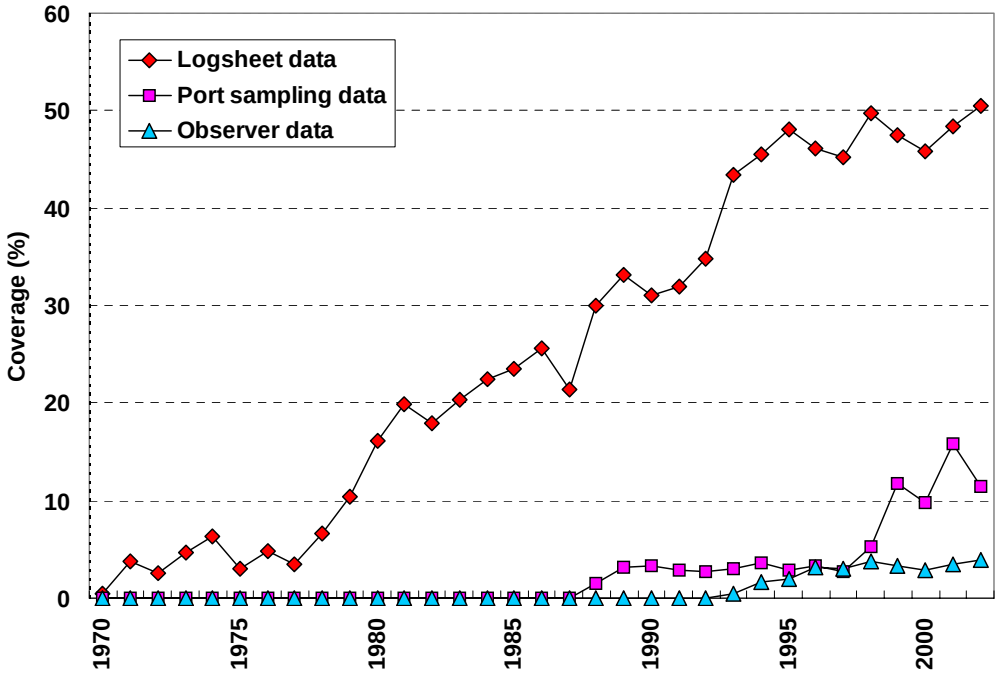


Figure 1. Trends in coverage from 1970 to 2002

Quality of port sampling and observer data

High priority should always be placed on improving the quality of sampling data through improved data management and data collection skills. In this regard, a request for more resources to support the significant increase in regional sampling activity was made. For the Pacific island countries and territories, sub-regional coordinators are desirable to help improve local processes for the control of data-quality. It is essential that the debriefing of observers should continue to be expanded, such that all observers are debriefed by qualified supervisors after each trip.

Availability of observer data for estimating catches of non-target species

The availability of observer data for eight categories of longliners in the WCPO was summarised in WP SWG–5. The observer data covering the distant-water longline fleets are not sufficient for estimating the catches of non-target species in the WCPO and increased observer coverage of these fleets is urgently required.

Proposal for the compilation of annual catch estimates for the Convention Area

The Commission will require annual catch estimates to be compiled for the Convention Area (see Figure 2); however, the western boundary of the Convention Area has not been specified in the text of the Convention. It was therefore proposed that, for statistical purposes, the western boundary of the WCPO Area that was established at SCTB12 be used in this regard, and that estimates of annual catches for both the Convention Area and the WCPO Area be provided. This will allow catches for the WCPO and the EPO to be easily summed to provide the total catch for the Pacific Ocean. The reporting of annual catches for both the Convention Area and the WCPO Area will concern China, French Polynesia, Japan, Korea and Taiwan, and these parties indicated that this was feasible. This will be an interim procedure, until the Commission establishes a policy on the provision of data.

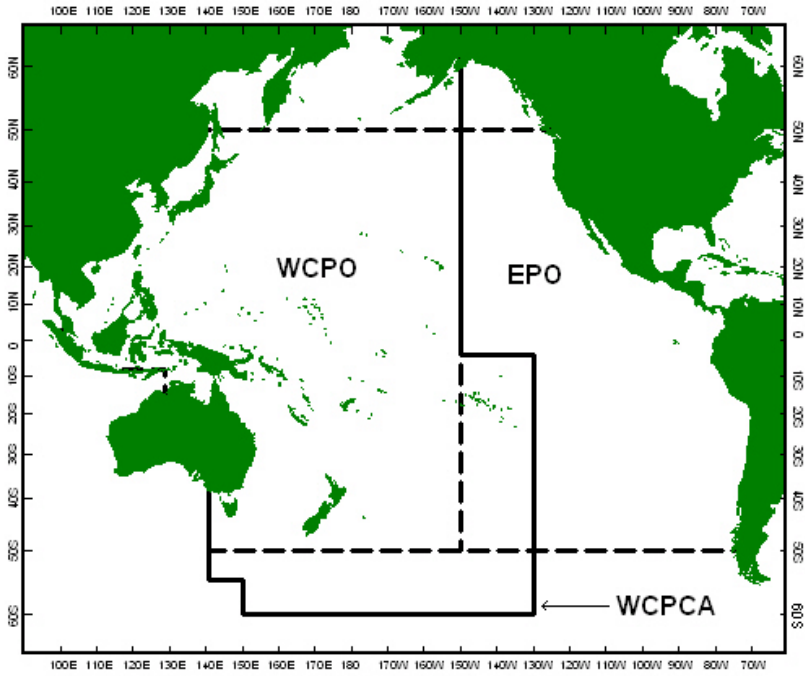


Figure 2. Convention Area (WCPCA), WCPO and EPO

Data collection in the Philippines and the Pacific Ocean waters of Indonesia

A 'Proposal for monitoring the catches of highly migratory species in the Philippines and the Pacific Ocean waters of Indonesia' (Information Paper INF-SWG-3) was developed by the OFP in conjunction with Indonesia and the Philippines and distributed to potential donors in December 2003. For each of the Philippines and Indonesia, there are two components: (a) a review of the tuna fisheries and the current statistical system and (b) port sampling and observer programmes.

Australia agreed to fund the review for the Philippines and is considering funding the review for Indonesia. The budget for port sampling and related activities, for two years in both countries, is USD 292,000. At PrepCon VI (Bali, April 2004), Taiwan and the United States announced contributions of USD 20,000 and USD 60,000 respectively. In order to allocate the available funds and to monitor project developments, the Indonesia and Philippines Data Collection Steering Committee was established by PrepCon. It met during PrepCon VI and allocated the currently available funds to the Philippines to enhance the current port sampling programme, which is operating at a low level of coverage due to lack of funds.

Dr Antony Lewis conducted the review in the Philippines from 8 to 28 July 2004. His report highlighted significant problems in the collection of fisheries statistics. A workshop will be held in Manila in October 2004 — with the Bureau of Fisheries and Aquatic Resources, the Bureau of Agricultural Statistics, industry and SPC — to consider the recommendations from the review and to plan the port sampling, which will commence following the workshop. CSIRO would conduct the review for Indonesia in 2005, subject to funding. The port sampling programme in eastern Indonesia will be established if funding for the two-year project is contributed by the potential donors (European Union, France, Japan, Korea and New Zealand). Observer programmes will be established in the Philippines and the Pacific Ocean waters of Indonesia when funding becomes available. The meeting strongly encouraged the potential donors to contribute the required funds as soon as possible.

Data-related tasks for the WCPFC Scientific Committee

A one-day meeting of the SWG to consider anticipated data-related tasks for the WCPFC Scientific Committee was held immediately prior to SCTB 17. Two working papers were presented. WP SWG-8, 'Legal aspects governing fisheries data', describes the international legal obligations in respect of the collection, compilation and dissemination of fisheries data by the Commission. WP SWG–6, 'Information regarding anticipated data-related tasks for the WCPFC Scientific Committee', discusses data standards and other data-related issues. WP SWG–6 contains background information regarding the tasks listed above, much of which is based on the experience accumulated by the Standing Committee on Tuna and Billfish over the 17 years of its existence. The working paper, which contains seven appendices containing relevant texts and a comprehensive list of references, with web links, is intended to be a reference document for use by the Scientific Committee.

Working Papers SWG–6 and SWG–8, and the report of the one-day meeting, will be considered at the third meeting of the PrepCon Scientific Coordinating Group, which immediately follows SCTB 17, under SCG3 agenda item 6, 'Advice on data standards and other data related issues for the Western and Central Pacific region'.

METHODS WORKING GROUP

The two primary tasks of the MWG for SCTB 17 were the completion of the extensive simulation analysis begun at SCTB 16 and detailed scrutiny of the 2004 bigeye tuna stock assessment prepared by the SPC Oceanic Fisheries Programme.

The results of the simulation analysis are complex. Absolute estimates of MSY-related reference points were often poor, while relative estimates (e.g. F_t/F_{MSY} or B_t/B_0) were usually better. The MULTIFAN-CL and SCALIA models had serious problems estimating natural mortality-at-age in most cases. Using the correct values of natural mortality substantially improved MULTIFAN-CL performance (particularly MSY-related values) in some cases, but not all. MULTIFAN-CL estimation performance seemed to improve with increasing simulation model complexity. Incorporation of data where CPUE is not an accurate index of abundance decreased the accuracy of most model estimates. The production models (particularly the Fox model using the global nominal CPUE) performed well when non-informative data were excluded from the analysis. The operational model used for the simulation analysis is extremely complex, and the results show that evaluating the performance of one complex model using a second complex model produces complex results that are difficult to interpret. Future simulations should be designed to elucidate specific aspects of assessment models (e.g. estimation of natural mortality).

The bigeye tuna assessment was conducted using a suite of catch per unit effort (CPUE) standardization methods and assumptions about catchability. The analysis using statistical habitat-based effort standardization and constant catchability for the principal longline fleets (LL1-LL5) and estimation of natural mortality at age (SHBS-MEST) produced an adequate fit to the data and the most credible estimates of other parameters. A new prototype method which also estimates trends in catchability for fleets LL1-LL5, the 'SHBS-MEST-LLq' model produced a better fit to the data and more pessimistic assessment results. However, the assumptions about initial catchability used in the current SHBS-MEST-LLq model are inappropriate and should be revised in the future. The long-term correlation between recruitment estimates for MFCL Region 2 and Indonesian catches was noted and investigated. The MWG considered use of likelihood profiles to be a useful means to communicate uncertainties in parameter estimates to fishery managers.

HMS BIOLOGY WORKING GROUP

The Group received 8 presentations on various aspects of the biology of highly migratory species. Subsequent discussion concluded that continued improvements in understanding of the basic biology of the key stocks of tuna, billfish, other highly migratory species caught as bycatch, would be a core requirement of the work of the Western and Central Pacific Fisheries Commission. It was highlighted that for most non-target species even the fundamental biological parameters that constitute the basic inputs required for stock assessment were unknown. The meeting therefore noted that the Commission should, when developing its databases, make provision for incorporating biological data. It was also noted that the Commission's requirements for information on the biology of highly migratory species should be directly related to information supporting the stock assessments and could include such information as maturity ogives, sex ratios, size frequencies, size at age, growth parameters, longevity and natural mortality.

FISHING TECHNOLOGY WORKING GROUP

The work of the Fishing Technology Working Group (FTWG) is highly diverse, ranging from the development of training materials useful to observer and port sampling programs to complex studies on effort standardization and the quantification of harvesting capacity. Central to the Terms of Reference of the FTWG is the principle that advances in fishing technology and vessel efficiency move quickly between ocean basins and must be accounted for as soon as possible to avoid sampling and analytical bias. A large agenda discussed a wide range of studies during a preparatory meeting to SCTB 17 which were summarized and further discussed by the SCTB Plenary. These studies included work related to:

- the application of gear technology to the reduction or mitigation of bycatch and the increased targeting (efficiency) of longline and purse seine fisheries;
- the development of information materials on longline gear technology and fisheries and training materials promoting the proper identification and discrimination of juvenile bigeye in multi-species catches and landings in both fresh and frozen condition;
- the development of different analytical means to examine and estimate vessel efficiency or productivity;
- issues and studies related to the collection, compilation and use of vessel and gear attributes for a variety of research oriented purposes;
- studies related to anchored and drifting FADs used by large-scale fisheries; including a compilation of information on FAD use and design, particularly for purse seine operations, and a study examining differential catch parameters for bigeye tuna taken on natural logs and drifting FADs;
- information papers and studies related to harvesting capacity and the management of fishing effort in the WCP region;
- detailed information on the status of the Palau Arrangement and the FFA initiative to regulate purse seine effort through a vessel day scheme;
- recent developments on a fine scale related to distant-water and domestic tuna fisheries, expansions and contractions of fisheries, licensing and joint-venture arrangements, changes in areas of operation, developments of new fisheries or fishing technologies, the development and status of shore-side infrastructure to fisheries, transhipment, marketing, port sampling and observer programs, information on the use of FADs and any significant changes to national policy related to industrial fisheries.

All of these studies and sources of information are important and relevant to the management of pelagic resources in the WCPO. However, if priorities need to be set, the Terms of Reference to the FTWG clearly state that the group should concentrate on issues of greatest concern to stock condition.

Given these directives, the FTWG recognises the problem of overcapacity and the need to quantify the impact of excessive harvest capacity on fishing mortality of species caught in the WCPO. The FTWG was informed that the FAO Technical Advisory Committee on Management of Fishing Capacity recognised that world tuna fishing capacity is excessive for current resources. The FTWG was also informed that an FAO Technical Consultation expressed concern about recent increases in purse seine fishing capacity in WCPO. Overcapacity in world-wide fisheries has potential ramifications for stock condition, resource sustainability, the economic viability of fleets, and potential ecosystem effects. In addition,

studies on the impact of large-scale anchored FAD arrays, the design and efficacy of drifting FADs and the species-specific identification of tunas in the Philippines and Indonesia are of primary concern to the FTWG and the SCTB in general.

The FTWG has spent considerable time examining, identifying and suggesting the types of technical data that would facilitate assessment of changes in fishing operations and efficiency. The FTWG recognises that while there are many data types which have been routinely collected, it is essential that these data types be explicitly linked to a management oriented purpose. The FTWG also recognised that technological innovations are introduced continually and that the best source of current information is through observer reports and maintaining a close dialogue with vessel operators.

The FTWG is of the view that continual monitoring of technological and operational changes in tuna fisheries in the WCPFC area will be necessary and that these requirements fall in three general areas: 1) fishery characterisation, 2) standardisation of fishing effort for stock assessment, and 3) catch targeting or bycatch avoidance, e.g. avoidance of juvenile bigeye catch by purse-seine. The FTWG was of a view that these areas of research should be considered as priority areas of study for the Commission. The meeting clearly recognized that the work that the FTWG conducts would not disappear with the formal dissolution of the SCTB and that a similar group within the Commission structure would be necessary to address these issues into the future.

HMS STOCK ASSESSMENT WORKING GROUP

RECENT DEVELOPMENTS IN THE FISHERIES

Catch

Annual total catches of the four main tuna species (skipjack, yellowfin, bigeye and albacore) in the WCPO increased steadily during the 1980s as the purse seine fleet expanded, remained relatively stable during most of the 1990s, increased sharply in 1998 and have remained at this elevated level since (Figure 3 and 4). The provisional total WCPO catch of tunas during 2003 was estimated at **1,940,546 mt**, the second highest annual catch recorded after 1998 (1,985,110 mt). During 2003, the purse seine fishery accounted for an estimated 1,172,780 mt (60% of the total catch), with pole-and-line taking an estimated 294,752 mt (15%), the longline fishery an estimated 213,259 mt (11%), and the remainder (13%) taken by troll gear and a variety of artisanal gears, mostly in eastern Indonesia and the Philippines.

The WCPO tuna catch (1,940,546 mt) represented 71% of the total estimated Pacific Ocean catch of 2,725,083 mt in 2003, and close to 50% of the global tuna catch (the provisional estimate for 2003 is ~4,000,000 mt). The eastern Pacific Ocean (EPO) catch (~790,000 mt) of the four main tuna species for 2003 was the highest ever.

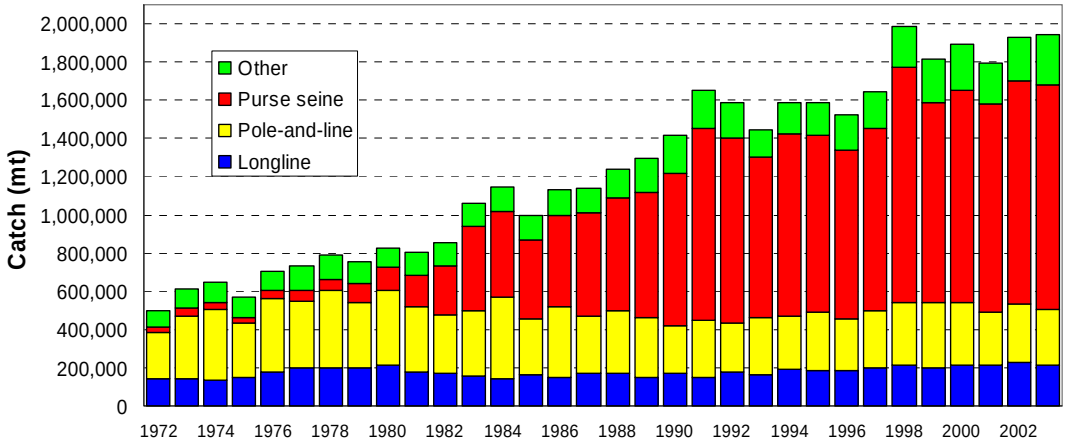


Figure 3. Catch (mt) of albacore, bigeye, skipjack and yellowfin in the WCPO, by longline, pole-and-line, purse seine and other gear types for the period 1972 to 2003

Since 1972 the WCPO catch by species has been dominated by skipjack (65% in 2003). The 2003 WCPO catch of skipjack (1,252,738 mt) was the third highest ever (the highest recorded skipjack catch was in 1998 – 1,301,054 mt). The WCPO yellowfin catch for 2003 (456,947 mt; 24%) was the highest in five years and only 8,000 mt less than the record catch in 1998 (465,642 mt). The WCPO bigeye catch for 2003 (95,991 mt; 5%) was the lowest for seven years. The WCPO albacore catch (includes catches of North and South Pacific albacore west of 150^0 W, which comprised 86% of the total Pacific Ocean albacore catch of 157,363mt in 2003) was 134,870 mt (7%) and was about 5,000 mt less than the record level in 2002 (139,848 mt).

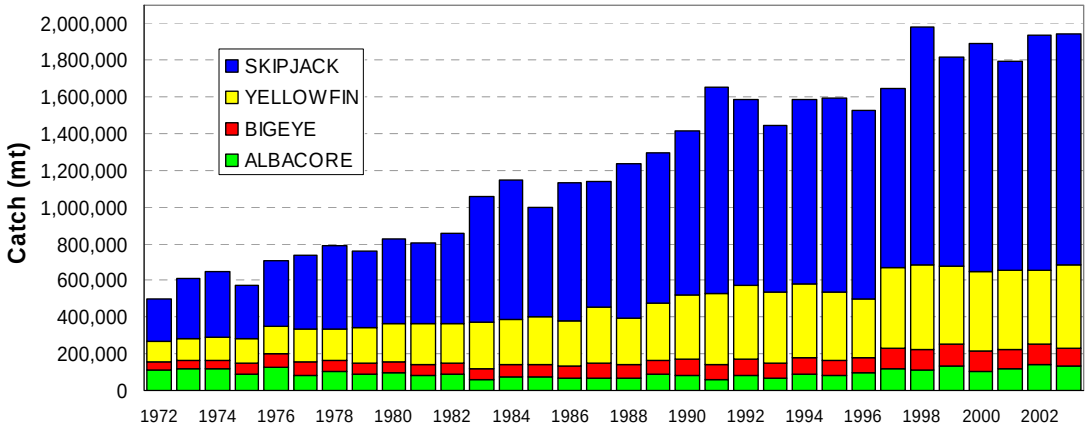


Figure 4. Catch (mt) of albacore, bigeye, skipjack and yellowfin in the WCPO for the period 1972 to 2003

Fleets

Purse seine fishery

In total, more than 200 purse seiners operated in 2003 in the WCPO. There has been a reduction in the number of US flagged vessels and an increase in the Pacific Islands' flagged vessels (e.g. PNG, Marshall Islands and Vanuatu), which has been expanding in recent years and is at its highest level ever (GEN-2). The catch of the PNG fleet is now nearly equivalent to

that of the Japanese tropical fleet. In 2001 New Zealand and China also started fishing in tropical waters. Significant number of Philippine purse seiners are operating both inside its EEZ as well as in PNG waters. Drifting FAD sets have been declining since 1999 in the major purse seine fleets, and the reason for this is not well known and thought to be related to the shift in fishing areas.

Longline fishery

The total number of longline vessels has fluctuated between 4,000 and 5,000 since the mid 1970s, and remained close to 5,000 since 1992. In recent years, there has been a gradual increase in the number of Pacific Islands domestic vessels, such as those from American Samoa, Cook Islands, Samoa, Fiji, French Polynesia, New Caledonia and Solomon Islands. These fleets mainly operate in their respective EEZs, with albacore the main species taken. The entrance into the fishery and subsequent decline of the smaller 'offshore' sashimi longliners of Taiwan and mainland-China, based in Micronesia, during the past decade is also noteworthy. The Korean and Japanese distant water fleets have declined somewhat in the WCPO in recent years. On the other hand, the Taiwan fleet increased substantially and shifted the target to bigeye in the eastern equatorial areas of the WCPO. Distant water longliners from China have recently begun fishing in the eastern portion of the WCPO.

Pole-and-line fishery

Economic factors and technological advances in the purse seine fishery (primarily targeting skipjack) have seen a gradual decline in the number of vessels in the pole-and-line fishery and stabilisation in the annual catch during the past decade. Some Pacific Islands domestic fleets (Palau, PNG and Kiribati) are no longer active, with only one or two vessels operating seasonally in Fiji

BIGEYE TUNA

Key attributes

Bigeye tuna are a relatively slow growing species that matures at approximately three to four years of age. Bigeye are known to grow to about 200 cm and over 180 kg when eight years or older. They have a wide distribution between 40°N and 40°S (Figure 5) and vertically between surface and 500 m deep (occasionally to 1000 m) due to their tolerance of low oxygen levels and low temperatures. These and other characteristics make them less resilient to exploitation than skipjack and yellowfin tunas. The geographical distribution of bigeye is continuous across the Pacific (Figure 5). However, it has been noted that there are areas of lower catch separating the principal fishing areas in the eastern (east of about 165°W-170°W) and the more western regions of the Pacific. It was also noted that though little information is available on mixing rates between these regions, the limited tag returns available suggest low mixing rates between the eastern and western Pacific. On this basis, and considering the existence of two major surface fishing areas in the western and central Pacific and eastern Pacific, stock assessment has been carried out on two different stock hypotheses, i.e. two-stock hypothesis (western and central Pacific and eastern Pacific) and a Pacific-wide stock hypothesis allowing the extent of basin-scale mixing to be estimated. Large fish are caught mainly by longline, and these longline-caught bigeye are the most valuable among the tropical tunas. Juvenile fish tend to form mixed schools with skipjack and yellowfin, which results in catches by the surface fishery, particularly in association with floating objects. Natural mortality is estimated to be relatively low compared with other tropical species.

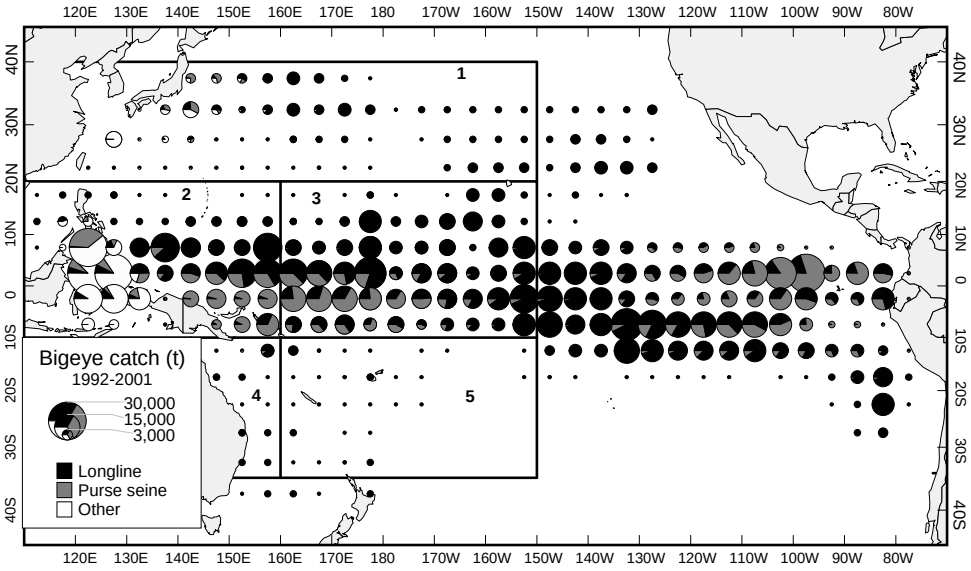


Figure 5. Distribution of bigeye tuna catch, 1992–2001. The spatial stratification used in the WCPO MULTIFAN-CL model is shown

Trends

Catch and CPUE

The total bigeye tuna catch in the WCPO for 2003 was 96,000 mt, the lowest for 7 years. This represents 53% of the total Pacific catch in the same year. Available statistics (Figure 6) indicate that 60% of the WCPO catch was taken by longline, and most of the remainder by purse seine (21%) and by the domestic fisheries of Indonesia and Philippines and others (18%). The total catch of small bigeye tuna by the purse seine fishery is uncertain, as they are not systematically separated from yellowfin at the unloading sites nor recorded separately on fishing logs. Purse seine catch in 2003, estimated through the statistical analysis of sampling data, continued to reduce to 20,300 mt since the 1999 record high of 34,600 mt due to a decreased use of drifting FADs. There is also considerable uncertainty in the estimation of the Indonesian and Philippines catches due to the lack of (or limitations in) systematic sampling programs. Nominal (unadjusted) CPUE for WCPO bigeye tuna derived from longline data indicated a sharp decline during the early stages of the fishery but has been fairly stable over recent years.

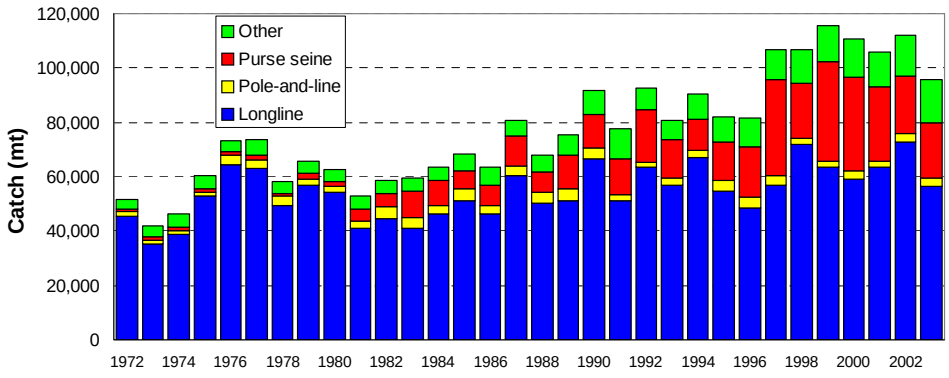


Figure 6. WCPO bigeye tuna catch by gear

Standardized CPUE was estimated by the General Linear Model (GLM), deterministic habitat-based standardization (HBS) and statistical habitat-based standardization (SHBS). However, the HBS estimate was not used in the MFCL model as this effective effort poorly predicted the catch and the trend was similar to that of SHBS. The trends of the remaining models (Figure 7) were generally similar, although CPUEs in Regions 2 and 3, where the most significant fisheries have existed, were somewhat different as they showed some high peaks between 1970s and 2000s, while CPUE in the other regions tended to show steady decline with minor fluctuation after the large decline that occurred at the beginning. The most recent years were the lowest for SHBS CPUE for Regions 1, 3 and 5. The SHBS CPUE for Region 3 indicated the most precipitous and continued decline. However, the GLM index shows increases in recent years in Regions 3 and 5. In summary, there are some regions which indicate some decline of CPUE in recent years, but there appears to be no indication of a significant recent decline in longline exploitable biomass, as has been documented for the EPO, the Atlantic and the Indian Ocean.

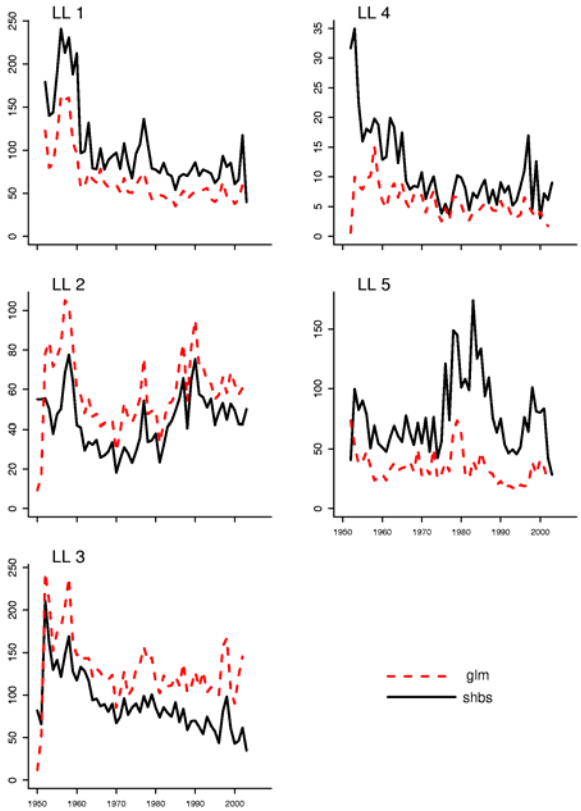


Figure 7. Catch-per-unit-effort (CPUE) for the longline fisheries LL1–LL5 standardised using two different methodologies. glm = general linear model; shbs = statistical habitat-based standardisation

Size of Fish Caught

Annual and recent quarterly catch-at-size by major fisheries is shown in Figure 8. The surface fisheries of the Philippines and Indonesia take large quantities of small bigeye in the 20-50 cm range. Purse seine sets on floating objects (i.e. associated schools), which are mostly 'mixed' schools of skipjack and yellowfin, generally take smaller fish (40-100 cm) than sets on unassociated or free-swimming schools. Bigeye taken in unassociated purse-seine sets are larger than those caught by associated sets and the amount is much smaller. The longline catch of adult bigeye tuna dominates those of other fisheries. Decadal trends in the length composition of the bigeye longline catch show a considerable decline in the proportion of large (>150 cm) fish in the catch, particularly during the early period of the fishery (ECO-3).

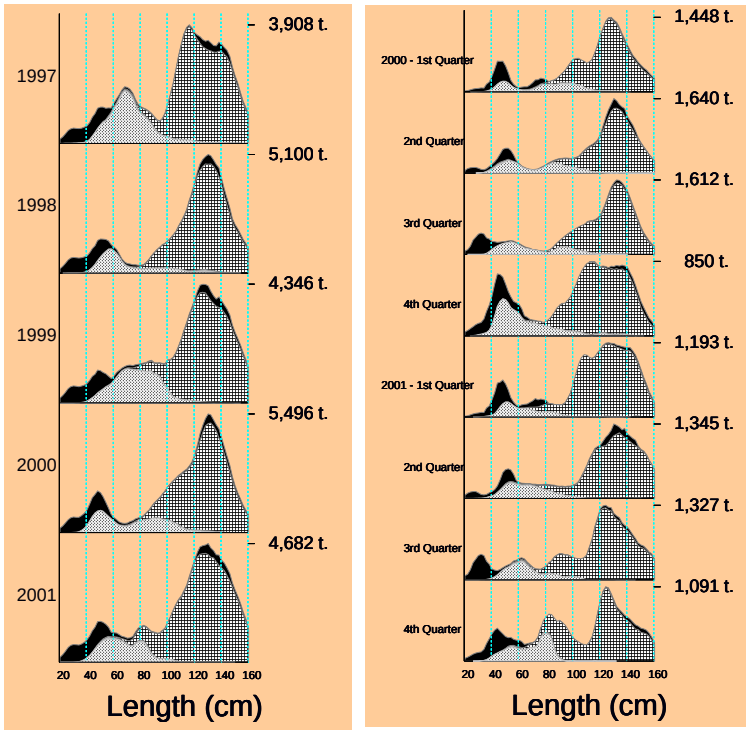


Figure 8. WCPO bigeye catch-at-size, expressed in weight. Black, dot, grey and hatched area indicate Philippine and Indonesian surface catch, associated catch by purse seine gear, unassociated catch by purse seine gear, and longline catch, respectively

Stock Assessment

The stock assessment (SA-2) was conducted using the statistical model 'MULTIFAN–CL' (MFCL) applied to data for the WCPO as has been done in recent years. Years covered were 1950-2007 the final 4-5 years being a projection period. The projection assumed that future fishing effort is constant at the same level of the most recent year for which the fishing effort is available (either 2002 or 2003 depending on fishery). Considerable size data for the Japanese longline fishery before 1965 were included in the analysis for the first time. The methodology of projections was improved and the initial stock condition was assumed to be in equilibrium and to have experienced the average total mortality of the first 20 quarters.

This year's MFCL runs were made using two effort series standardized by the GLM and SHBS methods applied to the Japanese longline fishing effort. Natural mortality rates at age were either estimated (MEST) or fixed (MFIX) and assuming fixed or variable (LLq) catchability for the longline fisheries. The estimated catchability trends for the LLq option often differed substantially among model regions in a manner that did not have an obvious mechanistic explanation. Therefore the LLq option was not considered to be suitable for the interpretation of stock status.

The run for which SHBS effort was used and natural mortality at age was estimated was designated as the base case analysis (SHBS-MEST). The results, shown below, were mostly taken from this base case, although results of other runs were also referred to as sensitivity runs where necessary.

Recruitment

The estimated recruitment (Figure 9) for all runs indicated an increasing trend with large interannual variability since the 1980s and reached the highest level in 1999, which is about 2.0-2.5 times higher than the 1980s. This increasing trend was first observed in the 2003 assessment. Once again, the possibility that increasing recruitment was simply a model response to increasing juvenile catch in the Indonesian and Philippines fisheries was raised. This was investigated by conducting a model run in which the Indonesian and Philippines catches were reduced by a factor of 100. Under these circumstances, average recruitment was slightly reduced and the increasing trend in Region 2 (where the Indonesian and Philippines fisheries occur) was not as strong. However, an increasing trend in recruitment still remained and this was thought to be related to the increase in longline CPUE in Region 2. However, it was concluded that increasing juvenile catches did seem to be having some effect on the recruitment estimates, and further research was required to develop an appropriate modelling response to this artefact.

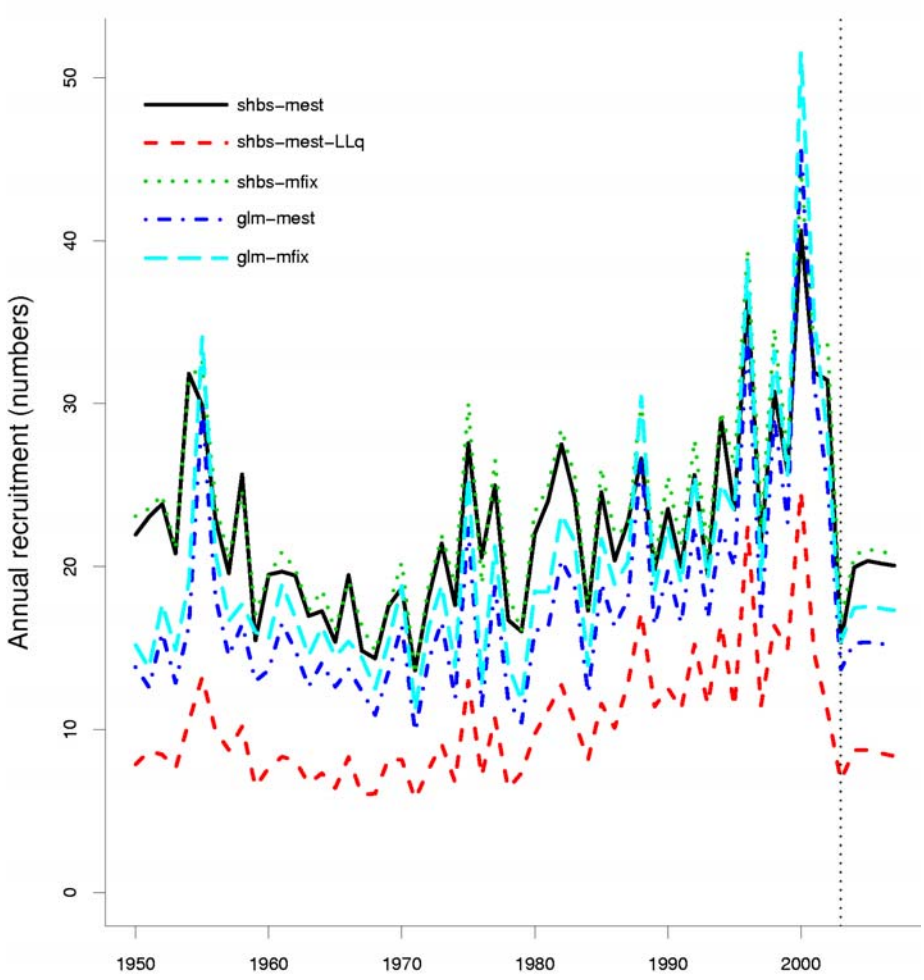


Figure 9. Estimated annual recruitment for the WCPO obtained from the separate analyses using different model options. The vertical dotted line indicates the point at which population projections are made with assumed levels of effort

Biomass

Total estimated annual average biomass of bigeye tuna in the WCPO indicated a similar declining pattern among different runs, although the absolute level was different (Figure 10). The largest decline was observed in the runs using GLM effort. In all runs, the largest decline occurred during the late 1950s and the early 1960s, and it has been fairly stable thereafter. The impact on the results of using estimated or fixed natural mortality at age was negligible.

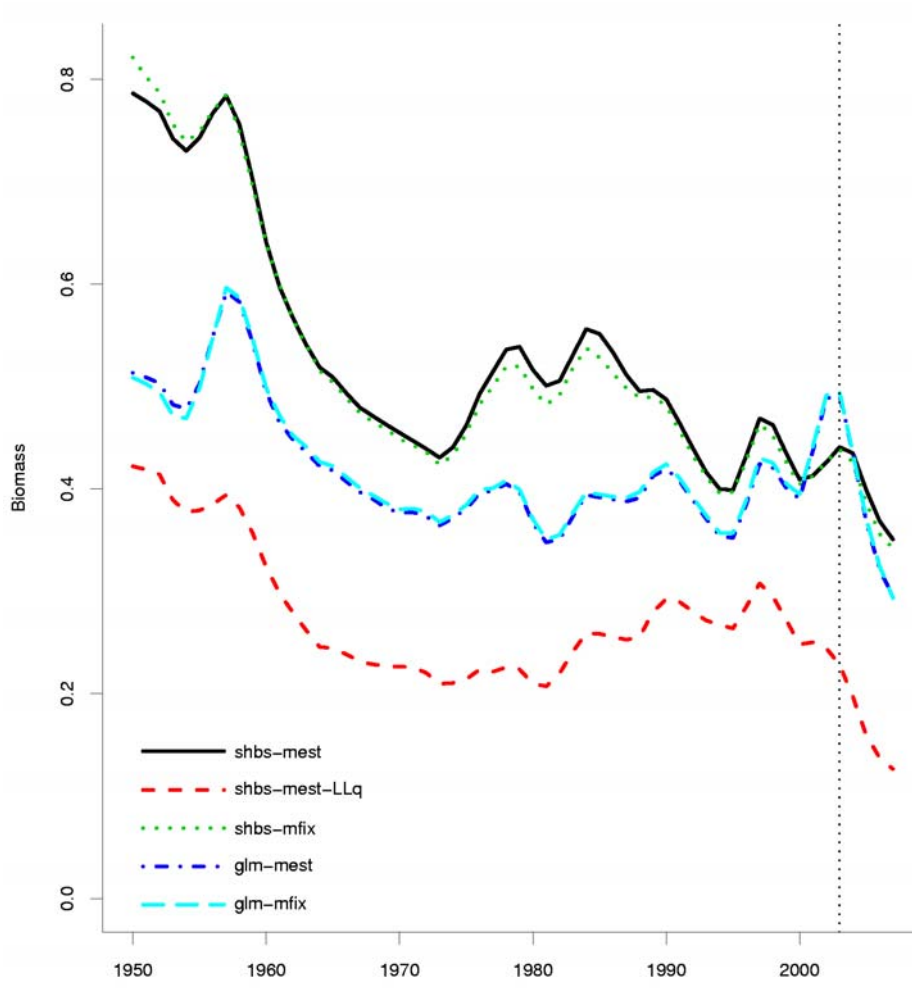


Figure 10. Estimated annual average total biomass (million t) for the WCPO obtained from the separate analyses using different model options. The vertical dotted line indicates the point at which population projections are made with assumed levels of effort

Fishing mortality

Average fishing mortality rates for juvenile and adult age classes increased continuously throughout the time series in a similar fashion for all runs (Figure 11). The juvenile fishing mortality in the most recent year is still lower than the adult fishing mortality in all runs. Fishery impact analysis shows that the highest impacts on the bigeye stock occur in the tropical regions (Regions 2 and 3 – Figure 12). The longline fishery has the highest overall impact on the stock; however, the surface fisheries catching juvenile bigeye have high impact in the tropical regions.

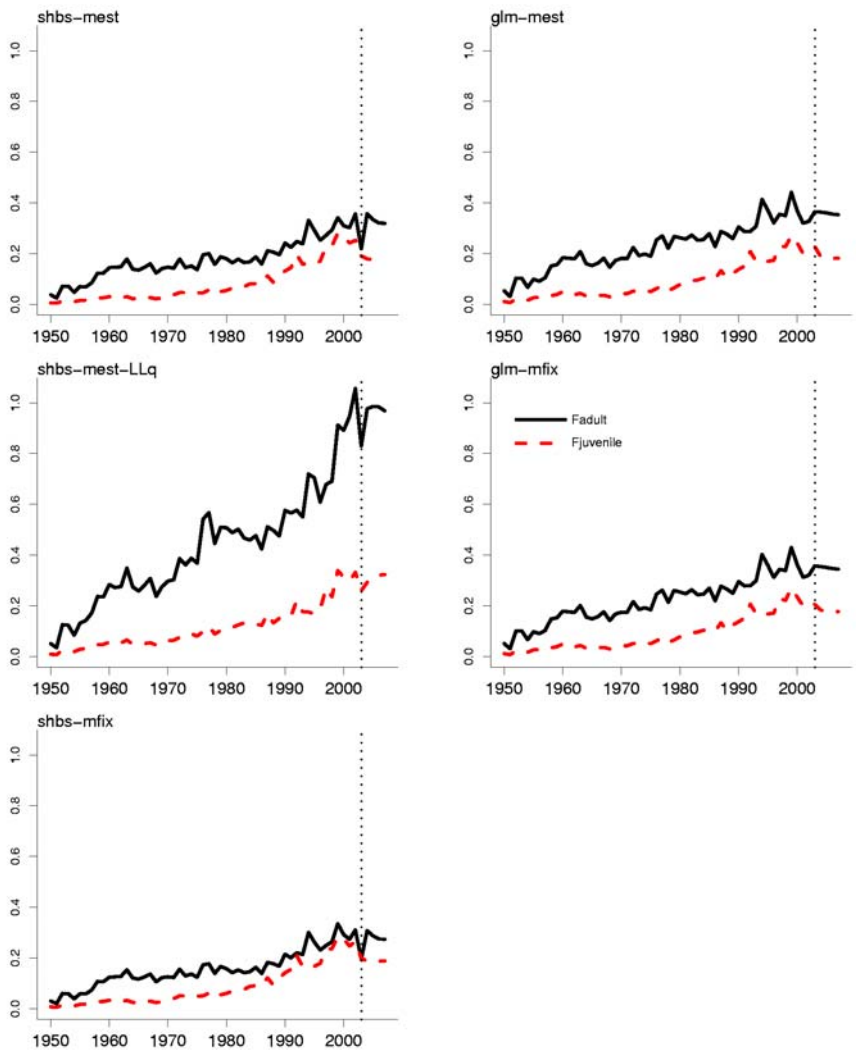


Figure 11. Estimated annual average juvenile and adult fishing mortality for the WCPO obtained from the separate analyses using different model options

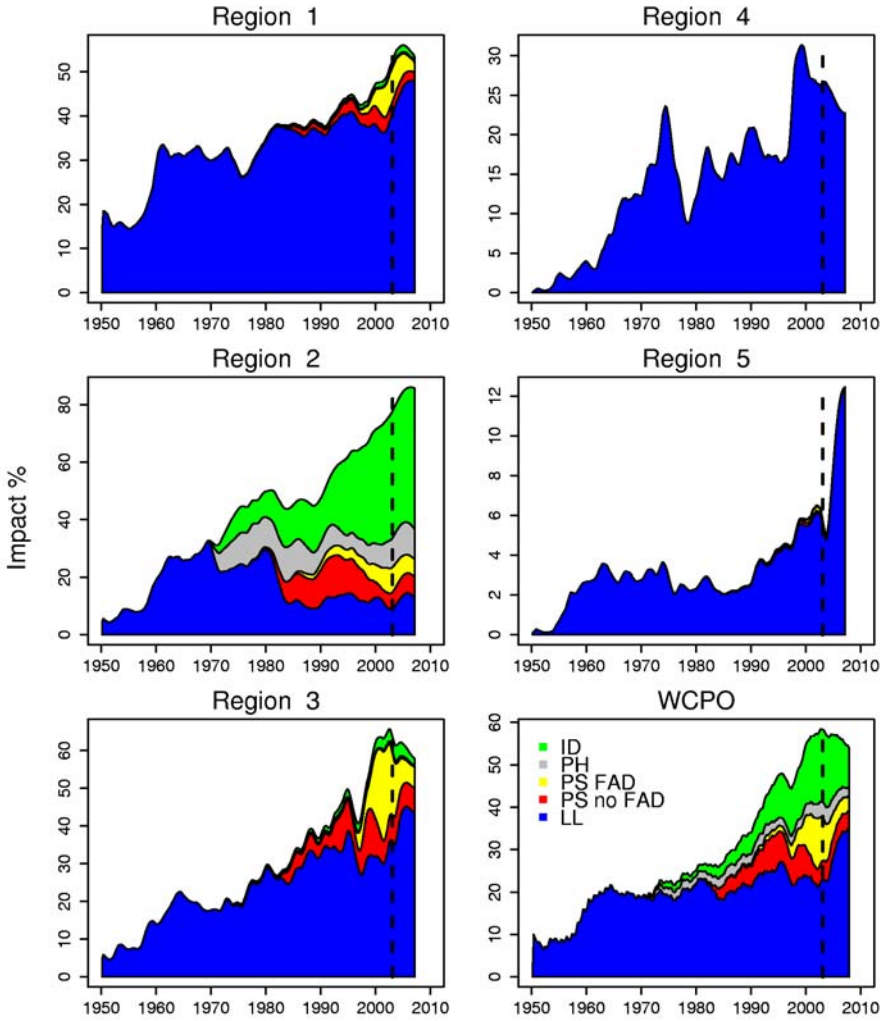


Figure 12. Estimates of reduction in total biomass due to fishing by region and for the WCPO attributed to various fishery groups. LL = all longline fisheries; ID = Indonesian domestic fishery; PH = Philippines domestic fisheries; PS FAD = purse seine FAD sets; PS non-FAD = purse seine log and school sets

Stock status

The 2004 assessment results were reviewed and confirmed as consistent with the 2003 assessment, although the point estimates of some reference points were slightly more optimistic in this assessment (Table 1, Figure 13). The current fishing mortality (i.e. the average for 1999-2001) is estimated to be close to *MSY* level ($F_{current}=F_{MSY}$) and the current biomass to be above the *MSY* level ($B_{current}>B_{MSY}$, not in an overfished state). This result is common for all runs. Probability distributions for $F_{current}/F_{MSY}$ and $B_{current}/B_{MSY}$ were developed by the likelihood profile method. These distributions (Figure 14) indicate that the current levels of fishing mortality carry high risks of overfishing but the probability that the stock is in an overfished state is close to zero.

The future stock status of WCPO bigeye will depend both on future fishing mortality and future recruitment. Recent recruitment has been estimated to be well above average, and if it falls to the long term average or lower, current catch levels would result in stock reductions to near and possibly below MSY-based reference points. Lower future recruitment is a possibility if the recruitment trends for bigeye in the EPO are mirrored in the WCPO, and if the hypothesis concerning the impact of large-scale ocean climate on tropical tuna recruitment, which was suggested in the paper presented to SCTB 17 (ECO-5), proves to be correct.

According to the information provided by the IATTC, the spawning stock biomass of bigeye tuna in the eastern Pacific Ocean (EPO) has now declined below the *MSY* level. The stock will likely remain in an overfished condition for some time because of high fishing mortality and low recent recruitment. The annual meeting of the IATTC adopted several management measures aimed at preventing further decline and promoting recovery of the stock. It was noted that the longline fishery operates continuously across the tropical Pacific (Figure 5) and that collaborative research with the IATTC on Pacific-wide bigeye assessment should continue.

Taking all above information into consideration, it is recommended that, as a minimum measure, there be no further increase in the fishing mortality rate for bigeye tuna from $F_{current}$. If future evidence supports a shift to a lower productivity regime, a decrease in total catch would be anticipated in order to maintain the stock at sustainable levels. The SCTB participants recognize there are still large uncertainties associated with the stock assessment of this species and recommend that the stock assessment be conducted again next year.

Table 1. Estimates of management measures based on the 2003 - 2004 stock assessments

Management Quantity	2004 Assessment	2003 Assessment
Most Recent Catch	96,000 MT (2003)	115,000 MT (2002)
Effort	Base case and others	All
MSY	56,000 ~ 62,000 MT	40,000~80,000 MT
$Y_{Fcurrent}$ / MSY	1.00	0.82-0.99[1]
$B_{current}$ / $B_{current,F=0}$	0.41~0.43	0.27 ~ 0.34
$F_{current}$ / F_{MSY}	0.89~1.02	1.11~2.00
$B_{current}$ / B_{MSY}	1.75~2.28	1.35~1.76

[1] These are the correct numbers - those given in the Executive Summary of SCTB16 were incorrect

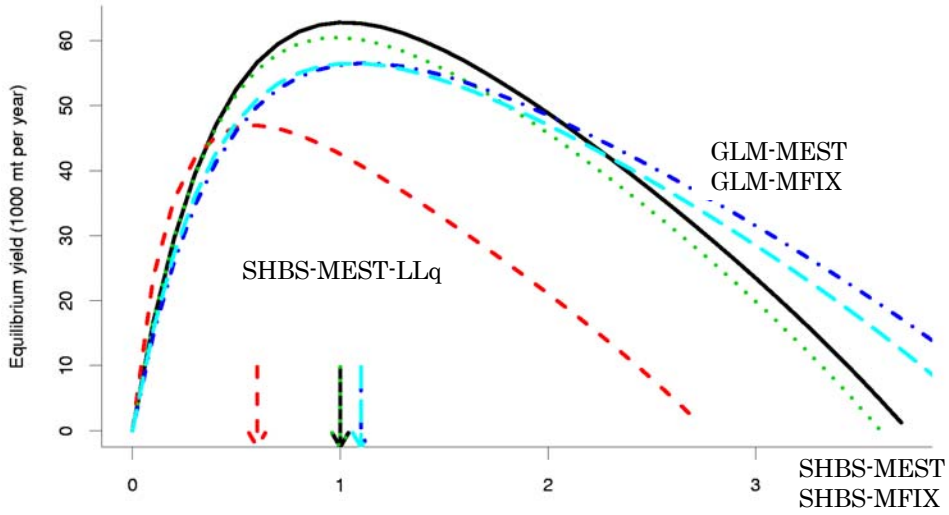


Figure 13. Yield curves estimated from the separate analyses using different model options. Arrows indicate corresponding F_{MSY} relative to the current fishing mortality multiplier

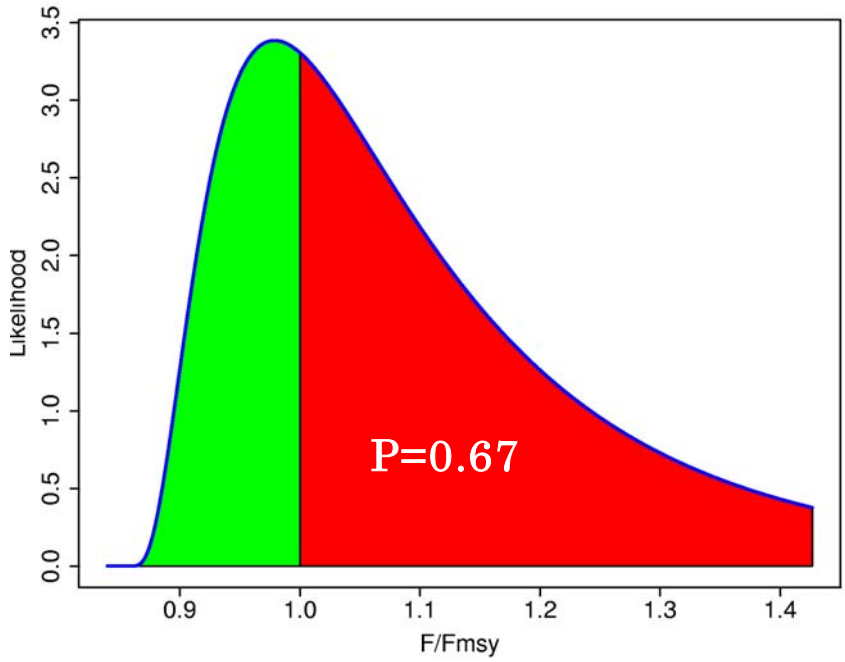


Figure 14. Probability distribution of $F_{current}$ / F_{MSY} based on the likelihood profile method (base case with steepness of mode = 0.9 and sd = 0.1)

YELLOWFIN TUNA

Key attributes

Yellowfin tuna are fast growing, mature at about two years of age and are highly fecund. Yellowfin can grow to 180 cm in length and weigh over 100 kg when they are about six years of age or older. The majority of the catch is taken from the equatorial region where they are harvested with a range of gear types, predominantly purse seine and longline. Catches of yellowfin tuna represent the second largest component (21–27% since 1990) of the total annual catch of the four main target tuna species in the WCPO. For stock assessment purposes, yellowfin tuna are believed to constitute a single stock in the WCPO.

Trends

Catch and effort

Since 1990, there have been large increases in the total catch of yellowfin with the development of the purse seine fishery. This has included a considerable catch of juvenile yellowfin associated with the FAD fishery. In recent years catches in the purse seine fishery overall have declined from the record catch taken in 1998. The catches of juvenile yellowfin in the Philippine and Indonesian domestic fisheries have also increased significantly since 1990, with these increases continuing to 2003, although the magnitude of these catches is not well determined.

Longline fisheries developed in the early 1950s with yellowfin tuna being the principal target species, though a major change took place after the mid-1970s with the increased targeting of bigeye tuna. Large-scale industrial purse seine fisheries developed in the early 1980s, principally targeting skipjack tuna but also taking large catches of yellowfin tuna. This development, together with increased catches by Indonesia and the Philippines, resulted in the yellowfin catches in the WCPO doubling from 200,000 to 400,000 mt between 1980 and 1990. Over the past decade, 40-60% of the total yellowfin catch each year has come from the purse seine fishery.

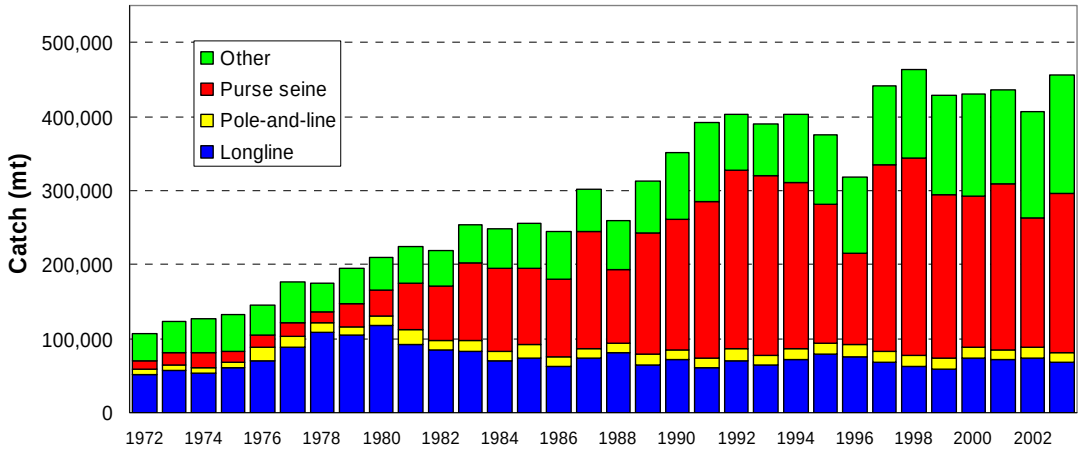


Figure 15. Annual WCPO yellowfin catch (mt) by gear

The 2003 catch of yellowfin tuna in the WCPO (Figures 15 and 16) was estimated at 456,947 mt. This level of catch represents the second highest catch on record, and is mainly due to an increase in the Philippines domestic purse seine and handline catches (Figure 15). Relatively high catches of yellowfin by all gears have also been reported for the EPO which contributed to a record high Pacific wide catch of yellowfin by all gears of 873,794 mt.

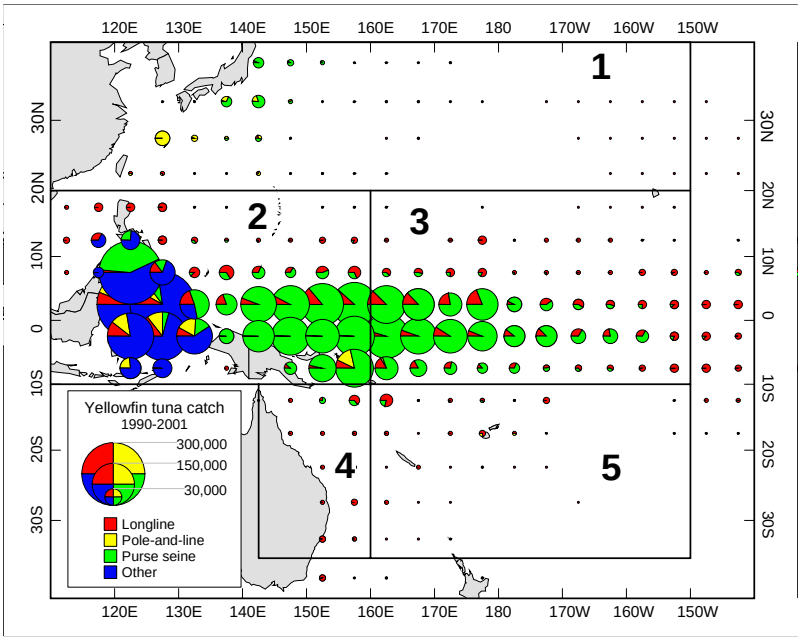


Figure 16. Distribution of yellowfin tuna catch, 1990-2001.
The five-region spatial stratification used in stock assessment is shown

In 2003 the purse seine catch (Figure 16) was estimated at 214,535 mt or 47% of the total WCPO yellowfin catch. The longline catches since 1990 (60,000–80,000 mt) have been well below catches taken in the late 1970s to early 1980s (87,000-117,000 mt). The 2003 longline catch is estimated to be 67,490 mt, or 15% of the total yellowfin catch. During 2003, the pole-and-line fisheries took 14,357 mt (3% of the total) while 'other' fisheries (largely taken by fisheries in the Philippines and Indonesia) accounted for 160,565 mt (35% of the total).

Time-series of nominal catch rates for the Japanese longline fleet display high inter-annual variability and regional differences, with an overall decline since the early 1950s in the equatorial WCPO but little or no overall trend in more temperate regions. Time-series of standardised catch rates for this fleet also display regional differences, with large differences also seen between the different indices within several regions. The GLM based index displays similar (if sometimes smaller) trends to the nominal catch rates, while the statistical habitat based method (SHBS) predicted a considerable decline in effective effort and an increase in standardized CPUE from the late 1970s to the 1990s.

Size of Fish Caught

The annual catch-at-size by principal fisheries are shown in Figure 17 while recent trends in quarterly catch-at-size are shown in Figure 18. These figures are from the Executive Summary for SCTB16. The domestic surface fisheries of the Philippines and Indonesia take large quantities of small yellowfin in the range 20–50 cm. Purse seine sets on floating objects (i.e. associated schools) generally take smaller fish than sets on unassociated or free-swimming schools, which are often 'pure' schools of large yellowfin. However, the size ranges of the

yellowfin taken in associated and unassociated purse seine sets vary from year to year. Yellowfin taken in unassociated purse-seine sets are of a similar size range to fish taken in the longline fishery and the handline fishery in the Philippines (both gears target adults in the range 80–160 cm). The purse-seine catch of adult yellowfin tuna is in fact higher than the longline catch in most years. There was a relative absence of medium-sized (60–100 cm) yellowfin in the catches from both the longline and purse seine fisheries during most quarters of 2000 and 2001, although a 'pulse' in this size range appears by the 4th quarter 2001.

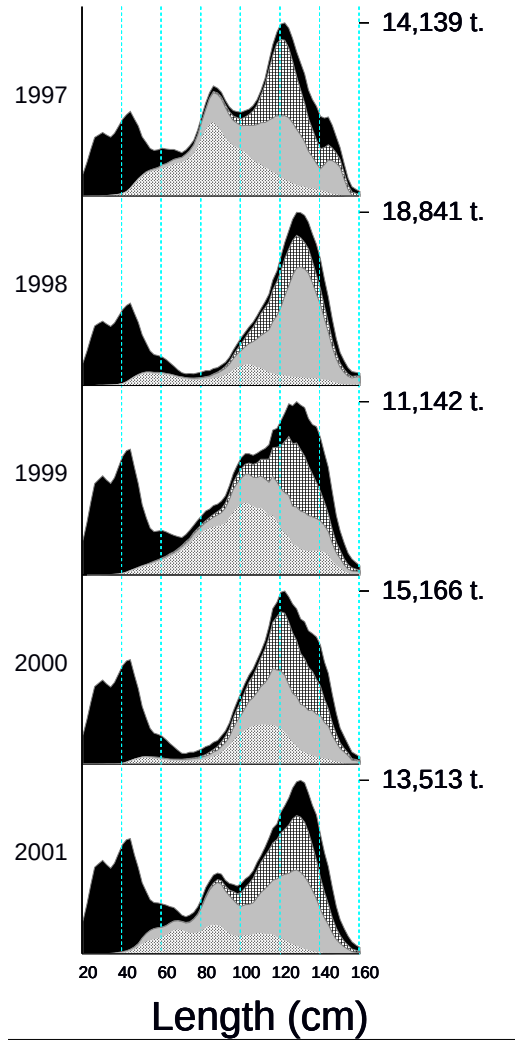


Figure 17. Annual Yellowfin tuna catch-at-size in the WCPO, 1997–2001.
The catch is broken down into the Indonesian / Philippines domestic fisheries component (black), the longline fishery component (hatched), unassociated-set catch from the purse-seine fishery (grey) and associated-set catch from purse-seine fishery (dotted). The y-axis scale is in weight – the figures on the right indicate the catch weight in a 2-cm size class.

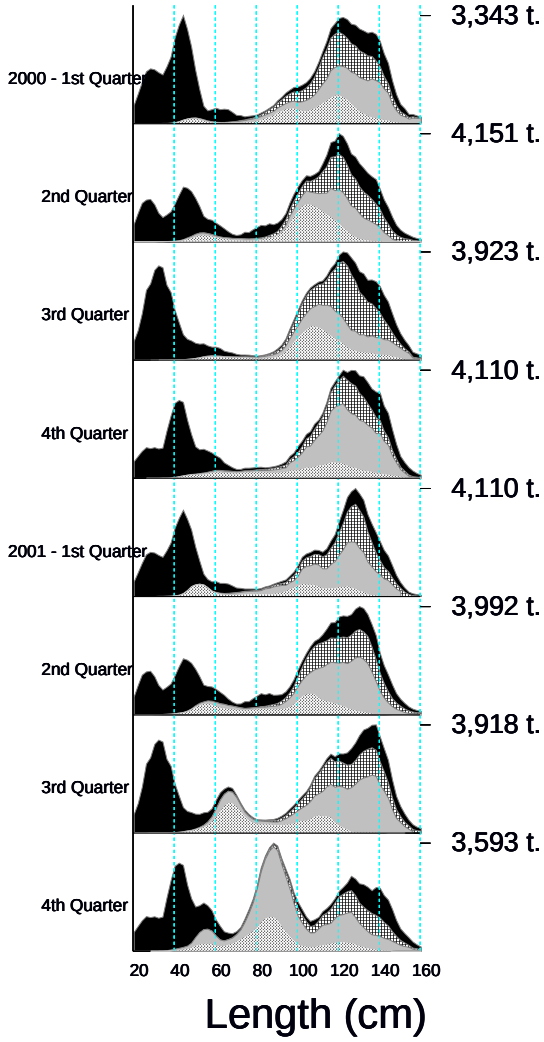


Figure 18. Quarterly Yellowfin tuna catch-at-size in the WCPO, 2000–2001.
The catch is broken down into the Indonesian / Philippines domestic fisheries component (black), the longline fishery component (hatched), unassociated-set catch from the purse-seine fishery (grey) and associated-set catch from purse-seine fishery (dotted). The y-axis scale is in weight – the figures on the right indicate the catch weight in a 2-cm size class.

Stock Assessment

The stock assessment was conducted using the statistical model 'MULTIFAN-CL' applied to the yellowfin data for the WCPO as has been done in recent years. This year's MFCL runs were made using two effort series standardized by the GLM and SHBS methods applied to the Japanese longline fishing effort. Natural mortality rates at age were either estimated (MEST) or fixed (MFIX) and assuming fixed or variable (LLq) catchability for the longline fisheries. The estimated catchability trends for the LLq option often differed substantially among model regions in a manner that did not have an obvious mechanistic explanation. Therefore the LLq option was not considered to be suitable for the interpretation of stock status.

Recruitment

Estimated recruitment numbers are sensitive to the standardised effort indices used in the assessment model, and assumptions made regarding natural mortality at age (Figure 19). In general, estimates of recruitment were higher for model options using an assumption of fixed natural mortality compared to options where natural mortality at age was estimated. However, all analyses revealed a strong temporal trend in recruitment. Initial recruitment was relatively high declining to a lower level during the 1960s and early 1970s. Recruitment subsequently increased to higher levels beginning in the late 1970s. Recruitment remained relatively high during the 1980s and 1990s. The recruitment indices also indicated that recruitment variability may have increased in recent years. Whether this change in the productivity of the stock reflects a change (or a 'regime shift') in oceanographic conditions or is an artefact of the increased catch of juvenile fish taken in the surface fisheries over this period remains unclear.

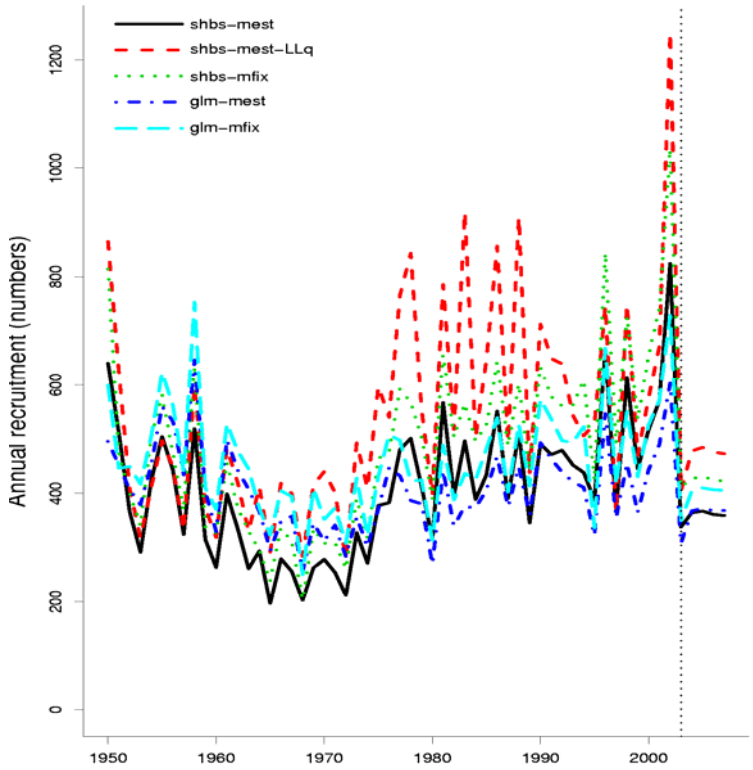


Figure 19. Estimated annual recruitment for the WCPO obtained from the five different model options. The vertical dotted line indicates the point at which population projections are made with assumed levels of effort

Biomass

The general trends in overall annual average biomass were comparable between the five model options, although there was considerable difference in the biomass estimates (Figure 20). The overall level of biomass for the two GLM models (GLM-MEST and GLM-MFIX) and the SHBS-MFIX models was lower than the base-case (SHBS-MEST) and the two GLM models revealed a considerable reduction (about 40%) in total biomass over the entire model period. Estimates of the current level of depletion of yellowfin in the WCPO indicate that the current biomass is 20-35% less than the level that would have occurred in the absence of fishing. Depletion is greater for some regions, notably the equatorial regions where recent depletion levels are near 50%. However, high levels of unfished biomass in some regions (e.g. Region 5) may be a model artefact and require further investigation.

Fishing mortality

Trends in estimated fishing mortality rates are shown in Figure 21. Fishing mortality for both juveniles and adults is estimated to have increased continuously since the beginning of industrial tuna fishing, with significantly more rapid increases since the early 1990s. These increases are attributable to increased catches in purse seine fisheries and catches of juveniles in particular in the domestic Indonesian and Philippine fisheries, together with the declines in overall biomass over the past decade. Fishery impact analysis shows that the highest impacts on the yellowfin stock occur in the tropical regions (Regions 2 and 3 – Figure 22). The longline fishery has relatively low impact on the stock, but the surface fisheries, particularly the Indonesian fishery, have high impact.

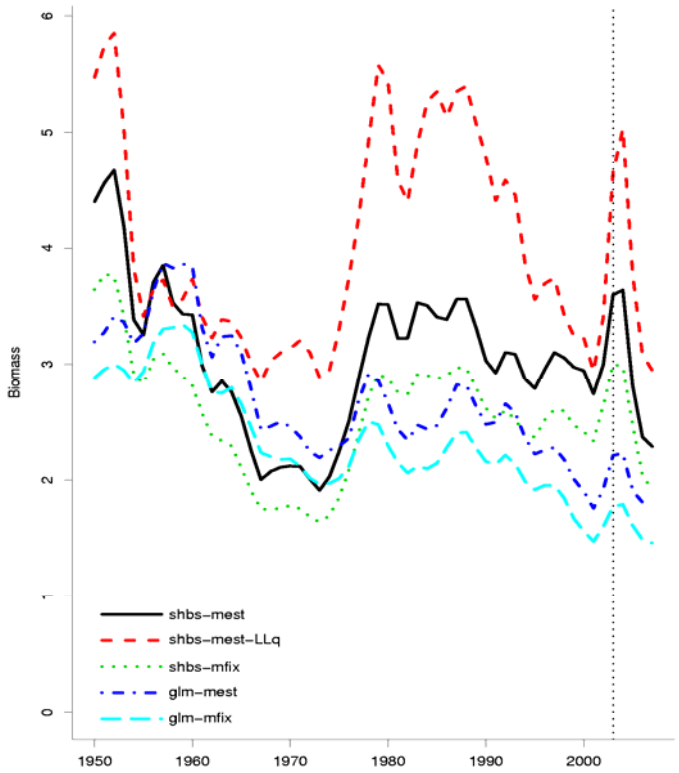


Figure 20. Estimated annual average total biomass (million t) for the WCPO obtained from the five different model options. The vertical dotted line indicates the point at which population projections are made with assumed levels of effort

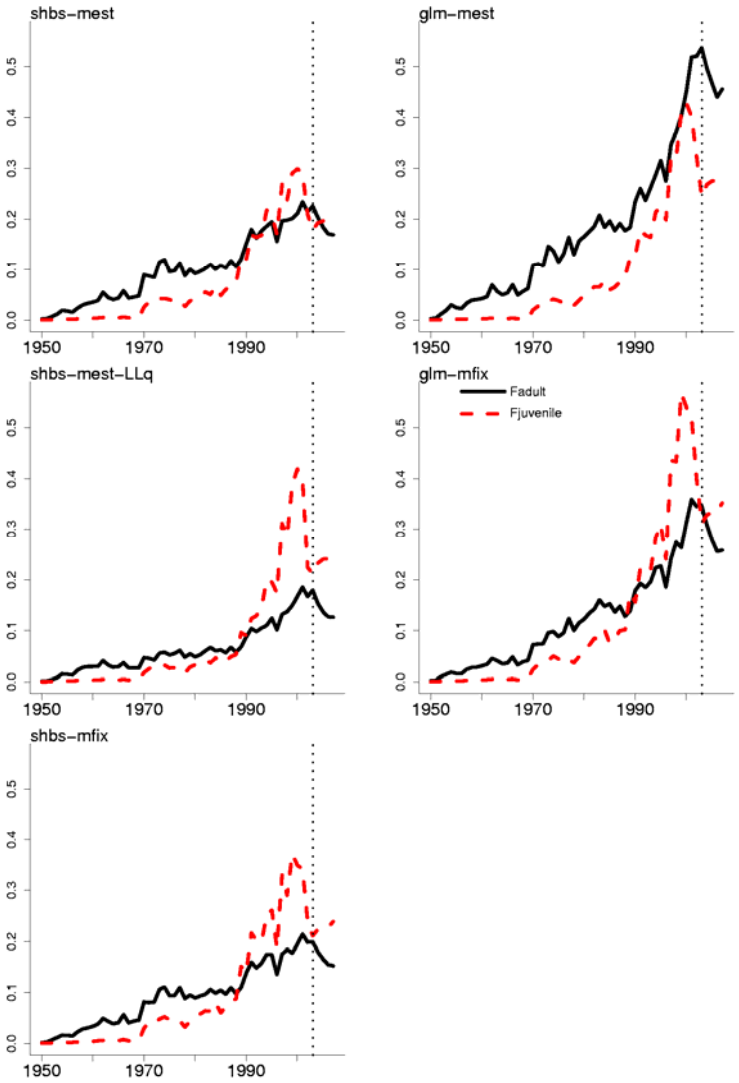


Figure 21. Estimated annual average juvenile and adult fishing mortality for the WCPO obtained from the five separate model options

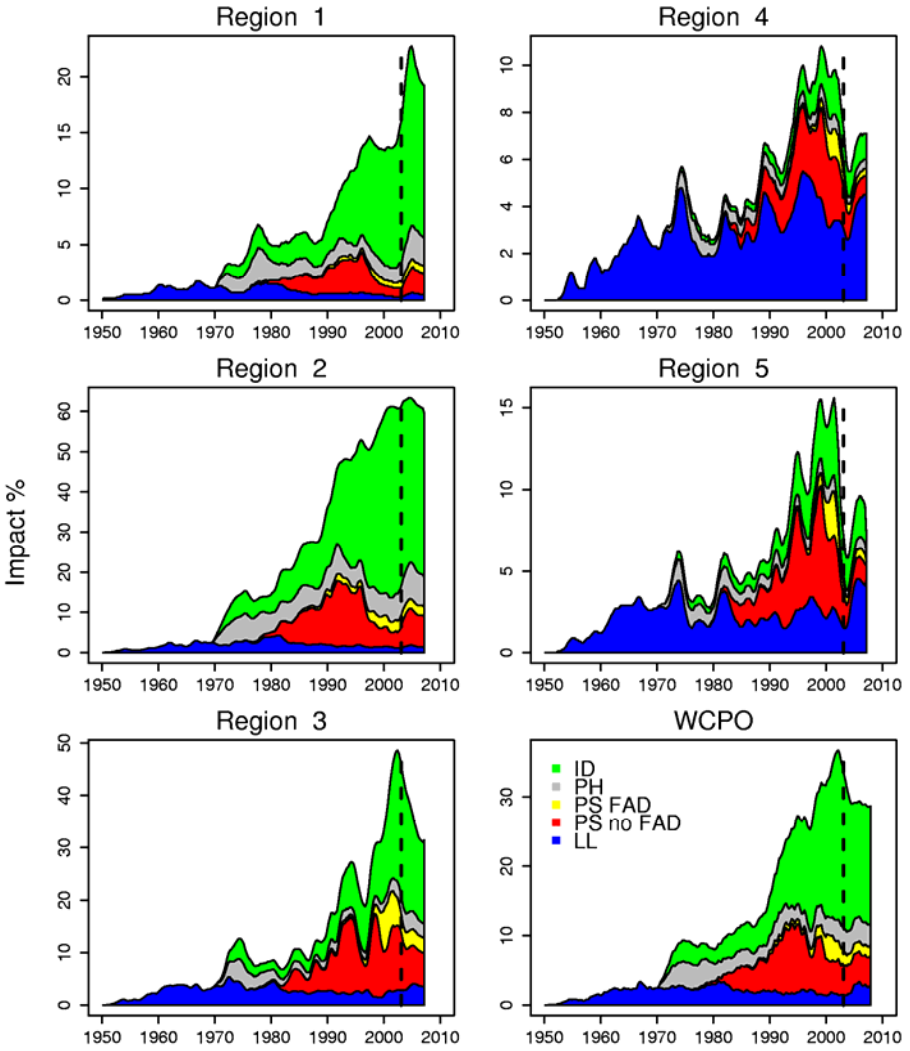


Figure 22. Estimates of reduction in total biomass due to fishing (fishery impact = 1-$B_t/B_{0,t}$) by region and for the WCPO attributed to various fishery groups. LL = all longline fisheries; ID = Indonesian domestic fishery; PH = Philippines domestic fisheries; PS FAD = purse seine FAD sets; PS non-FAD = purse seine log and school sets

Stock status

The assessment (SA-1) reviewed by SCTB 17 reaffirms the result of the previous assessment that the yellowfin stock in the WCPO is probably not being overfished ($F_t/F_{MSY} < 1$) and that it is not in an overfished state ($B_t/B_{MSY} > 1$). However, the stock is likely to be nearing full exploitation and any future increases in fishing mortality would not result in any long-term increase in yield and may move the yellowfin stock to an overfished state. While biomass-based reference points (Table 2) indicate that the long-term average biomass should remain above that capable of producing *MSY* if present catches are maintained, yield estimates (Figure 23) indicate that there may be limited potential to expand long-term catches from the fishery at the current pattern of age-specific selectivity. The assessment also indicates that the equatorial regions are likely to be fully exploited, while the temperate regions are likely to be lightly exploited. Furthermore, the attribution of depletion to various fisheries or groups of fisheries indicates that the Indonesian fishery has the greatest impact, particularly in its home region, but is also impacting other regions, as the assessment model indicates that Region 2 is a source of recruits for other regions. The purse seine fishery also has moderate impact, particularly in the equatorial regions.

It is important to note that the key reference points are sensitive to initial assumptions regarding the nature of the stock-recruitment relationship (Figure 24). The assumed prior distribution for the steepness parameter is highly influential and a relaxation of this assumption results in a more pessimistic assessment despite the lack of any evidence of a strong relationship between spawning stock biomass and recruitment (steepness is a parameter that describes the slope of the ascending limb of the relationship between spawning biomass and recruitment). For future assessments, a comprehensive review of appropriate values of SRR steepness for yellowfin is required to determine appropriate values for inclusion in a range of sensitivity analyses. The other main source of uncertainty is the historical and current levels of catch from the Indonesian fishery.

While recognizing continuing uncertainties associated with the present stock assessment, the SCTB reiterates the previous recommendation that there be no further increases in fishing mortality (particularly on juvenile yellowfin) in the WCPO. If future evidence supports a shift to a lower productivity regime, a decrease in total catch would be anticipated in order to maintain the stock at sustainable levels.

Table 2. Estimates of management measures based on the 2003 - 2004 stock assessments

Management Quantity	2004 Assessment	2003 Assessment
Most Recent Catch	456,947 mt (2003)	437,984 mt (2002)
Effort	Base case and others	GLM
MSY	248,000~310,000	381,000~554,000
$Y_{Fcurrent}$ / MSY	0.90~1.00	0.91
$B_{current}$ / $B_{current,F=0}$	0.51~0.67	0.65
$F_{current}$ / F_{MSY}	0.63~1.11	0.61
$B_{current}$ / B_{MSY}	1.75~2.46	1.59

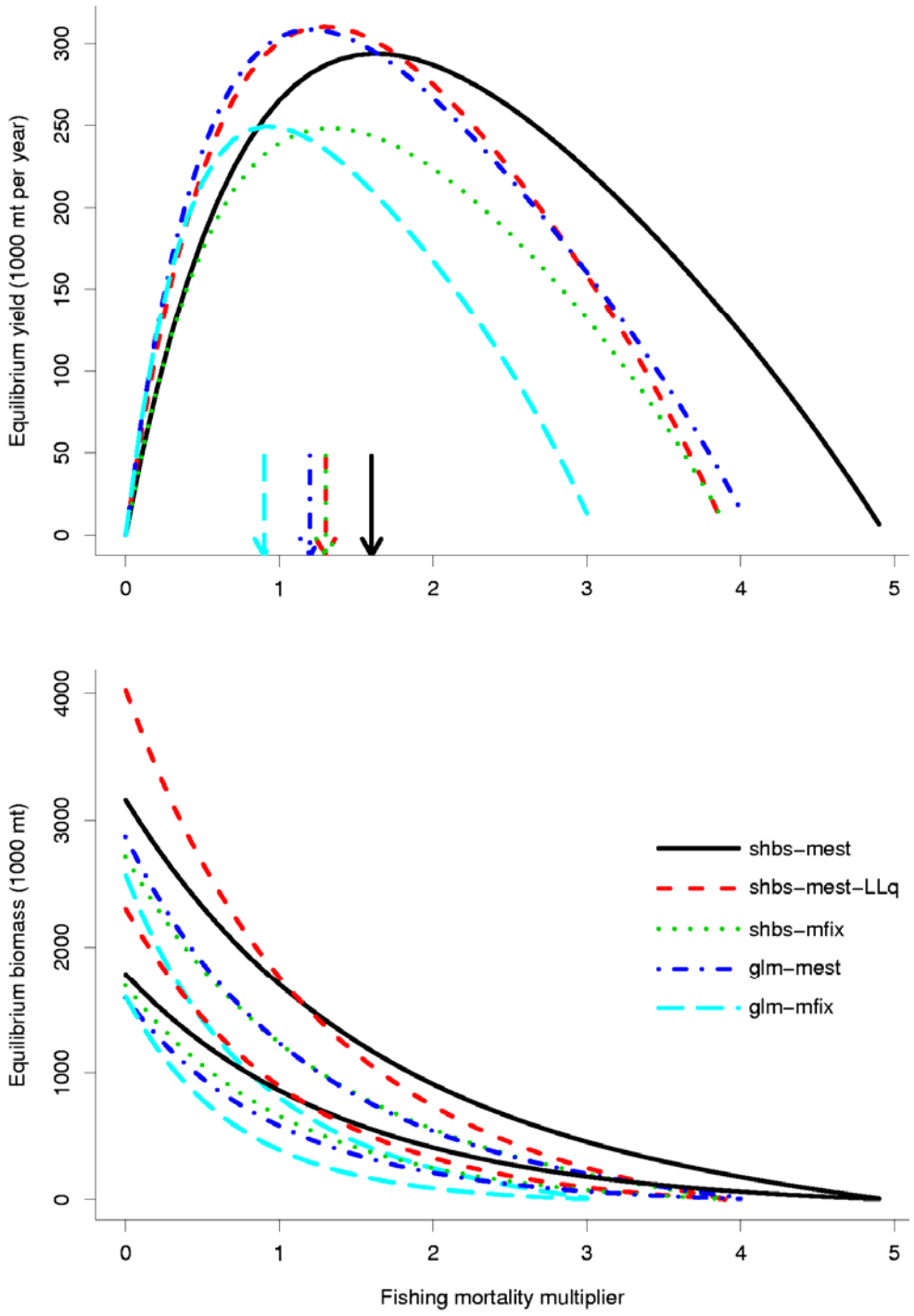


Figure 23. Yield, equilibrium biomass and equilibrium spawning biomass as a function of fishing mortality multiplier obtained from the five separate model options. In the upper panel, the arrows indicate the value of the fishing mortality multiplier at maximum yield

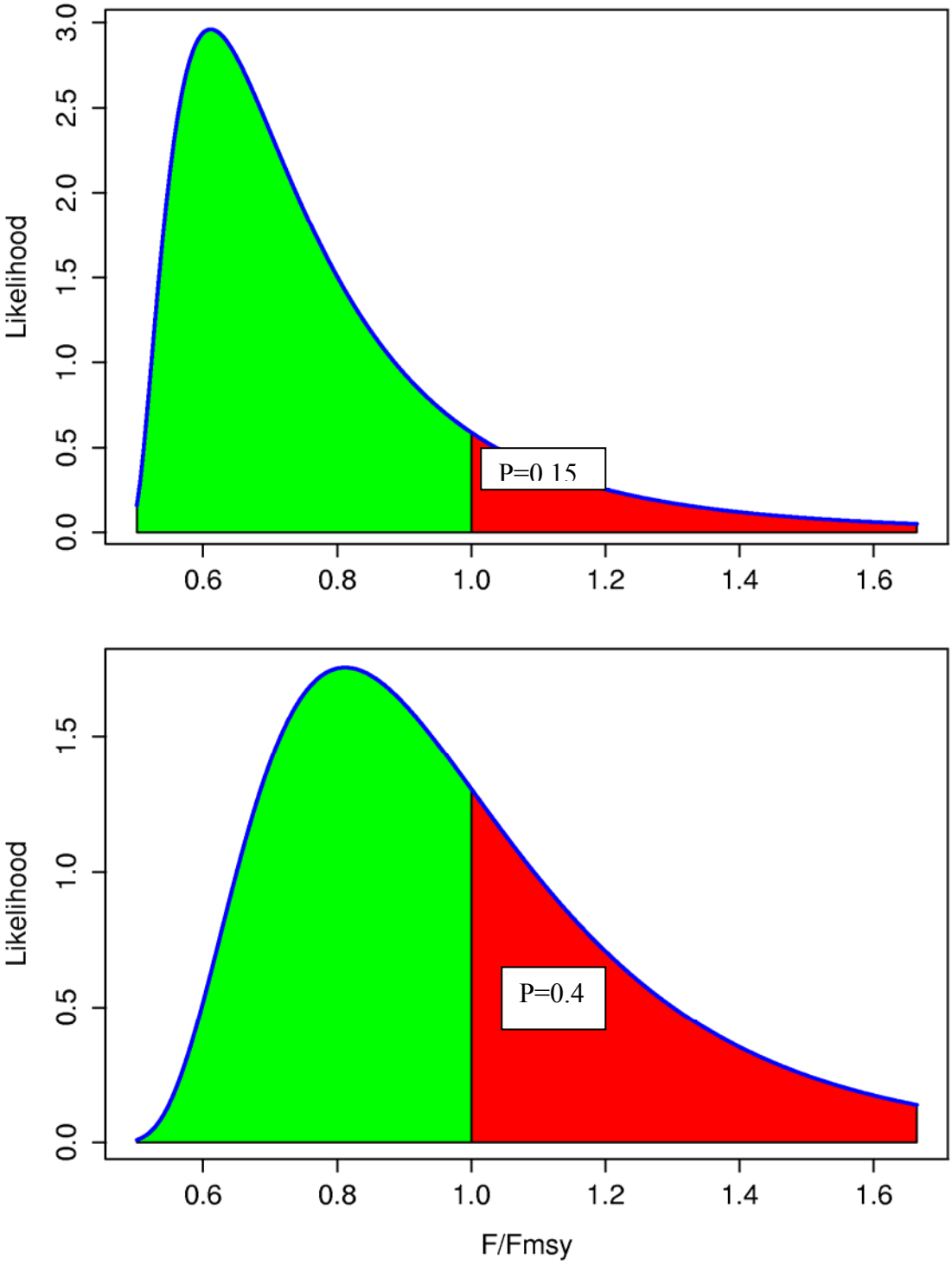


Figure 24. Probability distribution of $F_{current}$ / F_{MSY} based on the likelihood profile method with steepness priors of mode = 0.9 and sd = 0.1 (upper panel) and mode = 0.75 and sd = 0.1 (lower panel)

SKIPJACK TUNA

There was no formal assessment presented for skipjack in 2004 therefore the summary statement that follows is largely a repeat of that prepared at SCTB16.

Key attributes

Skipjack tuna is found year-round concentrated in the tropical waters of the WCPO. Its distribution expands seasonally into subtropical waters to the north and south. It is a species characterized by large stock size, fast growth, early maturation, high fecundity, year-round spawning over a wide area, relatively short life span (maximum age of 4 or 5 years old) and variable recruitment. It is assumed that skipjack in the WCPO constitute a separate population (for stock assessment and management purposes) to those in the EPO. The distribution of skipjack tuna catch, 1990–2003 is given in Figure 25.

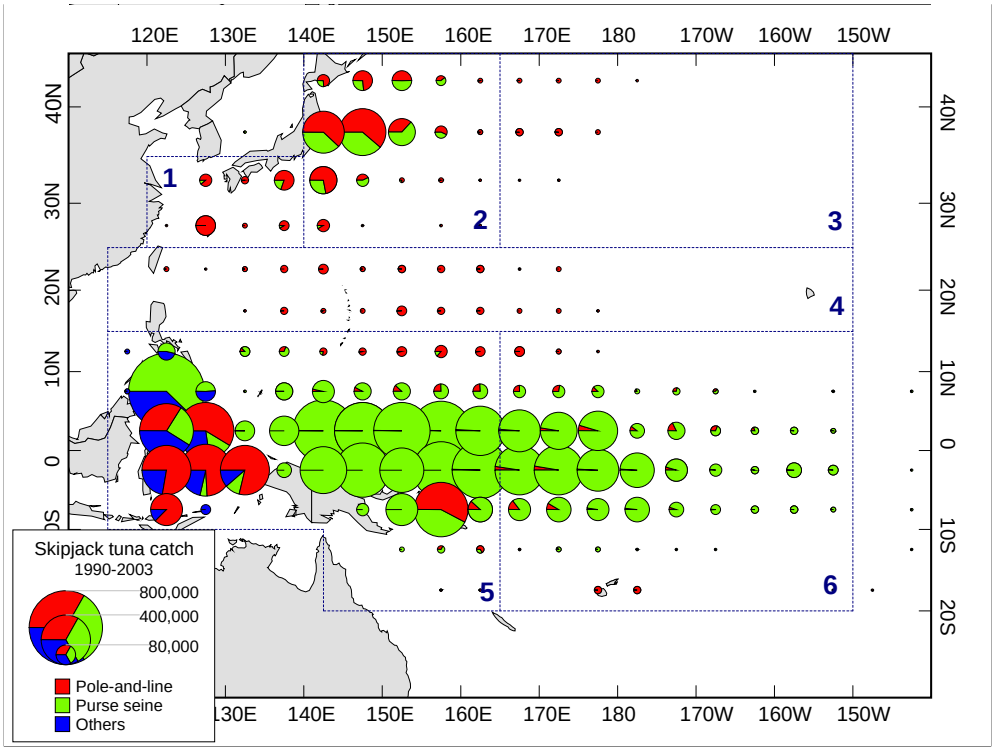


Figure 25. Distribution of skipjack tuna catch, 1990–2003

Trends

Catch and CPUE

The catch in 2003 was estimated to be 1,250,000 mt, a slight decrease on the 2002 catch; 75% (940,000 mt) was taken by purse seine gear, 19% (242,000 mt) by pole-and-line gear and 6% (approximately 70,000 mt) by other gears. Nominal CPUE for major purse seine fleets, except the US fleet, continues to be at high level, slightly decreased from 2002 level, being more than 20 mt/day fished in 2003 (Figures 26 and 27). This decline reflects the relatively poor catch (experienced by all fleets) in the second half of 2003. The fishing ground of the US fleet in 2002 was distributed in the eastern portion of the WCPO and differed from those of Japan, Korea, and Taiwan fleets; however, the area fished in 2003 was similar to that of other fleets.

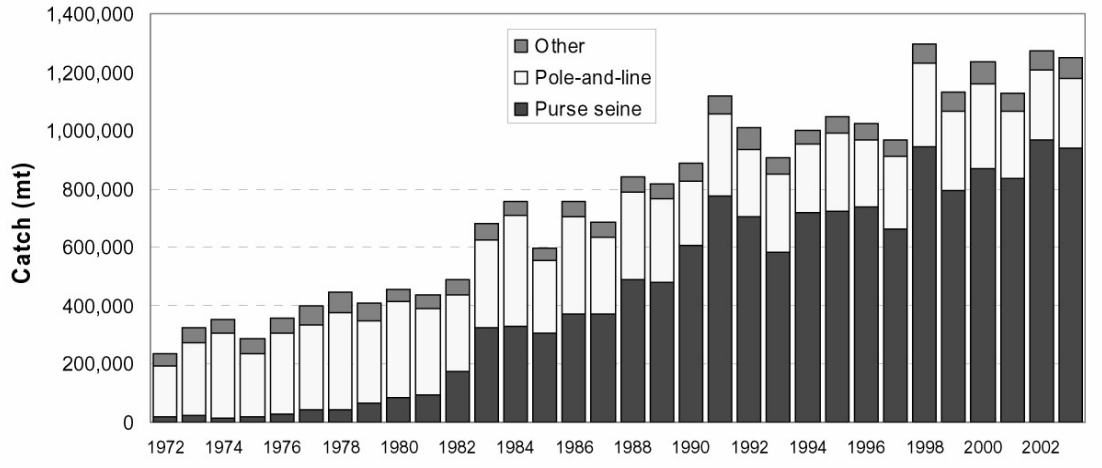


Figure 26. WCPO skipjack catch (mt) by gear for the period 1972 to 2003

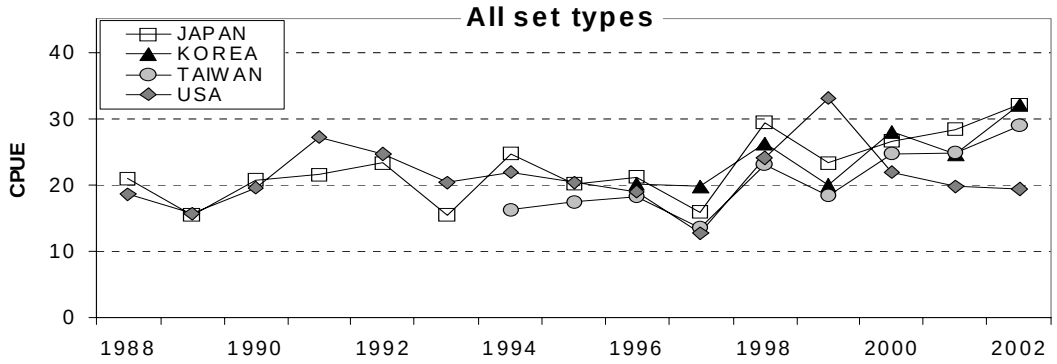


Figure 27. Nominal skipjack CPUE (mt per fishing days) for Japanese, Korean, Taiwanese and US purse seine fleets

Size of Fish Caught

Sizes of fish in the catch (based on weight) has largely been constant with a dominant mode at about 50-60 cm FL and a significantly smaller mode at about 30 cm FL (Figure 28). The larger mode consists of fish mainly caught by purse seine and pole-and-line gears and the smaller mode, by various gears of the domestic fisheries of the Philippines and Indonesia.

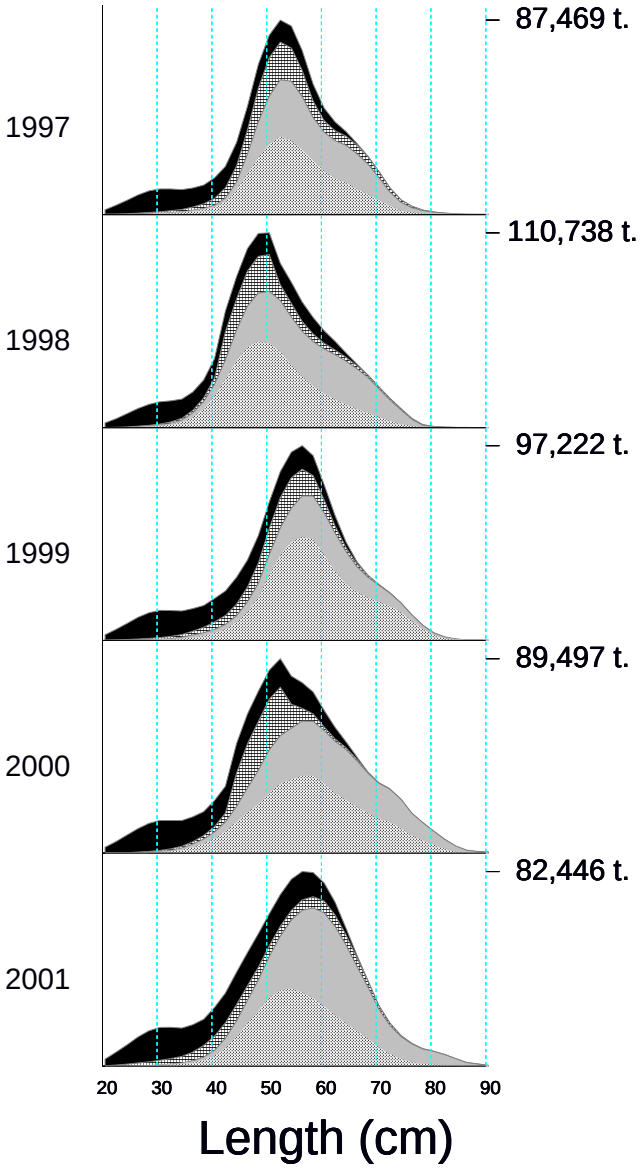


Figure 28. Annual Skipjack tuna catch-at-size in the WCPO, 1997–2001. The catch is broken down into the Indonesian/Philippines domestic fisheries (black), the pole-and-line fishery (hatched), unassociated-set catch from the purse-seine fishery (grey) and associated-set catch from purse-seine fishery (dotted). The y-axis scale is in weight; the figures on the right indicate the catch weight in a 2-cm size class

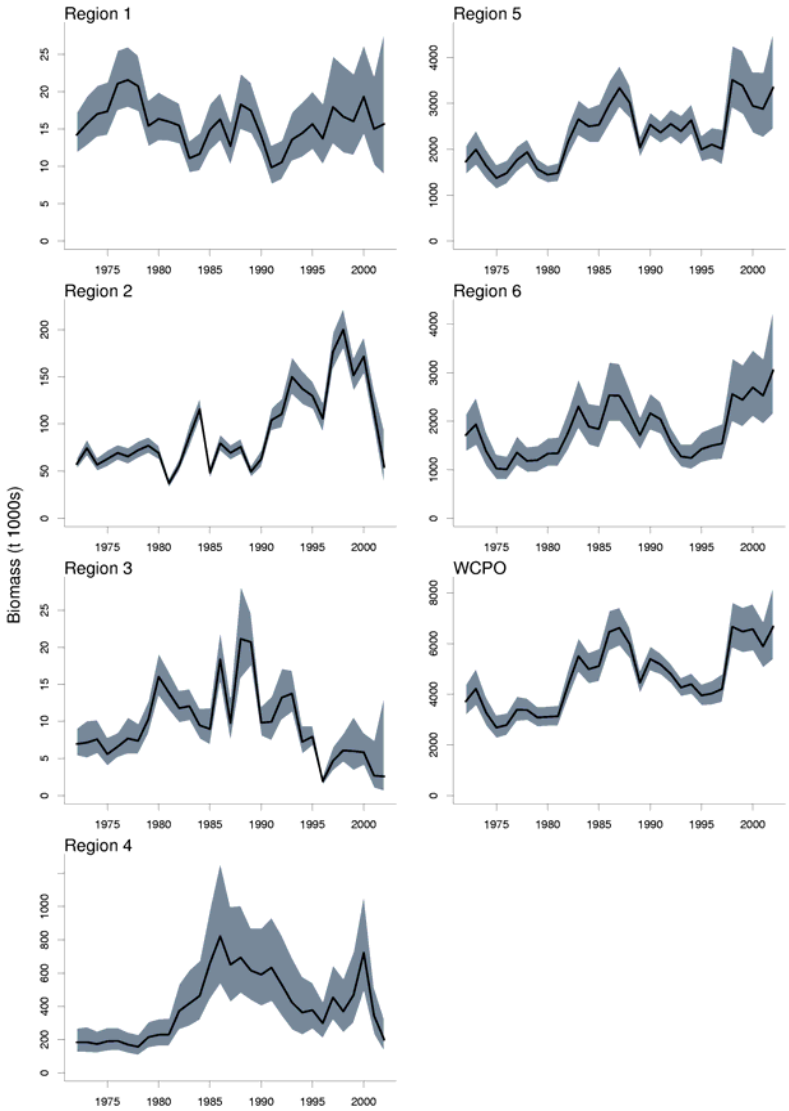


Figure 29. Estimated annual recruitment (millions) by region for the WCPO for the base-case analysis. The shaded area for the WCPO indicates the approximate 95% confidence intervals

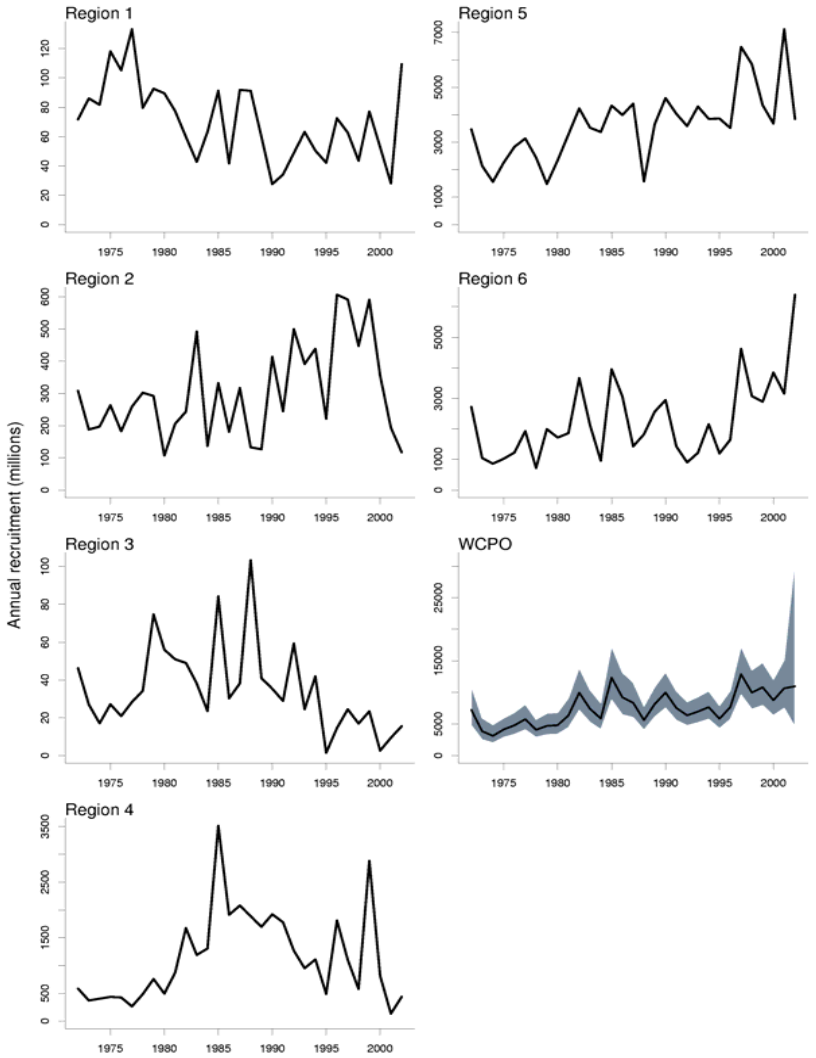


Figure 30. Estimated annual average total biomass (thousand t) by region and for the WCPO for the base-case analysis. The shaded areas indicate the approximate 95% confidence intervals.

Stock Assessment

Previous skipjack stock assessments have been undertaken with the MULTIFAN-CL model. No stock assessment of skipjack was undertaken in 2004 and the information presented below reiterate the results of the 2003 assessment.

Recruitment

Estimated recruitment has varied about three fold since 1972 and the trend has been upward. Estimated current recruitment, although less precise than estimates for earlier year classes, is among the highest in the time series (Figure 29). This high recruitment appears to be related to the El Nino phase of ENSO events.

Biomass

The level of biomass of skipjack tuna is largely dictated by the level of incoming recruitment to the population. Since 1972, the trend in estimated biomass has been upwards, following an apparent step-wise increase in recruitment (Figure 30). Current biomass is well above the biomass that would produce *MSY*.

Fishing mortality

The trend in estimated fishing mortality rate has been upwards since 1972, with the current overall fishing mortality rate (F) at a modest level of approximately 0.20-0.25 per year (Figure 31).

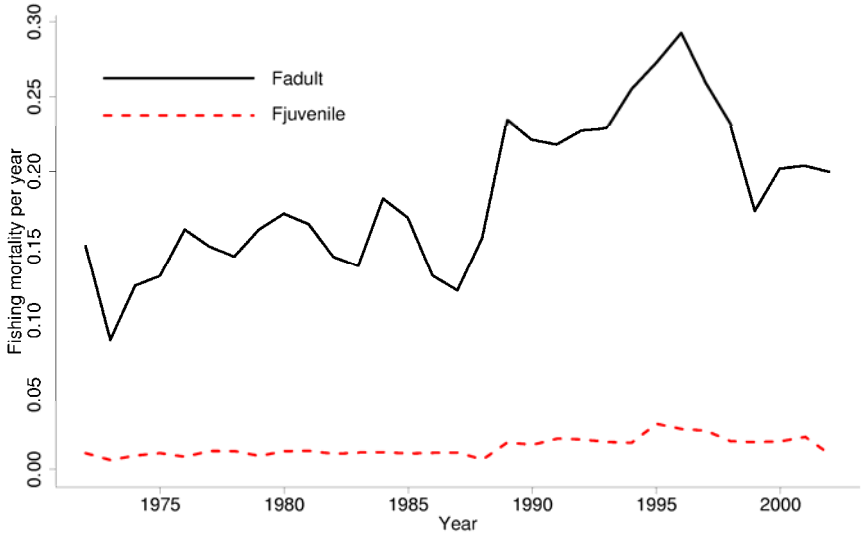


Figure 31. Estimated annual average fishing mortality rates for juvenile (age classes 1 and 2) and adult age-classes from the base-case assessment

Stock status

No formal stock assessment of skipjack was conducted this year and there was no additional information relating to fisheries indicators that could be used to update last year's stock assessment. Estimated biological reference points, particularly $B_{current}/B_{MSY}$ and $F_{current}/F_{MSY}$, indicate that the skipjack tuna stock of the WCPO is not overfished owing to recent high levels of recruitment and a modest level of exploitation relative to the stock's biological potential (Figure 32). Continued catches at the 1.2 million mt level are sustainable with continued high levels of recruitment (Figure 33), which are believed to be determined by principally environmental factors and not owing to a strong spawner-recruit relationship.

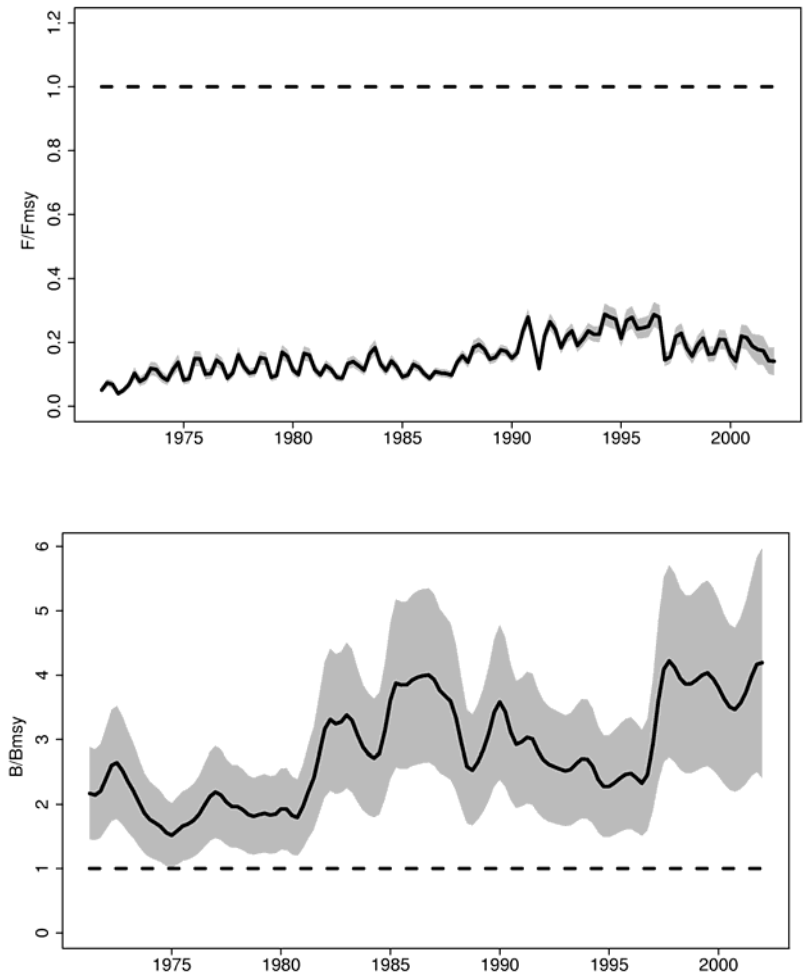


Figure 32. Ratios of F_t / F_{MSY} (top) and $B_t^{adult} / B_{MSY}^{adult}$ (bottom) with 95% confidence intervals. The horizontal lines at 1.0 in each case indicate the overfishing (a) and overfished state (b) reference points

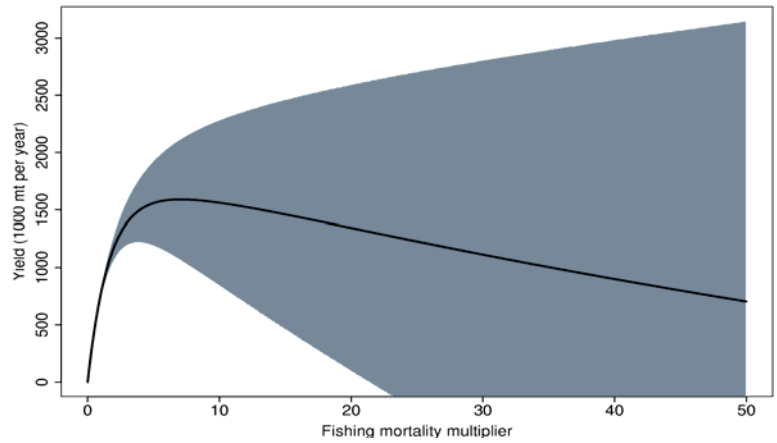


Figure 33. Predicted equilibrium yield and 95% confidence intervals as a function of fishing mortality (relative to the average fishing mortality-at-age during 1997-2001)

SOUTH PACIFIC ALBACORE TUNA

There was no formal assessment presented for albacore tuna in 2004. Therefore, the summary statement that follows is largely a repeat of that prepared at SCTB 16.

Key attributes

Albacore tuna comprise a discrete stock in the South Pacific Ocean. Mature albacore (age at first maturity, 4 – 5 yr; ~ 90 cm FL) spawn in tropical and sub-tropical waters between about 10°S and 25°S during the austral summer, with juveniles recruiting to surface fisheries in New Zealand coastal waters and in the vicinity of the sub-tropical convergence zone (STCZ – about 40°S) in the central Pacific about two years later, at a size of 45–50 cm in fork length. From this region, albacore appear to gradually disperse to the north, but may make seasonal migrations between tropical and sub-tropical waters. Albacore are relatively slow growing, and have a maximum fork length of about 120 cm. Natural mortality is low compared to tropical tunas, with significant numbers of fish reaching an age of 10 years or more.

Trends

Catch and effort

Catch in 2003 reached 55,371 mt, which is the second highest in the post-drift net period (Figure 34). Since drift netting ceased in 1992, catches have predominantly come from troll fleets of New Zealand and the US south of 30°S, and by longliners which fish mainly between 10°S and 50°S (Figure 35).

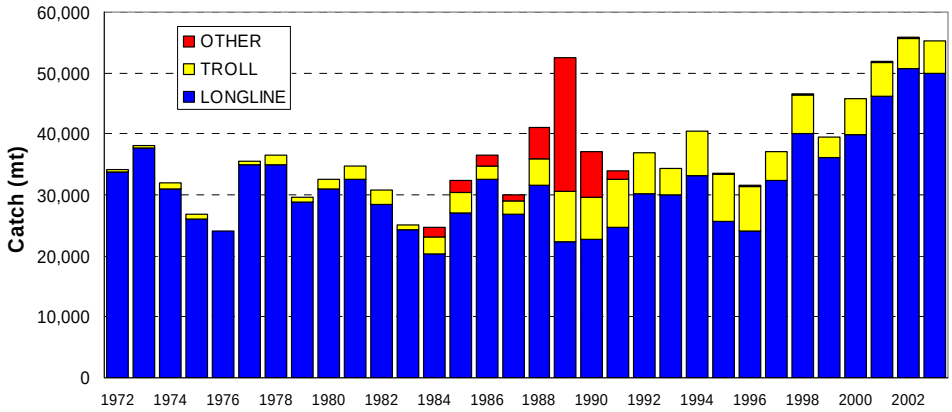


Figure 34. South Pacific albacore catch by gear type
'Other' is primarily catch by the driftnet fishery

Catches from the Pacific Island Country (PIC) longline fleets have increased in recent years. In 2002 these fleets accounted for 50% of the total longline catch. The Taiwanese fleet, which has traditionally targeted albacore and has accounted for the majority of the historical longline catch, recently moved some of its activities to target seasonally albacore in northern temperate waters or bigeye in the tropical waters of the WCPO. The catch of albacore by this fleet has therefore fallen in recent years.

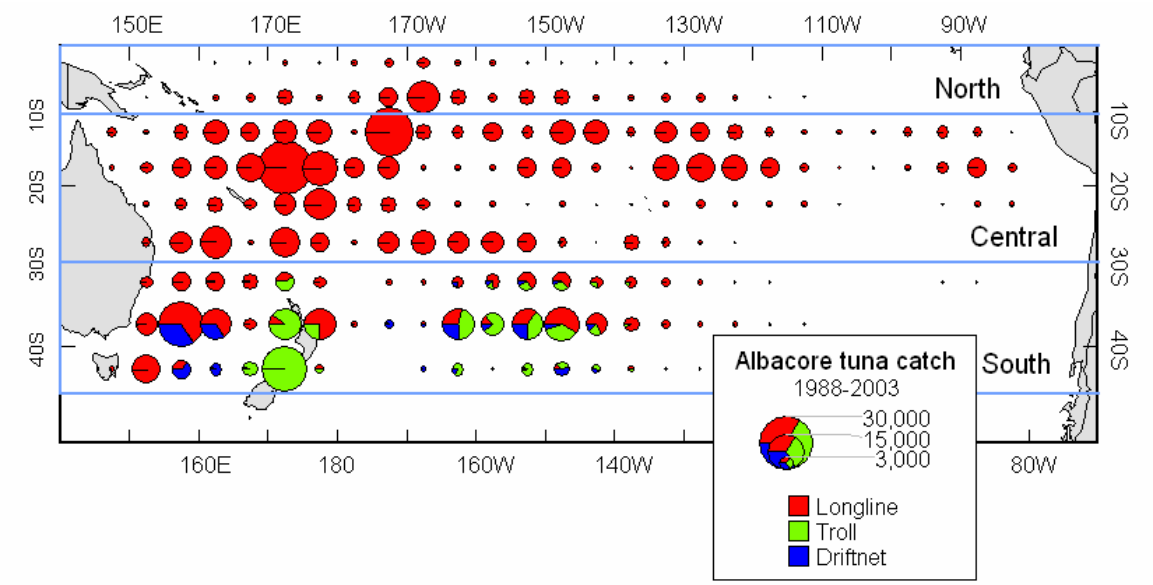


Figure 35. Distribution of South Pacific albacore tuna catch, 1988–2003

CPUE has been fairly stable in the central zone (10°–30°S), where catch rates from the PIC fleets have tended to converge in recent years. The current CPUE in several PIC longline fleets is significantly less than the levels attained in the early years of these fisheries. In some cases, high CPUE has been maintained by expanding the area of fishing to the extremes of the EEZs and beyond. There has been a gradual decline in the catch rates in a number of fisheries. This decline has been gradual in some fisheries and stronger in other areas, particularly Samoa and American Samoa. However, the CPUE for the Samoan and American Samoan fleets remains higher than other fleets despite these declines. Some degree of convergence in CPUE is also noted for the New Zealand and the US troll fleets, although CPUE for the US vessels has generally been higher and more variable.

Size of fish caught

Longliners catch larger albacore, with the size distribution typically comprising a single multi-age-class mode with a modal length of 90–100 cm (Figure 36). Troll catches are of smaller albacore, typically 50–85 cm in length. Size composition varies from year to year, but no trends are evident over the past five years.

Recruitment

Recent application of a high resolution environmental and population dynamics simulation model (SEPODYM) to South Pacific albacore has provided some preliminary results on the possible mechanisms for recruitment variability. Recruitment as estimated by MULTIFAN-CL (see stock status below) appears to be negatively correlated with El Nino events, which may explain low recruitment rates in the 1980s and 90s (Figure 37).

Biomass

Biomass levels have largely reflected the variation in estimated recruitment, peaking in the late 1950s and late 1970's (Figure 38). Current biomass is estimated to be about half of the maximum estimated levels and about 60% of the estimated biomass in the early 1950s. Biomass is concentrated in the area south of 10°S.

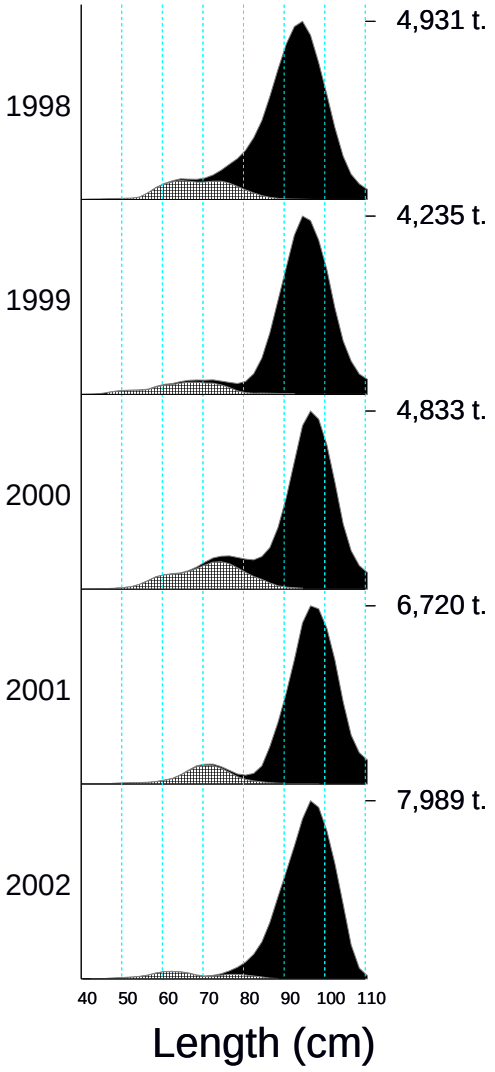


Figure 36. Annual albacore tuna catch-at-size in the south Pacific, 1998–2002. Longline = black; troll = hatched. The y-axis scale is in weight - the figures on the right indicate the catch weight in a 2-cm size class

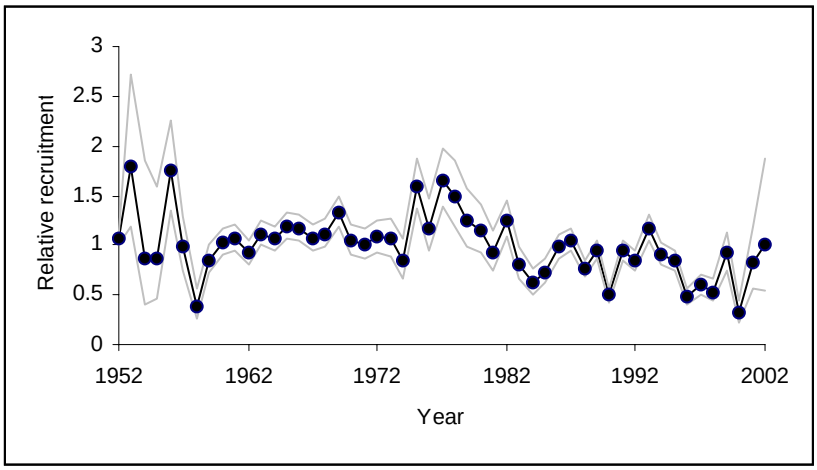
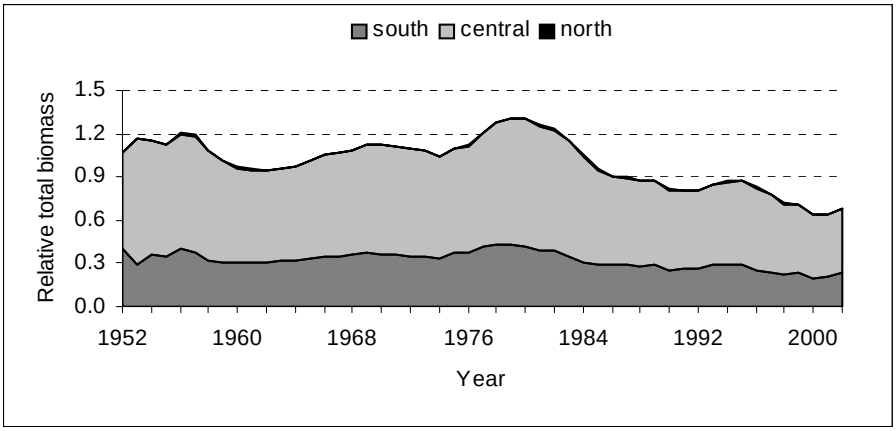


Figure 37. Estimated annual recruitment, with 95% confidence intervals, scaled to the average of the points estimates



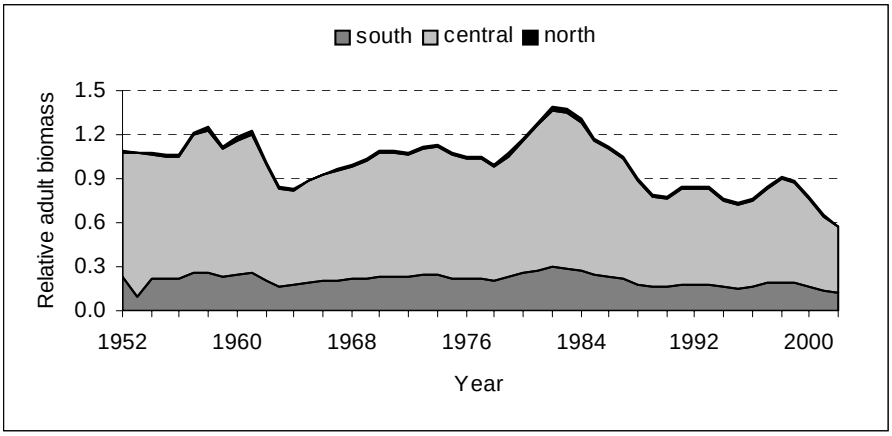


Figure 38. Estimates of relative total and adult biomass, by region

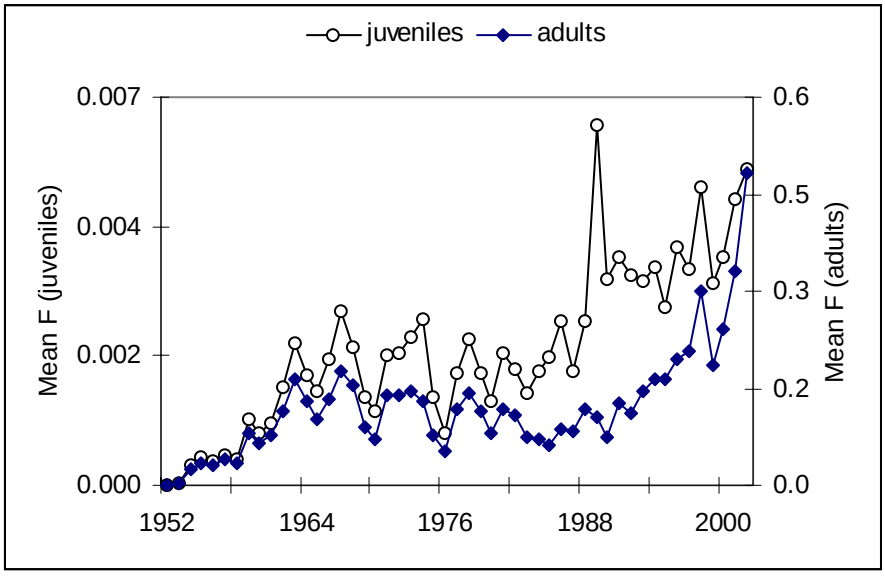


Figure 39. Estimated average annual fishing mortality rates for juveniles (ages 1-5) and adult (ages 6-12) albacore in the South Pacific

Fishing mortality

Fishing mortality is higher for adult albacore than for juveniles, reflecting the predominantly longline exploitation (Figure 39). Total fishing mortality appears to be considerably lower than natural mortality. The impact of the fisheries on total biomass is estimated to have increased over time, but is likely to be low to moderate across a plausible range of model assumptions.

Stock status

No formal stock assessment of South Pacific albacore was conducted this year and there was no additional information relating to fisheries indicators that could be used to update last year's stock assessment. The meeting therefore had no basis for altering the main features of last year's assessment, namely that it is unlikely that the South Pacific albacore stock is being overfished or that it is in an overfished state. The meeting did, however, consider further analyses of the declines in CPUE in some Pacific Island states in 2003. Results indicated that much of this decline is a consequence of changed oceanographic conditions, though high levels of localised effort may also be impacting on CPUE in these fisheries. Catch rates for most fleets have recovered over the last 12 months.

The current (2003) stock assessment was conducted with MULTIFAN–CL. The fishery for albacore is unique in that it has exhibited no significant trend in catches over the period of 1960 – 1995. Due to the problems faced by all assessments conducted with limited data on stocks, which have been apparently exploited at only low exploitation rates over the period of the fishery, the results obtained provide little information on the biomass of the stock. Improved results from this model would be expected if there were better return rates of tags placed on albacore.

The 2003 assessment gave similar results to the 2002 assessment, with a low impact of fishing on biomass, and indicated that the current biomass is at about 60% of unfished levels. It is therefore unlikely that the stock is being overfished or is in an overfished state.

ECOSYSTEM & BYCATCH WORKING GROUP

The Ecosystem & Bycatch Working Group (EBWG) heard seven presentations divided between ecosystem modelling and bycatch research.

There were five presentations under the ecosystem modelling part of the agenda. The first two papers concerned the application of SEAPODYM (Spatial Ecosystem And Populations Dynamics Model) to forage population and to the top-predator species. These preliminary results suggest that the El Nino phase of ENSO results in better recruitment for skipjack. An integrated analysis of tuna abundance and size structure as indicators of ecosystem impacts of fishing was presented. This study showed the changes estimated from the model for both the exploited and unexploited populations of skipjack, bigeye, yellowfin and albacore tunas. The use of individual/agent-based modelling was presented with examples of application to studies on turtle distributions and information sharing by fishing fleets. A paper on regime shifts in the WCPO and its tuna fisheries was presented. The paper described the Pacific Decadal Oscillation (PDO) and how the recruitment of WCPO skipjack, bigeye, yellowfin and albacore appeared to track changes in the PDO. This paper generated considerable discussion on how much weight could be put on these preliminary results, given the potential downturn in recruitment for skipjack, bigeye and yellowfin tuna.

A comprehensive account of fish and seabird bycatch in New Zealand tuna longline fisheries indicated that blue shark, albacore and Ray's bream comprised the dominant bycatch. The study demonstrated the importance of observer data in detecting the impacts of fishing on non-target species.

A review was presented of shark, seabird and sea turtle bycatch in Japanese tuna longline fisheries. Over the time period studied, some shark CPUEs, such as blue shark, were stable in all oceans, while others, such as shortfin makos showed declining trends in the North Pacific and Atlantic Oceans. Results from the Japanese study on the southern bluefin tuna fishery showed the efficacy of the combination of tori line and blue dyed bait for reducing seabird bycatch. Research on turtle mitigation showed that there was no difference between turtle takes for J-hooks and circle hooks, although the Japanese J-hooks are not exactly the same as the J-hooks used elsewhere, being slightly circular, and the size of the circle hooks is not the same in all studies. However, this study clearly showed that turtles caught on circle hooks were hooked predominantly in the mouth. Experiments were being conducted with longline gear to identify methods to ensure that hooks were consistently set deep to avoid hooking turtles.

The future of the EBWG was discussed. It was noted that there had been some degree of overlap between the EBWG and the Fishery Technology Working Group, particularly in terms of issues related to reducing bycatch (non-target, associated and dependent species). Although there was some concern about the grouping of ecosystem modelling with bycatch, there was a consensus that the two topic areas be maintained in a single working group, incorporating bycatch issues formerly handled by the FTWG. Standing Committee was asked to review the previous recommendations generated from the Billfish and Bycatch Research Group (BBRG), and recommendations for future ecosystem research.

SUMMARY OF DISCUSSIONS

1. PRELIMINARIES

1. The Seventeenth Meeting of the Standing Committee on Tuna and Billfish (SCTB 17) was held on 9–18 August 2004 in Majuro, Republic of the Marshall Islands at the invitation of the Chairman, Dr Sung Kwon Soh. The meeting was hosted by the Marshall Islands Marine Resources Authority (MIMRA). MIMRA and the Oceanic Fisheries Programme (OFP) of the Secretariat of the Pacific Community (SPC) served as Secretariat for the meeting.

2. SCTB 17 was attended by participants from Australia, Canada, Commonwealth of the Northern Marianas, Cook Islands, European Union, Federated States of Micronesia, Fiji, French Polynesia, Japan, Kiribati, Korea, Marshall Islands, Nauru, New Caledonia, New Zealand, Palau, Papua New Guinea, the Peoples Republic of China, Samoa, Solomon Islands, Taiwan, Tonga, Tuvalu, United States of America and Vanuatu. Participants from various regional and international organizations also attended the meeting. These included the Forum Fisheries Agency (FFA), the Inter-American Tropical Tuna Commission (IATTC), the Secretariat of the Pacific Community (SPC) and the Food and Agricultural Organisation of the United Nations (FAO). The list of participants is provided in Appendix 3.

3. The SCTB provides a forum for scientists and others with an interest in the tuna and billfish stocks of the western and central Pacific Ocean (WCPO) to meet to discuss scientific issues related to data, research, and stock assessment. Its aims are to:

- coordinate fisheries data collection, compilation and dissemination according to agreed principles and procedures
- review research on the biology, ecology, environment and fisheries for tunas and associated species in the WCPO
- identify research needs and provide a means of coordination, including the fostering of collaborative research, to most efficiently and effectively meet those needs
- review information pertaining to the status of the stocks of tunas and associated species in the WCPO, and to provide statements on stock status where appropriate
- provide opinions on various scientific issues related to data, research and stock assessment of WCPO tuna fisheries

1.1 Opening Ceremony

4. The Honourable Minister John M. Silk, Minister of Resources & Development and Chairman of the MIMRA Board of Directors, officially opened SCTB 17. His Excellency Witten Philipo, Acting President of the Republic of the Marshall Islands, was also in attendance. Minister Silk welcomed the participants and highlighted the importance of the SCTB and its members in providing scientific advice on the tuna resources of the WCPO and to the new Commission, which is to commence in December 2004. SCTB 17 was also blessed by Father Rich McCaulif of the Majuro Parish of the Catholic Church.

1.2 Adoption of the Agenda and Appointment of Rapporteurs

5. The Agenda for the meeting together with a list of the Working Papers presented at the meeting are provided in Appendices 1 and 2 respectively.

6. The meeting convened as six working groups; the Highly Migratory Species (HMS) Biology Working Group (BWG), the Ecosystem and Bycatch Working Group (EBWG), the Fishing Technology Working Group (FTWG), the Methods Working Group (MWG), the Statistics Working Group (SWG), and the Stock Assessment Working Group (SAWG). Plenary sessions were held in addition to the working group sessions and included: (1) Overview of the WCPO tuna fisheries, (2) National tuna fishery reports and reports by regional organisations, (3) Research and statistics planning and (4) Consideration of issues requested by PrepCon.

7. The SCTB 17 Secretariat assumed responsibility for coordinating the rapporteuring and the report of the meeting, with the assistance of participant rapporteurs. David Kirby and Brett Molony were appointed coordinating rapporteurs.

8. The coordinators for each research group and plenary session were as follows.

WCPO tuna fisheries:	Sung Kwon Soh
National tuna fishery reports:	Sung Kwon Soh
Biology WG:	Talbot Murray
Ecosystem & Bycatch WG:	Paul Dalzell
Fishing Technology WG:	David Itano
Methods WG:	John Sibert
Statistics WG:	Tim Lawson
Stock Assessment WG:	Naozumi Miyabe and Dr Max Stocker
Research and statistics planning:	Pierre Kleiber
Issues requested by PrepCon:	Gary Sakagawa

9. Participant rapporteurs were appointed by each of the coordinators as follows.

WCPO tuna fisheries:	David Kirby and Brett Molony
National tuna fishery reports:	David Kirby and Brett Molony
Biology WG:	Rob Campbell
Ecosystem & Bycatch WG:	David Kirby and Brett Molony
Fishing Technology WG:	Talbot Murray and Peter Williams
Methods WG:	Shelton Harley
Statistics WG:	Kim Duckworth
Stock Assessment WG:	Keith Bigelow, Mike Hinton, Talbot Murray and Peter Ward
Research and statistics planning:	Shelton Harley and David Kirby
Issues requested by PrepCon:	Brett Molony and Karl Staisch

1.3 Adoption of the Report of the Sixteenth Meeting of the SCTB

10. The report of the Sixteenth Meeting of the SCTB, held in Mooloolaba, Queensland, Australia, from 9–16 July 2003, was adopted.

2. OVERVIEW OF WESTERN AND CENTRAL PACIFIC OCEAN TUNA FISHERIES

2.1 Regional Overview

11. Peter Williams provided an overview of the WCPO tuna fisheries, with economic conditions, referring the meeting to Working Paper GEN–1. The presentation describes broadly each of the fisheries by gear and fleet, with emphasis on 2003 catches relative to those in recent years and was an introduction to the National Fisheries Reports (NFRs) which provide more detail on the catch and activities of each fleet.

12. The provisional total WCPO catch of tunas during 2003 was estimated at 1 940 546 mt, the second highest annual catch recorded after 1998 (1 985 110 mt). As in recent years, the catch was dominated by the purse seine fishery (Figure 2.1). During 2003, the purse seine fishery accounted for an estimated 1 172 780 mt (60% of the total catch), with pole-and-line taking an estimated 294 752 mt (15%), the longline fishery an estimated 213 259 mt (11%), and the remainder (13%) taken by troll gear and a variety of artisanal gears, mostly in eastern Indonesia and the Philippines.

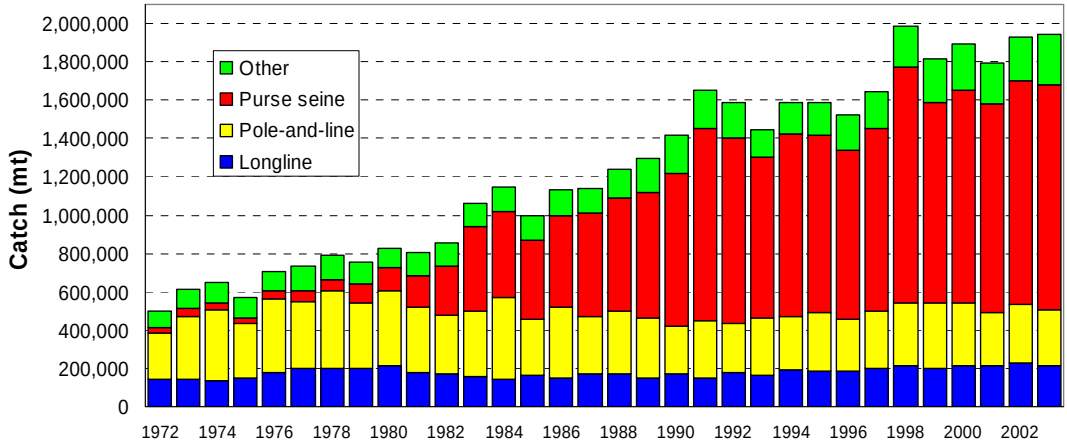


Figure 2.1. Catch (mt) of albacore, bigeye, skipjack and yellowfin in the WCPO, by longline, pole-and-line, purse seine and other gear types. More detailed information on catches is available from OFP

13. The WCPO tuna catch (1 940 546 mt) represented 71% of the total estimated Pacific Ocean catch of 2 725 083 mt in 2003, and close to 50% of the global tuna catch (the provisional estimate for 2003 is ~4 000 000 mt). The Eastern Pacific Ocean (EPO) catch (784,537 mt) of the four main tuna species for 2003 was the highest ever.

14. The WCPO catch by species, shown in Figure 2.2, has always been dominated by skipjack (65% in 2003). The 2003 WCPO catch of skipjack (1 252 738 mt) was the third highest ever (the highest recorded skipjack catch was in 1998: 1 301 054 mt). The WCPO yellowfin catch for 2003 (456 947 mt; 24%) was the highest in five years and only 8000 mt less than the record catch in 1998 (465 642 mt). The WCPO bigeye catch for 2003 (95 991 mt; 5%) was the lowest for seven years, and the WCPO albacore (134 870 mt; 7%) catch was about 5000 mt less than the record level in 2002 (139 848 mt).

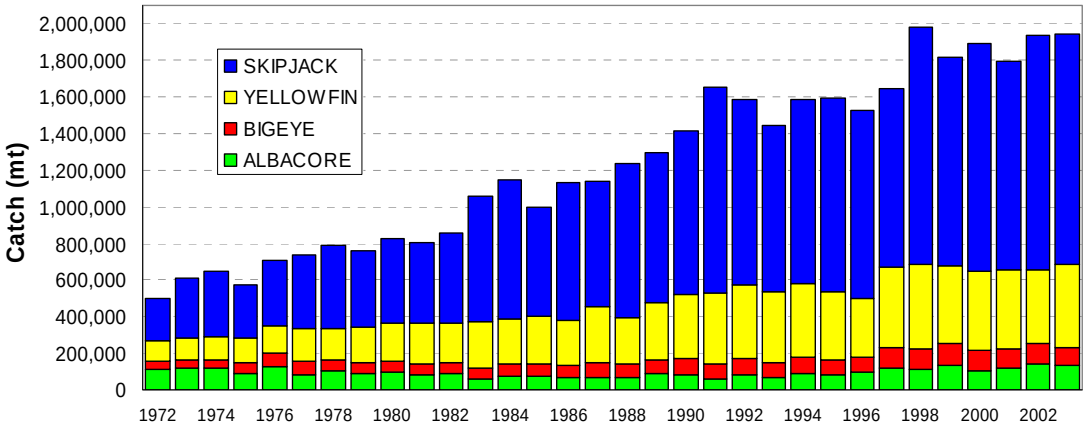


Figure 2.2. Catch (mt) of albacore, bigeye, skipjack and yellowfin in the WCPO. More detailed information on catches is available from OFP

15. The provisional 2003 purse-seine catch of 1 172 780 mt was the second highest on record after 1998, with annual catch in excess of 1 000 000 mt since then.

16. The purse seine skipjack catch for 2003 (937 929 mt: 80% of the total) was 34 000 mt less that the record for this fishery in 2002 (971 849 mt). The purse seine yellowfin catch for 2003 (214 535 mt: 18%) rebounded from relatively poor catches experienced in 2002 (only 174 366 mt). The estimated purse seine bigeye catch for 2003 (20,316 mt: 2%) continues the declining trend in catches since the record 1999 catch (34,634 mt), primarily due to the gradual reduction in fishing effort on drifting FADs over recent years. Catches during 2003 for the Taiwanese and US purse seine fleets were down on 2002 levels, but noticeably higher for the PNG purse seine fleet, which took more than the US fleet in 2003 and is on par with recent annual (tropical waters) catch by the Japanese fleet.

17. Unassociated school sets accounted for at least 50% of the total sets for the Asian purse seine fleets during 2003, and log sets were more common than drifting FAD sets for all purse seine fleets in 2003 for the first time since 1998. The percentage of sets on drifting FADs was generally lower for all purse seine fleets in 2003 than for recent years and continues the declining trend since 2000. The lower percentage of drifting FAD sets is thought to be related to the general change in the broad area fished by all fleets; that is, or the first time in several years, most of the fishing effort during 2003 was concentrated in the area to the west of 160°E, which is distinct from the area where drifting FADs are typically used, i.e. east of 160°E.

18. The annual skipjack CPUE for unassociated sets for the Korean and Taiwanese fleets remained high during 2003, while the skipjack CPUE for associated sets for all fleets dropped in 2003, resulting in a decline in overall skipjack CPUE. Relatively poor skipjack catches were experienced by all fleets in the second half of 2003, although there was some evidence of a recovery by the end of the year. The 2003 skipjack CPUE for the US fleet was again clearly lower than the other three fleets, although for the US fleet, yellowfin CPUE was at least on par with the other fleets, and slightly higher for sets on free-swimming schools. In general, yellowfin CPUE by set type and for all sets combined increased slightly in 2003, with no clear trend apparent for the past 4–5 years.

19. The preliminary pole-and-line catch estimate for 2003 (294 752 mt: 15% of total WCPO catch) is lower than the 2002 catch (303 933 mt), although the Japanese fleet catch estimate for 2003 has yet to be provided. As in previous years, skipjack accounts for the vast majority of the catch (82%); albacore taken by the Japanese coastal and offshore fleets in the temperate waters of the north Pacific (12%), yellowfin (5%) and a small component of bigeye (1%) make up the remainder of the catch. The Japanese distant-water and offshore (144 638 mt in 2002) and the Indonesian fleets (145 597 mt in 2003) typically account for most of the WCPO pole-and-line catch. The Solomon Islands fleet continues to recover (10 797 mt in 2003) from low catch levels experienced in recent years (only 2692 mt in 2000), but was still far from the level (over 20 000 mt) experienced in most years during the 1990s.

20. The provisional WCPO longline catch (213 259 mt) for 2003 was around 18,000 mt lower that the highest on record, which was attained in 2002 (231 968 mt). The WCPO albacore longline catch (84 592 mt) was easily the highest on record (the south Pacific albacore catch of 49 899 mt was the second highest on record after the 2002 catch). The bigeye catch (56 578 mt) for 2003 was the lowest for seven years, and the yellowfin catch (67 490 mt) was the lowest since 1999 (the yellowfin catch in 1999 was the lowest for nearly 30 years, and is understood to be related to the age class that had poor recruitment into the purse seine fishery in 1996).

21. The 2003 troll albacore catch (5 308 mt) was around 500 mt more than in 2002, despite fewer vessels operating during 2003. As usual, the fleets of New Zealand (3979 mt) and USA (1205 mt) accounted for most of this catch, with minor contributions coming from vessels from Canada and Australia. Catch rates of juvenile albacore in the troll fishery during 2003 were the highest for a number of years, although less effort was expended than in recent years due to adverse conditions. The positive trend in catch rates in the troll fishery during 2003 is a possible indication of what might be expected in the (adult) albacore longline fishery in a few years time.

2.2 Economic Condition of the Fishery

22. Chris Reid co-presented GEN–1. After a period of relatively stability during the 2nd half of 2001 and most of 2002 when skipjack prices (4–7.5 lbs, c&f) generally traded within a US$700–800/mt range volatility returned to the Bangkok market in 2003. In 2003 Bangkok skipjack prices fluctuated from under US$500/mt to about US$900/mt. Bangkok skipjack prices ended 2003 at about US$800/mt up US$100/mt from January, having fallen below US$500/mt during April and peaked at nearly US$900/mt in September. By mid-March 2004 Bangkok skipjack prices had declined to around US$650–670/mt, from this point on to the time of writing prices have been on a rapid upward trend with Bangkok skipjack (4–7.5 lbs, c&f) prices in the 1st week of July trading in a range of US$1030-1050/mt their highest level since August 1998. Prices at Yaizu and Spain followed a similar path in 2003 and the first half of 2004.

23 Yellowfin prices ended 2003 at significantly lower levels then seen at the start of the year. Bangkok prices for yellowfin (20 lbs and up, c&f) started the year at US$1200-1250/mt and ended the year at around US$1000/mt. Bangkok yellowfin have increased substantially over 2004 to date and are were at US$1450-1500/mt at the beginning of July. Prices at Yaizu and in Spain followed a similar path in 2003.

24. The estimated delivered value of the purse seine catch for 2003 is around US$916 million. This represents a decrease of around US$38 million or 4% on the estimated value of the catch in 2002. The decline in value was driven by a decline in average skipjack prices of 7% and 15% for Thai imports and Yaizu sales respectively. This was offset to some degree by increases in yellowfin prices of 2% and 6% for Thai imports and Yaizu sales respectively and a higher proportion of higher valued yellowfin taken in the 2003 catch.

25. The average price of pole-and-line caught skipjack from the southern WCPO landed at Yaizu over the 2003/04 season was 208JPY/kg, an increase of 50% compared with the average price during the 2002/03 season. The volume of pole-and-line caught skipjack from the southern WCPO landed at Yaizu was, however, 70% lower. Yaizu prices for pole-and-line skipjack caught in waters off Japan in the first half of 2004 rose by 20% compared with the same period in 2002. The estimated delivered value of the WCPO pole-and-line catch for 2003 is around US$334 million. This represents a decrease of around US$20 million or 6% on the estimated value of the catch in 2002.

26. Yellowfin prices in 2003 declined across the board on Japanese markets with falls in average prices at 10 major Japanese wholesale markets for fresh and frozen yellowfin, longline caught yellowfin landed at Yaizu, fresh yellowfin landed at selected Japanese ports and fresh yellowfin imports. While prices for imported fresh yellowfin in JPY declined marginally between 2002 and 2003 the appreciation of the JPY against the US$ saw prices in US$ remain steady or increase. While prices were down across many Japanese markets the price of imports of fresh yellowfin from the Oceania region saw a substantial increase with prices rising by 8% to 837 JPY/kg and in US$ terms rising by 17% to US$7.22/kg. After a decade of continued growth the value of US imports of fresh yellowfin declined by 1% in 2003 to US$94.0 million. This decline was a result of a 4% decline in volumes to 15,300 Mt which was partially offset by a 3% rise in average prices to US$6.15/kg.

27. Bigeye prices on Japanese market were mixed with both falls and marginal rises being recorded. However, as with fresh yellowfin there was a substantial increase in the price of fresh bigeye imports from the Oceania region with prices increasing by 15% to 951 JPY/kg and in US$ terms rising by 25% to US$8.20/kg. The value of US imports of fresh bigeye, for which statistics are only available since 2001, continued to grow in 2003 increasing by 28% to US$51.0 million. This increase was driven by a 16% increase in volumes (to 7,312 Mt) and an 11% increase in prices (to US$6.98/kg).

28. After the significant falls of 2002 albacore prices were either steady or rose marginally in 2003. Bangkok albacore market prices (10 kg and up, c&f) rose steadily through much of 2003 climbing from a low of US$1700–1750/mt in March to a US$2200–2250/mt in late December. Prices in the 1st quarter of 2004 were steady before increasing in April and May to reach US$2350–2400/mt and were trading in a US$2300–2400/mt range of early July.

29. The estimated delivered value of the longline tuna catch for 2003 is US$928 million marginally lower than the estimated value for 2002 of US$932 million. The significant decline in bigeye catches resulted in the value of this catch declining by some US$47 million despite a sharp rise in US$ terms of the average price of Japanese imports of fresh bigeye from the Oceania region and a marginal increase in US$ terms of the average price of frozen bigeye at selected Japanese ports. The value of both the yellowfin and albacore catch both rose by around US$21 million with the decline in the yellowfin catch being more than offset by a rise in US$ terms of the price of Japanese imports of fresh yellowfin from the Oceania region and Yaizu longline caught yellowfin, while both albacore volumes and prices rose.

2.3 National Fishery Reports

30. The Chairman called for presentations of national tuna fishery reports, which provide the meeting with an overview of recent fishery developments at a national level, involving domestic and foreign fleet activity.

Australia

31. Robert Campbell presented NFR-2, *Tuna and Billfish Fisheries of the Eastern Australian Fishing Zone and Adjacent High Seas*. Between 1995 and 1999 the longline component of the Eastern Tuna and Billfish Fishery (ETBF) underwent a period of rapid development with many vessels entering the fishery and annual effort increasing from around 3.8 million hooks to around 10.3 million hooks. During this period the total catch of the five main catch species in the fishery (YFT, BET, SWO, STM, ALB) more than tripled from 2430 mt to 7,518 mt. The mix of species in these catches also changed significantly over this time: yellowfin comprising around 57% of the catch in 1995 (ALB: 27%, BET: 8%, STM: 6% and SWO: 4%), while swordfish dominated the catch in 1999 (SWO: 41%, YFT: 27%, BET: 13%, STM: 11%, ALB: 8%). The spatial extent of the fishery also expanded considerably, with the number of 1º squares fished in any year increasing from around 150 to 260. An increasing portion of effort was located outside the Australian EEZ. Since 2000 the rapid expansion experienced in effort has been curtailed. Total annual effort between 2001 and 2003 was relatively stable, varying between 11.3 and 12 million hooks.

32. During 2003, about 140 vessels operated in the fishery and set ca. 12 million hooks. Landed catch of the five main species was 7903 mt, down about 8% from total of 8500 mt taken in 2002. The 2003 catch (estimated whole weight) comprised around 3400 mt of yellowfin, 2200 mt of swordfish, 1000 mt of bigeye, 600 mt of striped marlin, and 550 mt of albacore. Whilst catches of yellowfin tuna were steady in 2003, declines in the catch of the other target species was likely due to a combination of a switch to targeting yellowfin tuna and declines in the local availability of these other species. Availability of most species was poor during the first half of 2004 apparently due to oceanographic conditions which were extensive across the SW Pacific during 2003 and 2004. Standardised CPUE (shown in working paper MWG-1) indicate declines in the availability of some species in some regions of the ETBF in recent years. In particular, localised depletions of swordfish are indicated in the inshore regions off Mooloolaba, through catch rates remain high further offshore.

33. An observer program commenced in the ETBF in July 2003 with the objective of providing a coverage rate of 5.1% of annual effort. Management arrangements to reduce incidental catch of seabirds are also currently in place and trials are continuing into the effectiveness of mitigation measures. A management plan based on Total Allowable Effort with individual transferable quotas is to be introduced in 2005.

Canada

34. Max Stocker presented NFR-3*, An update for Canadian tuna fisheries in the north and south Pacific Ocean for 2003*. Canadians began fishing for albacore in the north Pacific with troll vessels using tuna jigs in the mid 1930s. Canadian trollers began fishing albacore in the south Pacific in the mid 1980s. In the last two decades, larger vessels in the Canadian troll fleet have increasingly expanded their albacore fishing from the North American coast westward past the dateline and southward to the southern tropical convergence zone.

35. The Canadian jig fishery is comprised of two fleets. The coastal fleet operates within and near the Canadian and United States fishing zones in accordance with zone and port access privileges under the Canada/US Albacore Tuna Treaty. Vessels in this fleet, mostly 35 to 60 feet in length, concentrate their fishing effort primarily from the southern California coast to the northern tip of Vancouver Island and, in some years, as far north as off the west coast of the Queen Charlotte Islands. The catch is primarily bled and blast frozen with some vessels holding fresh caught fish in ice or frozen brine. The catch from the coastal fleet is sold either into US or Canadian plants where the fish are sold in the canned tuna market or the fresh-frozen sashimi market. The Canadian high seas fleet is comprised of larger jig vessels (most greater than 60 feet) with crews typically of two to four fishermen that remain at sea for trips of several months. These vessels, most of which are equipped with large freezers, operate primarily from west of the dateline to the Canadian zone in the north Pacific. Offshore fishing in the north Pacific on the Midway and Wake Islands grounds usually starts in late May or June and, weather and tuna abundance permitting, lasts through late fall as the vessels follow albacore towards the North American coast. Offshore vessel catches are also sold into the canned market, although the majority is bled and blast frozen then sold into the fresh-frozen sashimi market. There are a number of small processors that have established special niche markets for albacore. The product is either smoked (hot or cold) or loined and sold directly to consumers.

36. The 2003 catch estimates are still preliminary. The distribution of total north Pacific Canadian catch between FAO Statistical Areas was based on the distribution of reported catch from logbooks. Logbooks have been received from 90% of an estimated fleet of 232 vessels that were fishing in 2002, and 95% of an estimated fleet of 187 vessels that were fishing in 2003. The total estimated Canadian catch in the north Pacific for 2003 was 6755 mt, compared to 4996 mt in 2002. Most of this catch (94%) was taken in FAO Area 67. Catch in 2003 in Area 61 was more than twice the catch in 2002, whereas the catch in 2003 in Area 77 was substantially less than the catch in 2002.

37. In recent years, between two and five Canadian flag vessels have fished southern albacore stocks below the equator during the November to March seasons. These vessels fished primarily in an area that extends from 130°W to 165°W and 30°S to 45°S. They landed their catch at ports in American Samoa, Fiji, French Polynesia (Papeete) and Canada. Based on analyses of transhipment records and discussions with skippers, Canadian landings in this fishery from its inception in 1987/88 to 1994/95 are estimated to have ranged from 134 to 335 mt per season. The estimated catch for the 2002/2003 fishing season was not available at the time of writing.

China

38. Song Liming summarised NFR-4, *National tuna fisheries report of China in WCPO*. Mainland China began to develop the distant water longline fishery in the late 1980's and began to develop tuna purse seine fishery in WCPO water later in 2001. In 2002, 125 tuna fishing vessels including 2 purse seiners were in active in WCPO, with a total catch of 15 300 mt. In 2003, 183 tuna fishing vessels (small scale tuna longliners were dominate) including 4 purse seiners were operated in the WCPO, with a total catch of 45 560 mt, comprising ALB: 6222.5 mt, BET: 8965.2 mt, YFT: 6735.1 mt, SWD: 1168.3 mt, BIL: 1043.3 mt, SKJ:20284 mt, others: 1141.7 mt.

39. Most small scale tuna longliners were mainly operating inside the EEZ waters of Palau, Tonga, Micronesia, Marshall Islands (targeting bigeye) and Fiji (targeting albacore), benefitting these countries' economies. The total fishing effort of the Chinese tuna fleet in the WCPO for 2002 and 2003 are, respectively, 22 850 thousand hooks and 63 591 thousand hooks for longline, and 212 fishing days (average catch: 34.7 mt/day) and 621 fishing days (average catch: 38.1 mt/day) for purse seine. Purse seiners were operating in tropical waters between 7ºN–10ºS and 137ºE–175ºE, mainly inside the EEZ waters of Pacific Island countries.

40. In 2003, total catch of longline fishing was 21899 mt; this increase (13958 mt more than that in 2002) of total catch of longline fishing was attributed to the catch of a part of the deep freezer large scale longliners (9031.7 mt, 64.7%) and the increase of the fleet (56 longliners more than that in 2002). The increase of total catch of Chinese fleet after 2001 was attributed to the joining of tuna purse seiners. In 2002, total catch reached 15300 mt, 48% of which (7360 mt) was caught by purse seine fishery. In 2003, total catch reached 45560 mt, 51.9% of which (23,661 mt) was caught by purse seine fishery.

41. In 2003, the proportion of bigeye tuna (8965.2 mt), yellowfin tuna (3358.1 mt) and albacore (6222.5 mt) in the total longline catch (21 899 mt) accounted for 41%, 15% and 28% respectively. Skipjack was the dominant species caught by purse seiners and accounted for 86% in the total catch of the purse seiners in 2003. Bigeye and yellowfin tuna caught by small scale tuna longliners were mainly exported to the Japanese and US sashimi markets by air if the quality met the requirement; other species were sold at local markets. Bigeye and yellowfin tuna caught by large scale deep freezer tuna longliners were also mainly sold to Japanese sashimi market by the deep freezer reefer.

42. Albacore caught by larger boats generally operating in the high seas of Southern Pacific Ocean were usually sold to the processing plant for canned products.

Albacore caught by small scale longliners with chilled sea water preserving equipment and super spool generally operating in the Fiji EEZ were usually sold fresh to the US market or sold to the processing plant for canned products. Catch of purse seiners was mainly sold to Thailand and processed for canned products. In June 2003, two observers joined the Chinese large scale deep freezer tuna fleet in Pacific Ocean. In April 2004, two observers joined the Chinese tuna purse seiner fleet in WCPO.

43. In June 2004, a training course about the fisheries management regulations in WCPO was delivered to fishermen and the managers of companies concerned. Further efforts, such as observer programs, are needed to collect size frequency data.

Cook Islands

44. Jason Marurai presented a summary of NFR-5, *The Cook Islands Tuna Fisheries Report*. As a result of a stable economic environment, increased support from financial markets and strategic government policy, the Cook Islands saw a remarkable growth in its domestic commercial longline fishery from 19 fishing vessels in 2002 to 46 in the current licensing period.

45. The fishery involves fishing activities in the northern (northern fishery) and southern (southern fishery) parts of the Cook Islands EEZ. Whilst the northern fishery concentrates on frozen cannery fish (primarily albacore) and unloads its catch in Pago Pago, American Samoa, the southern fishery concentrates on fresh chilled fish (primarily bigeye, yellowfin and swordfish) that unloads in Rarotonga, exporting to overseas markets such as Japan and USA.

46. Longline fleet structure comprises locally owned fishing vessels, locally based foreign fishing vessels and foreign fishing vessels with overall length of 10–34 m.

47. Although the fishery experienced a significant increase in total catch in 2003 from 2002, CPUE actually dropped for these two years, with CPUE in 2004 being consistent with 2003. Albacore recorded the highest percentages and swordfish increased significantly due to a couple of fishing vessels solely targeting the species in late 2003. The main export markets for these fish landed in the Cook Islands are in the USA followed by Japan though a considerable quantity remains on the local market.

48. Current onshore developments experienced in the Cook Islands are the continuing expansion of Avatiu Wharf, ensuring that the national VMS is compatible with the FFA VMS and a recent longline observer course for the local longline fleet.

Federated States of Micronesia

49. The summary of NFR-6, *FSM Tuna Fishery Report* was provided by Steven Retalmai but was not verbally presented. The current estimate of total catch by purse seine, pole-and-line and longline fisheries from logsheets submitted to NORMA for 2003 is 177 181 mt. This is comprised of 169 505 mt reported caught by purse seine, 5943 mt by longline and 1733 mt by the Japanese pole-and-line fleet. SPC's estimate from all sources is about 200 000 mt. This is a significant increase from 1999 (~164 000 mt), although the 1999 estimate is only composed of catches reported in the FSM EEZ whereas the 2003 estimate also includes catches reported within the WCPO.

50. There has been a drastic decline in the catch of the fisheries since the record year of 1995 that is largely a response to the ENSO events. In 2003 the fishing effort by purse seine fleets was increased and focused in two different areas within the FSM waters; southeast and southwest regions of the FSM EEZ.

51. The domestic fleet reported (by logsheets) no fishing effort in the FSM waters. In meeting flag state responsibilities, domestic companies were asked for effort and catch information. Only one of the purse seine companies representing 3 of the 8 FSM purse seiners and none of the longline companies responded.

52. The purse seine transhipment number and volumes were resultantly lower at FSM ports. There were only 135 transhipments for a total of 70 684 mt transhipped. There was no reported transhipments from the 2 other ports, Chuuk and Kosrae. Pohnpei hosted the most purse seine transhipments and Yap had only 20%. Pohnpei has become the most used transhipment port in the FSM. Transhipments appear to be higher in 2003 for Pohnpei for the first half of 2003. There was 92% of SKJ, 2% YFT, and 6% of yellowfin and bigeye mixed.

53. There were 674 longline unloadings in FSM ports for a total of 1415 mt. Most were in Pohnpei. Approximately 69% was yellowfin, 38% bigeye, and 1% albacore and other species of the total volume unloaded.

54. The FSM observer program made 40 placements in 2003 trips of 1476 sea-days on the three main fishing gear types operating. Compared to the number of trips into the FSM EEZ reported by vessels, this equates to a coverage of 2.7% overall for 2003. The trend in coverage for the program has been positive with a general increase in coverage over the past few years. This is also a factor of decreasing fishing effort in the FSM over the 3 years. Fishing effort seems to increase in the FSM EEZ in 2003, and so coverage slightly decreased from 2002 (highest coverage: 3.8%).

Fiji

55. Jone Amoi presented the summary of NFR- 7, *Fiji Tuna and Billfish Fisheries*. Since the inception of longline activity in the 1980s, longlining has become Fiji's dominant fishing method. For the past five years the number of domestic licensed longline vessels has increased significantly from 43 vessels in 1999 to 101 vessels in 2003. The total catches in 2003 by the longline Fiji fleet (licensed and Fiji-based) was 12,205 mt, 40% of which was caught outside Fiji's EEZ. The catch of tuna by the domestic longline fleet decreased to 10,252 mt from 10,906 mt in 2002. This was attributed to the decrease in albacore catch the most abundant of the three tuna species. CPUE trends also saw a decrease for albacore and consistent levels maintained for bigeye and yellowfin. Foreign purse seine vessels licensed to fish in Fijian waters for 2003 include the US purse seine fleet, fishing under the US Multilateral Treaty, and a Japanese purse seine vessel made three fishing trips to Fiji and catching a total of 704 mt of fish.

56. Fiji exported most of its tuna catch to America and Japan. Japan imported 20% compared to 61% for the US. The remaining 19% is exported to China and other countries. Fiji's billfish are also exported mainly to the US, buying close to 43% of the total billfish exports. Besides the US, the bycatch is exported to China, Thailand,

New Zealand and Japan. Albacore and skipjack are either processed at the local cannery (PAFCO) or exported to Pago Pago. The remainder of the bycatch and other damaged fish are sold locally at supermarkets, restaurants or directly to consumers.

French Polynesia

57. A report entitled, *Tuna Fisheries in French Polynesia in 2003* (NFR-8), was presented by Cédric Ponsonnet. The coastal fishery comprises two type of boat: the *Poti marara* and the *bonitiers.* Although the size of the *poti marara* fleet shows some vicissitudes along the years, this fleet seems to have reach the equilibrium and the individual fishing effort will probably remain quite steady. The *bonitiers*'s fleet has steadily decreased and it is more or less obvious that this trend will endure in the future. After several years of relative stagnation, the longline fleet increased significantly during the year 2003 with 64 longliners. Consistent with the increase of the fleet, fishing effort almost reached 18 millions hooks. Although individual effort remains quite steady, global fishing effort should increase during the next years.

58. Total catches fell by 13% in 2003 to 8409 mt: 1879 mt for the coastal fishery and 6530 mt for the longline fisheries. Albacore catches, which had reached records levels for the longline fleet in 2002 dropped by nearly 16%. Still, this species represent almost 47% of the total catches and 58% of the longline catches. The catches of skipjack, yellowfin and bigeye tuna reached 1003 mt (94% accounted for by the coastal fishery), 901 mt, 441 mt, respectively.

59. The CPUE of the *poti marara* decreased by 10% during the year, mainly due to a drop in the CPUE of yellowfin tuna and mahi mahi (–20% and –21% respectively). The *bonitiers*, which target skipjack, were less affected by the decrease in yields with a drop of only 4%, mainly due to a decrease in the CPUE of yellowfin tuna (–26%) and mahi mahi (–15%). The 2003 fishing season for longline was marked by a strong drop in overall yields, mainly due to the drop in albacore (–31%) and bigeye tuna yields (–36%). Yellowfin tuna and billfish yields stayed relatively stable, at –3% and +1% respectively.

60. In 2003, exports amounted to 1766 mt w.w.e., i.e. a 37% drop from 2002. At the same time as the drop in landings from freezer tuna boats, whole frozen tuna exports dropped 32% and the increase in frozen whole fish exports (+48%) did not compensate for the drop in frozen fillet exports (–33%). Limited by the decrease in production and handicapped by a very lucrative domestic market and a low US dollar, the export fresh fish market also dropped 48%. In particular, vacuum-sealed fresh fillet exports, that had started in 2002, were suspended in 2003 and whole fresh fish exports dropped some 44%.

61. The Government of French Polynesia has set itself a tuna fishery development goal of achieving an annual production of 30 000 mt by the end of the forthcoming 4 to 5 year period, for approximately 150 active longliners and 300 smaller artisanal coastal fishing boats. These estimates forecast that coastal production will level off at around 2500 mt annually. Of the 30 000 mt production target to be achieved five years hence, 8000 t should be consumed by the local market and 22 000 t exported.

Japan

62. Naozumi Miyabe presented a summary of NFR-11, *National Tuna Fisheries Report of Japan as of* 2004 to SCTB 17. Longline, pole-and-line and purse seine fisheries are used to catch tunas and billfishes in the WCPO. In addition to these three fisheries, trolling, which has been conducted by small boats in the coastal waters of Japan, is the next important fishing gear in terms of tuna catches. The magnitude of tuna catch by this gear is nearly 20 000 mt annually. Other gears such as trap and other anglings also catch tropical tunas but the amount is negligible.

63. Over the past 20 to 35 years, the fleet size of the three main tuna fisheries has reduced considerably, except for purse seiners, which have been stable since the early 1980s with around 35 distant water vessels. In both longline and pole-and-line fisheries, 20-49 GRT boats declined very quickly during the 1960s and 50-199 GRT boats followed this trend since the early 1980s. These declines were very drastic and fleets are are now all less than 15% of the peak. In the case of pole-and-line boats, the largest boat size (over 200 GRT) also declined since the mid 1970s, but the number of longline boats of the same size was maintained near constant until 1999, when Japan reduced that size of longline boat by 20%, in accordance with FAO's International Action Plan. The general declining trend was due to economic reasons.

64. Reflecting these changes in fleet size, fishing effort has also shown a similar decreasing trend. Offshore and distant water longline fisheries indicated a 55% decline from a peak in 1981. Catch declined for all tuna and billfish species except albacore and swordfish. Similarly, pole-and-line effort showed 70% decline from a high in 1977. Pole-and-line catch reduced by 50% since 1977. Only albacore indicated some recovery of catch in recent years. On the other hand, purse seine fishing effort has been high and stable since the mid 1980s, and the catch has been the highest level since the late 1980s. In accordance with these changes, there occurred some changes in the fishing area. Longline effort reduced in the waters around Japan as well as in the western part of WCPO. The pole-and-line fishing area was generally contracted and much less fishing is now being exerted in the equatorial region. During the high season for albacore (June to September), almost all fleets go to the Kuroshio extension zone (30ºN –38ºN) for albacore as well as skipjack fishing. Changes in the fishing grounds has also occurred in the purse seine fishery, the fleet moved further eastward from Nauru to Marshall Island and Kiribati since 1999. In the second quarter of 2003, however, the fleet carried out extensive fishing for skipjack in waters of FSM EEZ (around 150ºE) where little fishing took place since 1996.

65. Total catch of tuna and billfish in 2002 by longline (>20 GRT) was 56 000 mt, a slight increase over 2001 but only 44% of a high in 1980. All species indicated a decline, and yellowfin indicated the largest reduction (–80%) among major species.

66. Pole-and-line and purse seine fisheries are essentially skipjack fisheries, representing 62% and 82% of total catch in 2002, respectively. The total catch for these two fisheries in 2002 was 145 000 mt and 218 000 mt, respectively.

67. The total catch of bigeye, yellowfin and skipjack tunas in 2002, for all fisheries and sizes of boat, was 36 000 mt, 42 000 mt and 293 000 mt respectively. The combined total catch for these three species was 372 000 mt which is very close to the amount in 2001 and equivalent to 65% of the highest amount recorded in 1984.

Kiribati

68. Ribanataake Awira presented an overview of NFR-12, *The Domestic Tuna Fisheries of Kiribati*. As usual the pelagic fisheries were predominately operated by foreign fishing vessels. Beside the US Treaty and FSM Arrangement, Kiribati had a total of 22 bi-lateral access agreements with fishing companies and associations from 7 distant water fishing nations. Over A$31.4 million was generated in access fees and a total of 435 fishing vessels (PS 195, LL 221 and PL 19) and 13 supporting vessels (1 reefer carrier and 12 tankers) were licensed in 2003. As compared to last year's catch, an estimated drop of 64% in the annual total catch of SKJ was recorded, with a total of 71 811 mt. For YFT a drop in catch by 75% was recorded, with a total catch of 14 969 mt and BET experienced a drop of 44%, with a total of 5522 mt being caught in Kiribati waters by the distant water fleets. Only one transhipment was conducted in 2003 and ca. 1300 mt of catch was transhipped from 1 PS vessel.

69. For the domestic fishery for 2003, the total catch for SKJ was estimated as 944.5 mt and for yellowfin, a total of 1118.5 mt was recorded, landed from 1350 small powered skiffs. For the tuna longline trials, total catch of SKJ was 0.024 mt, BET: 0.755 mt, YFN: 2.319 mt, billfish: 0.34 mt, 'others' (includes sharks) 0.020 mt.

70. There are plans by Government to set up a fresh tuna base in Kiritimati and the national fishing company CPP is planning to construct two more super *wauowa* to follow the first one. Plans are also underway for a small-scale onshore tuna processing facility in Tarawa that may see an increase in activity in the surface tuna fishery, especially in the artisanal fishery, which already has a saturated domestic market for fresh skipjack.

Korea

71. Won-Seok Yang presented a summary of the Korean National Tuna Fishery Report (NFR–13) entitled *Korean Tuna Fisheries in the Western and Central Pacific Ocean*. A total of 210 vessels actively participated in fishing for tuna and tuna-like species in the Pacific Ocean including the WCPO during 2003. Total catch in the Pacific was about 235 000 mt in 2003, a decrease of about 14% over the previous year's catch. Of the total catch, purse seiners caught 190 000 mt (89%), whereas longliners caught 24 000 mt (11%) in the WCPO. While most of the purse seine catch came from the WCPO, longliners also caught tunas in the EPO.

72. Four major species comprised over 95% of the total Pacific tuna catch in 2003, of which 153 328 mt was skipjack, 49 883 mt was yellowfin, 20 575 mt was bigeye and 1795 mt was albacore. Billfish caught incidentally by Korean longliners in the Pacific were blue marlin, swordfish, striped marlin, black marlin and sailfish.

73. Most tuna catches from Korean longline fishery are exported frozen to Japan for the sashimi market, while about half the tuna catches from the purse seine fishery are sold on the Japanese market for canning and the other half is processed in local canneries for domestic consumption.

74. Korea initiated its observer program in 2002 for international fisheries including tuna fisheries and in 2003 two out of five trained observers were deployed

on Korean commercial fishing vessels operating in the CCAMLR Convention Area for 3 months from the late 2003 to the early 2004. During 2004, Korea will be deploying its observers on Korean tuna fleets fishing in the Pacific and Indian Oceans.

Marshall Islands

75. Glen Joseph presented a summary of NFR-14, the *National Tuna Fisheries Reports for the Marshall Islands*. The RMI pelagic fisheries include purse seine, pole-and-line, and longline fisheries, with access agreements for 2003 granted to Taiwan, Korea, Japan, New Zealand and the USA. In addition two Vanuatu flagged vessels of the Marshall Islands Fishing Venture, which contracts chilled longline vessels from some of the DWFNs, also operated in the EEZ of the RMI in 2003. There were also five RMI-based purse seine vessels operating under the FSM Arrangement, plus other purse-seine vessels from other FSM Arrangement signature countries.

76. The total longline catch in 2003 from the EEZ of the RMI was 3367 mt, up from 2002. The major species landed were yellowfin and bigeye tunas. Most of the longline catch was made by Japanese vessels. Most purse seine and longline effort in the EEZ of the RMI occurs south of 10°N. The purse seine catch was down on previous years with a total of 3643 mt of tuna (mainly skipjack), with a large reduction in effort. However, results for 2003 are preliminary at this stage. The pole-and-line catch in the EEZ of the RMI is made exclusively by Japanese distant water vessels and most effort is applied in the northern region of the EEZ, away from the purse-seine area. Similar to the purse-seine fishery, effort was significantly lower in 2003 as were the resulting catches (<500 mt). Transhipments were also down in 2003.

77. A National Tuna Fisheries Status Report and Tuna Management Plan are being reviewed in 2004 in order to develop management plans consistent with regional and internal measure in the WCPO. The observer programmes have also been revised to increase the data collected from fisheries in the EEZ of the RMI.

Nauru

78. Peter Jacob presented a summary of NFR-15, *Nauru Tuna Fishery Report*. Nauru has a small Exclusive Economic Zone (EEZ) only 320 000 km² in size. Despite its small size, however, Nauru's EEZ is a significant one due to the fact that abundant tuna resources, especially skipjack, yellowfin and bigeye, are found there. These resources are harvested mainly by purse seiners from distant water fishing nations (DWFNs), of which 153 were recorded as of August 2004.

79. Purse seine catches show a steady increase over the past five years, although data for 2003 are incomplete as logsheets are forthcoming from the vessel owners. Most of the catch is skipjack, with over 22 000 mt caught over the last five years, followed by yellowfin with nearly 6 mt and bigeye with about 1.3 mt, with the rest being bycatch of just over 0.8 mt.

80. Foreign longline operations existed in the past but data had been difficult to acquire. The domestic longline fishery operates a couple of small vessels undertaking fishing trials over the last four years and a third vessel from Fiji undertaking fishing trials under a joint venture arrangement during Nov–Dec 2003. About 20 mt of fish

were caught during 2003 and much less during 2004 (1.2 mt) due to the fact that the Fiji vessel left and technical problems were experienced with the two Nauruan boats, rendering them out of service. During 2003 nearly 9 mt of bigeye were caught, followed by yellowfin at about 4.8 mt, skipjack at 2.3 mt and albacore at about 1.5 mt. It is anticipated that better data collection methods will be implemented to improve the availability and accessibility of data over the next 12 months.

New Caledonia

81. Regis Etaix-Bonin presented the summary of fisheries in New Caledonia referring the meeting to NFR-16, *New Caledonia Tuna and Billfish Fisheries*. The New Caledonia tuna fleet comprises longliners only. In 2003, 29 vessels managed by 8 companies were licensed to fish in the EEZ; 28 of them were actually active. These longliners range from 15 to 30 m in length. The smaller boats are fresh sashimi vessels, the largest have frozen and sometimes processing (loining) facilities on-board.

82. In 2003, the total catch of the New Caledonia tuna fleet reached almost 2,500 MT of which 45% were albacore and 30% were yellowfin. Bigeye accounted for only 6% of the total catch. Last year, the fishery had to face a significant drop in the catch of albacore from March to September. As this species is predominant, the fishing companies are trying to develop new strategies to sell this product on better markets than canneries. The local market remains of interest; however, it is small. Because of EC approval of processing units in New Caledonia, it is now possible to export loins to this market: exports are therefore expected to slightly increase in the near future.

83. Due to the difficulties faced in 2003, the local government decided to grant subsidies to the exporting tuna companies. However, the fishery will have to strengthen collaboration amongst its members to prevent them from disappearing.

84. In this regard, it is expected that a study currently carried out under the ZoNeCo programme will have interesting outcomes to be used by the tuna companies as well as the local government to help better manage the resources.

New Zealand

85. Talbot Murray presented a summary of *New Zealand Domestic Tuna Fisheries in 2002 and 2003* (NFR-17). All principal market species of tuna and several tuna-like species occur in the NZ EEZ. Commercial fisheries began in the 1960s first for skipjack, then albacore and finally for southern bluefin tuna. Today NZ supports surface fisheries for albacore (trolling), and skipjack (purse seine) and since 1991 longline fisheries targeting bigeye and southern bluefin tuna. Total catches within the EEZ of all tunas & swordfish have generally been stable over the past 5 years at about 10 000 to 11 000 mt while the catch outside the EEZ (mostly by purse seine) has steadily increased and in 2003 was about 18 000 mt. The number of vessels fishing in the EEZ, increasing since 1999 to a peak of 193, declined in 2003 to 178. In addition the number of purse seiners operating primarily outside the EEZ has increased from 1 in 2001 to 4 in 2003.

86. Within the EEZ, albacore (5544 mt in 2002; 5991 mt in 2003) are caught by troll (about 60%) and longline (about 40%); skipjack (3321 mt in 2002; 3850 mt in 2003) is almost entirely caught by purse seine with minor amounts by trolling (< 2%), the remaining species are primarily caught by longline. The species caught primarily by longline inside the EEZ are: bigeye (200 mt in 2002; 157 mt in 2003), Pacific bluefin (56 mt in 2002; 37 mt in 2003), southern bluefin (463 mt in 2002; 389 mt in 2003), yellowfin (25 mt in 2002; 35 mt in 2003), and swordfish (917 mt in 2002; 619 mt in 2003). Small catches of all these species are also made by New Zealand flagged vessels outside the EEZ by trolling and longlining. However, substantial catches of skipjack (13613 mt in 2002; 14516 mt), and yellowfin (3267 mt in 2002; 3510 mt in 2003) by 4 purse seine vessels fishing under the FSM Arrangement occur outside the EEZ.

87. Most tuna and swordfish catch will be limited by TAC from October 2004 and this together with a drop in export earnings since 2001 is likely to result in further changes to the New Zealand tuna fishery. In addition, the successful fishing of small New Zealand based purse seiners together with large New Zealand flagged purse seiners fishing under the FSM Arrangement, which resulted in about 10 000 t catch in 2004, is expected to be repeated in future years, resulting in further increases in skipjack catches within the EEZ. This change in fishing increased the EEZ catch of skipjack by about 70% in 2004.

Palau

88. Katy Sissior presented NFR-20, *Tuna Fisheries in the Waters of the Republic of Palau*. The number of locally based longline fleet continue to decline to 90 vessels in 2003, while fishing effort seems to be stable. Yellowfin is still the predominant species followed by bigeye, blue marline and swordfish. Total catches are slowly picking up after dropping from year 2000 until 2002.

89. The level of logsheet coverage for the locally based longline fleet is high (close to 100%) and that includes port sampling. Japanese access vessels land in their home ports and are not sampled. Two locally owned fishing entities have obtained approval of their fishing agreements beside the existing Fishing Agreement between Palau and Japan, US Multilateral Treaties and the locally based foreign fishing company.

Papua New Guinea

90. Ludwig Kumoru presented NFR-21, *National Fisheries Report– Papua New Guinea*. Tuna is the largest of PNG fisheries and represents a balance of both domestic industry development and foreign (DWFN) access.

91. The fishery is guided by a National Tuna Fishery Management Plan, which establishes an overall management structure and an application framework for the longline, purse-seine and pole-and-line fisheries, including licence limits and total allowable catches. The Plan is currently under review to take account of recent developments including the handline fishery and changes to the Palau arrangement.

92. PNG has embarked on onshore investments in the tuna fishery and as a result foreign and domestic access by purse-seine vessels is increasingly linked to commitment to onshore investment, preferably in the form of tuna processing.

93. Tuna in PNG is currently harvested by two main methods: longline and purse-seine. The longline fishery is fully domesticated, meaning that all the vessels are owned and operated by PNG citizens. There are currently 42 licensed vessels but only 34 are active. The purse-seine fishery comprises 76 foreign vessels, 13 locally based foreign, 17 domestic, 8 non-PNG-sponsored vessels under the FSM arrangement and 25 US vessels under the US Multilateral Treaty.

94. Catch in 2003 was a historical high of 375 000 mt, with purse-seine accounting for 99% (370 000 mt). This was 20% of the regional tuna catch in 2003. The previous high catch was 368 000 mt in 1991.

95. Catch by Domestic/Locally Based Foreign vessels in PNG waters increased from 72 000 mt in year 2002 to 107 000 mt in 2003. Skipjack comprised 78 000 mt (73%), yellowfin 29 000 mt (27%) and bigeye 76 mt (<1%). The regional catch by these fleet also increased from 120 000 mt in 2002 to >160 000 mt in 2003.

96. The Philippine fleet operates under bilateral access arrangements in PNG waters; it experienced an increase in catch from 27 000 mt to 32 000 mt in 2003. Skipjack accounted for 24 000 mt (76%), yellowfin 7 000 mt (22%) and other species only 500 mt (2%). Catch by other fleets was as follows: Korea 74 000 mt, Taiwan 105000 mt, USA 29 000 mt, China 6000 mt and those under the FSM arrangement but sponsored by PNG was 16 000 mt.

97. Tuna longline catch steadily increased in the last four years. In 2002, the catch was 3800 mt and increased to 4400 mt in 2003. Yellowfin accounted for 1686 mt, bigeye was 377 mt and albacore was 857 mt. Catch was dominated by yellowfin, accounting for 40% of the total catch and 60% of the tuna catch.

98. PNG has one of the largest observer programs in the region. It currently has 65 trained observers. Besides working on tuna vessels the observers also cover non- tuna vessels such as prawn vessels, shark longline vessels, handline vessels and those doing trial fishing. Observer coverage on vessels fishing under trial fishing permits is 100%. Port samplers are stationed at major ports to do sampling during port calls.

99. Observer coverage in PNG has taken another turn in that it had been focussed on mothership or carriers operating in the FAD based tuna purse-seine fishery, but has now been changed to cover catching vessels. The observer coverage on motherships was 100% until last year; now the coverage target on the catcher vessels is 100%.

100. Chilled product (sashimi) is air freighted mainly to Japan but also to Sydney. Frozen products are exported to Philippines, Japan and Taiwan, canned tuna mainly to USA and European markets (Germany, Great Britain) with small quantities to MSG countries and fish meal to Australia and Japan. About 10 800 mt canned product was locally consumed in 2003.

101. A couple of the major projects reported to SCTB16 are complete. The Lombrum longline wharf in Manus was completed in September and opened in December 2003. The Kavieng wharf was complete in March 2003 along with the associated fish processing. The net mending facility in Manus is under construction; the chiller in Port Moresby airport was completed at the end of 2003 and is now operational. The 200 mt/day loining plant in Wewak opened early 2003 and is currently producing 50 mt/day tuna loins. The 100 mt/day cannery by Frabelle fishing, in Lae will be complete late this year with associated 600 mt cold storage.

102. Under the Government's export driven economic growth and recovery strategy further onshore development is being encouraged as a condition of access. Negotiation for a second cannery in Madang is in the final stages and there is interest in smaller plants in two other locations. Longline fishery operators are currently putting up small processing plants to do value adding in tuna. At least two of these plants are completed and three more are nearing completion.

103. The handline fishery has attracted a lot of interest and trial reports are positive. This fishery will be introduced by early 2005. The mid-water trawl fishery has also attracted a lot of interest and there are currently some proposals under consideration.

Samoa

104. Roseti Imo presented the *Samoa Tuna Fisheries Report* (NFR-23). The decline in catches that prevailed from 2002–2003 had a negative impact on the industry. Fishing was uneconomical hence many vessels became inactive. The total catch of the fleet decreased to 44% of the catches in 2002. The size distribution of the three main species of tuna albacore, yellowfin and bigeye showed an overall decrease in length. The distribution of effort was very high for Class C, D and E. Port sampling provided good data for estimating total catch of the fleet. The flow of data and information from the fishery is captured in the Statistics section of the Samoa Fisheries Division.

Solomon Islands

105. Eddie Oreihaka presented a summary of *Tuna Fisheries in The Solomon Islands in 2003*, (NFR-24). The Solomon Islands tuna fishery is slowly recovering after the past few years of social unrest and uncertainty. Eight domestic and locally based fishing companies have been licensed during 2003 and 2004 to fish in Solomon Islands waters. Of these, four companies were licensed to operate purse seiners, two for pole-and-liners and three for longliners. In addition to these, Japanese (PL, LL & PS), Taiwanese (PS & LL) and Korean (PS) fleets also fish in Solomon Islands EEZ under bilateral access arrangements, and the US purse seiners fish under multilateral treaty arrangements. Negotiations are underway to enable EU and NZ vessels to fish in Solomon Islands waters under similar bilateral access arrangements.

106. The total catch for all fleets in the Solomon Islands EEZ for 2002 and 2003 were 20 927 mt and 50 316 mt respectively. Of the 2003 catch, the domestic fleet accounted for 27 462 mt. This is an increase of near 10 000 mt compared to 2002 due to catch increases in PS and LL fleets. Foreign fleets catch for 2003 totalled 23 000 mt. This is expected to rise as more logsheet data comes in. As in previous years, SKJ and YFT dominated the catch, with 19 014 mt (69%) and 7321 mt (27%) respectively.

107. At this point in time, export statistics are still incomplete, although Japan remains the main destination for fresh fish. Arabushi, canned tuna and fish loins are also being processed for export to Italy.

108. A total of 144 transhipments, mostly by purse seiners, occurred between November 2003 and April 2004. This has provided the opportunity to place fisheries observers onboard some of the purse seiners. During 2003 a total of 142 observer trips was made. Most of these trips were made onboard the domestic pole-and-line vessels.

109. With the review of the National Tuna Management Plan planned for this year, it is anticipated that current deficiencies will be identified and rectified.

Taiwan

110. Dr Shih-Chin Chou summarized NFR-25, *Update of the Tuna Fisheries of Taiwan in the Western and Central Pacific Region.* Taiwan participates in three types of tuna fisheries throughout the Pacific Ocean. They are the frozen tuna longline fishery, the distant-water purse seine fishery and the fresh and/or chilled tuna longline. During 2003, the frozen tuna longline fleet constituted 142 vessels. This fleet target north and south Pacific albacore tuna, but in recent years, a higher proportion targeted on tropical. The provisional estimate for 2003 catch from this fleet was 11 710 mt, made up of albacore, but increasing proportions of bigeye and yellowfin due to increased effort in tropical waters.

111. The fresh/chilled tuna longline fishery, represented by vessels based in Taiwanese ports and operating both in the coastal and offshore waters of Taiwan, are typically smaller than 100 GRT. However, some of them have expanded their fishing ground to distant waters and operate in a pattern similar to tuna longline freezer vessels. The number of registered CTLL vessels (<100 GRT) was estimated as about 1180 in 2003. They might land their catch in Taiwan or in foreign bases. Total catch of tuna and tuna-like species landed in Taiwan by this fleet in 2003 was 47 062 mt. The provisional 2003 estimate for bigeye and yellowfin catch for the foreign-based fleet in the Pacific Ocean was 3 506 mt and 4 814 mt, respectively.

112. The distant-water purse seine fishery operated over a wide area of the tropical WCPO generally between 135°E–180° and 8°N–8°S. In 2002, fishing grounds extended to as far as 151°W due possibly to the impact of El Niño. During 2001/2002, fishing grounds started to move westward and were mainly located in the western and central part of the tropical Pacific Ocean (135–180°E, 8°N–8°S) with sporadic effort in areas east of 180°E. In 2003 the fishing grounds moved westward and concentrated in areas west of 180°E. This fleet, currently comprising 36 vessels, has become one of the major components of the Taiwanese tuna fishery. Its 2003 catch estimate was 201317 mt with 169492 mt of skipjack, 29058 mt of yellowfin and 2767 mt of bigeye.

113. The government has encouraged FTLL vessels to install the VMS through an incentive program since July 1996. All purse seine vessels operating in the Pacific Ocean have installed such a system and all FTLL vessels will be equipped with VMS in October 2004. Furthermore, during 2004 there are 9 observers dispatched to the three major Oceans. The data obtained will be reviewed and used for scientific purposes in the near future. The Government progressed some programs on marine

resource conservation, such as for green turtle and whale shark. Satellite telemetry has been carried out to study the migration patterns of green turtle and a sanctuary area was established in Pen-Hu Island to protect their spawning and nursery ground. For the whale shark, the government has set up a system to collect catch, fishing location, weight and length information. The government has also set a TAC of 80 fish/year since July 1 of 2002, and 120 fish for July 2003 to December 2004. Four whale sharks were tagged in April 2002 to study their migration behaviour.

Tonga

114. Sione Vailala Matoto presented the *Tonga Tuna Fisheries Report* NFR-27. The tuna fishery in Tonga is still in the development stage with only a small fleet of longline fishing vessels used in Tongan waters for catching tuna and other pelagic fish. Albacore remains the dominant species with surface (skipjack and yellow fin) tuna occurring more seasonally. Total tuna landings increased from 1202 mt in 1999 to a maximum of 1919 mt in 2001 and then dropped to 1647 mt in 2002 and to 1308 mt in 2003, but catch rates picked up slowly in the beginning of second half of 2004.

115. The number of tuna fishing vessels registered and licensed in Tonga increased from 13 in 1999 to 33 in 2003 and then dropped to 22 at present, with about 8 applications in process. Japanese and US markets remain the main destinations for tuna exported from Tonga while EU markets seem promising but yet to be explored.

116. Completion of the fisheries wharf, slipway, boatyard and fisheries market constructed in Vava'u under an EU-funded development project are the major onshore developments in Tonga at the current time, for the development of fisheries as a whole, including tuna fishing. Reviewing the Tuna Management Plan and drafting regulations under the Fisheries Management Act 2002 are an essential part of the management and development of tuna fishing in Tonga, in addition to the national observer program and installation of national VMS system.

Tuvalu

117. Nikolasi Apinelu presented a summary of NFR-28, *Tuvalu Tuna Fisheries Report*. Tuna are a significant social and economic resource at the community and national level. Tuvalu tuna resources are mainly exploited by DWFNs through access agreements. The small-scale domestic tuna fishery still remains modest with about 20 dories that fish full time and a further 30 that operate at artisanal level. These boats land around 110 mt of tuna annually to the local market, with subsistence catch of around twice that amount.

118. The annual catches for the past four years seem to increase from 37 797 mt in 2000 to 48 025 mt in 2001, the highest among the past four years, and then decreased dramatically to 7209 mt in 2003.

119. Three main vessel types currently operate in Tuvalu waters: purse-seiners are the most common, followed by longliners and a few pole-and-liners. The numbers of vessel increase from 151 in 2000 to 161 in 2001. There was a dramatic decrease in 2002 and 2003.

120. Skipjack dominates tuna catches, especially by purse-seiners (53 735 mt) followed by long liners, then pole liners. Most of these catch data are reported from the purse-seiners; the majority of the LL reported total catch only.

121. Korean longliners under CKP Agency offload their catch in Korea and Japan. Japanese purse-seiners offload their catch at their designated port in Japan whereas Taiwanese LL offload in Taiwan. Some longliners that offload in Fiji supplied local fish outlets with their bycatch. Local trollers operate domestically and bycatch is used at a subsistence level.

122. The National Fishing Cooperation of Tuvalu (NAFICOT) is the commercial arm of the Fisheries Department which specializes in fish processing and is currently under maintenance, with the intention to export tuna and other marine resources. Community Fishing Centres (CFCs) on the outer islands operate locally.

123. Two longliners donated by Korea arrived in Tuvalu in May 2004. The Government intends to refit both vessels in Fiji in the near future. The larger of the two is likely to be placed under management by an existing tuna operator in Fiji.

124. There has been very little transhipment activity in Tuvalu. The most recent was three Taiwanese long liners that transhipped in Funafuti lagoon in 2000.

United States of America

125. Russell Ito presented the summary of US tuna fisheries, referring the meeting to NFR-29, *Summary of U.S. fisheries for Highly Migratory Species in the Wester-Central Pacific Ocean, 1999-2003*. The US fishery is made up of five fisheries, namely purse seine, longline, troll and handline, distant-water troll, and pole-and-line. The purse seine fishery accounted for 83% of the total catch in 2003 and the longline fishery 14%. The 2003 catch of the purse seine fishery decreased from its 2002 level to 88 000 mt, with skipjack tuna making up 72%, yellowfin tuna 25%, and bigeye tuna 3% of the total. The catch of the longline fishery was 14 700 mt in 2003, down from 16 200 mt in 2002, with tuna catches predominating and a lesser proportion of billfishes. The decrease was attributed to the poor catches by the American Samoa longline fishery for albacore which dropped from 7100 mt in 2002 to 5000 mt in 2003. In the North Pacific, the proportion of tuna in the California- and Hawaii-based longline catch increased slightly to 9700 mt in 2003.

126. The US distant-water troll fishery in the South Pacific was about the same as the previous year, with 14 vessels that caught 1200 mt in 2003. The catch of the small-scale troll and handline fisheries in American Samoa, Guam, Hawaii, and Northern Marianas declined 19% to 2,100 mt in 2003. Tunas predominate in the total statistics. Catches by the pole-and-line fishery in Hawaii remained at a relatively low level though it increased 50% to 460 mt in 2003.

Vanuatu

127. William Naviti presented NFR-30, *Vanuatu Tuna Fisheries Report*. The Vanuatu tuna fishery is currently predominantly offshore, meaning that fish are exploited mainly by foreign longline fishing vessels and their catch is landed outside

Vanuatu. The current annual catch level for tuna is around 3000 mt. Albacore is the major species. There also exists, however, a small domestic tuna fishery involving about 12 gamefishing vessels and 100 artisanal skiffs. The annual catch from these vessels has been estimated to be between 50 and 60 mt, mainly comprising yellowfin, skipjack, marlin, mahi mahi and other billfish.

128. During the period between 2001 and 2003 unraised logsheet data held by SPC indicate there has been a reduction in the catch of albacore but relative increases in the bigeye and yellowfin catches, despite the number of licensed foreign fishing vessels remaining generally constant (~140). From this same data source it is observed that the CPUE (number of fish per 100 hooks) for bigeye has increased slightly and yellowfin CPUE has increased by a factor of five (0.06 to 0.032). Conversely, albacore CPUE has fallen to 1.810. The increased CPUE for bigeye and yellowfin can be attributed to targeting of fresh tuna by boats based in Fiji.

129. Recently, two frozen fish transhipments for 6 locally-based foreign fishing vessels chartered by a local company took place in Vanuatu. About two thirds of the transhipped catch was comprised of shark trunks. The fish were exported to Taiwan. Some port sampling was done and information will be sent to SPC.

130. Vanuatu intends to fully implement its Tuna Management Plan by the end of 2004 so that additional resources can be provided for enhancement of domestic tuna fishery development, fisheries research, and fisheries management activities.

131. In order to deter further IUU activities in Vanuatu waters, Fiji, Vanuatu and France are having talks to establish an MCS program on a trilateral level.

132. In the near future, Vanuatu also intends to authorize the use of Fiji fisheries observers aboard Fijian and Fiji-based vessels licensed to fish in Vanuatu waters.

3. REPORTS BY REGIONAL FISHERY ORGANIZATIONS

Food and Agriculture Organization of the United Nations (FAO): Fisheries Resources Division

133. Jacek Majkowski reported on FAO activities of relevance to SCTB, concentrating on those carried out by its Marine Resource Service. He outlined the objectives, activities and results of the FAO *Project on the Management of Tuna Fishing Capacity: Conservation and Socio-Economics*. He presented the conclusions and recommendations contained in the Statement prepared by the Technical Advisory Committee for the project at its 2nd Meeting held in Madrid, Spain in March 2004. He indicated that the Statement was presented to the *Technical Consultation to Review and Promote the Full Implementation of the IPOA to Prevent, Deter and Eliminate IUU Fishing and the IPOA on the Management of Fishing Capacity* (Rome, June 2004), resulting in recommendations specific to the western and central Pacific.

134. Dr Majkowski mentioned further developments of the FAO Fisheries Global Information System (FIGIS), pointing out the catch data and other information on tuna and tuna-like species that are available from that System. Referring to the 2003 meeting of the FAO Committee on Fisheries (COFI), he mentioned that Expert and Technical Consultations and other meetings were organized by FAO on IUU fishing, fishing capacity, turtles and CITES. Concluding his presentation, on behalf of FAO and particularly its Marine Resource Service, Dr Majkowski expressed thanks to all international organisations involved in various tuna research, fisheries and their management, including obviously SPC, for the contribution of their data, other information and expertise to FAO.

Inter-American Tropical Tuna Commission (IATTC)

135. Michael Hinton presented SA-9 reporting on the activities of the Inter-American Tropical Tuna Commission (IATTC) and the fisheries for tunas and tuna-like species occurring in the eastern Pacific Ocean (EPO). Resolutions were adopted at the June IATTC meeting for (a) conservation of bigeye and yellowfin tuna; (b) reporting of vessels not on IATTC registries that are operating in the eastern Pacific Ocean (EPO); (c) establishing a list of vessels identified as IUU fishing vessels; (d) establishing data provision and fisheries management compliance requirements in order for a non-member flag to be considered a cooperating non-party and not IUU; and (e) establishing VMS requirements for vessels operating in EPO tuna fisheries.

136. Currently spawning biomass of bigeye and yellowfin is less than that which would produce average maximum sustained yield (AMSY). Fishing mortality rates for bigeye are greater than those at AMSY, but due in large part to questions raised by managers about lack of sufficient information on movement of bigeye, there is a gap between the conservation measures recommended by the scientific staff and those adopted by resolution. Details of the EPO bigeye assessment are presented in the SCTB session on highly migratory species. Information on catches was presented, details of which are available in Document SA-9. The full text of IATTC resolutions is available at the IATTC website: http://www.iattc.org

Pelagic Fisheries Research Program (PFRP)

137. John Sibert presented a summary of the Pelagic Fisheries Research Program (PFRP) recent activities. In particular, Dr Sibert referred the SCTB 17 membership to the report of the first 10 years of operation of the PFRP and hard copies of the report were available at the SCTB 17 meeting.

138. Dr Sibert also indicated that requests for project funding might be called for in 2005, with particular emphasis on research into ecosystem-based fishery management and other topics.

4. STATISTICS WORKING GROUP (SWG)

4.1 Report on Data Collection, Compilation and Dissemination

139. The objectives of the Statistics Working Group are to co-ordinate the collection, compilation and dissemination of tuna fisheries data. Tim Lawson chaired the session and Kim Duckworth was rapporteur.

Data collection

140. The procedures that were established at SCTB 11 to co-ordinate data collection include (a) establishing minimum standards for data collection forms (which was done for catch and effort logsheets at SCTB 12) and reviewing forms used in the region; (b) developing coverage tables for catch and effort logsheet data, unloadings data, port sampling data and observer data; and (c) developing a regional sampling design for port sampling and observer programs.

141. Regarding the review of data collection forms, Working Paper SWG–7, 'Preliminary review of data collection forms used in the Philippines tuna fishery,' reviewed the sampling protocols and data collection forms used in (a) the National Stock Assessment Program (NSAP) conducted by the Bureau of Fisheries and Aquatic Resources (BFAR) and (b) port surveys conducted by the Bureau of Agricultural Statistics (BAS). The review will be considered at a workshop to be held in Manila in October (see SWG agenda item 5 below).

142. Regarding coverage tables, the coverage of tuna fisheries in the WCPO during 2002 by operational catch and effort data held by the OFP is 50.5%, the highest level ever achieved. Coverage by port sampling data for 2002 is 11.1% and coverage by observer data is 3.9%. Coverage tables for each gear type are presented in WP SWG–1. The principle gaps in coverage by operational data include the domestic fisheries of the Philippines and Indonesia, the distant-water longline fleets of Korea and Chinese Taipei, and the longline, pole-and-line and purse-seine fleets of Japan on the high seas. More information regarding gaps in data collection are given in Appendix II of WP SWG–6 and IP INF–SWG–4. Figure 4.1 illustrates trends in coverage from 1970 to 2002; the coverage for recent years may increase as more data become available.

143. The levels of coverage of the operational data used to determine aggregated catch and effort, which were provided by Japan, Korea (pre-1999) and Chinese Taipei, are unknown. Logsheet coverage of Korea longliners by operational data held by NFRDI declined from ~65% in 1999 to ~35% in 2003 (see NFR–13).

144. Regarding sampling programmes, recent developments in port sampling programmes and observer programmes is presented under SWG agenda item 4 below.

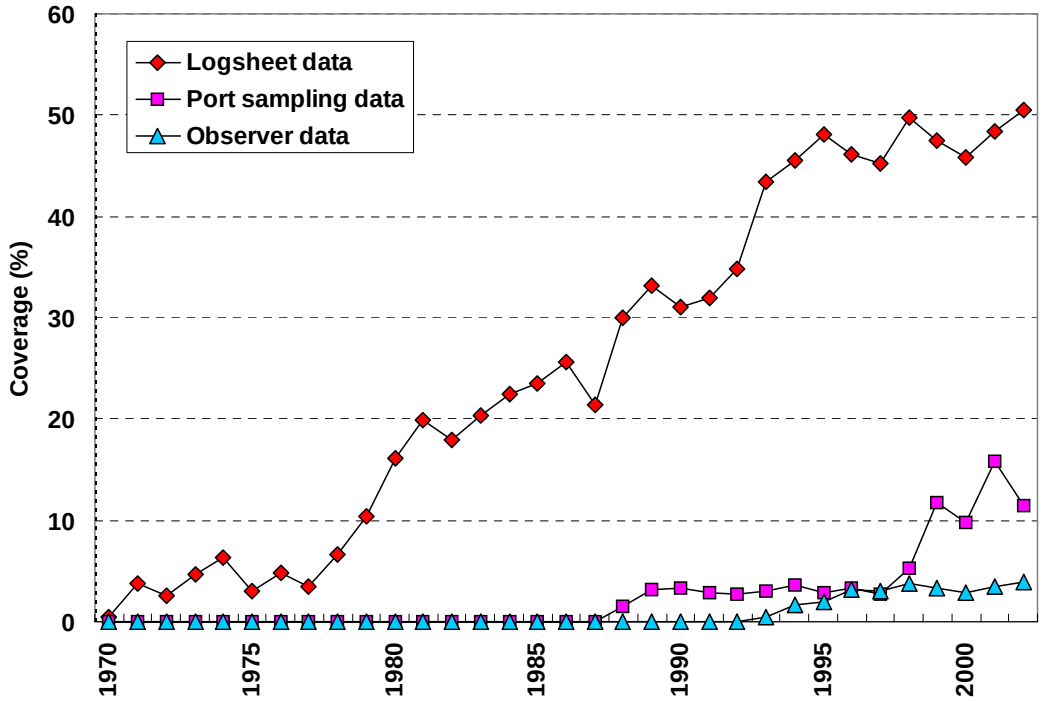


Figure 4.1. Trends in coverage rate of logsheets, port sampling data and observer data for industrialised fisheries operating in the WCPO. Source: SPC

Data compilation

145. The procedures for coordinating 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 by the OFP are given for each fishing nation in WP SWG–1 and IP INF–SWG–4. The highlights regarding data compilation are provided below:

Annual catch estimates

- Annual catch estimates for the Japanese offshore and distant-water longline fleet were included in Japan's national fishery report (see WP NFR–11). However, no 2003 estimates for Japanese coastal longline, coastal pole-and-line and offshore and distant-water pole-and-line fleets.
- Table 1 in Appendix III of Working Paper SWG-6 gives the dates on which annual catch estimates for 2003 were provided to SPC.

Catch and effort data:

- Operational catch and effort data have been provided by SPC members on a regular basis; however, the most recent data covering the Solomon Islands longline, pole-and-line and purse-seine fleets are for 2001, 2000 and 2002 respectively. Solomon Islands indicated that recent data would be provided immediately following SCTB 17.
- Aggregated catch and effort data have been provided by Japan and Chinese Taipei on schedule; however, the most recent data covering the Korean longline fleet are for 2001.

Size composition data:

- Data have been provided on a regular basis by those Pacific island countries and territories with port sampling programmes and observer programmes. (See SWG agenda item 4.4 for recent developments in port sampling and observer programmes.)
- Japan has provided size data for longline (albacore, bigeye and yellowfin) for 1948–2003; pole-and-line (skipjack) for 1964–2004; and purse-seine (skipjack) for 1970–2003.
- Korea has provided length data for purse-seine (skipjack) for 1993–2003, collected by port samplers.

146. Regarding the compilation of annual catch estimates for the domestic fleets of Indonesia and the Philippines, estimates of the total annual catch have been provided on a timely basis; however, annual catch estimates in recent years (1992–2003 for Indonesia and 1997–2003 for the Philippines) have not been broken down by gear type and estimates of annual bigeye and yellowfin catches for all years have been reported as a combined catch. No catch and effort data have been provided, and length data have been provided only sporadically. A proposal to re-establish sampling programmes in the Philippines and Indonesia was developed by the OFP and presented at PrepCon V; the proposal is discussed under SWG agenda item 5. Other gaps in the compilation of annual catch estimates, catch and effort data and size composition data are given in WP SWG–6 and INF–SWG–4.

147. Tables of annual catch estimates for 1950–2003 for tuna and billfish are presented in Working Papers SWG–2 and SWG–3 respectively. The estimates, particularly for recent years, will be updated with information reported at SCTB 17 and published in the SPC Tuna Fishery Yearbook, which is available on the OFP website: https://www.spc.int/OceanFish/Docs/Statistics/TYB.htm

Data dissemination

148. The procedures for coordinating the dissemination of data by the Statistics Working Group include reviewing instances of dissemination on an annual basis. It was reported that during the twelve-month period prior to SCTB 17, from July 2003 to June 2004, there were 121 releases of public domain data via the OFP website (down from 135 during the previous period), 21 releases of data by the OFP other than via the website (down from 26), and 55 releases of statistics and other information (up from 44) (Figure 4.2).

Review of SCTB16 directives to the Statistics Working Group

149. The directives to the SWG that were made at SCTB16 were reviewed.

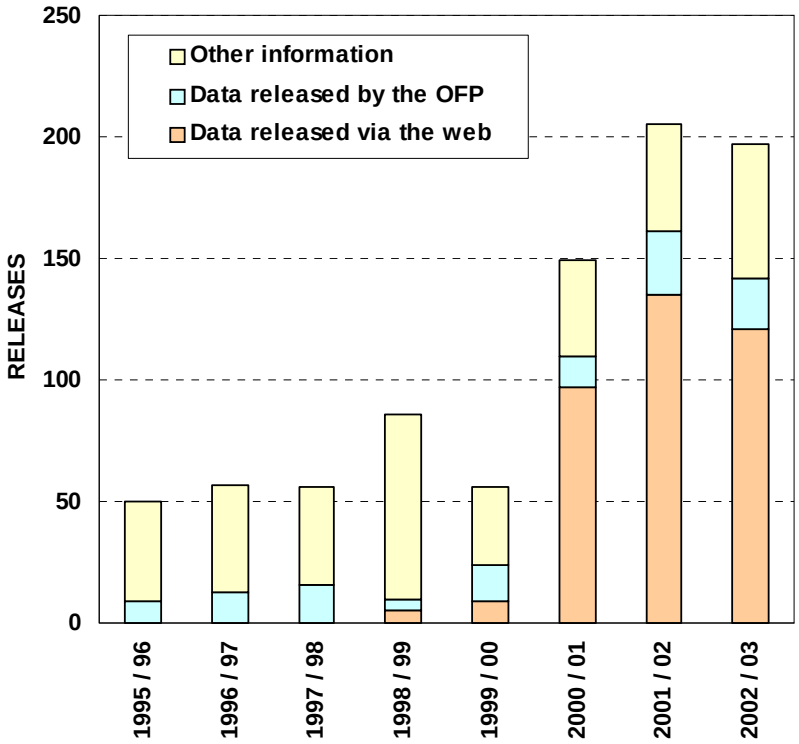


Figure 4.2. Data released by the OFP by type.

150. Directive 1. Conduct the following activities related to the establishment of standards for the design of national and regional observer programs:

(a) examine the relationship between observer coverage rates and the accuracy and reliability of estimators of catches and length frequencies for the offshore longline and purse-seine fleets operating in tropical waters. (SPC)

(b) review sampling protocols for the collection of species composition data and length data, and develop a proposal for standards for data collection forms. (SPC)

151. Directive 1(a) was addressed, in part, in WP SWG–4, 'Observer coverage rates and reliability of CPUE estimates for offshore longliners in tropical waters'. Estimates of coefficients of variation based on sampling theory were compared to sub-sampling; for unstratified sampling the coefficients of variation were identical, whereas for stratified sampling, coefficients of variation based on sampling theory were less than those based on sub-sampling. It was concluded that, for rare species (i.e. species with very low catch rates), reliable catch estimates will require 100% coverage. If 100% coverage is not possible, then coverage of 20% may be appropriate given that further increases in coverage result in smaller incremental improvements in the reliability of the estimates. These results are similar to those for offshore longliners targeting albacore (see SCTB16, WP SWG–4).

152. Directive 1(b) was not addressed; reviewing sampling protocols and setting standards for observer data collection forms will be a task for the Commission.

153. Directive *2. Review the availability of data to estimate the annual catches of other highly migratory species covered by the WCPF Convention, and species of special interest (marine turtles, sea birds and marine mammals). (SPC)*
This directive was addressed in WP SWG–5. The availability of observer data for eight categories of longliners in the WCPO is summarised below:

- Observer data covering the 'distant-water, bigeye and yellowfin' category may be sufficient for estimating catches of non-target species in limited geographic areas and time periods, such as the waters of Australia during 1991–1998 and New Zealand during 1987–1999. But due to incomplete coverage in regard to geographic area, time period and vessel flag, they are not considered sufficient for estimating the catches of non-target species by this category for the whole of the WCPO
- Observer data for the 'distant-water, albacore' category consist of only one trip and, hence, are insufficient for estimating catches of non-target species
- Observer data for the 'offshore, tropical waters' category may be sufficient for estimating catches of non-target species during 1993–2002
- Observer data for the 'offshore, albacore' category may be sufficient for estimating catches of non-target species during 1995–2002
- Observer data held by the OFP for the 'New Zealand' category, which cover domestic vessels, may be sufficient for estimating catches of non-target species during 1995–1999; data for subsequent years have not yet been provided to the OFP
- Observer data held by the OFP for the 'United States, Hawaii' category may be sufficient for estimating catches of non-target species during 1994–2002; data for subsequent years have not yet been provided to the OFP
- Observer data for the 'Other' category are insufficient; however, effort by the 'Other' category is negligible
- No observer data are held by the OFP for the longline fleets of Australia, Indonesia, Philippines and Taiwan (offshore, domestic). However, Australia has recently commenced an observer programme covering domestic longliners

154. Estimates of annual catches (tonnes) for the 'offshore, tropical waters' longline fleet category – which includes Chinese, Japanese, Chinese Taipei and local fleets operating from 10°S to 10°N – during 1998–2001 were estimated and are summarised by species group below

Species Group	1998	1999	2000	2001	1998 - 2001
Tunas	32,495	32,159	38,620	43,259	38,423
Billfish	5,398	4,573	7,295	4,713	5,816
Sharks and Rays	12,148	16,469	12,177	8,031	12,314
Other Fish	1,695	1,083	1,836	1,948	1,782
Total	51,736	54,284	59,927	57,951	58,336

The species composition (%) for the 'offshore, tropical waters' longline fleet category is given below:

Species Group	1998	1999	2000	2001	1998 - 2001
Tunas	62.8	59.2	64.4	74.6	65.9
Billfish	10.4	8.4	12.2	8.1	10.0
Sharks and Rays	23.5	30.3	20.3	13.9	21.1
Other Fish	3.3	2.0	3.1	3.4	3.1
Total	100.0	100.0	100.0	100.0	100.0

155. *Directive 3. Review the OFP vessel and gear attribute data and report summary information to the Fishing Technology Working Group at SCTB 17. (SPC)*
This directive was addressed in WP FTWG–1, which was presented at the FTWG preparatory meeting.

156. *Directive 4. Review the tuna fishery data collection forms of Indonesia, the Philippines and, if possible, Vietnam. (SPC, DGCF, BFAR, BAS, Vietnam).*
This directive was addressed, in part, in WP SWG–7, 'Preliminary review of data collection forms used in the Philippines tuna fishery, was presented above'. Data collection forms for Indonesia may be reviewed in 2005 by CSIRO during a review of the statistical system in eastern Indonesia (see SWG agenda item 5). No information is currently available regarding the tuna fishery statistical system in Vietnam.

157. *Directive 5. Review the data sources and the procedures used to estimate catches by the domestic fleets of Indonesia and the Philippines. (SPC, DGCF, BAS)*
This directive was addressed through the project discussed under SWG agenda item 5.

158. *Directive 6. Develop project proposals and seek sources of funding to establish sampling programmes in the Pacific Ocean waters of Indonesia and to provide support for ongoing sampling programmes in the Philippines. (SPC, CSIRO, DGCF, BFAR).*
This directive was addressed through the project discussed under SWG agenda item 5.

159. *Directive 7. Develop a proposal to harmonise data standards for the Western and Central Pacific Ocean and the Eastern Pacific Ocean. (SPC, IATTC)*
Liaison between OFP and IATTC in this regard has commenced. The harmonisation of data standards for the WCPO and the EPO will be a task for the Commission.

160. *Directive 8. Revise the format of the SCTB data summary working papers, with highlights of data gaps and improved graphical and tabular presentations of data availability.*
This directive was addressed in WP INF–SWG–4.

161. *Directive 9. Report estimates of annual catches in the WCPFC Area and consider modifying the WCPO Statistical Area established at SCTB12. (SPC)*
This directive was considered under SWG agenda item 2.

Discussion

162. During the discussion of the Coordinator's report on data collection, compilation and dissemination, the status of sampling of purse-seine catches of skipjack, in addition to yellowfin and bigeye, was questioned. In the sampling programmes supported by the OFP, skipjack are indeed sampled. The sampling protocol for observer programmes is to randomly select five fish from each brail, regardless of the species. These data have been used to adjust estimates of catches of yellowfin and bigeye based on logsheet data, but they have not yet been used routinely to adjust estimates of skipjack catches.

163. It was also suggested that sampling data for the fleets of different fishing nations could be combined to examine the species and size compositions within time-area strata, since it could be expected that the species and size compositions depend primarily on the time-area strata. However, it was noted that when the OFP examined species composition sampled by observers, it was found that they varied among fishing nations because targeting strategies and fishing techniques varied. When longline lengths sampled by port samplers were examined, it was found that they varied among fishing nations because discard practices varied.

164. It was noted that data on longline gear configuration was useful in identifying targeting practices and were essential for habitat-based standardisation of effort. Japan provides longline catch and effort data stratified by the number of hooks between floats, in addition to time-area strata, and China, the Republic of Korea, Chinese Taipei and the United States of America were strongly encouraged to also provide such data.

4.2 Proposal for reporting annual catches in the WCP Convention area

165. The Commission will require annual catch estimates to be compiled for the Convention Area (Figure 4.3); however, the western boundary of the Convention Area has not been specified in the text of the Convention. It was therefore proposed that, for statistical purposes, the western boundary of the WCPO Area that was established at SCTB12 be used in this regard. The appropriate part of the western boundary of the WCPO Area is from the north coast of Australia northwards along 129°E to 08°S and westwards along 08°S to the coast of the Indonesian peninsula, and from the Indonesian peninsula eastwards along 02°30N to the Malaysian peninsula. In order to compare catches in the WCPO and EPO, and to estimate catches the whole Pacific, it is also proposed that estimates of annual catches for both the Convention Area and the WCPO Area should be provided.

166. The reporting of annual catches for both the Convention Area and the WCPO Area will concern China, French Polynesia, Japan, Korea and Chinese Taipei, and these countries-territory-entity indicated that this was feasible. This will be an interim procedure, until the Commission establishes a policy on the provision of data.

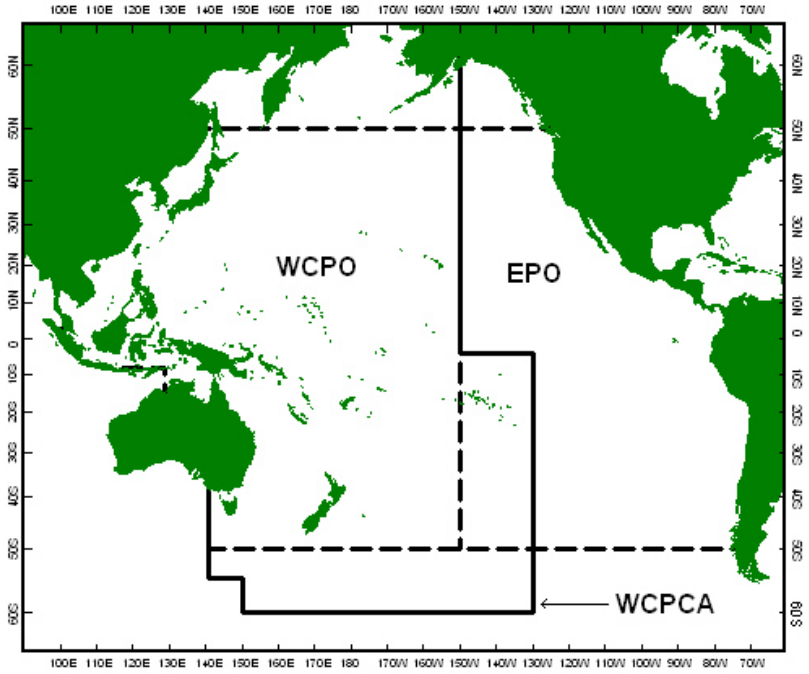


Figure 4.3. Current boundaries and new convention area for the WCPCA.

167. During the discussion, it was noted that catch estimates should also be compiled with reference to stock boundaries, for the purposes of stock assessment. It was also noted that the catch estimates presented in statistical bulletins and those used for stock assessment may not be consistent, and that these inconsistencies should be made transparent.

168. It was also noted that the Commission would compile catch statistics for North Pacific albacore and South Pacific albacore and that the appropriate statistical areas would be the Pacific Ocean separated by the Equator.

4.3 Report of the Preparatory Meeting on Anticipated Data-Related Tasks for the WCPFC Scientific Committee

169. A meeting of the Statistics Working Group was held on 9 August 2004, prior to SCTB 17, to consider anticipated data-related tasks for the WCPFC Scientific Committee. The meeting was attended by J. Amoe (Fiji), S.-C. Chou (Chinese Taipei), K. Duckworth (New Zealand), R. Etaix-Bonnin (New Caledonia), D. Hamm (United States), M. Hinton (IATTC), R. Imo (Samoa), D. Itano (United States), R. Ito (United States), T. Lawson (SPC), L. Manarangi-Trott (Cook Islands), J. Maruai (Cook Islands), P. Miyake (Japan), A. Mobiha (Papua New Guinea), M. Ogura (Japan), C. Reid (FFA), P. Sharples (SPC), K. Sisior (Palau), R. Skillman (United States), K. Staisch (FFA), M. Tenorio (Northern Marianas), Y. Uozumi (Japan) and W. S. Yang (Korea). The meeting was chaired by Tim Lawson.

Legal aspects governing fisheries data

170. Two working papers were presented. Ms Manarangi-Trott presented WP SWG-8, 'Legal aspects governing fisheries data', which describes the international legal obligations in respect of the collection, compilation and dissemination of fisheries data by the Commission. Obligations of members of the Commission in respect of data cover the following areas;

- collect and provide certain specified data to the Commission, consistent with Annex I of the UN Fish Stocks Agreement and as required by the Commission (Article 23)
- assess impacts of fishing through developing data collection and research programmes
- control of nationals and fishing vessels flying its flag, particularly in ensuring the provision of logsheet data to national fishery administrations in sufficiently frequent intervals to meet national requirements and regional and international obligations (Article 5, UNFSA Annex I)
- maintaining a record of fishing vessels, containing at a minimum information listed in Annex IV, and provide the information contained therein to the Commission
- exchange information on fishing activities of non-parties

171. The role of the Commission, the Secretariat and the Scientific Committee in respect of data is discussed in the working paper. Particular Commission data responsibilities to note are that it shall:

- adopt standards for collection, verification and for the timely exchange and reporting of data on fisheries for highly migratory fish stocks in the Convention Area in accordance with Annex I of the *[UN Fish Stocks]* Agreement;
- compile and disseminate accurate and complete statistical data to ensure that the best scientific information is available, while maintaining confidentiality, where appropriate (Article 10(1)d &e).

172. Other considerations include the capacity of small island developing States and territories to meet their obligations and the role of the Commission in respect of this under Article 30(4); the area of application of data standards; and the obligation to cooperate with other organizations.

173. During the discussion of WP SWG–8, it was noted that the references to 'best scientific evidence', 'uncertainty' and 'data standards' imply that quality controls will need to be implemented in regard to several aspects of the data.

Data-related tasks for the WCPFC Scientific Committee

174. Tim Lawson presented WP SWG–6, 'Information regarding anticipated data-related tasks for the WCPFC Scientific Committee', which discusses data standards and other data-related issues. He first noted that while the list of tasks was developed with the Scientific Committee in mind, certain of the tasks could be addressed by the Commission's secretariat or the scientific experts engaged under Article 13, rather than the Scientific Committee. He also noted that the forms in which the tasks could be addressed, such as by resolutions of the Commission or otherwise, will be determined by the Commission.

175. The list of the anticipated data-related tasks is as follows:

1. Draft the terms of reference of the Statistics Working Group
2. Draft a resolution on the scientific data to be provided by members of the Commission under Article 23 of the Convention
3. Draft a resolution on the principles and procedures for the dissemination of scientific data by the Commission
4. Advise the Commission regarding the contents of an annual report on the status of the collection, compilation and dissemination of data to be provided by the Commission's data managers
5. Monitor the status of data collection in the Philippines and the Pacific Ocean waters of Indonesia
6 Develop a strategy for improving the capacity of members to meet the data requirements of the Commission
7. Establish standards for the collection of scientific data, including operational catch and effort data, port sampling data and observer data
8. Advise the Commission regarding the scientific aspects of the regional observer programme to be developed under Article 28 of the Convention;
9. Establish procedures for evaluating the quality of the scientific data compiled by the Commission
10. Harmonise data collection standards for the Western and Central Pacific Ocean and the Eastern Pacific Ocean in collaboration with the Inter-American Tropical Tuna Commission
11. Establish an agreement on the exchange of tuna fisheries data between the Inter-American Tropical Tuna Commission and the Commission
12. Harmonise the procedures for the compilation and dissemination of data by the Commission and the Interim Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean
13. Recommend that the Commission become a member of the Coordinating Working Party on Fishery Statistics
14. Recommend that the Commission become a partner in the Fisheries Resources Monitoring System

176. WP SWG–6 contains background information regarding the tasks listed above, much of which is based on the experience accumulated by the Standing Committee on Tuna and Billfish over the 17 years of its existence. The working paper, which contains seven appendices containing relevant texts and a comprehensive list of references, with web links, is intended to be a reference document for use by the Scientific Committee.

177. During the discussion of WP SWG–6, it was again noted that it may be appropriate for certain tasks to be addressed by the Commission's secretariat or the scientific experts, rather than the Scientific Committee.

Public domain catch and effort data

178. Regarding the dissemination of public domain catch and effort data, it was noted that IATTC considers that data aggregated by 5° latitude and 5° longitude and quarter, for all fishing nations combined, are in the public domain, while ICCAT considers that longline data aggregated by 5° latitude and 5° longitude and month, and surface fishery data aggregated by 1° latitude and 1° longitude and month, stratified

by fishing nation, are in the public domain. At present, SPC considers that longline data aggregated by 5° latitude and 5° longitude and month, and surface fishery data aggregated by 1° latitude and 1° longitude and month, for all fishing nations combined, are in the public domain.

179. Regarding the dissemination of non-public domain data, IATTC requires that all draft publications must be reviewed to ensure that the data were used in an appropriate manner, such that the conditions accompanying the release of the data has been respected. In this regard, it was suggested that an additional task for the Commission may be to draft an agreement containing the conditions for the release of data that must be accepted by individuals requesting data, prior to the release of the requested data.

Dissemination of data for time-area strata with only a small number of vessels

180. The issue of the dissemination of data aggregated by time-area strata for strata with only a small number of vessels was raised. It was noted that certain countries release aggregated data only for strata for a minimum number of vessels. It was also noted that this practice may introduce bias in estimates of CPUE and that this should be examined.

Associations for data quality professionals

181. It was also noted that associations for professions concerned with data quality now exist in non-fisheries areas and that IATTC may adopt ISO standards for data management.

Falsification of data

182. The issue of the falsification of data was discussed. Falsification of catch and effort data by commercial sources can be detected by verifying the data with landings data and VMS data, or by comparing data recorded by one source to those from other sources for the same time-area stratum. For data falsified by samplers in port sampling or observer programmes, falsification can be detected by comparing data from other samplers and through close supervision of the samplers. The proper design of data collection forms may reduce the potential for the falsification of data.

IUU fishing in the WCPO

183. The issue of IUU fishing in the WCPO was raised. It was noted that the level of unreported catches in the region and the use of catch certification schemes to quantify the level of unreported catches was considered at SCTB15. The report of the discussions at SCTB15 in this regard is given below [2]:

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[2] Anonymous. 2003. Report of the Fifteenth Meeting of the Standing Committee on Tuna and Billfish, 22–27 July 2002, Honolulu, Hawaii, United States of America. Secretariat of the Pacific Community, Noumea, New Caledonia. http://www.spc.int/oceanfish/Html/SCTB/SCTB15/SCTB15.pdf

Mr Lawson also presented the report of the FAO Expert Consultation on the Harmonization of Catch Certification Schemes (WP SWG–6), which was hosted by IATTC in La Jolla California, from 9 to 11 January 2002. Trade documentation and catch certification schemes can be useful in determining the extent of unreported catches. Catch certification or trade documentation schemes have been implemented by CCAMLR (toothfish), CCSBT (southern bluefin), ICCAT (bluefin) and IOTC (bigeye), and IATTC has a catch certification scheme to monitor dolphin-safe tuna. It was noted that ICCAT intends to introduce a trade documentation scheme for bigeye and swordfish that will cover landings in the WCPO that are exported to ICCAT member countries (e.g. Japan, USA). The report of the Expert Consultation will be considered by the FAO Committee on Fisheries (COFI) Sub-Committee on Trade. One of its recommendations is to give priority for the development of new schemes to fisheries that are or may be subject to significant levels of IUU fishing. During the discussion of the report at SCTB15, it was suggested that while the extent of unreported catches in the WCPO is unknown, there is no reason to believe that it is a major problem at present. Therefore, the development of catch certification or trade documentation schemes for the WCPO should not be considered a priority. However, such schemes should be reconsidered if and when evidence of unreported catches, anecdotal or otherwise, is reported.

184. It was noted that the WCPO was the only ocean area in which catch certification systems for tuna fisheries had not been established. On the other hand, under the ICCAT trade documentation scheme, exporters in the WCPO must certify that catches of bigeye and swordfish were not taken in the Atlantic Ocean when exporting fish to ICCAT member countries, which implies that certain elements of a catch certification or trade documentation system for the WCPO are already in place. It was suggested that an additional task for the Scientific Committee could be to evaluate the information currently available regarding the level of unreported catches in the WCPO and consider whether a catch certification scheme should be established.

Joint-venture and charter vessels

185. The issue of the treatment of joint-venture or chartered vessels in regard to the nationality of the catch and obligations for the provision of catch data was raised. It was noted that the current OFP practice in this regard is consistent with the standard established by the Coordinating Working Party on Fishery Statistics[3], such that if the vessel has become for all practical purposes a local fishing vessel of the host country, then the OFP considers that the nationality of the catch is that of the host country. For such joint-venture and charter vessels, the OFP obtains catch and effort data primarily from the host country.

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[3] Anonymous. 2001. Report of the nineteenth session of the Coordinating Working Party on Fishery Statistics. Noumea, New Caledonia, 10–13 July 2001. FAO Fisheries Report. No. 656. Food and Agriculture Organization of the United Nations, Rome. ftp://ftp.fao.org/FI/document/cwp/cwp_19/y2606e.pdf

Third meeting of the Scientific Coordinating Group

186. Working Papers SWG–6 and SWG–8, and this report of the Preparatory Meeting on Anticipated Data-Related Tasks for the WCPFC Scientific Committee, will be considered at the third meeting of the PrepCon Scientific Coordinating Group, which immediately follows SCTB 17, under SCG3 agenda item 6, 'Advice on data standards and other data related issues for the Western and Central Pacific region'.

4.4 Recent developments in port sampling programmes and observer programmes

187. Peter Sharples presented an update on the status of port sampling and observer programmes in the Pacific Island countries of the region. Observer activity in national observer programmes has more than doubled since 2001; however, coverage levels are still low. There has also been significant increase in activity in the FSM Arrangement Observer Programme, together with the increase in size of this fleet. A decrease in activity in the USMLT Observer Programme corresponds to a decrease in the size of that fleet.

188. The OFP places high priority on improving the quality of data through improved data management and data collection skills. In this regard, a plea for more resources to support the significant increase in regional sampling activity was made. For the Pacific island countries and territories, sub-regional coordinators could be used to help introduce and develop improved supervision of data-quality. It is essential that the debriefing of observers should continue to be expanded, such that all observers are debriefed by qualified supervisors after each trip.

189. Other highlights of recent sampling activities include:

- Palau and Tonga commenced national observer programmes
- Fiji's port sampling and observer programmes moved to emphasise observer activity
- Cook Islands port sampling significantly improved; however, its observer programme is being redesigned
- Significant improvements in turtle awareness and handling have been made with select observer programmes through a NMFS initiative
- Australia runs its first 14-week competency-based observer training course, which is particularly significant since the OFP is considering the introduction of competency-based training standards in the Pacific Island region
- The coverage of the Hawaii-based longline fleet by port sampling is high (>90%) and the coverage by observers must be maintained above 20%

190. Small observer programmes are developing in China, Korea and Chinese Taipei, and a small observer programme continues in Japan.

191. Future activities include:

- American Samoa and Niue will start national observer programmes and Tonga's programme will develop further

- Regional competency-based training standards are to be developed for Pacific Islands
- The OFP support team of three staff for sampling programmes will continue to focus on improving data management and data-collection skills
- Port sampling in the Philippines will be enhanced through the PrepCon project (see SWG agenda 5) and port sampling in the Pacific Ocean waters of Indonesia will be established when funds become available
- Avenues will be sought to increase regional support of sampling programmes through the use of sub-regional coordinators

192. An outline of the work of the OFP's Fisheries Monitoring Supervisor, Deirdre Brogan, in verifying and evaluating data quality and improving data management was presented. All port sampling and observer data from 1998 to 2001 have been evaluated. Work is currently underway on the 1997 and 2002 data. Debriefing forms and protocols have been developed and training of de-briefers has been undertaken in the Federated States of Micronesia, Fiji, Marshall Islands, Papua New Guinea and Solomon Islands. During the discussion, it was noted that logsheet and landings data can be helpful in verifying observer data.

4.5 Tuna fisheries data for domestic fisheries of Indonesia and the Philippines

193. At the fifth session of Preparatory Conference for the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific (29 September – 3 October 2003, Rarotonga, Cook Islands), Working Group II (Scientific Structure and Provision of Interim Scientific Advice) received a proposal from the SCG for characterising the catches of highly migratory species in the Philippines and the Pacific Ocean waters of Indonesia. Working Group II confirmed the importance of obtaining catch data from Indonesia and Philippines and recommended that, in cooperation with Indonesia and the Philippines, the proposal be further developed, and as a high priority that participants in the PrepCon further consider how they might assist this initiative, through services or financial support.

194. The 'Proposal for monitoring the catches of highly migratory species in the Philippines and the Pacific Ocean waters of Indonesia' (Information Paper INF-SWG-3) was subsequently developed by the OFP in conjunction with Indonesia and the Philippines and distributed to potential donors in December 2003. For each of the Philippines and Indonesia, there are two components:

- review of the tuna fisheries and the current statistical system
- port sampling and observer programmes

195. Australia agreed to fund the review for the Philippines and is considering funding the review for Indonesia. The budget for port sampling and related activities, for two years in both countries, is US$ 292 000. At PrepCon VI (Bali, April 2004), Chinese Taipei and the United States announced contributions of US$ 20 000 and US$ 60 000 respectively. In order to allocate the available funds and to monitor project developments, the Indonesia and Philippines Data Collection Steering Committee was established by PrepCon. It met during PrepCon VI and allocated the currently available funds to the Philippines (see Appendix IV of WP SWG-6).

196. Antony Lewis conducted the review in the Philippines from 8 to 28 July 2004, and reported to SCTB 17 on several issues, including the lack of funding for data collection, under-reporting of commercial catches by industry, the lack of catch and effort logsheets for most commercial vessels, the creation of a new statistical category for handline vessels, the need to rescue sampling data collected under the National Stock Assessment Programme, etc. The review highlighted the need for funding and improvements to the current statistical system. A workshop will be held in Manila in October 2004 - with the Bureau of Fisheries and Aquatic Resources, the Bureau of Agricultural Statistics, industry and SPC - to consider the recommendations from the review and to plan the enhancements to data collection that will be implemented with project funding following the workshop.

197. CSIRO will conduct the review for Indonesia in 2005. The port sampling programme in eastern Indonesia will be established if funding for the 2-year project is contributed by the potential donors (European Union, France, Japan, Korea and New Zealand). Observer programmes will be established in the Philippines and the Pacific Ocean waters of Indonesia when funding becomes available. The meeting strongly encouraged the potential donors to contribute the required funds as soon as possible.

4.6 Other matters

198. There were no other matters.

4.7 SCTB 17 Directives to the Statistics Working Group

199. Directives to the SWG generated at SCTB 17 are listed below:

1. Examine the relationship between observer coverage rates and the accuracy and reliability of estimators of catches and size frequencies for the purse-seine fleets operating in tropical waters: (SPC)
2. Review the availability of data to estimate the annual catches of non-target species by purse seiners and, if sufficient data are available, estimate catches of non-target species: (SPC)
3. Compile information on the longline fishery in Vietnam, including estimates of annual catches: (SPC)
4. Compile annual catches for the WCPF Convention Area, in addition to estimates for the WCPO Area established at SCTB12: (SPC, China, French Polynesia, Japan, Republic of Korea, Chinese Taipei)
5. Compile catch and effort data covering distant-water longline fleets, stratified by hooks between floats, for habitat-based standardisation of fishing effort: (SPC, China, Japan, Republic of Korea, Chinese Taipei, United States of America)
6. Examine the bias introduced in estimates of CPUE by excluding strata with less than a minimum number of vessels from releases of catch and effort data aggregated by time-area strata: (United States of America)
7. Identify and rescue historical catch and effort data, such as pre–1972 Japanese pole-and-line data and pre–1950 fishing surveys: (Australia, Japan, United States of America, SPC)

200. Other directives to the Statistics Working Group are included in the work plans of the other working groups and research groups. It is suggested that these directives be reviewed by the Scientific Committee of the Commission.

4.8 Summary statement

201. A summary statement on issues relating to the Statistics Working Group was drafted, circulated to participants and discussed. The agreed statement was incorporated in the Executive Summary.

5. FISHING TECHNOLOGY WORKING GROUP (FTWG)

5.1 Introduction

202. David Itano opened and chaired the plenary session of the FTWG, noting that the FTWG had met in a Preparatory Meeting on day prior to the commencement of SCTB 17. The preparatory meeting serves as the full meeting of the FTWG where all working and information papers are presented and discussed. A detailed description of each paper is included in the Report of the Preparatory Meeting of the FTWG (Appendix 4). However, he noted that many persons attending the SCTB were not able to attend the preparatory meeting where a number of important issues had been discussed. For this reason, he proposed that the plenary session would briefly point to and summarize the Preparatory Meeting presentations and allow for the brief presentation of some papers by their authors.

Working and Information Papers to FTWG 17

5.2 Application of gear technology to bycatch reduction

203. The Chairman described FTWG-7b, -7c, -7d, -7e, and -7f that describe methods and the assessment of methods to reduce bycatch and interaction of longline gear with seabirds and marine turtles. FTWG-7g: *Reducing juvenile bigeye tuna mortality in FAD sets.* (Nelson P) described a project to explore the use of sorting grids or rings to allow escapement of juvenile bigeye and undersize tuna from purse seine sets. FTWG-7a: *Trial setting of deep longline techniques to reduce bycatch and increase targeting of deep-swimming tunas*. (Beverly S, Itano DG) described two independently developed but similar methods to increase longline targeting of deep-swimming tunas while avoiding interaction with bycatch species of the upper mixed-layer of the ocean such as marine turtles, billfish, seabirds and many pelagic shark species. The deep-setting longline technique developed in Hawaii was interesting in that it also developed the exploitation of a previously under-utilized seamount biomass of lustrous pomphret (*Eumegistis illustris*) which is a highly desirable market species in Hawaii. The Australian example noted the taking of large, deep-swimming broadbill swordfish during daytime hours that may have important implications to the reduction of turtle bycatch in longline fisheries. It was noted that shallow-set swordfish longline activity had been banned in Hawaii due to bycatch issues. The application of both methods to small-scale longline developments in conjunction with anchored or drifting FADs was also noted. Details of these papers are available in Appendices 2 and 4.

5.3 Training materials

204. Three Information Papers to the FTWG were noted. INF–FTWG-2: *Documentation and classification of fishing gear and technology on board pelagic longline vessels – Hawaii module* was described as an initial attempt to document gear technology used by regional longline fleets. This task was a specific directive from SCTB 16 following similar work describing regional purse seine technology. The Coordinator noted that it was intended that additional modules would describe important DWFN and domestic longline fleets operating in the WCPO, i.e. Japanese distant-water freezer boats or locally-based Taiwanese ice boats.

205. INF–FTWG–4: *Handbook for the identification of yellowfin and bigeye tunas in frozen condition* (Itano DG) and INF–FTWG–4: *Handbook for the identification of yellowfin and bigeye tunas in fresh condition* (Itano DG) were described as identification papers to discriminate between yellowfin and bigeye tuna in conditions as may be seen by observers or port samplers. The guides were developed to assist at observer and port sampling programs to improve the quantification of bigeye and juvenile yellowfin catches, discards and landings, particularly for purse seine fleets.

5.4 Regional information relevant to the FTWG – Country and fleet reports

206. The Chairman noted that the FTWG is particularly interested in documenting information on recent developments in regional fisheries, shore side developments, port sampling and observer programs and any issues related to FADs and FAD-based fisheries. A standardized format for these reports was developed prior to SCTB 17 and distributed to the FTWG some months prior to SCTB 17. However, most participants declined to compile a separate paper specific to the FTWG as all the pertinent information was submitted in the National Fishery Reports. However, it was noted that Mr Williams had provided the FTWG with a very useful summarization of recent developments in tuna fisheries during 2003.

5.5 Issues related to vessel production

207. The Chairman described FTWG-3: *Average purse seine vessel production in the Western and Central Pacific Ocean (WCPO) by fleet for the period 1980–2003* (Willams PG). The paper described changes in average catch, effort by set type and performance of the high-liners for four, distant-water and six Pacific Island domestic purse seine fleets over a lengthy time period of 1980 – 2003. The paper described an initial period of establishment for each fleet followed by a period of stabilization and gradual adoption and improvements in technical efficiency. It was interesting to note that some fleets appear to have stabilized at an average annual production rate, while others have increased steadily or decreased in recent years. However, the highest-performing vessels in each fleet appear to consistently out-perform their peers throughout the time series. The fact that some vessels consistently produce high catch rates was noted as a possible means to define important technical and social parameters to improved efficiency and catch rates for purse seine vessels. It was recommended that these high performing vessels be examined at a closer level provided matters of confidentiality were properly addressed.

208. The Chairman presented a summary of FTWG-5: *Using Malmquist indices to measure changes in total factor productivity of purse seine vessels while accounting for changes in capacity utilisation, the resource stock and the environment* (Squires D, Reid C). The paper was submitted in response to a request from SCTB 16 for the FTWG to investigate various ways to define vessel production, particularly analytical and quantitative approaches. The paper described the concept of total factor productivity (TFP) that attempts to model vessel production by factoring economic inputs, technical change, technical efficiency and improved scale of operations in relation to stock size, stock availability, gear vulnerability and broad-scale environmental conditions. It was noted that the study examined actual WCPO Korean purse seine data as an example dataset and the examination of this fleet had no particular significance. It was further noted that the approach was new and the final results should be considered preliminary and primarily for illustrative purposes.

5.6 Issues related to vessel and gear attributes

209. The Chairman described FTWG-1: *Review of vessel and gear attribute data held by SPC and FFA* (Millar C, Schneiter E). The study examined and evaluated SPC held observer data, the FFA Regional Register of Fishing Vessels, regional logsheet data and information compiled in the SPC Tuna Fishery Yearbook pertaining to detailed vessel and gear statistics. Several problems were noted from existing databases, many of which stem from a historical lack of validation and error checking. A common problem stems from the fact that model names and numbers have often been noted or input with various spellings and formats. In some cases, it is impossible to discern if blank entries refer to a value of zero, not recorded or absent.

210. The paper noted that observer coverage was low, but observers were probably the best source of detailed and current data on fishing operations and gear. In contrast the FFA Regional Register held detailed information on all vessels but the data was unverified and sometimes incomplete. The paper summarized data coverage by source and made a number of recommendations as described in the Appendix 4 (Report of the Fishing Technology Working Group, Preparatory Meeting).

211. The Chairman presented FTWG-2: *Vessel and gear attributes useful for the long-term monitoring and management of WCPO tropical tuna fisheries* (Itano DG). The paper reviewed past SCTB studies and reports relating to vessel and gear attributes and made recommendations for the collection of these data to address regional management goals. SCTB documents dating back to SCTB 11 were described as well as documentation of the EU project ESTHER *(Efficiency of Tuna Purse Seiners and Effective Effort*) that attempted to identify the main factors that contributed to increasing fishing power of the French and Spanish purse seine fleets in the Atlantic and Indian Oceans. Several SCTB papers on purse seine and longline gear and technology were also described. The paper condensed recommendations from all studies reviewed into a list of fifteen recommendations relating to the collection of vessel and gear attributes from regional fishing vessels, and recommended that these data be collected by a separate system working in conjunction with the FFA Regional Register. This suggestion was debated and discussed by several SCTB members as described in Appendix 4.

5.7 Issues related to FADs

212. The Chairman presented INF-3: *The development, design and recent status of anchored and drifting FADs in the WCPO* (Itano DG, Fukofuka S, Brogan D). The paper resulted from SCTB 16 directives to the FTWG to document available information on the use of FADs by large-scale fisheries in the WCP region. INF-3 compiles information from SPC observer reports, a few published sources and the personal experiences of the three authors. Acronyms are introduced referring to anchored or moored FADs (AFADs) and freely drifting FADs (DFADs).

213. The paper concluded that detailed information on the design of drifting FADs by fleet does not appear to be readily available. However, a great deal of this information may exist in free text fields of years of observer reports that have not been summarized. It was encouraged that these data sources be examined for available information on the design, deployment, use and enhancements to DFADs in relation to catch rates, particularly for bigeye tuna. Research on the mechanisms of aggregation and influence of different DFAD designs to species specific aggregation was also encouraged.

214. Adam Langley presented FTWG-4: *An analysis of the main factors influencing the catch of bigeye tuna in purse seine drifting FAD sets and a comparison with log sets* (Langley A). This paper was in response to SCTB 16 directives to the FTWG to examine catch parameters between natural logs and drifting FAD sets (DFADs) with a particular emphasis on the take of juvenile bigeye tuna. A more detailed description of this report is given in Appendix 4. A significant finding of the study was consistent with studies carried out by the IATTC in the Eastern Pacific Ocean where significant and consistent differences in bigeye catch rates were found between different vessels and fleets. It was strongly recommended that the gear and operational characteristics of vessels with consistently high bigeye catch rates be examined more closely. Of greater concern was the steady decline in bigeye catch rates throughout the period of the study. It was suggested that this general decline in bigeye catch rates by purse seine be investigated further in relation to larger scale spatio-temporal patterns.

5.8 Issues related to harvesting capacity and effort management

215. Four Information papers related to harvesting capacity issues were submitted to the FTWG consisting of abstracts or summaries of larger papers. The Chairman noted: FTWG-INF-1a: *Extracts from "Brief Review of World Tuna Fisheries"* (Miyake PM); FTWG-INF-1b: *Abstract from "Review of Longline Fleet Capacity of the World"* (Miyake PM); and FTWG-INF-1d: *Report of the Second Meeting of the Technical Advisory Committee (TAC) Madrid, Spain, 15-18 March 2004. Management of Tuna Fishing Capacity: Conservation and Socio-Economics*. These documents refer to work related to recent FAO initiatives relating to fishing capacity in world tuna fisheries. These studies indicate that purse seine and longline fishing capacity currently is in excess of that necessary to harvest current landings. These papers and abstracts are further described in Appendix 4.

216. The Chairman presented FTWG-INF-1c: *A survey of purse seine fishing capacity in the western and central Pacific Ocean, 1988 to 2003: Executive Summary* (Gillett R, Lewis AD). The study was contracted by NOAA Fisheries, Pacific Islands Region to investigate current levels of fishing capacity in the WCPO region. The study investigated various measures of fishing capacity, settling on the use of "carrying capacity" of regional purse seine fleets as a proxy for "fishing capacity", defined as cubic meters of refrigerated hold space. The study calculated hold capacity from data held in the FFA Regional Register of Fishing Vessels and the SPC/OFP Regional Tuna Fishery Database for eighteen different flag purse seine fleets operating in the WCPO.

217. Steadily rising figures were noted for the region in both numbers of active vessels and average hold capacity resulting in a steadily increasing carrying capacity and fishing capacity over the past 15 year period. Active vessel numbers have risen from 136 to 175 to 191 while calculated carrying capacity of the entire purse seine fleet rose from 140 000 m^3 to 200 000 m^3 to 233 000 m^3. The most important reservation the study noted in data outputs was the reliance on unverified information in the Regional Register. However, the main problems appear to exist with the historical data set. The study concluded that upgrading the accuracy of the data in the Regional Register was key to improving estimates of carrying capacity and to facilitate the development of alternative proxies for fishing capacity.

5.9 The Palau Arrangement and effort management in the WCPO

218. Chris Reid presented a paper prepared on behalf of author Len Rodwell of FFA, FTWG-6: *FFA initiatives related to the Palau Arrangement, purse seine management and the management of bigeye fishing mortality in the WCPO*. The Palau Arrangement for the Management of the Purse Seine Fishery in the Western and Central Pacific was developed by the Parties to the Nauru Agreement and entered into force in November 1995. The Arrangement as it currently stands sets a limit on the number of purse seine vessels that can be licensed by the Parties and allocates these licenses by fleet. However, due to steady increases in vessel efficiency and carrying capacity, the efficacy of management by vessel numbers is highly suspect. The main focus of the paper outlines the FFA initiative to manage purse seine effort in the WCPO through an allocation scheme based on vessel days.

219. The Vessel Day Scheme (VDS) will be based on a Total Allowable Effort (TAE) for purse seine vessel days set in three year Management Periods. The system will attempt to enhance the economic viability of the fishery and the biological sustainability of the resource through gradual reductions in fishing effort. Variations in fishing power are accommodated by pro-rating vessel day allocations by three categories of vessel size: less than 50 metres; between 50 and 80 metres; and greater than 80 metres length overall.

220. In response to questions from the meeting, Chris Reid explained that a Party to the scheme may freely transfer unused effort allocation between Management Years within a Management Period and also transfer up to 30% of unused effort between the final year of a Management Period and the first year of the next Management Period.

221. John Hampton explained that the determination of the three vessel size classes in the Scheme was based on an analysis of CPUE ratios by vessel size classes, and not a subjective or arbitrary assessment. Dr Hinton noted that the proposed Vessel Day Scheme appeared to be a positive response to PrepCon concerns over the status of bigeye in the region and commended the goals and intent of the proposes scheme.

222. Chris Reid reported that the Parties to the Palau Arrangement have decided in principle that the VDS will commence on 1 January 2005. However, he stated that the implementation date may need to be reviewed in light of further consideration of a number of logistical issues.

5.10 SCTB 17 Directives to the Fishing Technology Working Group

223. The Chairman noted that this was the last SCTB and the future of the FTWG was uncertain. As such, no specific tasks or research coordination had been developed during the Preparatory Meeting. However, it was acknowledged that the type of work conducted by the FTWG would not disappear with the dissolution of the SCTB and that it would be necessary that the work continue within the Commission structure. During the plenary session of the FTWG, specific recommendations of further work were suggested in relation to specific presentations. These directives included:

1. Continued characterization of regional longline fleets through descriptions of gear and fishing strategy
2. Examination of consistently high performing purse seine vessels as a means to identify factors important to increased efficiency
3. Continued efforts to rationalize the collection of data useful for the characterization of fisheries and the standardization of fishing effort for stock assessment purposes
4. Review of existing observer data to glean technical data on historical FAD use and design by fleet, particularly for drifting FADs. Examine FAD technical data in relation to fleet performance over time to examine species and size related catch parameters
5. Examination of gear and operational characteristics of purse seine vessels having consistently high bigeye catch rates as a possible means to reduce juvenile bigeye fishing mortality
6. Examination of bigeye tuna catch rates by purse seine gear that have been steadily declining in recent years in relation to larger scale spatio-temporal patterns in an effort to determine the relative impact of fishery related and environmental factors

5.11 Future role and direction of FTWG-like group

224. The Chairman reported that members of the FTWG had indicated that they supported the formation of a working group similar to the FTWG within or ancillary to the Commission. The general consensus arising from the Preparatory Meeting of the FTWG was that current members would be willing to assist in the development and work load if such a group were to be formed. The Chairman noted that the draft report of the Preparatory Meeting of the FTWG would be made available for review by participants and finalized through email correspondence within a month of the adjournment of SCTB 17. The Chairman thanked the SCTB and FTWG members for assistance and support over the previous years and adjourned the session.

5.12 Summary statement

225. A summary statement on issues relating to the FTWG was drafted, circulated and discussed. The agreed statement was incorporated in the Executive Summary.

6. METHODS WORKING GROUP (MWG)

226. The MWG was convened during the SCTB plenary on 12th August. It was chaired by John Sibert, with Shelton Harley and David Kirby as rapporteurs.

6.1 Report of the Preparatory Meeting of the MWG

227. The results of the MWG preparatory meeting of the 9th and 10th of August (see Appendix 5) were presented to the SCTB as a whole by Dr Sibert. Several points were clarified in the ensuing discussion.

Likelihood profiles

228. These express the aggregate uncertainties in all of the estimated parameters given the data on which the analysis is based, but would not diagnose systematic biases in the data.

Natural mortality and movement

229. The movement dynamics in the simulation model are quite different from those in the assessment models. These differences could contribute to the observed discrepancies between the two models, but the relationship has not been investigated.

Large marine ecosystems

230. "Longhurst bio-ecological areas" are based on a concept by Alan Longhurst identifying large areas of the oceans where the ecosystem is relatively uniform. These areas often correspond to geographic distribution of catch of different species of tunas. See Longhurst AR (1998) Ecological geography of the sea, Academic Press.

Functions of the MWG

231. The Chair of the HMS SAWG stated that MWG was fertile forum to discuss in detail the technical issues and that this forum should be maintained under the new commission, so that methods can be discussed openly and solutions defined. It was further suggested that the MWG might begin to examine ecosystem modelling approaches in detail and their applicability to pelagic fisheries.

Natural mortality

232. In some cases, the reference points estimated by assessment models were quite different from the reference points computed by the simulations. Natural mortality at age (M) appears to have a large impact of estimates of reference points. When given accurate estimates of M, the estimated reference points are more accurate. However, the assessment models are very sensitive to data in which the CPUE is not an accurate index of abundance and can produce erroneous estimates of reference points even when estimates of M are accurate. Two different treatments of M were used in the MFCL BET assessment: estimation of M (MEST models) and M fixed at values used

in IATTC (MFIX) models. The results are similar and the MEST models are more consistent with the data than the MFIX models. The IATTC M values are derived from considerations of differential mortality of males and females and other information on mortality (see SA-9 for further details). The effects of fixing M at the simulated values in complex scenarios was not evaluated due to time constraints. The MWG has clearly flagged estimation or natural mortality at age as a topic for further research.

Wider participation in stock assessments

233. SCTB16 directed the MWG to convene a meeting in Noumea prior to SCTB 17 for the purposes including wider expertise in the assessments. MWG members were reminded of this directive in January 2004, and a small group assembled in Noumea in July 2004 to participate in the BET and YFT assessments. The timing of the receipt of data in relation to the dates of the SCTB meeting imposes a severe constraint on the conduct of the assessments. Procedures for conducting stock assessments will be discussed further by the SCG and the WCPFC.

Ecosystem approach to fisheries

234. An ecosystem approach to fisheries was discussed and there was agreement that models used in an EAF would be a suitable topic for future MWG deliberations.

6.2 Summary statement

235. A summary statement was drafted, circulated to participants and discussed. The agreed statement was incorporated in the Executive Summary.

7. HMS STOCK ASSESSMENT WORKING GROUP (SAWG)

236. The SAWG was co-chaired by Naozumi Miyabe and Max Stocker, with Keith Bigelow, Mike Hinton, Talbot Murray and Peter Ward as rapporteurs.

7.1 Bigeye Tuna

237. Naozumi Miyabe chaired the session on bigeye tuna.

238. Keith Bigelow presented SA-7: *Relative abundance indices of the Japanese longline fishery for bigeye and yellowfin tuna in the western and central Pacific Ocean*. Alternative time-series estimates were provided for effective effort and relative abundance indices for bigeye and yellowfin tuna in the WCPO based on the Japanese longline fishery. Results were illustrated for three standardization approaches: general linear model (GLM), habitat-based standardizations (HBS); and a statistical habitat-based standardization (statHBS). The HBS approach was further developed by including contemporary information of habitat preferences for bigeye tuna based on archival and pop-up satellite archival tags (PSAT). Relative abundance indices for yellowfin and bigeye were similar to the 2003 assessments. Trends in effective and nominal effort were similar for the GLM yellowfin assessment; however, both the HBS and statHBS predicted a considerable decline in the effective effort targeting yellowfin and an increase in standardized CPUE from the late 1970s to the 1990s. For each standardization method, the relative trend in effective effort targeting bigeye was similar to the trend in nominal fishing effort.

239. It was noted that there was little electronic tagging data in MFCL Region 2 (SA-7: Figure 1), which is a key area, and that this may have some impact on the model. However, in this case the limitation is that there is only one tag recovery in the area. The problem is addressed in the statHBS by using a uniform prior and by estimation of temperature preferences. Since the statHBS estimates the habitat preferences, the lack of electronic tagging in area 2 has no impact within this standardization method.

240. Deviances from model fits for CPUE were presented and standardization model selection procedures were discussed. A direct simple approach, such as selection using AIC, was not used, instead the deviances taken in combination with examination of overall results of fitting the MFCL dynamics model using with the standardized effort series, were considered in selection of the final model.

241. A number of questions were raised concerning various figures that indicated the differences between predicted and observed catch and CPUE. A point was also raised about the possibility that there may be instances when BET move to shallow regions and not be subject to capture by longline. Clarification was requested for the differences between the proportion of time at temperature for the archival/PSAT tags and statHBS shown in SA-7: Figure 9, and it was suggested that these should be done at smaller scales. It was explained that the results identified as statHBS in the figure were actually the fitted temperature preferences disaggregated by MFCL area.

242. It was recommended that results would be more clear and fewer questions might arise if there were plots of spatial residuals to see how they vary over time, as was done in previous years: it was noted that this could be done.

243. It was recommended that additional error structures (e.g. log-normal) be considered in the modelling to improve model fits. It was noted that on Table 3, when data for 1975–2003 is used only 30 to 40% of the variance is accounted for, but when using the entire period this increases to ca. 90%. This was explained as the difference between fitting to CPUE and fitting to catch, with the latter providing a better fit.

244. A question of the value of tracking (archival and PSat tagging) studies was raised to the participants. It was noted that HBS and statHBS may be simply viewed as two approaches (deterministic and statistical) to applying the method of habitat based standardization. With respect to application and value beyond basic research, there has been essentially no real design consideration given to these tag studies, particularly with respect to sizes of fish, life stages, locations of tagging, and such which are important to understanding behaviour and habitat utilization. Nor has there been real consideration given to design with respect to integration of data into stock assessment or stock structure analyses. It was also noted that frequently habitat models used in HBS or statHBS do not include aspects of fish behaviour which are beyond temperature, e.g. feeding or spawning behaviour or other conditions which may impact on catchability and thus the probability functions in the model. Thus, in one sense, results from statHBS may be viewed as predictions of observations which will arise from tagging data obtained from individuals across the sexes, sizes, and life stages of a species. It was agreed that tag studies using archival and PSAT tags should continue and should be well designed for data to be of maximum use in stock assessment and management.

245. It was clarified that the HBS-based models assumed a catenary model for the gear distribution of hooks-per-basket for the Japanese fishery. It was noted that both data on gear configuration (hook depths) and predicted depth are needed. Data were lacking for fleets other than Japan and are needed from all fleets including gear configuration data for all fleets.

246. There was noted a positive bias in the residuals from the model fit. The question was raised as to how this bias would impact on the recommendations or conclusions reached based on the model. It was then noted that perhaps use of relative errors between regions to adjust penalties within the MFCL model to give weight to more informative models would be good. Further discussion noted that while there may appear to be a bias, this was actually the result of scaling in the plot, which tended to over-emphasize the appearance of bias. There was actually a time trend in the residuals, but not a bias. During this discussion it was noted that the impact of large catches on the analysis is minimized due to the "robustified" aspects of the model. A question was raised about weighting the catch in 5º × 5º areas, but it was pointed out that it would not be an appropriate weighting scheme under this type of standardization, as it is already accounted for in the method.

247. John Hampton presented SA-2, the MULTIFAN-CL based stock assessment of bigeye tuna in the WCPO. The bigeye tuna model is age- and spatially structured (40 age-classes, 5 regions) and the catch, effort, size composition and tagging data used in the model are classified by 17 fisheries and quarterly time periods from 1950 through 2007. The last 4−5 years (depending on the fishery) are a projection period into which the last year's fishing effort for each fishery is assumed to continue.

248. On the basis of all of the results presented in the assessment, we conclude that maintenance of current levels of fishing mortality carries a high risk of overfishing. Should recruitment fall to average levels, current catch levels would result in stock reductions to near and possibly below MSY-based reference points. Reduction of juvenile fishing mortality in the equatorial regions would have significant benefits for both the bigeye tuna stock and the longline fishery.

249. The discussion focused on MFCL assumptions, results and interpretations. Clarification was required on why the ratio of exploited to unexploited biomass (depletion) was not equal to one (1) at the start of the time-series (1950). The structural assumption in the MFCL model was that the population at the start of the time-series was not completely in an unexploited state as fisheries were active near Japan and Hawaii. Fishing mortality at the start was assumed to be similar to the initial few years of the time-series.

250. Results on movement between areas appeared negligible which equates to conducting five regional assessments. Movement has a small penalty and is probably not influential. Conventional tagging does not indicate substantial movement, but future model iterations could consider higher movement coefficients. Understanding movement is critical and further underscores the need for future tagging.

251. The distribution of bigeye catch indicates the eastern boundary of the WCPO could be moved to 170ºW to better delineate WCPO and EPO stocks. The spatial stratification could be revised, however there are political realities. With reference to

stock segregation and management units, tagging in the EPO indicates movement to 165ºW, but little is known about movement from the WCPO into the EPO. The 2003 assessment considered separate WCPO and EPO analyses as well as a Pacific-wide analysis. While time constraints did not allow a Pacific-wide assessment in 2004, the WG encouraged such as analysis and separate WCPO/EPO analyses in the future.

252. There were elevated recruitment estimates in recent years similar to the 2003 assessment. The recruitment estimate in MFCL Region 2 is highly uncertain due to the inclusion of Indonesia and Philippines data and it was suggested that these fisheries could be removed from Region 2 to constitute a separate area. While this would reduce the uncertainty in recruitment estimates in Area 2, the model could do anything as there is no effort information. Disaggregation can be reconsidered in the future if better data for the Philippines is obtained.

253. The inclusion of Indonesia and Philippines data had little influence on the estimate of *MSY* and there was an inquiry if the presence or absence in the model was critical. Bigeye biomass in those areas is moderate and it is more important to obtain estimates of size composition. Testing the uncertainty is difficult given the few sample data.

254. The assessment conducted projections based on average effort for the most recent year of data. If the projections had been based on average rather than elevated recruitment in recent years then the projections would be revised downwards.

255. Projections also considered longline catch with no surface fishery. Several participants thought this was valuable; however, a wider range of simulations should be conducted that consider various reductions in both longline and surface fisheries. Projections in future assessments were encouraged to specify catch rather than effort.

256. Considerable discussion focused on expressing information for management consideration. There was discussion on accepting *MSY* as a target or limit reference point. If *MSY* is a limit reference point, then this would be exceeded. A UN agreement encourages that *MSY* should be a limit and not a target; however several participants indicated that it may be inappropriate to compare *MSY* and current catches. The decision on target vs. limit reference points will be made in the future when management information decides what level of risk is acceptable. A preferred approach may be to use F/F_{MSY} as a reference point and managers can select a risk level (i.e. probability of overfishing) that they are comfortable with and then scientists can develop a recommendation on how F should be reduced.

257. The model can estimate *MSY* for the WCPO and an inquiry was made if it could set TACs for individual countries. The spatial stratification of the model makes it difficult to make inferences on an EEZ scale. If national TACs are specified, the sum of national TACs should approximate regional level estimates of *MSY*.

258. For comparative purposes, the use of simple models (e.g. production models) could be used which do not require such data intensive methods. The MWG had a similar recommendation, though it was noted that simple models have low confidence intervals, and better parameter estimation, but there are larger assumptions coincident with fixing a lot of parameters.

259. Shelton Harley presented a summary of the fishery data and the most recent stock assessment for bigeye tuna in the eastern Pacific Ocean (SA-9 Section D). This assessment was undertaken in May 2004 by the staff of the Inter-American Tropical Tuna Commission. Catch data showed the large shift in catches from longline, which dominated prior to 1990, to purse seine, which has taken at least 50% of catches in the past 10 years. Size composition data indicated strong recruitment during the mid 1990s followed by below average recruitment for almost all quarters since 1998. As a consequence, total biomass and spawning biomass is estimated to have decreased dramatically since 2000 and is predicted to decrease in the future to below the lowest levels estimated for the period modelled (1975–2004). At the beginning of 2004, spawner biomass is estimated to be below the level associated with the *MSY*. Under all model scenarios considered, fishing mortality levels were estimated to be greater than those corresponding to the *MSY* levels, with the base case assessment indicating that current fishing mortality should be reduced by about 35%. Key uncertainties in the assessment include: the value of steepness assumed in the assessment, estimates of recent longline catches, and the extent to which uncertainty in stock structure may modify the management implications.

260. There was clarification that the Chinese longline data was included in the assessment. There was an inquiry as to where the recruitment came from the in EPO. The model has no assumption on where recruitment comes from, though tagging indicates that recruitment probably comes from the EPO. Similarly there is no assumption of a S-R relationship. The trend in spawning stock biomass was thought to be realistic, though more fish from the western side of the EPO should be sampled to look at the maturity-at-age estimates.

7.2 Yellowfin Tuna

261. Max Stocker chaired the session on yellowfin tuna.

262. Adam Langley presented the paper SA-1, *Stock assessment of yellowfin tuna in the western and central Pacific Ocean.* The 2004 stock assessment for yellowfin tuna in the western and central Pacific Ocean was implemented in MULTIFAN-CL. The yellowfin tuna model is age- and spatially structured (28 age-classes, 5 regions) and the catch, effort, size composition and tagging data used in the model are classified by 17 fisheries and quarterly time periods from 1950 through 2007. The key assumptions were equivalent to last year's assessment. The data set has been updated to include an additional year of data from key fisheries plus the inclusion of additional historical weight frequency data.

263. A range of sensitivity analyses were undertaken comparing different methods of standardising fishing effort in the main longline fisheries — statistical habitat standardization (SHBS) and GLM — using estimated (MEST) or assumed (MFIX) values of natural mortality-at-age, priors on steepness, alternative catch histories for the Indonesian fishery, and assuming fixed or variable catchability for the main longline fisheries.

264. Overall, the SBHS analyses were slightly more optimistic than the GLM-based analyses, with higher recruitment, lower current fishing mortality, and higher current and equilibrium biomass, although natural mortality was lower in the SHBS analyses.

Similarly, the MEST analyses were more optimistic than the corresponding MFIX analyses. Natural mortality was estimated to be considerably lower for the juvenile age classes and higher for the older age classes compared to the fixed age-specific natural mortality schedule. This was balanced with higher levels of recruitment for the MFIX analyses, but lower levels of biomass and lower overall yields compared to the MEST analyses.

265. Overall, the GLM-MEST and SHBS-MEST are most comparable to the GLM and SHBS analyses in last year's assessment. For both sets of analyses, the current results are more pessimistic than last year's results with lower overall recruitment, lower equilibrium yields, higher current exploitation rates, and higher impacts due to fishing.

266. At this stage, we regard the variable longline catchability model as experimental and requiring further investigation.

267. It is also important to note that the key reference points are sensitive to our initial assumptions regarding the nature of the stock-recruitment relationship. The assumed prior distribution for the steepness parameter is highly influential and a relaxation of this assumption results in a more pessimistic assessment despite the lack of any evidence of a strong relationship between spawning stock biomass and recruitment. For future assessments, a comprehensive review of appropriate values of SRR steepness for yellowfin is required to determine appropriate values for inclusion in a range of sensitivity analyses.

268. The main reference points from the stock assessment indicate that overfishing is probably not occurring ($F_{current} > F_{MSY}$) and the long-term average biomass should remain above that capable of producing *MSY*, except in the case of the most pessimistic sensitivity analysis. However, there is limited potential to expand long-term yields from the fishery at the current pattern of age-specific selectivity. However, this apparently healthy situation arises mainly from low levels of exploitation in sub-equatorial regions of the WCPO. Reduction of juvenile fishing mortality in the western equatorial region (Region 2), principally the Indonesian fishery, would have significant benefits for both the yellowfin tuna stock and the longline fishery.

Discussion

269. Discussion focused on possible improvements to the 2004 assessment (SA-1).

Spatial stratification

270. Region 5 is dominated by the South Pacific Gyre, which is characterized by low nutrient levels and low productivity. Only a relatively small proportion of the total yellowfin tuna catch was taken from that region. However, the model estimated that it contained about 40% of the current total biomass. Consequently, Region 5 buffers estimates of stock-wide reference points against variations in more intensely fished areas like Region 2.

271. Most areas of Region 5 have been fished at one time or another. However, substantial areas are not fished in any given year. The 2004 model assumed average abundance in those unfished areas. It would be useful to check how alternative hypotheses about abundance in unfished areas affect the overall assessment.

Catch and effort data

272. The yellowfin tuna assessment would benefit from improvements to the time series of size, catch and effort data from several fisheries, particularly the Indonesian fisheries. In addition to improve the statistical habitat model that standardizes longline fishing effort, the standardization of purse seine effort needs to be initiated.

Size data

273. In addition to using the most recent year of size frequency data, the 2004 model included data from 1950–1965 Japanese longline activities and 1998-2002 weight frequency data from PNG. There is a need to investigate how representative those datasets are and how they should be weighted in the model.

Natural mortality

274. The 2004 model results were sensitive to the assumptions regarding natural mortality at age. Model reference points were more pessimistic from the sensitivity analysis that included a fixed schedule of natural mortality at age. By contrast, the fixed and estimated schedules of natural mortality were quite similar for bigeye tuna.

Recruitment

275. The 2004 model used a Beverton and Holt stock-recruitment relationship because the abundance and recruitment data show low contrast. Other types of relationships could be tested, e.g. a Ricker stock-recruitment relationship. The assessment was particularly sensitive to the value selected as a model prior for the steepness parameter of the stock-recruitment relationship. However, an analysis of stock-recruitment relationships in other yellowfin tuna fisheries was unlikely to provide improved estimates of the steepness parameter. Closer examination of size frequency data might provide useful insights into recruitment processes.

Oceanographic influences

276. Broad-scale oceanographic events, such as ENSO, may influence ocean productivity, recruitment, catchability and the movements of pelagic species like yellowfin tuna. The 2004 model incorporated some of those effects on catchability through the statistical habitat standardization of longline fishing effort. However, it assumed constant, age-dependent movement with time. Oceanographic events could be included in the model, but care is required to ensure that important signals in the data (e.g. recruitment) are not lost.

277. There is evidence from both the Eastern and Western Pacific that recruitment fluctuations might be linked to regime shifts, e.g. recruitment of yellowfin tuna was particularly low during the 1970s. Care is required in interpreting the 2004 assessment in case another period of low recruitment is developing. The 2004 model estimated recruitment, but it might be possible to specify a range of recruitment levels for the purpose of calculating yield for the WCPO fishery.

Movement

278. A region-wide, conventional tagging program would provide further insights into mixing rates between areas, movements in relation to oceanographic events and point estimates of mortality rates.

Other model refinements

279. Further refinements include further exploration of models that allow catchability of the longline fisheries to vary, approaches to compartmentalizing fisheries, the weighting of various datasets, and estimating selectivity.

Reference points

280. Concerns were expressed about the limitations imposed by focussing on equilibrium based reference points such as *MSY*. The equilibrium assumption added another layer of uncertainty to the assessment. To provide management advice, specific management objectives are required that specify limit- and target reference points, e.g. "a 75% probability of maintaining biomass at the level that will produce MSY". Fishery managers need to specify an acceptable level of risk, arbitrarily indicated as 25% in this example.

281. Other, model-independent, reference points such as indices of size and fishery distribution need to be developed.

Conclusions

282. The main conclusions of the YFT assessment is that the stock is not overfished ($B_{current} / \widetilde{B}_{MSY} > 1$) and that overfishing is probably not occurring ($F_{current} / \widetilde{F}_{MSY} < 1$). However, this apparently healthy situation arises mainly from low exploitation levels in sub-equatorial regions of the WCPO. Reduction of juvenile fishing mortality in the western equatorial region (Region 2), principally the Indonesian fishery, would have significant benefits for both the YFT stock and the longline fishery.

7.3 Skipjack Tuna

283. Naozumi Miyabe chaired the session on skipjack tuna.

284. Adam Langley presented SA-5, *A standardized analysis of skipjack tuna CPUE from the WCPO drifting FAD fishery within skipjack assessment area 6 (MFCL 6)*. The current stock assessment of skipjack is influenced by recent trends in CPUE from the purse-seine fisheries, particularly in the equatorial area of the fishery. An analysis was undertaken of drifting FAD CPUE data from MFCL area 6. The analysis revealed different trends in catch rate between fleets that are probably due to spatial differences in the operation of the fleets with the US fleet operating further east. Trends in nominal and standardized CPUE from the US drifting FAD fishery revealed a strong decline in skipjack catch rates (catch per set) from 1998 to 2002. There was a slight increase in catch rate in 2003 although fishing effort was limited. A further analysis was undertaken including a range of oceanographic variables in the model. However, these variables did not contribute substantially to the analysis and did not provide an explanation for the declining in CPUE. Further consideration of area and fleet structure in the MFCL model is required to account for the observed variation in CPUE trends within Region 6 in future assessments.

285. In the FAD data analysis, it should be noted that catch per day/set represents the size of the school aggregated around the FAD. To consider the abundance of the fish distributed in the area, the amount of catch per FAD deployed in the area should be considered with an indication of FADs concentration. But there are few data available about FADs deployments in the fleet area.

286. It was pointed out that oceanographic data, especially remotely-sensed ocean colour, may not be suitable for effort standardization because of low signal to noise ratios that reduce data accuracy in the absence of local bio-optical algorithms.

287. Log sets could also be considered as associated school operation sets similar to FAD sets and these two data sets could be analysed in the effort standardization. Data reliability should be checked in further analyses; for example in the US fleet it was difficult to separate log and drifting FAD sets in the early years of the fishery.

288. Performance and operation strategy of individual vessels had moderate explanatory ability and could be considered further.

289. Adam Langley then presented working paper SA-6, *A spatially based analysis of purse-seine skipjack CPUE from unassociated sets in the equatorial area of the WCPO, including the development of an oceanographic model for the fishery*.

290. An exploratory analysis of skipjack purse-seine CPUE data was undertaken to investigate trends in the spatial distribution of the fishery and consider the development of a spatially-based indicator of fishery performance for the non-FAD component of the fishery. A cluster analysis was used to determine the main area of the fishery for each month and summary statistics were derived to summarize temporal trends in these indicators. Potential indicators include the size of the area fished, fishing intensity, and average catch density. No strong trends in the spatial analysis were evident from 1998 to 2003. A GLM analysis was undertaken to relate observed skipjack catch to a range of oceanographic variables. The resulting model was used to compare the distribution of fishing effort to the most favourable fishing areas. This analysis indicated that the Taiwanese and Korean fleets were operating in areas of higher expected catch during more recent years. These analyses are preliminary and further development of the spatially-based approach is required.

291. It was noted that the concentration of purse seine operations varied temporally. Future analysis could consider the size of clusters and environmental conditions.

292. HMS Stock Assessment Working Group decided to carry over the SCTB16 MULTIFAN-CL model results on skipjack stock status and the latest CPUE trends of major purse seiners for inclusion in the Executive Summary.

293. The explanation of the decreasing trend of US fleet CPUE was discussed. Since 2000, there was little overlap between the US fleet and other DW fleets. Catch by the US fleet in the eastern area of WCPO was small relative to other fleets distributed to the west, therefore local reductions of CPUE would not be expected. Recent CPUE declines for the US fleet could not be explained in the current analysis.

7.4 South Pacific Albacore

294. Max Stocker chaired the session on South Pacific albacore, noting that while no formal stock assessment had taken place this year, the meeting should consider whether information presented might alter any aspect of last year's assessment. If so, this information should be brought to the attention of the WCPF Commission.

295. Adam Langley presented working paper SA-4 *An examination of the influence of recent oceanographic conditions on the catch rate of albacore in the main domestic longline fisheries*, examining the influence of recent oceanographic conditions on the catch rates of albacore in the main domestic longline fisheries targeting albacore.

296. Recent trends in albacore catch rates were examined for the main domestic longline fisheries operating in the sub-equatorial area, including Fiji, Tonga, French Polynesia, Samoa, American Samoa, Cook Islands, and New Caledonia. Catch rates in these fisheries declined in mid 2002 and remained unseasonally low for the remainder of 2002 and the first half of 2003. The period of low catch rates was attributed to oceanographic conditions, particularly the influence of a large mass of warm water that developed in the vicinity of the Solomon Islands and extended eastward throughout the range of the main albacore longline fisheries. For several fisheries, a GLM model was developed to relate monthly albacore catch rates to the prevailing oceanographic conditions. The models were informative and have applications in considering management issues in the fishery, for example, investigating the frequency and duration of periods of exceptionally low catch rates.

297. A similar effect had been observed in the Indian Ocean in Taiwanese data and the propagation of CPUE declines had been linked to Rossby waves. It was suggested that this should be further investigated. It was noted that Taiwan accounts for most of the albacore catch in the South Pacific and therefore was a better source of consistent data that the newly developed Pacific island longline fisheries. It was suggested that Taiwanese data should be used to look for this effect on a broader scale.

298. The meeting recalled that in last year's assessment the declines in Pacific island fisheries in 2002 were regarded as evidence of localised depletion. The presenter noted that the declines observed in Pacific island longline CPUE for albacore were obscured by the seasonal changes and were not evident after a few months. He further noted that the lower CPUEs observed in these fisheries were also a feature of broader scale longline CPUE for the Taiwanese fleet. It was noted that in the Australian longline fishery there appeared to be a level of fishing effort below which localised depletion was ephemeral while above that level it appeared to be permanent. Localised depletion while still possible, especially when effort increases dramatically on a small geographical scale, now seems less likely than a temporary change in oceanographic conditions as the explanation for the observed declines in recent years in several Pacific island longline fisheries.

299. The importance of this work to Pacific island fisheries managers was noted with the suggestion that this work be continued. It would be particularly useful to be able to anticipate how often such declines in albacore CPUE might occur. In order to conduct such analyses it will be necessary to develop longer time series of CPUE that might be possible using Taiwanese longline data over a broader geographical area.

300. Joe Helu presented working paper SA-8, *An evaluation of recent trends in the domestic longline fisheries operating in the south Pacific Ocean*, evaluating the recent trends in domestic longline fisheries operating in the South Pacific Ocean.

301. The production of indices of stock abundance estimates for albacore in each Pacific island EEZ is hampered by inadequate and incomplete data. To counter these problems, trends in the domestic fleets are evaluated using multiple linear regression and similar fleets and areas are pooled. The areas used in previous stock assessments was further stratified for this purpose along the 180^{o} meridian and 30^{o}S forming 4 areas: NW (Area 1), NE (Area 2), SW (Area 3) and SE (Area 4). An index of abundance was calculated for each area. The stratification and the CPUE trend evaluation of the domestic fleets was used to propose forming three groups: 1) New Caledonia and Fiji, 2) French Polynesia, American Samoa and Tonga, and 3) Samoa and the Cook Islands. New Caledonia and Fiji group is in Area 1 and the other groups are in Area 2. The pooled data and the index of the abundance appear to be more appropriate on a statistical basis for use in MULTIFAN-CL to provide stock abundance estimates for the domestic islands EEZ.

302. The meeting noted that it would be valuable to investigate using Longhurst's oceanographic provinces as an alternative area stratification. It was further noted that to date equivalent data had not been available from American Samoa and that it would be valuable to rerun the analysis using these data.

7.5 Other Items

303. The Chair introduced the final agenda item relating to possible future changes to the stock assessment working group that would facilitate the evaluation of stock assessment results and the development of stock status reports for the Commission.

304. The working group considered the structure used this year was an improvement over previous years, especially in reducing the redundancy inherent in repeating discussion of issues common to most stocks when working groups are aligned along species groups.

305. One future improvement would be to better integrate the consideration of stock assessment methods with the results of stock assessments for a particular stock. It was suggested that more comprehensive reporting by the Methods Working Group would help, especially if that report specifically identified methodological issues affecting the interpretation of the most recent stock assessment results.

306. It was generally agreed that formal stock assessments could not be done for all species of interest to the Commission every year owing to the small number of people with expertise in modelling tuna population dynamics. Discussion identified the need to agree on how to report stock status to the Commission in years when no formal stock assessment is conducted and how to determine which stock assessments will be done in a given year. It was proposed that the Commission's Scientific Committee

should develop a set of principles that would guide the identification of stocks requiring assessments. Such principles might include consideration of:

- Availability of new information that might alter views of stock status
- Concern over stock status or specific sustainability concerns
- Length of time since the last stock assessment
- Changes to stock assessment models and or basic fisheries data

307. Given that a full stock assessment could not be done for all tuna stocks next year, it was proposed that a stock assessment be done for bigeye because of sustainability concerns and South Pacific albacore because of the potential for new methods of CPUE standardisation to alter the most recent assessment (2003). Other tuna stocks would not be assessed in 2005. It was suggested that for stocks where no assessment is conducted that a set of fisheries indicators, including standardised CPUE indices, be developed to provide some basis for determining whether stock status has changed since the last assessment. It was also suggested that for these stocks simpler assessment approaches (e.g. production modelling) might be done.

308. While the focus of the Commission for the foreseeable future will probably be the four main tuna stocks, it was recognised that there is a need for stock assessments of other species. In particular there is likely to be a need to conduct stock assessments for various billfish. To some extent national science groups may meet the requirement for stock assessments of species other than the main tuna stocks and such assessments could be evaluated at future meetings of the Commission's Scientific Committee.

309. It was further suggested that there would be benefit in re-running this year's stock assessments for bigeye and yellowfin with next year's data as well as conducting a new assessment of bigeye. This would provide a sensitivity test of the stock assessment models to new data. The OFP indicated that they could begin that work by re-running this year's assessment models with existing data for 2002. The OFP also reminded the meeting that while the Commission was relying on the OFP to conduct stock assessments in the interim, this additional activity had budget implications, but they would do everything in their power to meet these expectations.

7.6 Summary statement

310. A summary statement on the presentations and discussion of the Stock Assessment Working Group was drafted, circulated to participants and discussed. The agreed statement was incorporated in the Executive Summary.

8. HMS BIOLOGY WORKING GROUP (BWG)

311. Talbot Murray lead the session of the Biology Working Group, outlining the agenda and noting that the aim was to review biological research being carried out in the WCPO within a single working group, instead of it being spread across the previous species-specific and bycatch research groups. Rob Campbell was rapporteur.

8.1 Presentations

312. Shelton Harley presented BIO-3 on length-at-maturity of porbeagle, mako and blue sharks in New Zealand, noting that the purpose of this work was to improve the basis for setting TACs for these species in New Zealand waters. The results indicate that male porbeagle sharks matured at 140–150 cm fork length and females at about 170–180 cm. New Zealand porbeagles therefore mature at shorter lengths than they do in the North Atlantic Ocean. Shortfin mako males matured at 180–185 cm and females at 275–285 cm. Blue shark males matured at about 190–195 cm and females at 170–190 cm; however these estimates were hampered by small sample sizes, difficulty obtaining representative samples from a population segregated by sex and maturity stage, and maturation occurring over a wide length range. It is not clear that regional differences in median maturity exist for shortfin mako and blue sharks.

313. In reply to a question regarding how a TAC would be calculated for shark species, it was explained that this would be based on an assessment of historical catches from within the EEZ. It was also explained that whilst the stock structure of the three species remained uncertain, it was considered that separate stocks of mako and porbeagle sharks could exist in the southwest Pacific whilst blue sharks may have either a similar stock structure or possibly constitute a single Pacific-wide stock. In response to a query about tagging sharks in New Zealand, it was explained that generally such tagging had thus far only been done on an opportunistic basis by recreational fishers. There had been fairly extensive tagging of mako sharks by this means and recoveries indicated a high degree of movement between Fiji and New Zealand waters. The Quota Management Scheme (QMS) also allowed for the release of live fish and so this framework could accommodate more tagging. It was also explained that placement of these sharks under the QMS did not mean that a new fishery for sharks was being developed. In New Zealand, sharks are considered bycatch but there was a move to place all species caught in some volume under the QMS so that catches would be reported and monitored.

314. Shelton Harley presented BIO-4 on age, growth, maturity, longevity and natural mortality of shortfin mako shark. Growth is rapid in early years and quickly declines. Vertebral data showed that males and females grow at similar rates until age 7–9 years, after which the relative growth of males slows. Von Bertalanffy growth parameters were: male L_{inf} = 302.16 cm fork length (FL), K = 0.0524 and t_0 = –9.04 years: female L_{inf} = 732.41 cm FL, K = 0.0154 and t_0 = –10.79 years. MFCL analysis of length frequency data from the tuna longline fishery estimated substantially faster growth than that derived from vertebral ages. MFCL growth rates were considered reliable up to age 2–3 years, and thereafter vertebral ages were considered more reliable. Longevity estimates based on the maximum ages from vertebral band counts were 29 and 28 years for males and females respectively. Natural mortality estimates calculated from Hoenig's (1983) equation were 0.14 for males and 0.15 for females. Ages at 50% maturity determined by probit analysis of paired age and maturity data were 6.9 years for males and 19.1 years for females. Indirect age at maturity estimates from conversion of length at maturity data were 8–9 years for males and 20–21 years for females. Median maturity in males corresponded with the age at which male growth rate declined. Shortfin mako is a large, slow-growing, late-maturing species with high longevity and low natural mortality. Comparison of growth curves reported here with overseas studies suggests there are no regional differences in growth rates.

315. In response to a query as to how the ages were validated, it was explained that the age of at least one fish was validated using the bomb radio carbon method. While Dr. Harley was unsure of the full range of other methods that may be used to age sharks, he indicated that for some shark species other spines could be used. It was also explained that while other methods exist for estimating *M*, the Hoeing equation was used to provide a rough estimate of natural mortality. In response to a query that a maturity of 19 years for a fish that lived to age 28 was an unusual life strategy it was stated that mako sharks in the Atlantic had a similar life strategy, maturing at around 14-15 years and living to around 20 years. It was considered that such a life strategy would not support large catches.

316. Alain Fonteneau presented BIO-8 on natural mortality of tuna as a function of age, using bigeye as an example. Based on a review of the literature concerning this fundamental parameter, the U-shape curve of M_i expected for all living species as a function of their sizes and ages is discussed. High levels of M_i are a biological rule for larvae and juvenile: a minimal rate of M_i tends to be observed before first spawning, followed by increasing M_i during spawning and for older fishes due to biological senescence. The biological factors contributing to variability in M_i for tunas were presented and discussed. The profiles and levels of M_i presently used for bigeye tuna by tuna Commissions were compared. The biological validity of differences in the M_i at juvenile ages between different species (for instance small yellowfin and small bigeye) was discussed. VPA models were conducted on catch at age vectors typical of bigeye fisheries, using various vectors of M_i. A subsequent yield per recruit analysis tends to confirm that the potential negative effects of catching large amounts of small bigeye tuna are highly dependant of the M_i vector. It was concluded that, for bigeye, scientists should take this major biological uncertainty better into account.

317. In response to this presentation it was indicated that juvenile bigeye and yellowfin tuna in Hawaiian waters have different diets that may indicate that they have different life histories. Dr. Fonteneau replied that whilst this may be true, the feeding behaviour in warm tropical waters, where most juvenile fish occurred, was similar. Another query however indicated that, unlike yellowfin, small bigeye vulnerable to pole-and-line fishing do not generally occur in the tropical regions, which again may indicate different life strategies. The meeting was also informed that archival tagging indicated different behaviour between yellowfin and bigeye under FADs. It was also suggested that life characteristics may also be quite different among similar non-fish species, e.g. humans and chimpanzees.

318. David Itano presented BIO-2 on monitoring movement patterns, residence times and feeding ecology of tuna, billfish and oceanic sharks within a network of anchored FADs based on his work with Kim Holland, Laurent Dagorn, Dean Grubbs, and Yannis Papastamatiou. The archipelago-scale movements of yellowfin and bigeye have been examined in Hawaii through conventional tagging experiments to determine exchange rates and interaction between Hawaii-based fisheries. In addition, the PFRP has funded a suite of integrated FAD related investigations examining the feeding behaviour of tuna on FADs as well as broader trophic relationships of tunas in Hawaii compared to the broader eastern and western Pacific basins. The conventional tagging project revealed the overwhelming importance of seamounts, FADs and nearshore ledges to the vulnerability of local tuna resources.

319. In order to gain finer-scale information on how tuna partition their environment, thirteen anchored FADs surrounding the island of Oahu have been equipped with VEMCO sonic receivers. The receivers, mounted 20 m below the FAD float, can detect the presence of sonic tagged fish within approximately 1 km of the buoy. Ninety yellowfin and bigeye tuna have been surgically implanted with individually coded sonic transmitters, with the FADs monitored continuously for a 2 year period. The project is collecting data useful for the estimation of residence times, times of arrival and departure and movement patterns of tuna on FADs that is size and species specific and fishery independent. Behavioural information on directed movements between FADs, school fidelity and cohesion and fishery independent means to evaluate productivity of individual or groups of FADs is also being revealed.

320. In response to a query as to what constituted 'good' and 'bad' FADs, Mr Itano explained that whilst all FADs in the study were similarly constructed, they varied as to the depth of water they were placed in. Some were in deep water (e.g. 2000 m) while others were in shallower waters (e.g. 1000 m). Also, there were differences in the characteristics of their physical location, e.g. along banks etc.

321. Miki Ogura presented BIO-7 on movements of skipjack based on otoliths micro-chemistry and also gave a brief summary of work on stock discrimination based on a preliminary analysis of micro satellite DNA in skipjack. Work on otolith micro-chemistry, done with colleagues Arai, Kotake, Kayama and Watanabe, examined the strontium (Sr) and calcium (Ca) concentrations in otoliths of skipjack tuna in the western Pacific Ocean by wavelength dispersive X-ray spectrometry on an electron microprobe, to find an indicator showing migratory history. Otolith Sr:Ca ratios of tropical water fish were kept to be constant throughout the otolith. In contrast, the ratios of most fish from temperate water had a transition point from low ratio to high ratio. A similar pattern of Sr:Ca ratio was found in a skipjack tagged in temperate waters and recaptured in the tropics. It was suggested that Sr:Ca ratios may be affected by experienced water temperature during their migratory history and it may be a possible environmental indicator of their migratory history.

322. Valerie Allain presented BIO-1 analysing differences in the diet of yellowfin from different areas of the WCPO. This work is being done to improve understanding of ecosystem dynamics and to determine if tuna from the low primary production warm pool move to feed at the edge. Yellowfin diet is analysed to detect differences in different areas of the western and central Pacific using stomach content data and stable isotope analysis as a tracer of trophic level and of the origin of the fish. Yellowfin were collected in Polynesia, New Caledonia, Micronesia and Solomon Islands-Papua New Guinea (SI/PNG). The small number of samples did not allow an analysis of the diet in Micronesia. By weight, the most important prey are fish, molluscs and then crustacea. In New Caledonia, fish are the dominant prey and crustacea are negligible; most of the prey are epi/mesopelagic fish (lancetfish, Scombridae), or epipelagic fish (skipjack, flying fish). The pelagic squid *Stenoteuthis oualaniensis* is also an important prey item. In SI/PNG the diet is dominated by epipelagic prey (flyingfish, skipjack, crab larvae) and by epipelagic juvenile stages of reef/coastal fish (surgeonfish, triggerfish). The pelagic squid *Stenoteuthis oualaniensis* is also important in this area, as is the meso/bathypelagic fish Paralepididae. In Polynesia a large portion of the prey are epipelagic juvenile stages of reef/coastal fish (rabbit fish, triggerfish). Epipelagic prey (skipjack, amphipods),

meso/bathypelagic fish (Paralepididae, Nemichthyidae) and squid are also an important part of the diet. A clear isotope difference is observed between the samples of Micronesia and New Caledonia, samples of SI/PNG are between the two. The lack of data on diet for Micronesia and on isotopes for Polynesia and SI/PNG did not allow explanation of the difference between isotope values observed in the different areas. However, it is highly probable that the large difference observed between New Caledonia and Micronesia (equivalent to one trophic level) is related to geographic isotope differences in the food web rather than to a major difference in diet. Isotope analysis appears to be a good tracer of the geographic origin of the fish. Different trophic structures seem to exist in the different areas; however, the similarities and differences observed need to be confirmed by analysis of additional samples.

323. In response to a query as to whether there were differences related to the size of fish, Dr. Allain explained that one would expect an inverse relationship. One would need to sample fish of the same length to see if they had the same isotope ratios. As to whether the percentage of prey species observed in stomach samples was just a reflection of what was available, and whether there was temporal stability in diets, Dr Allain indicated that collection of data to answer this question remained problematic due to the large amount of data needed. While the project had collected samples over a number of years, the number of samples in any year remained small. It is difficult to measure diel differences in stomach contents as the time of fishing and capture remained uncertain, though one could speculate about diel differences in availability of meso/bathypelagic prey. In reply to a query about whether anchovies had been observed in any stomachs, it was indicated that while they had not, anchovies would be difficult to identify as they were digested very rapidly. It was also noted that samples for a range of other species were also being collected (see INF-ECO-1).

324. Shelton Harley presented BIO-6 on New Zealand's port sampling program for juvenile albacore caught by trolling. Albacore were sampled from three ports, Auckland, New Plymouth and Greymouth in the 2003/4 fishing year. Albacore had a mean fork length of 64.3 cm, and ranged in size from 40–94 cm, with nearly all fish (99%) in the 52-76 cm range. Length-weight relationships were determined for a sub-sample of the fish landed. Nearly all albacore sampled in the troll fishery over the period from 1996/7 to 2003/4 were in the 47–81 cm size range (99%), with a mean fork length of 63.3 cm. There is considerable variability in the size composition from year to year. In contrast longline caught albacore are larger, with an average fork length of 80.0 cm, and most fish (99%) in the 56–104 cm size range. Albacore caught by trolling around the New Zealand coast tend to be smaller than those caught by troll vessels from the USA, fishing in the sub-tropical convergence zone, the only other surface fishery for South Pacific albacore. Fish caught by longline throughout the South Pacific are all larger sub-adult and adult fish. Continued monitoring of catch composition for juvenile albacore in the New Zealand troll fishery is a critical input to the length-based regional stock assessment of the South Pacific albacore stock.

325. After Dr Harley's presentation it was stated by the scientists responsible for conducting the South Pacific albacore stock assessment that the length frequency data collected from the New Zealand troll fishery was a critical input into the South Pacific albacore stock assessment. The troll fishery monitoring was especially important in estimating recruitment to the South Pacific stock as the longline data has very little information on the relative abundance of juvenile albacore. As such continued

monitoring of the size structure of the New Zealand troll fishery was considered critical to the assessment and as such there was a request that the collection of this data be continued. It was also noted that in addition to providing summaries of the size frequency samples taken, it would assist the future consideration of the albacore stock assessment to have these samples scaled to the entire New Zealand troll fishery catch. It was also explained that analyses of otoliths undertaken by the OFP indicated that albacore of 50 cm in length were about 1 year old, which was different from the ages used in previous assessment. This was given as an example of how informative the New Zealand port sampling had been and it was further requested that in addition to the size frequency sampling that has been done that it would help improve our understanding of age and growth if New Zealand could continue to provide otoliths samples as they did in 2003. It was explained that, provided ongoing funding can be secured, every effort would be made to continue port sampling of the troll fishery and it was anticipated that this would include sampling otoliths from the smallest albacore.

8.2 Function of BWG

326. The Chair invited comments on the possible function and future role of the BWG in future scientific meetings and in providing direction for future research.

327. Several comments, supported by the plenary, highlighted the view that the results of fundamental biological research are crucial in underpinning the performance of stock assessments. In this regard, the BWG provides a mechanism for reviewing such work in a timely manner (as publication in journals can take several years) and can assist in identifying key research priorities for future work, especially high priority work required for stock assessments. The formulation of priorities was also seen as important for obtaining funding as it provided a mechanism for highlighting the need of such research to funding agencies. Furthermore, the BWG, through its Chair, would be in a position to champion the need for such work to the undertaken.

328. Several participants also expressed the view that given the ecosystem basis of fisheries management that biological research needed to focus on issues other than just those required to support stock assessments. This included understanding the biology of bycatch species, predator-prey relationships, and the biological processes underpinning the spatial distribution and dynamics of these species. The BWG would also be in a position to direct biological research on species for which stock assessments may be required in the future, such as sharks and billfish.

329. It was also stated that the Commission would need to assemble all biological data required for stock assessment purposes, and in this regard ensure that adequate sampling protocols are adopted throughout the fishery. It was pointed out that within ICCAT all vessels operating in the associated fisheries have a legal requirement to provide samples and that perhaps a similar protocol could be adopted in the WCPO.

330. An opinion was also expressed that at the moment much of the information related the biology of the species caught in the WCPO is scattered and difficult to access, and that one of the role of the WCPF Commission through the Scientific Committee should be to centralize and update such information as the results of research become available. In this regard, a suggestion was made that the Commission consider publishing reports along the lines of the ICCAT SCRS reports.

331. The meeting concluded that improved knowledge of the basic biology of key stocks of tuna, billfish and other HMS caught as bycatch, would be a core requirement for the work of the Commission. It was highlighted that for most species even basic inputs to a stock assessment was lacking. The meeting therefore noted that the Commission should, when developing its databases, make provision for incorporating biological data. It was also noted that the Commission's requirements for information on the biology of HMS should be directly related to information supporting stock assessments and could include such information as maturity ogives, sex ratios, size frequencies, size-at-age, growth parameters, longevity and natural mortality.

8.3 Summary statement

332. A summary statement of the Biology Working Group was drafted, circulated and discussed. The agreed statement is incorporated in the Executive Summary.

9. ECOSYSTEM & BYCATCH WORKING GROUP (EBWG)

333. Paul Dalzell chaired the Ecosystem and Bycatch Working Group, which included seven presentations divided between ecosystem modelling and bycatch research. Brett Molony was rapporteur.

9.1 Modelling

334. There were five presentations under the ecosystem modelling part of the agenda.

335. The first two papers were presented by Patrick Lehody and concerned the application of a spatial ecosystem model to forage population and to the top-predator species. The Spatial Ecosystem And Populations Dynamics Model (SEAPODYM) is an improved version of SEPODYM that was developed at the Oceanic Fisheries Programme since 1995 and presented in previous SCTB meetings. A first major change in this new version is the introduction of several forage components to account for different behaviour of tuna species. This was described in a first working paper (ECO-1). It seems appropriate to classify the micronekton (forage) components based on their vertical distributions, which control their relationships with and availability to top predators; most of both the forage species and the top predator species show daily migrations to the upper layers during the night. A conceptual 3-layer, 7-component model of functional groups of forage was proposed on the basis of a literature review. A first step toward the quantitative modelling of these different components was provided with a 2-layer, 3 component model. Each component is defined as a population of prey of different species characterized by two parameters: the age of recruitment (T_r) in the forage population and the mean age ($T_r + 1/\lambda$) directly linked to the mortality coefficient of the population (λ). Both parameters T_r and λ are linked to the ambient temperature. Transport is described with an advection-diffusion equation, using oceanic currents in the considered layer for the advective terms. A first evaluation of the simulations was presented using direct and indirect observations.

336. With these changes in the forage modelling, it was also necessary to reconsider the approach to link the dynamics of the predators (tuna) to these different prey populations. Several other changes have been introduced; in particular, the possibility to have seasonal reproductive behaviour. Results from a first application to 2 tuna species (skipjack and yellowfin) were presented and discussed in a second working paper (ECO-2). The dynamics of the tuna species is constrained by the definition of two habitat indices. The adult habitat that constrains the movement is based on accessibility coefficients to each forage component, depending on the temperature and oxygen affinities of the species, and age. The spawning habitat constrains the tuna recruitment to environmental conditions (temperature, food and predators). Spawning seasonality is introduced by shifting the conditions of the adult habitat toward those of the spawning habitat in relation with the seasonal cycle of day-length. Multiple fisheries are also include and predicted catch and catch rates used to evaluate the simulations against observations. Future developments and applications that can be envisaged for providing a useful tool for the management of tuna stocks in the context of climate and ecosystem variability, complimentarily with statistical population models.

337. John Hampton presented an analysis of tuna meta-population abundance and size structure as indicators of ecosystem impacts of fishing (ECO-3). The analysis integrated the results of the 2003 skipjack, yellowfin, bigeye and South Pacific albacore MFCL-based assessments to provide estimates of composite abundance and population size structure in the tropical WCPO. The impacts of fishing on abundance and size structure were also estimated. Skipjack and yellowfin dominated the abundance, with yellowfin abundance declining and skipjack abundance increasing over the past 50 years. The impact of fishing on meta-population abundance in recent years is a 30% reduction in abundance from unexploited conditions when skipjack is included, and a 60% reduction if skipjack is excluded. The fishing impacts on size structure are severe for the largest fish of each species. This is an expected result of exploitation. The possible ecosystem responses to depletion of large tunas could include increase in populations of lower trophic levels (prey species) and replacement by competitor species capable of occupying the same niche. Whether the levels of depletion of large tunas estimated here could result or have resulted in such ecosystem responses is difficult to assess with available data and models. Continued monitoring of fishery-induced changes in target species biomass and size structure, the abundance of important non-target species, the trophic dynamics of the ecosystem and models that integrate this information would ultimately be required to answer this question.

338. Discussion of the ECO-3 presentation included a comparison between the results of this study and those of a recent paper (Myers & Worm 2003), which looked at declines in longline CPUE to make conclusions about the status of Pacific (and other oceans) tuna and billfish stocks. It was noted that an unfortunate aspect of the paper by Myers & Worm was that the CPUE of the longline fleet was assumed to be similar across the entire area. The declines were not confined to the area where the data was collected. Discussion also included the application of this approach to the smaller fisheries of isolated island states (e.g. Hawaii), extension of the analysis beyond the study area within the tropical zone, and implications for changes in population fecundity as a result of the loss of large fish.

339. David Kirby presented a paper a paper on the use of individual/agent-based modelling, outlining the philosophy and purpose of the approach and describing a range of applications in both social and natural science (ECO-4). The essence of the individual-based approach is the derivation of the properties of systems from the properties of the individuals constituting those systems. Individual/agent-based models (I/ABMs) are needed:

- because individual properties cannot be fully taken into account in state variable models, and;
- to understand how individual properties determine the system's properties.

This emphasis on *understanding* the system, as a means towards faithful simulation of its aggregate properties, is where I/ABMs can be particularly useful. The computational agents depicted in I/ABMs might be individual animals, plants or people, but they may also be higher-level units such as fish schools, fishing vessels or institutions; the approach is relevant to simulation modelling of any scenario involving information-based and state- and/or environment-dependent decision making. The paper presented some background discussion and an outline of present projects developing I/ABMs and suggested some directions for future research, for example, in exploring the effect of information exchange among fishing vessels on the relationship between CPUE and abundance. A case study towards the development of a rule-based I/ABM for bigeye tuna based on archival tag data was also presented

340. Dr. Kirby then presented a paper on the topic of decadal-scale environmental variability and 'regime shifts' affecting tuna recruitment in the WCPO (ECO-5). Functional approximations for observed long-term variability in tuna recruitment estimates and environmental properties were explored. Long-term variability in recruitment may be periodic and therefore predictable, but while the link to basin-scale climate indices is clear, the link to proximate environmental forcing is not immediately obvious. However, the observed variability is synchronous among species and with large-scale ecosystem changes documented for the North Pacific. An ecosystem indicator called Fisher Information was calculated for both North Pacific and WCPO data and proves capable of detecting regime shifts in both environments. This presentation is preliminary work towards a new project to further investigate the relationship between long-term variability in climate and recruitment in the WCPO, which will formally commence in 2005, funded by the PFRP. The project will focus on retrospective analysis to develop ecosystem indicators, and will explore the use of these indicators in refining recruitment estimates for tunas.

341. There was considerable discussion about the implications of this research and the conclusions that could be drawn from it. Given that this was a preliminary analysis, additional work was clearly required. However, the indication that recruitment may decline to average or below average levels for skipjack, yellowfin and bigeye should not be ignored, given the levels of fishing on yellowfin and bigeye stocks and the potential compounding effect of natural variablity and overfishing.

9.2 Bycatch

342. Talbot Murray presented a paper on fish bycatch in New Zealand tuna longline fisheries (ECO-6) and also referred to the New Zealand National Fishery Report, which included information on seabird bycatch. Data were collected from a local bigeye tuna fishery which fished primarily around the North Island, and a foreign (Japanese) longline charter vessel fishery for southern bluefin tuna around the South Island. Observer coverage in the southern fishery was close to 100% on the four vessel foreign longline charter fleet and between 2-3% on the domestic 50-vessel bigeye tuna fleet. Comprehensive data on fish bycatch from both fleets was presented, with blue shark, albacore and Ray's bream comprising the dominant bycatch. Discussion of this presentation included volume of bird bycatch, use of fish grease as a bird repellent, bycatch variability, use of landings data to estimate bycatch, and sea turtle bycatch.

343. A review was presented by Hiroaki Matsunaga of shark, seabird and sea turtle bycatch in Japanese tuna longline fisheries (ECO-7). Over the time period studied, some shark CPUEs, such as blue sharks, were stable in all oceans, while others, such as shortfin makos showed declining trends in the north Pacific and Atlantic Oceans. Results from the Japanese study on the southern bluefin tuna fishery showed the efficacy of the combination of tori line and blue dyed bait for reducing seabird bycatch. Research on turtle mitigation showed that there was no difference between turtle takes for J-hooks and circle hooks, although the Japanese J-hooks are not exactly the same as the J-hooks used elsewhere, being slightly circular, and the size of the circle hooks is not the same in all studies. However, this study clearly showed that turtles caught on circle hooks were hooked predominantly in the mouth, which may improve the survivorship of sea turtles. Experiments were being conducted with longline gear to identify methods to ensure that hooks were consistently set deep to avoid hooking turtles.

344. There was discussion of the differences in the circle hook experiments versus those conducted by the US in the Atlantic. It was noted that the US experiments used larger circle hooks, and that the Japanese results were similar to observations made in the Azores with smaller circle hooks.

9.3 Recommendations and Future Directions for the Ecosystem & Bycatch Working Group

345. Paul Dalzell sought direction from STCB on the future of the EBWG. It was noted that there had been considerable overlap between the EBWG and the Fishery Technology Working Group (FTWG), particularly regarding bycatch. Although there was some concern about the grouping of ecosystem modelling with bycatch studies, there was consensus that the two topics be maintained in a single working group but that technical measures for bycatch mitigation would also be of interest to the FTWG.

346. Paul Dalzell also asked SCTB to review the previous recommendations generated from the Billfish and Bycatch Research Group (BBRG). The BBRG recommendations were edited as follows, based on the discussions during the EBWG:

1. The Commission may wish to compile a checklist of species for stock assessments beyond those for the four principal species. This would include billfish stocks and those shark species thought to be most at risk

2. The EBWG notes the importance of observer programs in obtaining accurate estimates of bycatch. As such efforts should be made to improve observer coverage in WCPO pelagic fisheries in order to obtain more reliable statistics on bycatch, and to permit risk analysis on bycatch species. Prior to implementation, the objectives for an observer program and the process by which they can be met should be clearly identified

3. With respect to turtle bycatch, the most urgent task is to introduce mitigation measures to minimize turtle bycatch in longline fisheries. Other priorities include using observer programs to estimate turtle mortality rates for various longline fisheries and the collection of biological data. The EBWG also recommends closer collaboration and liaison by participants with the appropriate government and regional agencies to ensure that turtle nesting sites are inventoried, and non-fishery related impacts on turtle populations are clearly identified and addressed, to place fishery impacts to turtle populations in context. Some of this broader analysis may be done by other organizations, but the Commission should remain informed of the issues and be able to evaluate information and analyses as they are used to set management policy

4. The EBWG recommends that a watching brief be maintained on other bycatch issues as they arise, e.g. future developments under the FAO IPOAs on seabird fishery interactions, and on shark fisheries

347. Finally, the EBWG summarized the elements of ecosystem research which will be required for fishery management by the new Commission, as follows;

- Impacts of the environment on pelagic fisheries and stocks
    - Large-scale work on pelagic ecosystem modelling
    - Local-scale (within EEZ) ecosystem modelling
- Impacts of pelagic fisheries on the pelagic ecosystem
    - Use of models such as SEAPODYM, ECOSIM/ECOPATH
    - But, the above require substantial commitment to collection and analysis of time series data (e.g. stomach contents) on species interactions across the WCPO
    - Need to develop new modelling approaches, e.g. I/ABMs
- Bycatch issues
    - Bycatch estimation and fishery impacts relative to other human impacts
    - Bycatch mitigation research
- Habitats of special concern
    - Marine debris impacts
    - Impacts on seamounts

348. At the end of the session for the EBWG, Ray Clarke presented the preliminary results of an analysis investigating the catch of juvenile bigeye and yellowfin tunas by the US purse seine fleet for the years 1989 through 2003. (The criteria for juvenile yellowfin were fish <100 cm, and bigeye <120 cm). Using predominately length-frequency data collected by NMFS samplers in American Samoa, a series of chartlets were developed parsing the available length frequency data collected over the sample period into unassociated (or free schooling/swimming) or associated (natural log or FAD) purse seine sets. The chartlets depict the annual variability of the US purse seine fleet activities over the period, the relative catch of juvenile fish in the sampled catch and the limited likelihood of easily determining "hotspots" within the WCPO. More juveniles were caught in sets associated with FADs and floating objects but there were no hot spots identified from the data.

349. Ray Clarke also showed a figure showing leatherback turtle migrations from PNG which all headed south. This was in response to the presentation by Talbot Murray indicating that a few leatherback turtles had been caught in the domestic longline fishery. Comments by the group after the brief presentation included further dividing the data into more refined size classes, providing information on the relative sample size and expanding the strata to cover a greater area thereby potentially providing more robust estimates of the relative composition of the catch.

9.4 Summary statement

350. A summary statement of the EBWG was drafted, circulated to participants and discussed. The agreed statement is incorporated in the Executive Summary.

10. RESEARCH AND STATISTICS PLANNING

351. Pierre Kleiber led the plenary session on Research and Statistics Planning with Shelton Harley and David Kirby as rapporteurs.

352. The session started with two presentations by Tony Lewis, the first reviewing tuna fisheries and tuna fishery statistical system in the Philippines, and the second presenting a feasibility study for a large-scale tagging project in the WCPO.

10.1 Philippines tuna fisheries and statistical systems

353. The "Review of tuna fisheries and the tuna fishery statistical system in the Philippines", was undertaken following recommendations from SCTB 16, SCG 1 and 2, and PrepCon 5, with funding support from ACIAR. The one-month review was undertaken in July 2004, and will be followed by a workshop in October, to consider the outcomes of the review and recommend necessary actions to improve the current system. Preliminary indications are that the current tuna catch by Philippine flag vessels is considerably underestimated, but that much of the unaccounted catch is taken outside Philippines waters. The Philippines would not currently be in a position to fulfil data reporting obligations to the WCPF Commission. Various steps to improve the situation, involving activities by the Bureau of Agricultural Statistics (BAS), the Bureau of Fisheries and Aquatic Resources (BFAR) and other agencies, in cooperation with industry, will be proposed to the October workshop. Some funding has already been committed by several countries to support these initiatives.

354. Chi Loo Sun noted that OFP had assisted in setting up systems and asked if we see results from those efforts and what might be done to improve things now.

355. Dr. Lewis replied that OFP was involved in 1993/4 in sampling tuna landings, which was the genesis of the national stock assessment program. Residual problems are not with the assessment program but with a new mandate to transfer responsibilities to a different agency. The system is still providing useful information.

356. John Hampton expressed thanks to Dr. Lewis for a undertaking a big task with important implications for stock assessments: if we can incorporate these data into assessment models they should improve. He then asked if Taiwanese catch is documented in the system or whether Taiwan can provide the data directly

357. Dr. Lewis clarified that about 50 000 mt is landed a year, half of which is exported by airfreight. There are good landings and size composition data but catch estimates do not include unlicensed vessels; basic calculations suggest that catch by these vessels is between 5000 and 10 000 mt.

358. Chung-Hai Kwoh informed the meeting that some small longliners are operating in neighbouring high seas, some of which are based in Philippines. Taiwan has tried to get landing figures but these are not likely to be made available without cooperation from other countries

359. David Itano asked to what degree will these data enter the tuna fishery yearbook or other documentation.

360. Tim Lawson responded that it is a bit early to revise yearbook estimates based on this information but this item will be discussed at a workshop in Manila in October. When BAS sends information back to SPC we can use this in MFCL, but for now we can note in the yearbook that current estimates are probably underestimated.

10.2 Large Scale Tuna Tagging Project

361. Dr Lewis then presented a progress report on the development of a proposal for a large scale tagging project in WCPO, as recommended by successive SCTBs as a high priority research need. The objective of the project would be to provide updated assessments of yellowfin, bigeye and skipjack tuna throughout the range of their stock in the WCPO, based on a large-scale tagging experiment, to reduce uncertainty in existing stock assessments and to estimate current exploitation rates for all species. Nominal release targets were identified, based on expected return rates at assumed current exploitation rates, and return numbers necessary for robust parameter estimation. Requirements of the experimental design were identified, with options for the optimal tagging platform (vessel) ranging between a single all-purpose vessel or a tactical modular approach involving a combination of vessels and fishing opportunities in various areas. The former option was likely to be more cost effective provided a suitable vessel could be identified and operated. An indicative budget of USD 5.5 million was outlined, this providing a target for seeking funding support.

362. Sung Kwon Soh asked about the duration of such a project and how many vessels might be involved.

363. Dr. Lewis responded that the project would take place over a minimum of 2 years but may stretch over a longer time period in order to cover seasonal and interannual changes in oceanographic conditions. The core work would be done by a single pole-and-line vessel augmented by selective charters for other situations.

364. There was a suggestion to form a small working group to develop the proposal further and perhaps develop a brochure to market the proposal and to present to PrepCon 7 in December.

365. Shelton Harley stated that realistic rewards and high observer covereage have made EPO tagging successful and asked whether this is incorpoated in the budget.

366. Dr. Lewis noted that the OFP had pioneered such an approach, with extensive coverage and suitable rewards; observers are not covered in this budget but are expected to be financed directly through the Commission budget.

367. John Hampton thanked Dr. Lewis for his presentation. He also noted that recovery rates may be conservative. Dr. Hampton suggested that the concept of a large scale tagging project over a 2 year time frame, executed every 10 years, as a routine quasi-fisheries independent tool (cf. trawl surveys for demersal fisheries), is an idea that we should promote. This project would be a good demonstration of the concept, but in the long term, tagging should simply be routine. Buying a vessel could be a good idea compared to charter costs for a long period.

368. Dr. Lewis stated that the possibility of buying a vessel has been explored in the Philippines but there are not many steel pole-and-line vessels left. These can be more easily modified than fibreglass-reinforced plastic vessels.

369. John Sibert supported continuous tagging, noting that while the cost seems high it is a trivial amount to invest in an industry worth ca. US$ 2 billion a year.

370. Apolosi Turaganivalu also supported the project and asked whether albacore might be included in the study.

371. Dr. Lewis responed that while no-one would doubt the value of an ALB program it would need a different approach and a different vessel; however, if there were sufficient interest then a different project should be developed.

372. Talbot Murray noticed the emphasis on BET, YFT and SKJ and wondered how we might emphasise BET & YFT and if there were a way to extend the project to cover the whole distribution of BET, in collaboration with IATTC for example.

373. Dr. Lewis noted that there is a clear directive from SCG that this tagging should be undertaken in coordination with tagging in the EPO. It is not clear whether this can be done simultaneously as EPO tagging is already underway. A range of options has been prepared to maximise the proportion of BET. This is always a problem with pole-and-line catches so we must look at different techniques, e.g. work on Cross Seamount illustrates innovative ways to take a large size range of BET. Tagging around TAO bouys would also help. Extending the geographical range of the project would simply cost more but could easily be done

374. John Hampton stated that the OFP is discussing with IATTC the possibility of extending their current program into the central Pacific. There is a need to identify funding sources but 2 possible vessels have been identified in the Solomon Islands.

375. Chung-Hai Kwoh asked about how the numbers of releases (30 000–50 000 for each species) were selected.

376. Dr. Lewis clarified that the starting point was based on simulations done to work out number of returns needed to have robust parameters in assessment models.

377. David Itano, in reference to Dr. Murray's question on BET, recommended that vessels should be equipped with state of the art electronics, detecting and deploying FADS, and suggested that it may be possible to solicit manufacturers to sponsor the project and donate equipment. Dr. Lewis acknowledged this as a good point and noted the general need to maximise regional participation.

378. Rob Campbell asked whether the tags to be used had been chosen and costed.

379. Dr. Lewis replied that while this was a crucial part of experiment it had not been specifically costed as it was not an expensive component of the overall project.

380. John Hampton asked if there were any ideas to deal with the problems in maximising the chances of catching BET. This would necessitate moving East but it then becomes difficult to get good bait supply. The plan for IATTC is to bring a full load of bait from the Gulf of Panama but we wouldn't be able to do the same.

381. Dr. Lewis agreed that in the WCPO bait species are much less robust but we could use milkfish from Kiribati, or purchase bait in Hawaii and Japan.

382. Alain Fonteneau stated that in the Indian Ocean, where a similar project is underway, each country is paying US$ 200 000 and the EU is paying US$ 17 million; they have 2 pole-and-line vessels for 1.5 years. Dr. Fonteneau felt that it should be possible to obtain funding from the EU under the Lomé agreement. There is plenty of money available but it is difficult to spend because of the strict criteria that apply. The meeting was encouraged by this and felt that it needed to know more about strategic funding from the EU.

383. Zero Suzuki stated his appreciation of efforts so far but was concerned that the final proposal to the Commission would require a lot more detail, so we should establish a strategy and a coordinating group to develop the proposal as soon as possible. The final proposal should emphasise the need to cover a wide area, in order to maximise the chances of getting funding. For example, there would be a possibility of help from Japan for tagging of SKJ near the Marshall Islands.

384. John Sibert spoke in support of Dr Suzuki, stating that it is hard to estimate movement parameters from areas with few tag releases/recaptures: RTTP was difficult in that regard as it was too spatially constrained.

385. John Hampton agreed that there was a need to develop a full proposal for the Commission but felt that at the first meeting it probably wouldn't be ready to make a decision or to endorse. Nevertheless, we should have the concept ready and available, while the detailed operational plan can be spelled out subsequently. A working group to develop this is a good idea and we should consider how to finance this.

386. Talbot Murray endorsed this view and added that there is a need to put the concept to the Commission as soon as possible, to emphasise how the experiment will help inform decision making with regard to management options. There is a need to be more specific about cost and justification. We also need to know more about the BET tagging carried out by IATTC and to map how the two programs could work together, to demonstrate paths of cooperation between the Commissions and to detail any extra benefits that might derive.

387. Gary Sakagawa added that we should also be looking ahead beyond immediate concerns (i.e. BET) to other issues (i.e. SKJ). He supported the idea of having a group to consider expansion of this activity to other regions, bringing in as many external groups as possible, so as to ensure that recoveries occur.

10. 3 Further discussion on research and statisics planning

388. The meeting then discussed a broad list of research and fishery statistics needs presented by the Chairman, and John Hampton presented a list of research issues relating to the development of an ecosystem approach to fisheries management. There was considerable debate about the best format for structuring the discussion and presenting these issues, during which the meeting was reminded by Lara Manarangi-Trott that the Convention already provided definitions and guidance as to the areas of research required. Furthermore, SCTB 16 and SCG 2 had identified a range of research priorities that were not reflected in the topics for discussion. The meeting therefore adjourned for lunch while a Drafting Committee chaired by Pierre Kleiber met to restructure the list of research topics considering the points raised in plenary. When SCTB 17 reconvened, the following points were presented, discussed and approved for inclusion in the Executive Summary:

Better estimation of current catch and catch composition from Indonesia, Philippines and Vietnam

389. A 'Proposal for monitoring the catches of highly migratory species in the Philippines and the Pacific Ocean waters of Indonesia' was presented at PrepCon VI (Bali, April 2004). Under this project, a review of the tuna fisheries and the current statistical system was conducted in the Philippines in July 2004, with funding from Australia. This review highlighted significant problems with the collation of fisheries statistics in the Philippines. One year of port sampling will commence later in 2004, with funding from the United States and another donor. SCTB strongly encouraged potential donors to contribute funds for the balance of the project, i.e. a second year of port sampling in the Philippines and two years of port sampling in Indonesia. There is also a continuing need to compile information on the longline fishery in Vietnam, including estimates of annual catches.

Reconstruction of early catch history (catch, effort, size composition) for all fisheries

390. The incorporation of complete time series of significant industrial fishing into stock assessments generally allows a fuller understanding of population abundance variability over a range of environmental regimes. Significant progress has been made, e.g. the incorporation of pre-1965 Japanese longline size data into bigeye and yellowfin tuna stock assessments. Current work is examining pre-1972 skipjack data for the Japanese pole-and-line fisheries. Further efforts in this area will be important to further reduce uncertainties in the stock assessment.

Further development of methods to standardise effort, including the better use of vessel operational details, environmental data and archival tagging data

391. This work has been ongoing and improvements in effort standardisation for both longline and purse-seine fisheries were presented to SCTB 17. There is a need for finer scale data on the environment and on habitat preferences, as well as information on vessel, gear and operational details, for example, better information to estimate hook depths. Additional variables may be included in the standardisation of effort and more flexible use of standardized effort made in assessment models. There is a forthcoming IATTC meeting on purse seine effort standardization and its deliberations will be considered. The use of 'Longhurst'-type Large Marine Ecosystems as regions for stock assessments will be explored.

Ongoing efforts to reduce uncertainty in assessments, through improved data inputs, sensitivity analysis and simulations

392. There is a need for better species composition data, especially on improved discrimination between small yellowfin and bigeye. Statistical relations among observer, logbook, and port sampling and landing data need to be established. WPFC databases should provide for general biological data, particularly for parameters relevant to stock assessment. Assessment models should refine the parameterization of catchability between regions and explore the estimation of mortality at age. The use of simple production models may also be explored. Bigeye assessments should be compared for the EPO, WCPO, Pacific-wide and with other oceans. Fishing power and effort needs to be characterized and quantified, and there is a broad range of issues related to FADs.

Evaluation of possible regime shifts/changes in productivity and development of improved/alternative estimates of recruitment where possible

393. In response to the SCG 2 recommendations, a project proposal was developed by OFP in collaboration with NRIFSF and NIWA. The project has been funded by the Pelagic Fisheries Research Program of the University of Hawaii and preliminary results were presented at SCTB 17. This work will continue through the collection of empirical data and simulation studies to characterise long-term variability in catch histories and physical/biological time series from the WCPO. Operational metrics to detect changes in productivity and recruitment will be developed. These and other ecosystem indicators may then be used in stock assessments. SCTB 17 also recommends the development of empirical recruitment indicators to compare with model estimations

Large-scale tagging experiments for the main target tuna species in the WCPO

394. This has been recommended by successive SCTBs as the highest research priority for the region. Such a project will provide better estimates of movement, mortality and other important parameters for stock assessment. Previous work undertaken more than 10 years ago has underpinned stock assessments but there is a need for regular if not continuous tagging studies of all species of interest. This work could be considered analogous to trawl surveys for demersal fisheries as the data provided are quasi-independent of the fisheries themselves. A large-scale tagging experiment would also permit further scientific research relevant to WCPO fisheries, including biology, ecology and oceanography. Various options for conducting tagging of tropical tunas were presented to SCTB 17 and the likely costs of a two-year tag release programme estimated. The meeting agreed to establish a small group to further develop a concept paper that might be made available to the Commission at its December 2004 meeting.

Assessing impacts of fishing and the environment on the pelagic ecosystem

395. The WCPFC Convention (Article 5d) requires members 'to assess the impacts of fishing, other human activities and environmental factors on target stocks, non-target species, and species belonging to the same ecosystem or dependent upon or associated with the target stocks'. This can be achieved through studies of forage species by in situ sampling and/or diet analysis, the continued development of modelling methodologies, the definition and identification of habitats of special concern, and the mitigation of bycatch. Biological/ecological studies should be carried out for species of special concern.

Regional Observer Programme

396. Article 28 of the Convention requires the Commission to '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'. The data needed for scientific purposes includes size and species composition, bycatch and discards. There needs to be coordination with national observer programmes, particularly regarding species of special concern. Additionally, there is a need for sub-regional coordinators for supervision of port samplers and observers. Data collection needs to be expanded to all fleets, in particular distant water longline fleets, and information should be collected on IUU (Illegal, Unregulated, Unreported) fishing activities.

11. CONSIDERATION OF ISSUES REQUESTED BY PrepCon WG II

397. Gary Sakagawa led the session dealing with the Consideration of issues requested by PrepCon WG II, with Brett Molony and Karl Staisch as rapporteurs.

11.1 Data Standards

398. Two working papers (SWG6 and SWG8) were presented as an introduction to data standards for the new Commission. The first paper (SWG 6) was presented by Lara Manarangi-Trott and provided a review of the legal framework for data requirements. The second paper (SWG8) was presented by Tim Lawson and provided specific tasks on data standards and requirements to be addressed by the Commission.

399. The groups concluded that data standards are an important task that the Commission needs to address. This task could be guided by information in SWG 6.

11.2 Requisites for management options analyses

400. A presentation was given by Brett Molony on the highlights of the GEN-2 and GEN-3 papers, which reviewed the fleet capacity, catch and effort of the purse seine and longline fleets, respectively. In addition, the length–frequency of bigeye and yellowfin tuna captured by the two fisheries, and from different sets in the purse seine fishery, were compared.

401. Although the numbers of purse seine and longline vessels had increased dramatically, the capacity of each fleet was poorly understood, with only limited data available on vessel registries. Further, the vessels on the longline registry held by the FFA only incorporated distant water vessels (about 23% of the entire WCPO fleet). It was noted that individual countries have individual registers that should be collected to produce a more complete WCPO registry.

402. Catch and effort in both fisheries was increasing, especially in equatorial areas (MFCL Regions 2 & 3 from BET and YFT assessments). Longliners captured much larger fish, on average, than purse seiners, although size data was limited.

403. In the longline fishery, bigeye catches had increased while yellowfin catches had decreased by 50% since 1980. This is due to a shift to deeper hook setting by the longline fleet to better target bigeye tunas. As a result, bigeye CPUE was higher for the major fleets than the overall mean WCPO CPUE. The CPUE for yellowfin was similar for all fleets in the WCPO. More larger and smaller yellowfin were captured in MFCL Region 3 than Region 2 by the longline fleet. Although the data were limited, a similar pattern for bigeye was apparent.

404. In the purse seine fleet, set type was the major influence on bigeye CPUE, with FAD and log sets displaying a CPUE 10 -100 time higher than from unassociated sets. Yellowfin CPUE was not affected by set type. Although drifting FADs have allowed bigeye catches to increase in MFCL Region 3 there was no evidence of bigeye hotspots. Larger yellowfin were captured in unassociated sets compared to log and FAD sets, although a similar CPUE (tonnes per set) was recorded for all set types. Larger yellowfin were captured from within MFCL Region 3 than in Region 2, with a higher proportion of larger yellowfin from unassociated sets. Although the data were limited, a similar pattern for bigeye was apparent.

405. It was noted that the Philippine and Indonesian data was not included in this presentation due to data quality issues. However, the information would be of use by SCG 3 in discussions on developing management options.

11.3 Reference Points

406. The groups discussed reference points and decisions rules for management. With regard to Reference points it was pointed out that discussing reference points at this meeting may be a bit premature because managers of the new Commission would need to provide guidance on their requirements. Specific reference points could then be identified to guide the new Commission.

407. IATTC had a meeting on reference points and that this would be a good guide for the technical discussion. It was noted that a paper on reference points was presented at SCTB 15 and this should be referred in future discussions. It was also noted that protocols used by the United States and Australia, for example, should be reviewed and appropriate parts adopted.

408. It was noted that data for SCTB 17 stock assessment results are not up to date but 2 years old; in some cases, findings were based on data up to 5 years old. Therefore reference points need to be flexible and conservative and not necessarily those for equilibrium conditions. It was also noted that having a single reference point would be dangerous and that a number of reference points need to be used. Again, the Commission would need to provide advice on its requirements.

409. The group was also reminded that the UN fish-stocks agreement refers to reference points but does not specify that the points have to be equilibrium conditions; however, if equilibrium reference points are used then it wouldn't be in contravention of the UN agreement. With this in mind it was noted that at all times the best and clearest advice with respect to available reference points should always be provided.

410. It was concluded that the subject is very broad and time didn't permit for a thorough discussion, the group decided to leave further discussion on this matter to the SCG. Further, the new Commission would decide on what management advice and management objectives it needs and it is hoped that the new Commission will discuss them with the Scientific Committee. The group was reminded that a range of tools are available to assess management options and measures.

11.4 Structure of current WGs

411. There was agreement that the current structure of WGs as used in SCTB 17 was very effective and was an improvement over the previous structure. It was also noted that the process works well when the chairs of the WGs work as a team in steering and coordinating their activities during the period between meetings. The group therefore recommended that a similar structure be used by the Commission.

11.5 Summary statement

412. A summary statement on the outcomes of Consideration of issues requested by PrepCon WG II was drafted, circulated to participants and discussed. The agreed statement was incorporated in the Executive Summary.

12. CLOSE OF MEETING

413. At the end of SCTB 17, Chairman Sung Kwon Soh (Korea) asked participants to share their personal experiences of the SCTB.

414. Apolosi Turaganivalu (Fiji, on behalf of the Pacific Island countries), John Hampton (OFP), John Sibert (PFRP, USA), Chung-Hai Kwoh (Taiwan), Ziro Suzuki (NRIFSF, Japan), Talbot Murray (New Zealand), Jacek Majkowski (FAO), and Chairman Soh himself all spoke fondly of the achievements of the SCTB throughout the years.

415. All speakers were in agreement that the SCTB had achieved far more than its original modest goals, that the data collection, compilation and analyses have evolved dramatically, and that the stock assessments are now world class.

416. Notwithstanding the concerns expressed by SCTB 17, stock conditions remain healthier in our region than for other oceans and participants expressed the hope that sustainability of the resources would be ensured by quick and wise management.

417. One of the most important achievements of SCTB has been to bring together representatives of the Distant Water Fishing Nations and the Pacific Island Countries and Territories on an equal footing. Colleagues have become friends and from friendships grew understanding. This has assisted the development of Pacific Island Countries and Territories and of WCPO fisheries. SCTB has provided a unique experience and learning process and participants at SCTB 17 hope that the collegiality and cooperative spirit of SCTB will continue through into the SC.

418. All speakers highlighted the critical role played by the SPC, and in particular the OFP and its present and previous leaders, in providing support for SCTB meetings and technical assistance to SPC members and other parties. Views were expressed that the critical role of the OFP be retained and its capabilities expanded within the context of the new Commission.

419. Thanks were extended to our Chair, Sung Kwon Soh, to all the Working Group Chairs, to the rapporteurs, and a special thanks to Glen Joseph and all the MIMRA team for hosting this last meeting of SCTB. Glen Joseph thanked the Honourable Minister John M. Silk, all the MIMRA staff, the participants at STCB17, the staff of OFP and the Marshall Island Resort staff.

420. Our Chair then formally closed the last meeting of SCTB on Wednesday 18th August 2004, at 17:45 hrs, bidding farewell to SCTB and welcome to the SC and the new Commission.

APPENDIX 1. AGENDA

17th Meeting of the Standing Committee on Tuna and Billfish
Majuro, Marshall Islands
9-18 August 2004

Date	Time	Agenda Item
Sun 8 Aug	1600-1700	Registration
Mon 9 Aug	0830-1700	Methods WG (Chair – John Sibert) Statistics WG (Chair – Tim Lawson)
Tue 10 Aug	0830-1700	Methods WG (Chair – John Sibert) Fishing Technology WG (Chair – David Itano)
Wed 11 Aug	0800-0900	Registration
	0900-0945	Plenary session Preliminaries Announcements Opening address Adoption of agenda and format of reports Adoption of the SCTB 16 Report Appointment of coordinating rapporteur Outline of issues requested for SCTB/SCG consideration
	0945-1030	Plenary session Overview of WCPO tuna fisheries GEN 1: Overview of fisheries, including economic condition
	1100-1230 1400-1530 1600-1730	Plenary session • National Tuna Fishery Reports • Reports by Regional Fisheries Organizations (limit of 10 minutes, 8 slides per presentation)
Thu 12 Aug	0830-1000	Statistics WG (Chair: Tim Lawson)
	1030-1230	Fishing Technology WG (Chair: David Itano) Methods WG (Chair: John Sibert)
	1400-1530 1600-1730	HMS Biology WG (Chair: Dan Sua) • Age and growth • Reproductive biology • Tagging studies (conventional and archival) • Other biological work of relevance to stock assessment

<table>
<tr><td rowspan="4">Fri 13 Aug</td><td>0830-1000</td><td rowspan="6"><u>HMS Stock Assessment WG</u> (Co-Chairs: Naozumi Miyabe & Max Stocker)
• Longline CPUE analyses for bigeye and yellowfin – habitat models, GLMs, etc
• MFCL bigeye assessment
• MFCL yellowfin assessment
• Skipjack assessment – CPUE analyses
• Albacore assessment – CPUE analyses
• Billfish assessments
• Others ?</td></tr>
<tr><td>1030-1230</td></tr>
<tr><td>1400-1530</td></tr>
<tr><td>1600-1730</td></tr>
<tr><td rowspan="2">Sat 14 Aug</td><td>0830-1000</td></tr>
<tr><td>1030-1230</td></tr>
<tr><td>Sun 15 Aug</td><td colspan="2">Free day</td></tr>
<tr><td rowspan="4">Mon 16 Aug</td><td>0830-1000</td><td rowspan="4"><u>Ecosystems WG</u> (Chair: Paul Dalzell)
• Ecosystem modelling (e.g. SEPODYM and others)
• Ecosystem description
• By-catch issues</td></tr>
<tr><td>1030-1230</td></tr>
<tr><td>1400-1530</td></tr>
<tr><td>1600-1730</td></tr>
<tr><td rowspan="4">Tue 17 Aug</td><td>0830-1000</td><td rowspan="2"><u>Plenary session</u>
Research and statistics planning</td></tr>
<tr><td>1030-1230</td></tr>
<tr><td>1400-1530</td><td rowspan="2"><u>Plenary session</u>
Consideration of issues requested by PrepCon WG II</td></tr>
<tr><td>1600-1730</td></tr>
<tr><td rowspan="4">Wed 18 Aug</td><td>0830-1000</td><td rowspan="4"><u>Plenary session</u>
Clear Executive Summary
Close</td></tr>
<tr><td>1030-1230</td></tr>
<tr><td>1400-1530</td></tr>
<tr><td>1600-1730</td></tr>
<tr><td>Thu-Sat 19-21 Aug</td><td colspan="2">SCG 3</td></tr>
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APPENDIX 2. LIST OF WORKING PAPERS

WORKING PAPERS

GENERAL

GEN–1 Williams P, Reid C. **Overview of the western and central Pacific Ocean (WCPO) tuna fisheries, including economic conditions – 2003.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia and Forum Fisheries Agency. Honiara, Solomon Islands.

GEN–2 Molony BW. **Review of fleet capacity, catch and effort of the purse-seine fleets in the Western Central Pacific Ocean, with emphasis on the use of FADs.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

GEN–3 Molony BW. **Review of fleet capacity, catch and effort of the long-line fleets in the Western Central Pacific Ocean**. Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

STATISTICS WORKING GROUP

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

SWG–2 Lawson T. **Estimates of annual catches of albacore, bigeye, skipjack and yellowfin tuna in the Western and Central Pacific Ocean.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

SWG–3 Williams P. **Estimates of annual catches for billfish species taken in commercial fisheries of the western and central Pacific Ocean.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

SWG–4 Lawson T. **Observer coverage rates and reliability of CPUE estimates for offshore longliners in tropical waters of the Western and Central Pacific Ocean.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

SWG–5 Lawson T. **Availability of observer data for estimating catches of non-target species by longliners in the Western and Central Pacific Ocean, with catch estimates for offshore fleets in tropical waters.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

SWG–6 Lawson T. **Information regarding anticipated data-related tasks for the WCPFC Scientific Committee.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

SWG–7 Williams P. **Preliminary review of data collection forms used in Philippines tuna fisheries.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

SWG–8 Manarangi-Trott L. **Legal aspects governing fisheries data.** Ministry of Marine Resources, Rarotonga, Cook Islands and the University of Wollongong, N.S.W., Australia.

METHODS WORKING GROUP

MWG–1 Campbell R. **Performance indices, reference points and use of CUSUM plots for monitoring the performance of the longline fishery off eastern Australia.** CSIRO Marine Research, Hobart, Australia.

MWG–2 Wang C-H. **Improvement of the Schaefer model and its application.** Institute of Oceanography, National Taiwan University, Taipei, Taiwan, ROC.

MWG–3 Kolody DS, Jumppanen PC, Ricard DG, Hartog JR, Preece AL, Polacheck T. **Extracts from SESAME: a simulation-estimation stock assessment model evaluation project focused on large pelagic species.** CSIRO Marine Research, Hobart, Australia.

MWG–4 Sibert J. **Comparison of stock assessment methods using an operational model.** Pelagic Fisheries Research Program, JIMAR, University of Hawaii, USA.

FISHING TECHNOLOGY WORKING GROUP

FTWG–1 Millar C, Schneiter E. **Review of vessel and gear attribute data held by SPC and FFA.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

FTWG–2 Itano DG. **Vessel and gear attributes useful for the long-term monitoring and management of WCPO tropical tuna fisheries.** Pelagic Fisheries Research Program, JIMAR, University of Hawaii, USA.

FTWG–3 Williams PG. **Average purse seine vessel production in the Western and Central Pacific Ocean (WCPO) by fleet for the period 1980–2003.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

FTWG–4 Langley A. **An analysis of the main factors influencing the catch of bigeye tuna in purse seine drifting FAD sets.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

FTWG–5 Squires D, Reid C. **Using Malmquist indices to measure changes in total factor productivity of purse-seine vessels while accounting for changes in capacity utilisation, the resource stock and the environment.** National Marine Fisheries Service, USA. Forum Fisheries Agency, Honiara, Solomon Islands.

FTWG–6 Rodwell L. **FFA initiatives related to the Palau Arrangement, purse seine management and the management of bigeye fishing mortality in the WCPO.** Forum Fisheries Agency, Honiara, Solomon Islands.

FTWG–7 **Technology related projects and proposals to mitigate bycatch levels in longline and purse seine fisheries.**

a. Beverly S, Itano D. **Trial setting of deep longline techniques to reduce bycatch and increase targeting of deep-swimming tunas.** Secretariat of the Pacific Community, Noumea, New Caledonia and University of Hawaii, Honolulu, Hawaii.

b. Gilman E, Brothers N, Kobayashi D. **Assessment of methods to minimize seabird mortality in Hawaii pelagic longline fisheries – abstract.** Blue Ocean Institute, Honolulu, Hawaii

c. Gilman E, Boggs C, Brothers N. **Performance assessment of an underwater setting chute to mitigate seabird bycatch in the Hawaii pelagic longline tuna fishery – abstract.** Blue Ocean Institute, Honolulu, Hawaii

d Gilman E, Watson J, Boggs CH. **State of knowledge for minimizing turtle bycatch in pelagic longline fisheries – abstract.** Blue Ocean Institute, Honolulu, Hawaii

e. Swimmer Y, Arauz R, Ballestero J, McNaughton L, Higgins B, McCracken M, Brill R. **Effects of bait colour on sea turtle-longline fishing gear interactions: Can blue bait reduce turtle bycatch in commercial fisheries?** National Marine Fisheries Service, Honolulu, Hawaii

f. Swimmer Y, Arauz R, Musyl M, Mc Naughton L, Ballestero J,. Brill RW. **Survivorship and dive behaviour of olive ridley (*Lepidochelys olivacea*) sea turtles after their release from longline fishing gear off Costa Rica**. National Marine Fisheries Service, Honolulu, Hawaii

g. Nelson P. **Reducing juvenile bigeye tuna mortality in FAD sets.** Inter-American Tropical Tuna Commission, La Jolla, USA

HMS BIOLOGY WORKING GROUP

BIO–1 Allain V. **Diet of yellowfin tuna in different areas of the western and central Pacific Ocean.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

BIO–2 Itano DG, Holland K, Dagorn L, Grubbs D, Papastamatiou Y. **Monitoring movement patterns, residence times and feeding ecology of tuna, billfish and oceanic sharks within a network of anchored FADs.** Pelagic Fisheries Research Program, JIMAR, University of Hawaii, USA.

BIO–3 Francis MP, Duffy C. **Length at maturity in three pelagic sharks (*Lamna nasu, Isurus oxyrinchus* and *Prionace glauca*) from New Zealand**. National Institute of Water and Atmospheric Research, New Zealand; Ministry of Fisheries, New Zealand.

BIO–4 Bishop SD, Francis MP, Duffy C. **Age, growth, maturity, longevity and natural mortality of the shortfin mako shark (*Isurus oxyrinchus*) in New Zealand waters.** National Institute of Water and Atmospheric Research, New Zealand; Ministry of Fisheries, New Zealand.

BIO–5 Manning MJ, Francis MP. **Age and growth of blue sharks from the New Zealand Exclusive Economic Zone.** National Institute of Water and Atmospheric Research, New Zealand; Ministry of Fisheries, New Zealand. (Available at later time).

BIO–6 Griggs L. **Monitoring the length structure of New Zealand commercial landings of albacore during the 2003/04 fishing year.** National Institute of Water and Atmospheric Research, New Zealand; Ministry of Fisheries, New Zealand.

BIO–7 Arai T, Kotake A, Kayama S, Ogura M, Watanabe Y. **Movements and stock discrimination of skipjack tuna, *Katuwonus pelamis*, in the Western Pacific by otolith Sr:Ca ratios.** National Research Institute of Far Seas Fisheries, Shimizu, Japan.

BIO–8 Fonteneau A, Pallares P. **Tuna natural mortality as a function of their age: the bigeye tuna case.** IRD, Sete, France.

HMS STOCK ASSESSMENT WORKING GROUP

SA–1 Hampton J, Kleiber P, Langley A, Hiramatsu K. **Stock assessment of yellowfin tuna in the western and central Pacific Ocean.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

SA–2 Hampton J, Kleiber P, Langley A, Hiramatsu K. **Stock assessment of bigeye tuna in the western and central Pacific Ocean.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

SA–3 Wang C-H. **Assessing south Pacific albacore stocks by improved Schaefer model.** Institute of Oceanography, National Taiwan University, Taipei, Taiwan, ROC.

SA–4 Langley AD. **An examination of the influence of recent oceanographic conditions on the catch rate of albacore in the main domestic longline fisheries.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

SA–5 Langley AD. **A standardised analysis of skipjack tuna CPUE from the WCPO drifting FAD fishery within skipjack assessment area 6 (MFCL 6).** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

SA–6 Langley AD. **A spatially-based analysis of Purse-seine skipjack CPUE from unassociated sets in the equatorial area of the WCPO, including the development of an oceanographic model for the fishery.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

SA–7 Bigelow K, Langley AD, Patterson T. **Relative abundance indices of the Japanese longline fishery for bigeye and yellowfin tuna in the western and central Pacific.** National Marine Fisheries Service, Honolulu, Hawaii. Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

SA–8 Langitoto Helu S. **An evaluation of recent trends in the domestic longline fisheries operating in the south Pacific Ocean.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia; University of Auckland, New Zealand.

SA–9 IATTC. **Tuna and billfish in the EPO in 2003.** Inter-American Tropical Tuna Commission. La Jolla, USA.

HMS ECOSYSTEM WORKING GROUP

ECO–1 Lehodey P. **A Spatial Ecosystem And Populations Dynamics Model (SEAPODYM) for tuna and associated oceanic top-predator species: Part I - Lower and intermediate trophic components.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

ECO–2 Lehodey P. **A Spatial Ecosystem And Populations Dynamics Model (SEAPODYM) for tuna and associated oceanic top-predator species: Part II - Tuna dynamics and fisheries.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

ECO–3 Hampton WJ. **Tuna Meta-Population Abundance and Size Structure as Indicators of Ecosystem Impacts of Fishing.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

ECO–4 Kirby DS, Allain G, Lehodey P, Langley A. **Individual/Agent-based Modelling of Fishes, Fishers, and Turtles.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

ECO–5 Kirby DS, Lehodey P, Hampton J, Langley A, Allain V. **Regime Shifts in the WCPO and its Tuna Fisheries.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

ECO–6 Ayers D, Francis MP, Griggs LH, Baird SJ. **Fish bycatch in New Zealand tuna longline fisheries.** National Institute of Water and Atmospheric Research, New Zealand; Ministry of Fisheries, New Zealand.

ECO–7 Matsunaga H, Nakano H, Kiyota M, Minami H, Nobetsu T. **Progress on the researches for the solution of incidental catch of sharks, seabirds and sea turtles in Japanese tuna longline fishery.** National Research Institute of Far Seas Fisheries, Shimizu, Japan.

NATIONAL TUNA FISHERY REPORTS

NFR–1 AMERICAN SAMOA (did not attend)

NFR–2 AUSTRALIA – Ward P, Bromhead D. **Tuna and billfish fisheries of the eastern Australian fishing zone and adjacent high seas.** Fisheries and Marine Sciences, Bureau of Rural Sciences, Dept of Agriculture, Fisheries and Forestry, Canberra, Australia.

NFR–3 CANADA – Stocker M, Shaw W. **An update for Canadian tuna fisheries in the north and south Pacific Ocean for 2003**. Fisheries and Oceans Canada. Nanaimo, British Columbia, Canada.

NFR–4 CHINA – Song L, Xu L, Dai X. **National Tuna Fishery Report of China in WCPO.** Shanghai Fisheries University, Mainland China.

NFR–5 COOK ISLANDS – Marurai J. **Cook Islands Tuna Fishery Report.** Ministry of Marine Resources, Cook Islands.

NFR–6 FEDERATED STATES OF MICRONESIA – Retalmai S. **Federated States of Micronesia Tuna Fishery Report.** National Oceanic Resource Management Authority, Federated States of Micronesia.

NFR–7 FIJI – Amoe J. **Fiji tuna and billfish fisheries.** Fisheries Department, Ministry of Fisheries and Forests, Fiji.

NFR–8 FRENCH POLYNESIA – Ponsonnet C. **Tuna Fisheries in French Polynesia.** Service de la Pêche, Tahiti, French Polynesia.

NFR–9 GUAM (did not attend)

NFR–10 INDONESIA (did not attend)

NFR–11 JAPAN – Miyabe N, Ogura M, Matsumoto T, Nishikawa Y. **National Tuna Fisheries Report of Japan as of 2004.** Fisheries Agency of Japan, Tokyo; National Research Institute of Far Seas Fisheries, Shimizu, Japan.

NFR–12 KIRIBATI – Awira R. **The Domestic Tuna Fisheries of Kiribati.** Fisheries Division, Ministry of Fisheries and Marine Resources, Republic of Kiribati.

NFR–13 KOREA Moon D-Y, Soon-Song K, Koh J-R. **Korean Tuna Fisheries in the western and central Pacific Ocean.** National Fisheries Research and Development Institute, Busan, Korea.

NFR–14 MARSHALL ISLANDS – Joseph G. **National Tuna Fisheries Report for the Marshall Islands.** Marshall Islands Marine Resources Authority, Republic of Marshall Islands.

NFR–15 NAURU – Jacob P. **Nauru Tuna Fishery Report.** Nauru Fisheries and Marine Resources Authority, Nauru.

NFR–16 NEW CALEDONIA – Etaix-Bonnin R. **New Caledonia Tuna and Billfish Fisheries.** Service de la Marine Marchande et des Pêches Maritimes Noumea, New Caledonia.

NFR–17 NEW ZEALAND - Kendrick T, Murray T. **New Zealand Domestic Tuna Fisheries in 2002 and 2003.** National Institute of Water and Atmospheric Research, New Zealand; Ministry of Fisheries, New Zealand.

NFR–18 NIUE (did not attend)

NFR–19 NORTHERN MARIANAS (did not attend)

NFR–20 PALAU – Sisior K. **Tuna fisheries in the waters of the Republic of Palau.** Bureau of Oceanic Fisheries Management, Palau.

NFR–21 PAPUA NEW GUINEA – Kumoru L. **National Fisheries Report – Papua New Guinea.** Papua New Guinea National Fisheries Authority, Port Moresby, Papua New Guinea.

NFR–22 PHILIPPINES (did not attend)

NFR–23 SAMOA – Imo R, Time S, Su'a T. **Samoa Tuna Fisheries Report.** Samoa Fisheries Division. Ministry of Agriculture, Forests, Fisheries and Meteorology.

NFR–24 SOLOMON ISLANDS – Oreihaka E. **Tuna Fisheries in The Solomon Islands in 2003.** Fisheries Department, Honiara, Solomon Islands.

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NFR–26 TOKELAU (did not attend)

NFR–27 TONGA – Vailala Matoto S. **Tonga Tuna Fisheries Report.** Ministry of Fisheries, Tonga.

NFR–28 TUVALU – Apinelu N. **Tuvalu Tuna Fisheries Report.** Fisheries Department, Ministry of Natural Resources Development, Tuvalu.

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NFR–30 VANUATU – Naviti W. **Vanuatu Tuna Fisheries Report.** Fisheries Department, Vanuatu.

NFR–31 VIETNAM (did not attend)

NFR–32 WALLIS & FUTUNA (did not attend)

INFORMATION PAPERS

GENERAL

Report of the Sixteenth Meeting of the Standing Committee on Tuna and Billfish (SCTB16), 9-16 July 2002, Mooloolaba, Australia. CSIRO, Hobart

STATISTICS WORKING GROUP

INF–SWG–1 Evans DW. **Fisheries Data Quality Indicators.** Food and Agricultural Organisation (FAO), United Nations. Rome, Italy.

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INF–SWG–3 Lawson T. **Proposal for Monitoring the Catches of Highly Migratory Species in the Philippines and the Pacific Ocean Waters of Indonesia, prepared for the Preparatory Conference for the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

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FISHING TECHNOLOGY WORKING GROUP

INF–FTWG–1 Miscellaneous. **Update of tuna harvesting capacity issues relevant to WCPO pelagic fisheries.**

a. Miyake PM. **Extracts from "BRIEF REVIEW OF WORLD TUNA FISHERIES" – abstract and summary.** FAO Technical Paper Series (Draft)

b. Miyake PM. **Abstract from "REVIEW OF LONGLINE FLEET CAPACITY OF THE WORLD".** FAO Technical Paper Series (Draft)

c. Gillett R, Lewis AD. **A survey of purse seine fishing capacity in the western and central Pacific Ocean, 1988 to 2003: Executive Summary.** Administrative Report AR-PIR-03-04, National Marine Fisheries Service, Pacific Islands Region.

d. **Report of the Second Meeting of the Technical Advisory Committee (TAC) GCP/INT/851/JPN. Madrid, Spain, 15-18 March 2004. MANAGEMENT OF TUNA FISHING CAPACITY: CONSERVATION AND SOCIO-ECONOMICS.** FAO/Government of Japan Cooperative Programme. Meeting Report No. 2. Food and Agriculture Organization of the United Nations. Rome, April 2004.

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HMS BIOLOGY WORKING GROUP

INF–BIO–1 Chiang W-C, Sun C-L, Yeh S-Z, Su W-C. **Age and growth of sailfish (*Istiophorus platypterus*) in waters off eastern Taiwan.** Institute of Oceanography, National Taiwan University, Taiwan. Taiwan Fisheries Research Institute, Taiwan.

INF–BIO–2 Leroy B, Lehodey P. **Note on the growth of the South Pacific albacore.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

INF–BIO–3 Sun C-L, Yeh S-Z, Liu P-Y. **Sex ratio of the bigeye tuna caught by the Taiwanese offshore longline fishery for 1998 and 2002-2004 in the western and central Pacific Ocean.** Institute of Oceanography, National Taiwan University, Taipei, Taiwan.

HMS STOCK ASSESSMENT WORKING GROUP

INF–SA–1 Fonteneau A, Ariz J, Delgado A, Pallares P, Pianet R. **A comparison of bigeye stocks and fisheries in the Atlantic, Indian and Pacific Oceans.** IRD. France.

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ECOSYSTEM WORKING GROUP

INF–ECO–1 Alain V. **Ecopath model of the pelagic ecosystem of the WCPO.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia.

INF–ECO–2 Stevens J. **Sustainability of pelagic shark catches in the Australian region.** CSIRO Marine Research, Hobart, Tasmania.

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APPENDIX 4. REPORT OF THE PREPARATORY MEETING OF THE FISHING TECHNOLOGY WORKING GROUP

1. Introduction

A preparatory meeting of the Fishing Technology Working Group was held 10 August 2004 in Majuro, Marshall Islands, one day prior to the commencement of SCTB 17. Mr Itano, FTWG Coordinator served as Chairman of the meeting with 39 participants in attendance (Annex I). The meeting reviewed and discussed several working and information papers that had been submitted in response to specific tasks resulting from discussions held during SCTB 16 in Mooloolaba, Australia.

The Chairman noted the structure of the meeting would remain informal and discussion oriented. The agenda to the preparatory meeting was reviewed and rapporteurs assigned to cover the approved agenda as listed in Appendix II. The agenda (Annex II), covered a diverse range of topics addressing the Task List to the FTWG for SCTB 17 which included papers on bycatch mitigation, training materials, a review of country and fleet developments, the estimation of vessel production, and issues related to the collection of gear and vessel attributes, FADs, harvesting capacity and over-capacity in WCP fisheries and effort management.

The emphasis of the group is to monitor developments in any industrial tuna fishery with potential to significantly influence sampling programs, catch and effort analyses, and data sources and data quality useful for management related research. Membership and contributions are open to all SCTB participants and promoted with national, regional and industry affiliated organizations. Information on new fishing methods and technology, bycatch reduction methods, expansions/contractions in regional fishing effort, FAD related issues and the quantification of effective fishing effort are relevant. The formation and Terms of Reference for the FTWG are documented in Working Paper FTWG-4 of SCTB 14 (2001).

2. Application of gear technology to bycatch reduction

This section reviewed seven papers on technically based methods to reduce bycatch while increasing effective targeting in longline and purse seine fisheries. It was noted that bycatch solutions that can demonstrate no impact to or improved catch rates must be developed to promote voluntary adoption of these techniques by commercial fishermen. Mr. Itano began presentation of **FTWG-7a: Trial setting of deep longline techniques to reduce bycatch and increase targeting of deep-swimming tunas (S. Beverly and D. Itano)**. This paper presented two similar but unique and independently developed systems to improve the targeting of deep-swimming species, like bigeye and swordfish, while reducing interactions with bycatch species that frequent the shallow mixed-layer.

Mr. Itano reported on an innovative Hawaii-based handline fisherman who had developed a small-scale, deep-longline technique to target highly aggregated bigeye and pomfret (Bramidae) species over a shallow seamount. The system relies on the use of weights between the surface floats and the section in which branchlines are attached to place all hooks at a minimum depth as determined by the location of the weight in relation to the floats. This specialized gear type has demonstrated high catch

rates on bigeye of a larger size class than is available to the handline fishermen operating on the same seamount. The technique also discovered and developed a new fishery by seasonally targeting seamount associated lustrous pomfret (*Eumegistis illustris*). This species is actively sought after by Honolulu-based fish buyers for the domestic (Hawaii) and US mainland markets for the restaurant trade.

Mr Beverly presented the second part of FTWG-7a, describing field trials of a deep-setting longline technique initially proposed for development to SCTB 16[4]. This technique applied a similar system to larger scale longline fishing, primarily as a means to improve effective fishing effort for deep-swimming bigeye tuna. Mr Beverly conducted field trials on two vessels, and succeeded in perfecting the methodology as confirmed by the use of Star-Oddi time depth recorders (TDRs). The system used 3 kg weights snapped on the mainlines after the surface floats, followed by baited branchlines, another 3 kg weight and a surface float. This produced a deep-set basket of gear with a minimum hook depth deeper than where the weights were attached.

The target depths using the new gear were achieved and additional sag between weights added additional depth to sets. However, it was found that the technique would not work without using a line shooter during the set. Catch rates were very favourable compared to regular (unweighted) sets and no protected bycatch species were taken. The fishermen were very surprised and impressed with the take of large swordfish during the day (confirmed by TDR data), which may represent a viable way to continue swordfish-targeted fisheries while avoiding night time shallow-set gear that has a higher potential for turtle bycatch. In addition, it was noted that the technique may be a useful means to deploy and control hooks at depth to gather more data useful for the definition of bigeye and albacore habitat necessary for modelling and stock assessment purposes.

At the conclusion of the meeting, Mr Beverly noted inconsistencies in US national policy related to bycatch mitigation where Hawaii-based longline vessels are required to use large, stainless steel hooks and mackerel or fish like bait for swordfish-targeted fishing while US east coast fisheries are required to use squid and galvanized hooks.

The Chairman noted that the use of galvanized hooks is in response to environmental concerns that stainless steel hooks should not be promoted as they will not rust out from fish or bycatch species that escape or are released from the gear.

Mr Beverly noted that SEO/Birdlife (BirdLife of Spain) sponsors a competition to encourage fishermen to design mitigation techniques to reduce seabird bycatch in longline fisheries. The award went to Australian and New Zealand fishermen this year who shared the ^18,000 prize. Their suggestion was to deploy small amounts of fish liver grease into a vessels wake during the setting operation. This method, in conjunction with a "tori pole" fish avoidance streamer was found to be highly effective in discouraging seabirds from entering the line setting zone where most bird interactions occur. Mr Beverly noted that other ideas could be submitted to the 2005 competition and that he would be submitting his deep-longline technique for consideration.

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[4] *FTWG-9 Proposal for a deep setting technique for longline fishing to enhance target CPUE and to avoid certain bycatch species*

The Chairman then presented five abstracts related to the reduction of protected species interactions in longline fisheries, primarily the Hawaii-based pelagic longline situation, as follows:

- FTWG-7b: Assessment of methods to minimize seabird mortality in Hawaii pelagic longline fisheries – abstract. [in review] (Gilman E., Brothers N., Kobayashi D)

- FTWG-7c: Performance assessment of an underwater setting chute to mitigate seabird bycatch in the Hawaii pelagic longline tuna fishery – abstract. (Gilman, E., C. Boggs, and N. Brothers)

- FTWG-7d: State of knowledge for minimizing turtle bycatch in pelagic longline fisheries – abstract. [in review] (Gilman, E., J. Watson, C. Boggs)

- FTWG-7e: Effects of bait colour on sea turtle-longline fishing gear interactions: Can blue bait reduce turtle bycatch in commercial fisheries? (Y. Swimmer, R. Arauz, J. Ballestero, L. McNaughton, B. Higgins, M. McCracken, R. Brill)

- FTWG-7f: Survivorship and dive behaviour of olive ridley (*Lepidochelys olivacea*) sea turtles after their release from longline fishing gear off Costa Rica. (Y. Swimmer, R. Arauz, M. Musyl, L. McNaughton, J. Ballestero, R. Brill)

These papers describe the use of side setting of the gear, an underwater setting chute and the use of thawed and blue-dyed bait to reduce seabird bycatch and the use of large circle hooks, deeper setting of gear and the use of fish-type bait (vs squid) to reduce sea turtle interactions. All of these techniques appear to be promising for bycatch mitigation with the exception of blue-dyed bait which was not supported as a viable mitigation technique to reduce sea turtle bycatch. However, it was noted that the use of an underwater setting chute requires further research and development to produce less costly and robust chutes that can be incorporated into existing vessels and fishing operations. WP FTWG-7f described post tagging condition of olive ridley sea turtles from longline gear in Costa Rica, with broader application to other regions. Generally, survival rates appear promising but further work was encouraged.

The Chairman presented **FTWG-7g: Reducing juvenile bigeye tuna mortality in FAD sets (P. Nelson)**. The author of the working paper operates in conjunction with the IATTC to examine the use of sorting grids to reduce the take of juvenile tunas and specifically juvenile bigeye in drifting object purse seine sets. It was noted that limited field trials have been conducted that were generally inconclusive or needed a more dedicated charter arrangement to effectively test the techniques. Additional methods were proposed to separate juvenile bigeye from target tuna species, but were highly theoretical in nature.

It was noted that significant difficulties would have to be overcome for sorting grids to become a viable mitigation technique for purse seine gear. However, the Chairman noted that attempts to mitigate bycatch in regional fisheries should be actively pursued by the region and the reduction of bycatch should be flagged as a priority.

3. Training materials

The Chairman briefly described three Information documents submitted to FTWG 17 to assist in training and information dissemination to observer, port sampling, surveillance and enforcement programs**. INF-2: Documentation and classification of fishing gear and technology on board pelagic longline vessels – Hawaii module (Swenarton, (T. & S. Beverly)** described an initial attempt to describe a regional longline fishery in a well-illustrated manner well suited for training purposes. It was noted that the description of the Hawaii-based fishery was welcome and intended to be followed by similar descriptions of the important distant-water and domestically based longline fisheries of the WCPO, i.e. distant-water freezer sashimi boats, Pacific Island ice-storage fleets, French Polynesian catcher/processors, etc.

Mr Itano presented **INF-4: Handbook for the identification of yellowfin and bigeye tunas in frozen condition (Itano, D. G.)** and **INF-5: Handbook for the identification of yellowfin and bigeye tunas in fresh condition (Itano, D. G.)**. These documents address the importance of improving species-specific identification and enumeration of catch, particularly for bigeye tuna in mixes species landings. INF-4 was initially tabled to SCTB 16 and represents the only known identification guide for yellowfin and bigeye discrimination using examples of fish in a brine frozen condition as would typically seen by a port sampling program. The handbook was a side product of a sampling audit conducted by the author in Pago Pago, American Samoa on contract to the NMFS, Southwest Fisheries Science Center. It was noted that the handbook has been released for regional distribution to assist the broader objective to improve catch and effort data.

INF-5 was a logical development of the work to the identification of bigeye and yellowfin tuna in a fresh condition as would be seen by at-sea observers. The author noted that both identification handbooks were originally produced in MS PowerPoint format to allow interactive training purposes. The PowerPoint versions of the handbooks could be made available to legitimate regional and domestic organizations on request, but it was noted that individual images should not be reproduced without the express consent of the author and original photographer.

4. Regional information relevant to the FTWG – Country and fleet reports

The FTWG Preparatory meeting provides all participants to report on recent developments in their respective fisheries that may be of interest to SCTB. The Chairman developed a standardized format for these reports that was distributed to the group several months prior to SCTB 17 (Annex III). This format requested information relevant to harvesting capacity, spatio-temporal trends in catch, shore side developments, port sampling/observer programs, FAD issues and any significant changes to national policy related to large-scale fisheries.

An overview of WCPO purse seine and longline fisheries in 2003 was presented by Mr Williams. The main points are included in Appendix IV. The meeting agreed that this general overview of the broader WCP region was extremely useful to set the stage for finer scale reports of regional developments. Brief verbal reports from Pacific Island countries and territories were provided for the Solomon Islands, PNG, Fiji, the Marshall Islands, Cook Islands, Samoa, New Zealand, Palau, CNMI and American Samoa and from the distant-water entities of Korea, Taiwan and the US

Significant overlap between this agenda item and what is reported in National Fishery Reports during the SCTB plenary. Several representatives of countries or fleets declined to provide a summary report to FTWG as they preferred to provide this information as a part of their National Fishery Report presentation during Plenary. The Chairman proposed that the presentations made to FTWG would be combined with information from National Fishery Reports and compiled in FTWG INF-7.

5. Issues related to vessel production

Mr Williams reported on **FTWG-3: Average purse seine vessel production in the Western and Central Pacific Ocean (WCPO) by fleet for the period 1980 – 2003 (P. Williams)**. This paper was in response to SCTB 16 directives to provide a relatively simple comparison of purse seine efficiency by rating purse seine landings by fleet over a lengthy time period. The paper reported on; average annual vessel catch for the four main distant-water and six Pacific Island domestic purse seine fleets for the period 1980 – 2003; a comparison of average annual vessel catch (by fleet) to the average annual catch for the highest performing vessel in each fleet; a comparison of annual effort by set type for the main DWFN fleets; and a comparison of average vessel catch per trip and average number of trips by fleet for the larger fleets.

The paper proposes two distinct periods for the distant-water fleets: a period of establishment when vessel numbers and average catches increased gradually followed by a period of consolidation and gradual advances in efficiency. During the latter period, poor performers dropped out while annual landings gradually increased with advances in experience and technology or the adoption of new fishing methods. The Korean fleet has consistently had the highest average catches since 1990, which is impressive considering this fleet has adopted a fishing strategy dominated by unassociated sets. Average annual catches for the Taiwanese fleet rises in parallel with but slightly behind the Korean vessels while Japanese vessel numbers and average annual catch has been remarkably stable over the time period at approximately 4000 – 5000 t per year. In recent years, the US purse seine fleet figures indicate a general decline in average annual purse seine production.

An examination of the fleet "highliners", or the highest producing vessel per fleet indicates that the same vessels have consistently out-performed the fleet average for all years for which data is available. For Pacific Island fleets, the Marshall Islands and PNG (FSM Arrangement) vessels have high annual catch rates as they are mainly comprised of modern, ex-Taiwanese flag vessels. The data suggests that lower catch rates for FSM and PNG fleets may be a result of these fleets "carrying" a number of poor performers.

Mr Itano noted the consistent finding that a few boats consistently out-perform the rest of their fleets and suggested they should be examined to see what factors may be influencing their elevated catch rates. Also, the study points out the importance of transhipment close to the fishing grounds to higher annual landings per boat. This is a feature of the Korean and Taiwanese fleets as opposed to the US and Japanese fleets that return to a distant home port to unload and reprovision.

Mr Reid presented **FTWG-5: Using Malmquist indices to measure changes in total factor productivity of purse seine vessels while accounting for changes in capacity utilisation, the resource stock and the environment (Squires, D. & C. Reid)**. This paper described the use of Malmquist indices to measure changes in the total factor productivity (TFP) of purse seine vessels in the WCPO in response to a FTWG directive to examine alternate methods to analyse vessel efficiency, particularly for purse seine gear. The paper provided a description of the concept of total factor productivity, its component parts (technical change, technical efficiency and scale efficiency) and how changes in capacity utilisation, the resource stock and environmental conditions can be accounted for in measuring TFP. The paper also provided a formal presentation of the use of Malmquist indices in measuring changes in TFP and presented a preliminary empirical analysis of the TFP changes of the Korean purse seine fleet in the WCPO over the period 1997-2002.

In response to queries from the meeting, Mr Reid explained that there was no particular significance to the analysis of Korean purse seine data by the study. He explained that this was an initial examination of a new method to examine vessel production and should be considered preliminary in nature.

Comments received concurred that this was an interesting attempt to fold in many factors that contribute to overall vessel efficiency but should be considered mainly for the methodology and not the final results. Further development of the model with higher stratification of inputs and data sources was encouraged.

6. Issues related to vessel and gear attributes

Mr Sharples presented **FTWG-1: Review of vessel and gear attribute data held by SPC and FFA (C. Millar, and E. Schneiter)** on behalf of the authors. This directive resulted from a long-term objective of the FTWG to evaluate the type and need for collection of vessel and gear parameters from regional fishing vessels. The paper examined observer data, the FFA Regional Register of Vessels, logsheet data and the SPC Tuna Fishery Yearbook and compiled data on quality and coverage rates of these data by fleet.

A number of problems were encountered with the data, including the lack of validation and error checking with highly detailed observer data, many mis-spellings of common items leading to erroneous data entries, duplication of vessels in the database and difficulty in being able to discern if a data entry meant “zero”, “not recorded” or “absent”.

The study recommended to: consider the necessity of collecting highly detailed, difficult to verify information on model type and number; consider coverage rates in selecting which method is best for data collection; the avoidance of free text fields for small items that leads to hundreds of variations and typographic errors that are difficult to standardize and the avoidance of data ambiguity. It was suggested that this ambiguity be avoided by making data collection forms specifically ask if an item was present, absent or not noted. The paper noted the importance and need to incorporate data checks and verification for information provided by observers and to the Regional Register.

Mr Itano noted that the paper suggested that a quantifiable attribute for a gear attribute may be preferable to collect unless standardized lists of codes could be developed for each attribute. He suggested that some easily noted measure of power might be preferable to collect instead of detailed information on the make, model and series of marine electronics, such as the maximum range of a sonar or frequency of a sonar unit. The reasoning was that programs seldom have the time, manpower or funding to search through large databases to research the specifications of each model of gear.

Mr Sharples and others disagreed, noting that the collection of gear "power" had been attempted for some data fields collected by the FFA Regional Register. The idea was abandoned as observers had a difficult time finding a consistent indication of power for various items like the power of a purse seine winch or power block. They maintained that it was better to collect detailed model information that could be researched later if needed.

Mr Staisch informed the meeting that many of the data entry problems had been solved by the new online Regional Resister system (CARAVEL) that prompted users to complete specific data fields. Data quality is expected to improve in the future if a proposed Data Quality Officer position is filled. It was noted that most of the problems with the Regional Register data was with historical data pre-2000.

Mr Itano presented **FTWG-2: Vessel and gear attributes useful for the long-term monitoring and management of WCPO tropical tuna fisheries (Itano, D. G.)**. The paper reviewed past studies by the SCTB and other organizations or programs that examined the collection of vessel and gear attributes for various purposes (primarily to monitor efficiency changes in fleets). Several SCTB documents, dating back to SCTB 11 were reviewed as well as documents produced by the ESTHER Program *(Efficiency of Tuna Purse Seiners and Effective Effort*) that attempted to identify the main factors that contributed to increasing fishing power of the French and Spanish purse seine fleets in the Atlantic and Indian Oceans. Several SCTB papers on purse seine and longline gear and technology were also reviewed.

Mr Itano proposed that advances in purse seine efficiency are advanced by: 1) adequate fishing power (large net, powerful winches, etc.); 2) minimizing time to load catch (rapid net hauling and sacking, "Spanish style" brailing); 3) powerful refrigeration systems; 4). maximizing actual fishing effort (use of remotely monitored FADs, auxiliary FAD tender or search vessels, integrated electronics); 5) the minimization of down-time between fishing trips ("floating" the catch during unloading process, pre-sorting catch to market categories for rapid unloading, transhipment of catch close to the fishing grounds); and 6) the rapid adoption of innovative fishing technology and methods.

Based on the recommendations of the reviewed data sources, a list useful and "not useful" gear and vessel attributes or suggestions for data collection were proposed as follows:

1. Adopt and verify a standardized measurement system, preferably metric.
2. Agree upon a standardized definition of vessel length, i.e. length overall or waterline length, etc.

3. Abandon GRT as the primary definition of vessel "size" and adopt volume of fish hold capacity, i.e. cubic meters (m^3)[5]
4. Data forms specific to each vessel gear type may be more efficient than a single form for all gears. However, sections like vessel characteristics, vessel electronics or remote sensing are general to all vessels and can be standardized to all forms.
5. Categorize vessel and gear attributes into categories of data that are relatively stable vs those that are more dynamic, and update dynamic data more often and perhaps by different means.
6. Develop criteria to define "significant" changes to a vessel or operational strategy and mechanism to report and update these changes soon after they are implemented.
7. Collect detailed information on the fish storage method including well plan with volume and chilling or freezing process
8. Collect information on the strategy and process of fish loading (i.e. brailing method), onboard processing, onboard sorting/discarding, fish storage and catch offloading; particularly if transhipment is involved.
9. The presence or absence of specialized gear should be qualified in some way to indicate degree of use, possibly by observer programs.
10. Avoid free text fields on data collection forms which lead to hundreds of variations and miss-spellings that are difficult to deal with later.
11. Consider abandoning the collection of highly detailed information on the make and model of items like marine electronics in favour of some general, easily noted quantifiable attribute that defines the power of the item in question along a standardized scale, i.e. maximum range of bird radar unit, frequency and maximum detection range of a sonar unit, etc.
12. Concentrate on the collection of data on new or innovative gear or methods, or those with highest potential impact to resources, like FADs. Collect detailed data on FAD configurations.
13. Develop data collection for longline vessels that clearly define target depth and target species, including shark targeting vessels, however a solution for vessels that change target frequently will have to be found.
14. For pole-and-line vessels, collect data on the number of real live fishermen as well as the number of automated poling stations to better define fishing power.
15. Avoid data ambiguity and subsequent recording difficulty by indicating if an attribute was present/absent/not noted.

Mr Itano suggested that the collection of the type and quality of data necessary would not be possible with existing mechanisms due to the lack of data verification and error checking currently taking place. The conclusion of the paper was that a separate, but linked data collection registry would be necessary to target the collection of vessel and gear attributes. By supplying basic vessel data that has been verified independently from the vessel companies, this register would be able to supply the Regional Register with up to date and accurate data useful for monitoring and surveillance purposes. More dynamic data fields that may change on a more frequent or regular basis (i.e. longline targeting and gear configurations, purse seine setting modes, FAD details) could be cross checked and verified to some degree with

[5] FFA currently uses standardized Gross Tonnage on Regional Register applications.

observer data. It was noted that the formation of this register would release the Regional Register from the time consuming task of collecting and entering these data allowing it to concentrate on monitoring and compliance issues.

Mr Staisch noted that the Commission register data fields had already been set in Annex IV of the Convention, and were far more basic than those currently being collected in the Regional Register. He suggested that the collection of more highly detailed data under the Convention would be unlikely given the reluctance that some parties had expressed to provide basic data. Such a database would also require full Commission approval which would be time consuming and difficult to obtain.

Mr Beverly noted that it is important to note the vessel ownership regime is important to understand in gauging the efficiency of a particular vessel. For example, the efficiency of a commercial fishing operation may vary considerably between a government run vessel compared to an owner/operator whose entire income relies on catch. Also, the integration of a land based operations manager or coordinator who is in frequent contact with the vessel by radio can significantly increase the efficiency of a vessel. Dr Fonteneau noted the importance of satellite remote sensing data to increased vessel efficiency.

Mr Staisch reiterated his experience, based on years of observer coordination that the collection of information on the power of equipment is much harder to collect for observers compared to the make and model of individual items. The Chairman agreed but noted that once collected, this sort of detailed data is seldom analysed further and requires a great deal of additional work to ascertain power from make and model data. Dr Hinton added that all free text fields should not be eliminated as this may presume established data responses and thus inhibit the collection of information on new or innovative gears and methods. The Chairman agreed that some descriptive fields must be kept as free text fields, noting the concern could be addressed by offering the choice of "other/explain" if the answer required further explanation.

Mr Langley noted that the date of introduction of key pieces of equipment identified as significantly improving vessel efficiency should be determined on a fleet by fleet basis. The collection of this type of information would likely require interviews with long-time participants in the fishery. Dr Murray reminded the meeting that it was of primary importance to define the reasons for collecting this sort of data and how it will be used for specific analytical purposes.

7. Issues related to FADs

Mr Itano presented **INF-3: The development, design and recent status of anchored and drifting FADs in the WCPO (D. Itano, S. Fukofuka & D. Brogan).** The paper resulted from SCTB 16 directives to the FTWG to document available information on the use of FADs by large-scale fisheries in the WCP region. INF-3 compiles information from SPC observer reports, a few published sources and the personal experiences of the three authors. Acronyms are introduced referring to anchored or moored FADs (AFADs) and freely drifting FADs (DFADs).

The paper describes the early development of AFADs in the Philippines and the current status of large-scale AFADs in PNG, Indonesia, the Philippines and the

Solomon Islands deployed to support handline, ringnet, pole-and-line and purse seine fisheries. The evolution of purse seining on floating objects is described from sets on natural drift objects like logs, or unimproved flotsam, to groups of logs tied together or enhanced with additional flotation and netting, to purpose built drifting FADs of various designs. Descriptions and photographs of some DFAD types used by the major DWFN fleets operating in the region are provided with a description of the concurrent evolution of radio buoy technology that has made DFADs a very productive method of purse seining. Additional improvements that may increase the productivity of AFADs and DFADs are discussed, such as the use of artificial light, chumming barrels and fish oil dispensers.

DFAD descriptions seemed to have one feature in common which was the addition of several meters (20 – 50 m) of heavy purse seine webbing suspended below the flotation device and weighted at the bottom to form a vertical panel of net. Several theories on the purpose of this netting are provided, but the reasons are not conclusively known.

The paper concludes that detailed information on the design of drifting FADs by fleet does not appear to be readily available. However, a great deal of this information may exist in free text fields of years of observer reports that have not been summarized. It was encouraged that these data sources be examined for available information on the design, deployment, use and enhancements to DFADs in relation to catch rates, particularly for bigeye tuna. Research on the mechanisms of aggregation and influence of different DFAD designs to species specific aggregation was also encouraged.

Mr Sharples concurred that a natural drift log that had been enhanced with netting or flotation was unofficially classified in their observer training sessions as a DFAD and not a log. However, this definition has not been adopted in a formal sense by regional fishery organizations and needs further clarification.

Mr Langley presented **FTWG-4: An analysis of the main factors influencing the catch of bigeye tuna in purse seine drifting FAD sets and a comparison with log sets (Langley, A.)**. This paper was in response to SCTB 16 directives to the FTWG to examine catch parameters between natural logs and drifting FAD sets (DFADs) with a particular emphasis on the take of juvenile bigeye tuna. On examination of the data, it was found that DWFN logsheet data was not sufficiently reliable in the discrimination of natural logs vs DFADs for this type of analysis. To ensure a high level and consistency of data inputs, only observed trips on US Multilateral vessels were examined within a core area of drifting object sets bounded by 0 - 10°S and 170°E – 170°W. After sorting the data for periods when both set types were reasonably abundant, a validated dataset for the period 1998 – 2002 was examined.

There was a general decline in catch rates of bigeye and yellowfin throughout the period with a less pronounced decline in skipjack catches. Overall, bigeye were caught in a slightly higher proportion of DFAD sets compared to log sets, and the difference was statistically significant. A strong seasonal effect was noted with bigeye catches peaking during the austral summer, but the main target species (skipjack) was similarly affected. Virtually all bigeye catches were taken in early morning sets, but this time period defines associated setting in the WCP and the major temporal strata

of annual skipjack landings. However, bigeye catches peak around new moon when skipjack catches are lowest. Highest catch rates of skipjack occur around full moon.

Of particular note was the finding that consistent differences in bigeye catch rates exist between individual vessels in the fleet. Two vessels have significantly high catch rates of bigeye while others are historically low bigeye producers. Given that the dataset contains only observed trips, these differences appear to be real. These findings suggest that there may be a clear difference in operational modes between vessels and that bear further investigation. Finally, the steady decline in bigeye catch rates since the beginning of the time series is of concern and should be investigated on a larger spatio-temporal scale from validated purse seine trips.

The limited data available for this analysis highlights the need for better set- and species-specific data from purse seine fleets throughout the range of the fishery.

Dr Murray suggested that the influence of ENSO events should be factored into the analysis. Mr Langley stated that he had looked at this and found no statistically significant impact to bigeye catch rates on associated sets, although a qualitative examination of oceanographic data revealed a considerable shift in environmental conditions over the study period that may account for the decline in CPUE for all three species. In addition, the relative abundance of logs does appear to increase in the eastern region of the fishery during strong El Nino events.

8. Issues related to harvesting capacity and effort management

Four Information papers related to harvesting capacity issues were submitted to the FTWG consisting of abstracts or summaries of larger papers. Dr Miyake presented the first three documents that were produced in response to actions undertaken by FAO to assist nations in implementing IPOAs on IUU and Fishing Capacity issues. With external funding, FAO created the Technical Advisory Committee (TAC) to draft guidelines for the management of world fishing capacity, which met for the second time in March, 2004. Abstracts from two relevant papers presented at that meeting were supplied to SCTB. FTWG **INF-1a: Extracts from "Brief Review of World Tuna Fisheries" (P.M. Miyake)** describes the past 50 year history of the development of longline, purse seine and pole-and-line fisheries in relation to technical advancement in equipments and fishing methods. **INF-1b) Abstract from "Review of Longline Fleet Capacity of the World" (P.M. Miyake** estimated current large-scale longline fishing fleet size on the worldwide basis.

The report of the second TAC meeting was also introduced by Dr Miyake as **INF-1d: Report of the Second Meeting of the Technical Advisory Committee (TAC) Madrid, Spain, 15-18 March 2004. MANAGEMENT OF TUNA FISHING CAPACITY: CONSERVATION AND SOCIO-ECONOMICS.** Dr Miyake indicated that analyses presented at the meeting (DEA) indicated that purse seine fishing capacity currently exceeds that which is necessary to harvest the current world tuna landings. Also it was noted that the longline fishing capacity is also higher than necessary to harvest world longline catches. Consequently, the meeting recommended that the moratorium should be implemented for expansion of any large-scale fishing vessels worldwide. Within the proposed limit, it also recommended that capacity can be transferred to any developing countries.

In consequence, FAO convened a Technical Consultation on IUU and Fishing Capacity issues in June, 2004. This Consultation made special note that the fleet size and capacity, particularly for purse seiners has increased very rapidly in recent years in the WCPO region. Also noting that the matter need urgent attention, and recognizing that no regional fisheries management organizations were in active status within this area, the Consultation suggested that any expansion of new vessels to the fishery be halted immediately and that efforts be made to reduce fishing capacity to previous levels.

It was noted that an informal meeting was recently held in Sapporo, Japan where potential non-compliance issues regarding the new WCP Commission were discussed. The continual increase in harvesting capacity in the WCP area was discussed in detail. Factions at the meeting called for the cessation of new construction of large purse seine and longline vessels and recommended that recently constructed large purse seine vessels entering the WCPO fishery should be removed by 31 July 2007 in an effort to reduce excess capacity in the fishery.

Mr Itano presented **INF-1c) A survey of purse seine fishing capacity in the western and central Pacific Ocean, 1988 to 2003: Executive Summary (R. Gillett and A.D. Lewis).** This study was contracted by NOAA Fisheries, Pacific Islands Region to investigate current levels of fishing capacity in the WCPO region. NOAA Fisheries submitted the executive summary of the report to FTWG for general information purposes with the intention to formally publish findings from the study at a later date. The study investigated the use of tonnage, length and crew size as proxies for "fishing capacity" in regional purse seiners; settling on the use of volume of refrigerated hold space. The primary information source was the FFA Regional Resister of Fishing Vessels. The study noted significant problems with the Regional Register data which is supplied by vessel owners with few mechanisms for data verification and cross-checking. However, this situation has improved significantly in recent years with a new online data filling procedure and should improve further when a Data Quality officer is recruited. The main problems appear to exist with the historical data set.

The study evaluated vessel participation and total estimated carrying capacity (m^3) for 18 national flag vessels over the past 15 years. Data for 1998, 1995 and 2003 are provided indicating the number of active vessels increased from 136, 175 to 191 respectively. During this period, the carrying capacity of the fleet increased from 140,000 to 200,000 to 233,000 m^3. This represents an overall increase of 67% in carrying capacity during the 1988–2003 period when average capacity per vessel also increased from 1073 m^3 to 1222 m^3. The most important reservation the study noted in data outputs was the reliance on unverified information in the Regional Register. Also, the study found that the Regional Register data for hold space had been filled out in a mixture of units and in some cases it was impossible to ascertain which unit was intended. The study noted that carrying capacity was an imperfect proxy for fishing capacity but was the best measure currently available for WCP fleets.

The study concluded that upgrading the accuracy of the data in the Regional Register was key to improving estimates of carrying capacity and to facilitate the development of alternative proxies for fishing capacity.

9. The Palau Arrangement and effort management in the WCPO

Mr Reid presented a paper prepared by L. Rodwell of FFA, **FTWG-6: FFA initiatives related to the Palau Arrangement, purse seine management and the management of bigeye fishing mortality in the WCPO.**

The Palau Arrangement for the Management of the Purse Seine Fishery in the Western and Central Pacific was developed by the Parties to the Nauru Agreement and entered into force in November 1995. The Arrangement as it currently stands sets a limit on the number of purse seine vessels that can be licensed by the Parties and allocates these licenses by fleet.

The Parties to the Palau Arrangement in 2000 commissioned a comprehensive review and analysis of the purposes, objectives and principles of the Palau Arrangement. The major recommendation of the consultancy report was to replace the limits on vessel numbers by fleet in the Arrangement with limits on vessel days by zone. The Parties accepted this recommendation and propose to implement purse seine fishing day limits by a Management Scheme called the Vessel Day Scheme (VDS).

The Vessel Day Scheme aims to enhance the economic and biological sustainability of the western and central Pacific purse seine fishery by, controlling the level of fishing effort by purse seine vessels within limits consistent with resource sustainability; and increasing economic benefits to resource-owning states and economic returns to participating vessel owners.

The Scheme provides for an annual level of Total Allowable Effort (TAE) for purse seine fishing in the waters of the Parties to be set for Management Periods of three years. The annual TAE for the waters of the Parties for the first three year Management Period will be set at 27,386 days. This is the average level of purse seine effort in the waters of the Parties for the period 2000 to 2002 estimated by SPC/OFP. The Parties have set the annual TAE at this level for the first Management Period in response to the recommendations of the second meeting of the Scientific Coordinating Group that: there be no further increases of fishing mortality on the bigeye and yellowfin (particular juvenile yellowfin) stock and the resolutions of the Preparatory Conference urging participants to exercise reasonable restraint in the expansion of fishing effort.

For the purpose of the Scheme, a fishing day is defined as any calendar day, or part of a calendar day, during which a purse seine vessel is in the waters of a Party outside a port, but does not include days for which advance notice has been given that a vessel will be in the waters of a Party but will not be undertaking fishing activities – such as when a vessel is in transit. Recognising that the fishing power of vessels varies, particularly with the size of vessels, the Parties have decided that fishing days by vessels of different sizes should be accounted as follows: vessel length overall less than 50 metres - 0.5 day, vessel length overall between 50 and 80 metres - 1 day and vessel length overall in excess of 80 metres - 1.5 days.

In order to meet their obligations under the FSM arrangement and the Multilateral Treaty with the US, the Parties have set aside pools of fishing days to provide for fishing effort by FSM Arrangement vessels fishing outside the waters of their Home Parties and US Treaty vessels. The number of days in these pools has been calculated as the average fishing days in the waters of the Parties for the period 2000 – 2002 by vessels fishing under the FSM Arrangement and the US Treaty. The balance of the days in the TAE available for allocation to the Parties is 21,175. Each Party is allocated a portion of the 21,175 days available for allocation as a Party Allowable Effort (PAE), calculated by equally weighting of the distribution of assessed relative biomass of skipjack and yellowfin within the Party's waters, and the average of the annual distribution of the number of vessel days in the waters of each of the Parties during the period 1996-2002.

Each Party will be free to use their fishing days as they wish, however, they will have an obligation to ensure that the number of fishing days by purse seine vessels in its waters does not exceed that Party's annual PAE allocation provision with regard to transfers. There will be penalties in the form of deductions of PAE if a Party exceeds its annual PAE.

The Parties recognise the need for the allocation of fishing effort to include some flexibility to respond to changes in fishing conditions across the region, especially the impact of changes in oceanographic conditions. The scheme includes arrangements for transferability including that parties may freely transfer unused PAE between themselves for a Management Year; a Party may freely transfer unused PAE between Management Years in the same Management Period; and, a Party may transfer up to 30% of its PAE (if not used) between the final Management Year of a Management Period and the first Management Year of the following Management Period.

All purse seine vessels undertaking fishing activities in the Area will be required to be registered on a VDS register, which will be used to monitor each Party's use of its allocated PAE. A precondition for a vessel's registration on the VDS register will be registration on the FFA VMS and Regional Registers. Vessels will be required to send regular ALC transmission reports while they are in the Area, so that their fishing activities may be monitored.

The Parties to the Palau Arrangement have decided in principle that the VDS will commence on 1 January 2005. However, this may need to be reviewed in light of further consideration of a number of implementation and associated issues.

10. Organization of FTWG plenary session

The Chairman noted that the FTWG was allotted only one hour in Plenary to report on the FTWG Preparatory Meeting and discuss relevant issues. Noting that many members of the SCTB had not benefited of the numerous presentations made during the Preparatory Meeting, it was suggested that all talks be summarized and briefly presented by the Chairman. It was decided that two or three FTWG Working Papers would be presented in more detail. Adam Langley and Chris Reid agreed to present briefs of WP-4 and WP 6 respectively.

11. Future role and direction of FTWG-like group

The floor was opened to discuss the future of the FTWG or a group like the FTWG with similar Terms of Reference that may be formed within the WCP Commission structure. There was consensus that the work conducted by the group was not handled by any other group and this body of work would not disappear with the end of the SCTB. There was general support from participants for future assistance and research support if such a group formed.

12. Research Coordination and Planning

As this was the final meeting of the entire FTWG, and specific research tasks were not fully developed during the Preparatory Meeting. However, as in previous years, the development of research priorities will be developed following the FTWG Plenary session and finalized by email. The Chairman thanked the group for their contributions and comments and the meeting was officially closed.

Annex I. List of participants

Name	Affiliation
Steve Beverly	SPC Coastal Fisheries Programme
Shin-Chin Chou	Fisheries Agency, Taiwan
Sangaa Clark	Ray Research, New Zealand
Paul Dalzell	Western Pacific Fishery Management Council
Kim Duckworth	Ministry of Fisheries, New Zealand
Alain Fonteneau	IRD, France
David Hamm	NOAA Fisheries, Pacific Islands Fishery Science Center
John Hampton	SPC, Oceanic Fisheries Programme
Shelton Harley	Ministry of Fisheries, New Zealand
Minoru Honda	Forum Fisheries Agency
Roseti Imo	Samoa Fisheries
Russel Ito	NOAA Fisheries, Pacific Islands Fishery Science Center
Glen Joseph	MIMRA, Marshall Islands
David Kirby	SPC, Oceanic Fisheries Programme
Ludwig Kumoru	National Fisheries Authority, PNG
Adam Langley	SPC, Oceanic Fisheries Programme
Tim Lawson	SPC, Oceanic Fisheries Programme
Bruno Leroy	SPC, Oceanic Fisheries Programme
Lara Manarangi-Trott	Ministry of Marine Resources, Cook Islands
Jason Marurai	Ministry of Marine Resources, Cook Islands
Naozumi Miyabe	National Research Institute of Far Seas Fisheries, Japan
P.M. Miyake	Japan Tuna
Augustine Mobiha	National Fisheries Authority, PNG
Brett Molony	SPC, Oceanic Fisheries Programme
Talbot Murray	Ministry of Fisheries, New Zealand
Miki Ogura	National Research Institute of Far Seas Fisheries, Japan
Edwin Oreihaka	Department of Fisheries & Marine Resources, Solomon Islands
Cedric Ponsonnet	Service de la Peche, French Polynesia
Chris Reid	Forum Fisheries Agency
Gary Sakagawa	NOAA Fisheries, Southwest Fisheries Science Center
Peter Sharples	SPC, Oceanic Fisheries Programme
Kathay Sisior	Bureau of Oceanic Fishery Management, Palau
Sung Kwon Soh	Ministry of Maritime Affairs and Fisheries, Korea
Liming Song	Shanghai Fisheries University, China
Karl Staisch	Forum Fisheries Agency
Apolosi Turaganivalu	Ministry of Fisheries and Forests, Fiji
Yuji Uozumi	National Research Institute of Far Seas Fisheries, Japan
Peter Williams	SPC, Oceanic Fisheries Programme
Won Seok Yang	National Fisheries Research & Development, Korea

Annex II. FTWG Preparatory Meeting Agenda

17th Standing Committee on Tuna and Billfish
Majuro, Marshall Islands

Fishing Technology Working Group
Preparatory Meeting – Agenda
Tuesday, August 10, 2004 -- (0830 – 1600)

Note: (author or authors), <<person presenting or coordinating topic>>

1) Introduction <<Coordinator>>

a) Introductions, adoption of agenda and assignment of rapporteur(s)

b) Review of FTWG Task List for SCTB 17

2) Application of gear technology to bycatch reduction <<Coordinator>>

a) FTWG-7a: (S. Beverly and D. Itano) Trial setting of deep longline techniques to reduce bycatch and increase targeting of deep-swimming tunas. <<S. Beverly, D. Itano>>

b) FTWG-7b: (Gilman E., Brothers N., Kobayashi D.) Assessment of methods to minimize seabird mortality in Hawaii pelagic longline fisheries – abstract.

c) FTWG-7c: (Gilman, E., C. Boggs, and N. Brothers. Performance assessment of an underwater setting chute to mitigate seabird bycatch in the Hawaii pelagic longline tuna fishery – abstract. .

d) FTWG-7d: (Gilman, E., J. Watson, C. Boggs) State of knowledge for minimizing turtle bycatch in pelagic longline fisheries – abstract. [in review]

e) FTWG-7e: (Y. Swimmer, R. Arauz, J. Ballestero, L. M^{c}Naughton, B. Higgins, M. McCracken, R. Brill) Effects of bait colour on sea turtle-longline fishing gear interactions: Can blue bait reduce turtle bycatch in commercial fisheries ?

f) FTWG-7f: (Y. Swimmer, R. Arauz, M. Musyl, L. M^{c}Naughton, J. Ballestero, R. Brill) Survivorship and dive behaviour of olive ridley (*Lepidochelys olivacea*) sea turtles after their release from longline fishing gear off Costa Rica.

g) FTWG-7g: (P. Nelson) Reducing juvenile bigeye tuna mortality in FAD sets.

3) Training materials

a) INF-2: (Swenarton, T. & S. Beverly) Documentation and classification of fishing gear and technology on board pelagic longline vessels – Hawaii module <<S. Beverly>>

b) INF-4: (Itano, D. G.) Handbook for the identification of yellowfin and bigeye tunas in frozen condition <<D. Itano>>

c) INF-5: (Itano, D. G.) Handbook for the identification of yellowfin and bigeye tunas in fresh condition <<D. Itano>>

4) Regional information relevant to the FTWG – Country and fleet reports

a) Standardized format of reports and consolidation of information <<Coordinator>>
b) Brief overview of WCPO purse seine and longline fisheries 2003 to present <<P. Williams>>

c) National reports to FTWG <<Open>>

d) DWFN reports to FTWG <<Open>>

5) Issues related to vessel production

a) FTWG-3: (P. Williams) Average purse seine vessel production in the Western and Central Pacific Ocean (WCPO) by fleet for the period 1980 – 2003 <<P. Williams>>

b) FTWG-5: (Squires, D. & C. Reid) Using Malmquist indices to measure changes in total factor productivity of purse seine vessels while accounting for changes in capacity utilisation, the resource stock and the environment <<C. Reid, FFA>>

6) Issues related to vessel and gear attributes

a) FTWG-1: (C. Millar, and E. Schneiter) Review of vessel and gear attribute data held by SPC and FFA <<P. Sharples>>

b) FTWG-2: (Itano, D. G.) Vessel and gear attributes useful for the long-term monitoring and management of WCPO tropical tuna fisheries <<D. Itano>>

7) Issues related to FADs

a) INF-3: (D. Itano, S. Fukofuka & D. Brogan) The development, design and recent status of anchored and drifting FADs in the WCPO <<S. Fukofuka, D. Itano>>

b) INF-6: (L. Kumoru) Notes on the use of FADs in the PNG purse seine fishery <<L.Kumoru>>

c) FTWG-4: (Langley, A.) An analysis of the main factors influencing the catch of bigeye tuna in purse seine drifting FAD sets and a comparison with log sets <<A. Langley>>

8) Issues related to harvesting capacity and effort management

a) Harvesting Capacity – introduction of reference papers and open discussion <<Coordinator>>

i) INF-1a) (P.M. Miyake) Extracts from "Brief Review of World Tuna Fisheries"

ii) INF-1b) (P.M. Miyake) Abstract from "Review of Longline Fleet Capacity of the World"

iii) INF-1d) (FAO) Management of Tuna Fishing Capacity: Conservation and Socio-Economics.

iv) INF-1c (R. Gillett and A.D. Lewis). A survey of purse seine fishing capacity in the western and central Pacific Ocean, 1988 to 2003: Executive Summary.

b) The Palau Arrangement and effort management in the WCPO

i) FTWG-6: (L. Rodwell) FFA initiatives related to the Palau Arrangement, purse seine management and the management of bigeye fishing mortality in the WCPO <<C. Reid, FFA>>

ii) Discussion of purse seine management and the Vessel Day Scheme <<C. Reid>>

9) Organization of FTWG plenary session

10) Future role and direction of FTWG-like group << open discussion >>

11) Other matters

12) Close of meeting

Annex III. Standardized format for Country and Fleet reports to FTWG:

A. Harvesting Capacity

a. 2003: gross landings by major gear types or fleet

b. Trends in catch and effort for Jan - June 2004 for longline and purse seine

c. # of purse seine vessels covered under the Palau Arrangement

d. # purse seine and longline vessels active under:
1. DWFN licensing
2. Domestic arrangements
3. Joint venture or special arrangements

e. Any recent developments of note pertaining to:
1. significant expansion or contraction of longline or purse seine effort
2 areas of operation
3. development of new fisheries or fishing technologies

B. Shoreside Developments

a. Shoreside processing (briefly describe)
b. Transhipment situation
c. Marketing and markets for landings

C. Port sampling and Observer programs (describe)

D. Issues related to anchored FADs or use of drifting FADs

E. Significant changes in national policy related to industrial fisheries

F. Other

APPENDIX 5. REPORT OF THE PREPARATORY MEETING OF THE METHODS WORKING GROUP

Introduction

The Methods Working Group held its 4th meeting on 9–10 Aug 2004 in Majuro, Republic of the Marshall Islands, prior to the 17th meeting of the Standing Committee on Tuna and Billfish. John Sibert served as chair; Shelton Harley and Dale Kolody served as rapporteurs. The meeting was attended by Jone Amoe, Keith Bigelow, Robert Campbell, Sangaa Clark, Paul Dalzell, John Hampton, Shelton Harley, Bert Kikkawa, David Kirby, Pierre Kleiber, Dale Kolody, Adam Langley, Patrick Lehodey, Naozumi Miyabe, Brett Molony, Talbot Murray, Keisuke Satoh, John Sibert, Robert Skillman, Sun Kwon Soh, Liming Song, Max Stocker, Chu-Lu Sun, and Mike Tenorio. The agenda is included in attachment 1; the documents presented are listed in the SCTB 17 list of documents.

Progress on tasks from SCTB 16

1. Complete simulation analysis – Completed and reported below (SCTB16/MWG-1; SCTB 17/MWG-3; SCTB 17/MWG-4)

2. Review 2004 OFP bigeye assessment – Completed and reported below

3. Convene hands-on inter-sessional meeting of a subset of MWG participants in Noumea prior to SCTB 17 – a group met in Noumea in June and July of 2004 to work collaboratively on yellowfin and bigeye assessments.

4. Examine both WCPO and Pacific-wide assessments for inter-regional consistency– no formal comparisons were scheduled.

5. Conduct additional simulations of bigeye fisheries to investigate:

   a. possible recruitment artefacts – no formal simulations were conducted but the effects of juvenile catches on recruitment estimates were tested during SCTB 17 and will be reported in the stock assessment session.

   b. effort standardization errors – the statistical habitat-based standardization (SHBS) was improved and included in the 2004 assessments.

   c. sensitivity of estimates of recruitment and natural mortality at age to tagging data – no work was done on this topic

6. Evaluate utility of current suite of reference points noting planned IATTC meeting on this topic – report available from IATTC, some results included in current assessments, e.g. likelihood profiles of bigeye and yellowfin F/F_{msy}.

7. Further investigation of effort standardization, especially for BET & YFT by inclusion of additional variables and exploring sub-regional stratification. Work on effort standardization is on-going. Oxygen appears to be more influential in mediating longline CPUE in the EPO than in the WCPO.

Progress on recommendations from SCTB 16

1. Enhancements to MULTIFAN-CL – the following enhancements are under development or have been completed:
    a. sex structure in model and data – under development
    b. fitting to age data – under development
    c. simultaneous assessment of multiple species – under development.
    d. include Japanese longline bigeye size composition data prior to 1965 – included in 2004 assessment
    e. include Philippines species and size composition data – data in hand but need verification – under development
    f. include improved estimates of Indonesian catch data and explore model sensitivity to these data – no improved data are available, but sensitivity runs are in progress and preliminary results are available.
2. Document statistical habitat-based effort standardization methods – completed and reports are available (SCTB 17/SA-5; SCTB 17/SA-7).
3. General recommendations related to stock assessments:
    a. WCPO participation in ICCAT methods comparison of BET assessments,
    b. Model potential ecosystem effects of species interactions
    c. Develop standards for and implement an archival tag data repository - "beta" version under evaluation by PFRP.

Results of simulation studies

Simulation-estimation studies used to evaluate MULTIFAN-CL and other stock assessment models were presented, completing work begun prior to SCTB-15 and continued through SCTB-16. The study involved fitting stock assessment models to fishery data (time series of total catch, length frequency distributions, effort, tag releases/recaptures) simulated from a fairly complex (spatially dis-aggregated in 5º X 5º degree resolution, iterated on a monthly time step) operating model parameterized to resemble WCPO yellowfin tuna fishery dynamics (Labelle 2002, 2003). There were 5 simulation scenarios ranging from a simple 1 fishery X 1 region case to a 16 fishery X 7 region case; each with 40 stochastic realizations. MWG-3 summarized performance of some key biomass- and MSY-related estimators for a range of assessment models: MULTIFAN-CL, SCALIA, Fox and Schaefer production models, and provided a brief overview of a complementary study with a larger emphasis on Southern Bluefin Tuna. Results were presented in terms of frequency distributions of error ratios (e.g. assessment model estimate / known operational model value). MWG-4 summarized model performance in a slightly different format (including results from A-SCALA), and explored some of the likely causes of variability in model performance. In this case, estimator performance was expressed in terms of standardized bias. Results from the two papers were similar and suggested:

- Absolute estimates of MSY-related reference points were often poor, while relative estimates (e.g. F(t)/F(MSY)) were usually better
- Relative biomass estimates B(t)/B(0) were usually better than absolute biomass B(t).

- The production models (particularly the Fox model using the global nominal CPUE) generally performed better than the complicated integrative models in terms of global relative biomass estimates.

- MULTIFAN-CL and SCALIA had serious problems estimating natural mortality in most cases. Using the correct value of M substantially improved MULTIFAN-CL performance (particularly MSY-related values) in some cases, but not all.

- MULTIFAN-CL estimation performance seemed to improve with increasing simulation model complexity

- The relationship between longline CPUE and abundance was generally very good in the operating model, and assessment model performance was generally closely linked to the assumptions about the reliability of CPUE as a global abundance index (e.g. production model performance improved when global nominal longline CPUE was used as a relative abundance index, rather than CPUE from a single large fishery; SCALIA often performed the worst of all models when the effort was given low weight, but performance improved dramatically when effort from the large fisheries was strongly weighted). In at least one scenario (2F X 1R), the PS CPUE was uninformative and presumably contributed to the degraded estimation performance of the complicated integrative models.

These simulations illustrated that complicated integrative stock assessment models can make serious estimation errors, in part because it is easy to get some assumptions wrong (in addition, there may also be statistical biases, but these simulations were not set up to test this). Conversely, the study illustrates how simple models can perform very well, if they are based on the most informative data and ignore the deceptive data. However, we would not necessarily expect these results to be true in general, as this one study might have grossly misrepresented the information content of different sources of data compared with the real world. **Unfortunately, given the way the simulation scenarios were set up with multiple complicated assumptions, it is impossible to elucidate the effects of any specific model specification problem (e.g. how do effects of spatial aggregation units affect M estimation?).** Furthermore, the automated application of assessment models does not allow for interactive model evaluation using fitting diagnostics and common sense, as would normally occur in a real stock assessment using a single data realization. It is difficult to ignore the fact that the production models performed as well as they did, and it was suggested that a simple production model might be run in parallel with complicated WCPO assessments next year, to check for large discrepancies.

This simulation exercise explicitly evaluates the performance of one complex model using a second complex model. The results are often complex results, and it is difficult to decide which model is in error. With the benefit of hindsight, it was observed that the key results of the simulation study could have been realized with far less work (simpler simulation scenarios and fewer realizations). Future simulation studies should be designed with more focused objectives and adaptive design to improve our ability to learn from estimation problems. Some potential topics for simulation studies were identified including: the value of long term tagging studies in compensating for poor CPUE standardization, improving M-at-age estimation, and testing whether the development of a purse seine fishery is likely to create recruitment estimate biases (justification for these topics is discussed below).

Review of SPC/OFP bigeye assessment

The MULTIFAN-CL bigeye tuna (BET) assessment was presented from document SA-2, and the methodology and discussion focused on methodological issues. The assessment was structured similar to 2003 with updated data (Japanese size data pre-1965, and an additional year of data for longline, and Indonesian and Philippine PS fisheries), and the addition of fishery projections through 2007 with constant current effort. The following 5 model specifications were employed:

> SHBS-MEST Statistical habitat-based standardised effort for LL1.LL5, *M*-at-age estimated, constant catchability for LL1.LL5.
>
> SHBS-MEST-LLq Statistical habitat-based standardised effort for LL1.LL5, *M*-at-age estimated, catchability for LL1.LL5 allowed to vary independently over time, but with the initial catchability constrained to be equal.
>
> SHBS-MFIX Statistical habitat-based standardised effort for LL1.LL5, *M*-at-age assumed at fixed levels, constant catchability for LL1.LL5.
>
> GLM-MEST General linear model standardised effort for LL1.LL5, *M*-at-age estimated, constant catchability for LL1.LL5.
>
> GLM-MFIX General linear model standardised effort for LL1.LL5, *M*-at-age assumed at fixed levels, constant catchability for LL1.LL5.

Most of the scenarios yielded similar inferences, but the exploratory SHBS-MEST-LLq was substantially different. This model results in the best fit to the data (lowest – log-likelihood), but this is achieved with the addition of many additional parameters, under the assumption that tags and size frequency data are informative enough to compensate for incomplete longline effort standardization conducted in external analyses. In this case, the estimated catchability trends often differed substantially among model regions in a manner that did not have an obvious mechanistic explanation. It was noted that catchability trends could not be reliably estimated as noted in SBT simulation studies (MWG-3), even with unrealistically good data and good assumptions about underlying system dynamics. It was recognized that the approach should not be given much weight in the current assessment, and possible improvements to this approach were discussed, including:

> 1) constrain the mean longline catchability across regions to be identical (as opposed to just the starting point as currently implemented).
>
> 2) consider integrating effort standardization as another component of the assessment model which would also allow standardization uncertainty to propagate through the model (it was noted that this was not computationally practical within an MFCL assessment at present)
>
> 3) constrain effort deviations (or catchability) in relation to the uncertainty of the standardized effort (this would require a modification to MFCL code for time-dependent variances)

There was little difference between the fixed and estimated M model results, and the M estimates were rather similar to the fixed M assumptions. The values of M at age used in the fixed M analysis were similar to those used in the IATTC analysis, which were based on several independent estimates including some of the OFP tagging data.

Implementation of short term projections was recognized to be a positive development to the assessment. Constant catch predictions might be a useful future extension to complement the constant effort projections, because it might provide a more realistic interpretation of how the fleet would respond to changing abundance, or how future management actions might be implemented.

The quality of fit diagnostics for SHBS-MEST did not suggest any major inconsistencies between model predictions and observations, but a few points of concern were noted:

1- size distributions for LL5 (aggregated over time) are slightly mismatched. This might be caused by assuming constant selectivity across LL fisheries or changes in selectivity since development of island nation fleets

2- there are temporal patterns in the residuals of the size frequency distribution for some fisheries, with a particularly strong trend in weights of LL1. It is not clear if this is a result of age composition estimation errors, or a biological effect. There could be discarding effects in early years or changes in selectivity associated with establishment of EEZs.

3- the Australian tag recoveries are under-estimated (might suggest that migration rate estimates out of the Coral Sea used in the current analysis are too high)

The stock recruitment relationship for BET is probably not very well-determined because of the high recruitment variability and low biomass contrast. The model estimates high compensation (steepness) in the absence of a steepness prior, but it was deemed important to recognize that we cannot rule out a more pessimistic alternative. The presence or absence of a steepness prior does not have much effect on the spawner-recruit (SR) steepness estimates, but it does have a considerable effect on the uncertainty as described by the likelihood profile. YFT SR results were examined as a contrasting example, in which the absence of a prior on steepness was supportive of a very unproductive stock (steepness MPD ~0.4, broad likelihood profile). In the YFT case, visual inspection again suggested that the stock and recruitment estimates were not very informative with respect to steepness. It was proposed that the central focus of the assessments should emphasize steepness assumptions that represent the species biology over the estimated SR at this time.

Likelihood profiles were recognized as a good way to illustrate reference point uncertainty, particularly for asymmetrical distributions. Some colourful examples were illustrated in which coloured areas could be used to illustrate good and bad probabilities for managers although some presentations are preliminary (eg. Cumsum). It was recognized that the difference between the act of over-fishing and the state of being over-fished needs to be made clear to the WCPFC.

There is a consistent relationship between increasing recruitment and increasing purse seine catch in Region 2 (and to a lesser extent area 3) for BET over the last ~20 y, and it was unclear if this was an artefact of the assessment. This may reflect a data problem because Indonesian and Philippine total catch and species composition data are poorly characterized. However, it may also reflect a valid biological process that seems to coincide with a similar trend observed in the EPO.

Recommendations for reducing uncertainty in stock assessments

The following two general recommendations are critically important to reduce uncertainty in stock assessment. They have been endorsed on several previous occasions by the SCTB and by the WCPFC Preparatory Conference. So far full funding for this work has been elusive and only preliminary work has been undertaken:

1. Improved data collection from Indonesia and the Philippines
2. Large-scale tagging studies to provide better estimates of movement, mortality and other parameters of interest.

The following specific technical recommendations are intended to generally reduce uncertainty in stock assessment.

1. 3. Explore estimation of M at age to resolve apparent inconsistencies with simulations
2. In collaboration with IATTC, examine WCPO and Pacific-wide BET assessments for inter-regional consistency
3. Continue to improve effort standardization by inclusion of additional variables and more flexible use of standardized effort in assessment models.
4. Consider purse seine effort standardization taking into account results of IATTC meeting on PS effort standardization.
5. Use constant catch in MFCL projection period
6. Refine parameterization of catchability between regions in MFCL analysis for LLq models
7. Explore use of simple production models to compare biomass and reference point estimates
8. Explore use of "Longhurst" large marine ecosystem regions in MFCL
9. Begin to examine methods used in the ecosystem approach to fisheries.

Annex A5-I: List of Participants

John Sibert (chair), Shelton Harley, Dale Kolody Jone Amoe, Keith Bigelow, Robert Campbell, Sangaa Clark, Paul Dalzell, John Hampton, Shelton Harley, Bert Kikkawa, David Kirby, Pierre Kleiber, Dale Kolody, Adam Langley, Patrick Lehodey, Naozumi Miyabe, Brett Molony, Talbot Murray, Keisuke Satoh, John Sibert, Robert Skillman, Sun Kwon Soh, Liming Song, Max Stocker, Chu-Lu Sun, and Mike Tenorio.

Annex A5-II: SCTB 17 Methods Working Group Agenda

August 9, 10

1. INTRODUCTION– John Sibert
2. SELECTION OF RAPPORTEURS
3. ADOPTION OF AGENDA
4. RESULTS OF SIMULATION STUDIES
   a. Extracts from SESAME: a simulation-estimation stock assessment model evaluation project focused on large pelagic species; Dale Kolody, P.C. Jumppanen, D. G. Ricard, J. R. Hartog, A. L. Preece, T. Polacheck; MWG-3
   b. Comparison of stock assessment methods using an operational model; John Sibert; MWG-
   c. Discussion
   d. Conclusions
5. REVIEW OF SPC/OFP BIGEYE ASSESSMENT
   a. Stock assessment of bigeye tuna in the western and central Pacific Ocean; John Hampton, P. Kleiber, A. Langley and K. Hiramatsu. SA–2
   b. Discussion
   c. Conclusions
6. CONTRIBUTED PAPERS
   a. Performance indices, reference points and use of CUSUM plots for monitoring the performance of the longline fishery off eastern Australia; Robert Campbell; MWG–1.
   b. Relative abundance indices of the Japanese longline fishery for bigeye and yellowfin tuna in the western and central Pacific; K. Bigelow, A.D. Langley and T. Patterson; SA–7
   c. Possible utility of catch limits for individual purse-seine vessels to reduce fishing mortality on bigeye tuna in the eastern pacific ocean; S. Harley, P. Tomlinson, and J. Suter
   d. importance of the assumed steepness of the spawner-recruitment relationship. S. Harley, S. Hoyle, and M. Maunder
7. PROGRESS ON TASKS AND RECOMMENDATIONS FROM SCTB16
8. FUTURE PLANS
   a. Review MWG terms of reference – Sibert
   b. Future plans
9. OTHER BUSINESS
10. PREPARATION OF REPORT

August 12, SCTB Plenary

11. MWG Report – Sibert
12. Other Business

APPENDIX 6. SCIENTIFIC NAMES OF SPECIES

ENGLISH NAME	SCIENTIFIC NAME
Tuna and Tuna-Like Species	
Albacore	*Thunnus alalunga*
Bigeye	*Thunnus obesus*
Bullet tuna	*Auxis rochei*
Frigate tuna	*Auxis thazard*
Kawakawa, Eastern little tuna	*Euthynnus affinis*
Pacific bluefin	*Thunnus orientalis*
Skipjack	*Katsuwonus pelamis*
Southern bluefin tuna	*Thunnus maccoyii*
Wahoo	*Acanthocybium solandri*
Yellowfin	*Thunnus albacares*
Billfish	
Black marlin	*Makaira indica*
Pacific 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.
Whale shark	*Rhincodon typus*
Other Species	
Mahi mahi	*Coryphaena hippurus*
Opah	*Lampris guttatus*
Monchong (pomfrets)	*Taractichthys steindachneri, Eumegistus illustris*
Marine Turtles	
Green	*Chelonia mydas*
Leatherback	*Dermochelys coriacea*
Loggerhead	*Caretta caretta*
Olive Ridley	*Lepidochelys olivacea*
Sea Birds	
Black-footed albatross	*Phoebastria nigripes*

APPENDIX 7. ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
AMSY	Average maximum sustainable yield
ARG	Albacore Research Group
A-SCALA	Age-structured statistical catch-at-length analysis
ASPM	Age structured production model
AVHRR	Advanced Very High Resolution Radiometer
B	Biomass
BAS	Bureau of Agricultural Statistics (Philippines)
B_{MSY}	Equilibrium population biomass at maximum sustainable yield
BBRG	Billfish and Bycatch Research Group
BET	Bigeye tuna
BFAR	Bureau of Fisheries and Aquatic Resources (Philippines)
BRG	Bigeye Research Group
BW	Body weight
c&f	Cost and Freight
CF	Condition factors
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
COFI	Committee on Fisheries (FAO)
COMTRADE	commercial trade statistics database of the UN Statistics Division
CPUE	Catch per unit of effort
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
DGCF	Directorate General of Capture Fisheries (Indonesia)
DWFN	Distant water fishing nation
EDF	European Development Fund
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
EU	European Union
F	Instantaneous rate of fishing mortality
F_{MSY}	Fishing mortality rate at maximum sustainable yield
FAD	Fish aggregating device
FAO	Food and Agriculture Organization of the United Nations
FFA	South Pacific Forum Fisheries Agency
FFC	Forum Fisheries Committee
FIGIS	Fisheries Global Information System
FL	Fork length
FTWG	Fishing Technology Working Group

FSM	Federated States of Micronesia
GAM	General additive model
GLM	General linear model
GPS	Global Positioning System
GRT	Gross registered tonnage
GSI	Gonadosomatic index
HMS	Highly migratory species
I/ABM	Individual/Agent-based model
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
IEO	Instituto Español de Oceanografía
IPTP	Indo-Pacific Tuna Programme
IOTC	Indian Ocean Tuna Commission
IPOA	International Plan of Action
IRD	Institut de la Recherche pour le Développement (formerly ORSTOM)
IUU	Illegal, unreported and unregulated
JIMAR	Joint Institute of Marine and Atmospheric Research (UH)
kg	Kilogram
km	Kilometre
LCEM	Landed Catch and Effort Monitoring Project (Philippines)
M	Instantaneous rate of natural mortality
m	Metres
MAF	Ministry of Agriculture and Fisheries (New Zealand)
MFMR	Ministry of Fisheries and Marine Resources (Solomon Islands)
MIMRA	Marshall Islands Marine Resources Authority
MULTIFAN-CL	Multi-Factor Analysis software (CL: catch length) – the principal model used for stock assessments in the WCPO
MFCL	ditto
MSY	Maximum sustainable yield
mt	Metric tonnes
NAD	Non-target, associated and dependant (species)
nm	Nautical mile
NFA	National Fisheries Authority (PNG)
NFC	National Fisheries College (PNG)
NFR	National Fishery Report
NFRDI	National Fisheries Research and Development Institute (Korea)
NMFS	National Marine Fisheries Service (USA)
NORMA	National Oceanic Resource Management Authority (FSM)
NRIFSF	National Research Institute of Far Seas Fisheries (Japan)
NSAP	National Stock Assessment Project (Philippines)
NTU	National Taiwan University
OAL	Overall length
OFDC	Overseas Fisheries Development Council (Taiwan)
OFP	Oceanic Fisheries Programme (SPC)
OPAGAC	Organization de Productores Asociados de Grandes Atuneros Congeladores
PIAFA	Pacific Insular Area Fishery Agreement
PIAO	Pacific Islands Area Office (NMFS)

PIC	Pacific island country
PFRP	Pelagic Fisheries Research Program (UH)
PNG	Papua New Guinea
PROCFish	Pacific Regional Oceanic and Coastal Fisheries Project (SPC)
PSAT	Pop-up satellite archival tag
RIMF	Research Institute for Marine Fisheries (Indonesia)
RSW	Refrigerated sea water
SAT	Samoan Tala
SBR	Spawning biomass ratio – the ratio of the spawning biomass to the spawning biomass of the unexploited stock
SCALIA	Statistical catch-at-age/length integrated analysis
SCTB	Standing Committee on Tuna and Billfish
SeaWiFS	Sea-viewing Wide Field-of-view Sensor Project
SEPODYM	Spatial environmental population dynamics model
SKJ	Skipjack tuna
SPC	Secretariat of the Pacific Community (formerly the South Pacific Commission)
SRG	Skipjack Research Group
SSB	Spawning stock biomass
SST	Sea surface temperature
STCZ	Sub-tropical Convergent Zone
SWG	Statistics Working Group
TAC	Total allowable catch
UH	University of Hawaii at Manoa
UN	United Nations
US	United States of America
USA	United States of America
USD	USA dollar
USMLT	US Multi-lateral Tuna Treaty
WCPO	Western and Central Pacific Ocean
w.w.e.	wet weight equivalent
WPRFMC	US Western Pacific Regional Fisheries Management Council
WTPO	World Tuna Purse Seine Organization
VMS	Vessel monitoring system
VPA	Virtual population analysis
YFT	Yellowfin tuna
YRG	Yellowfin Research Group