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Seventeenth Meeting of the Standing Committee on Tuna and Billfish

Majuro, Republic of the Marshall Islands 9–18 August 2004

Executive Summary

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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 SungKwon 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.

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.

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.

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.

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.

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. SCTB17 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.

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

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 modeling 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

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 SCTB17 and SCG, among them data standards and advice on analyses of management options respectively. SCTB17 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 SCTB17. 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 SCTB17, 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 SCTB17, 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 SCTB17 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.

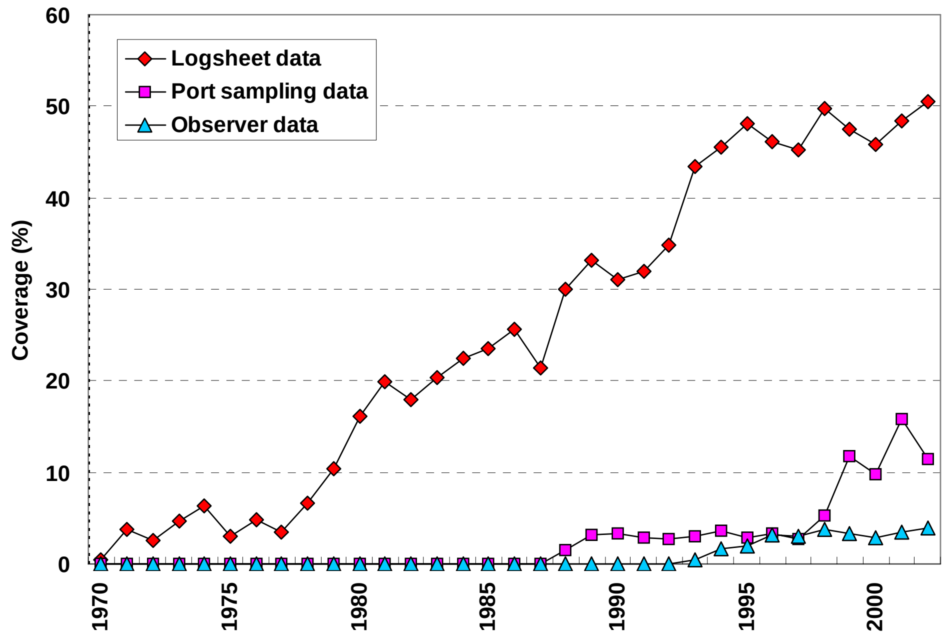


Figure 1. Trends in coverage from 1970 to 2002

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.

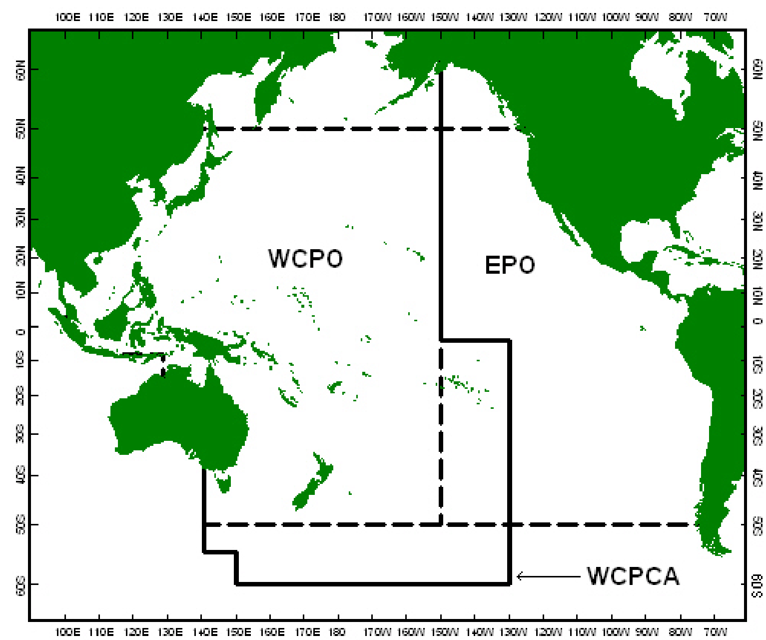


Figure 2. Convention Area (WCPCA), WCPO and EPO

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 SCTB17. 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 SCTB17, 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.

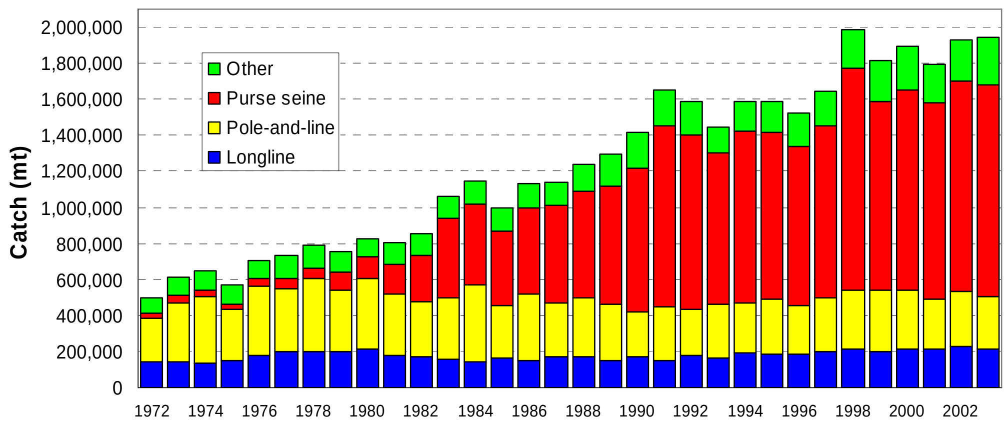


Figure 3. Catch (mt) of albacore, bigeye, skipjack and yellowfin in the WCPO, by longline, pole-and-line, purse seine and other gear types for the period 1972 to 2003

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).

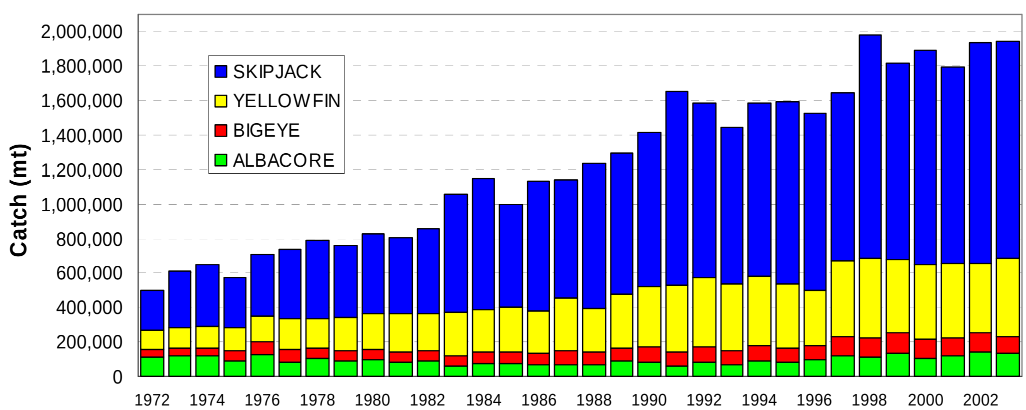


Figure 4. Catch (mt) of albacore, bigeye, skipjack and yellowfin in the WCPO for the period 1972 to 2003

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.

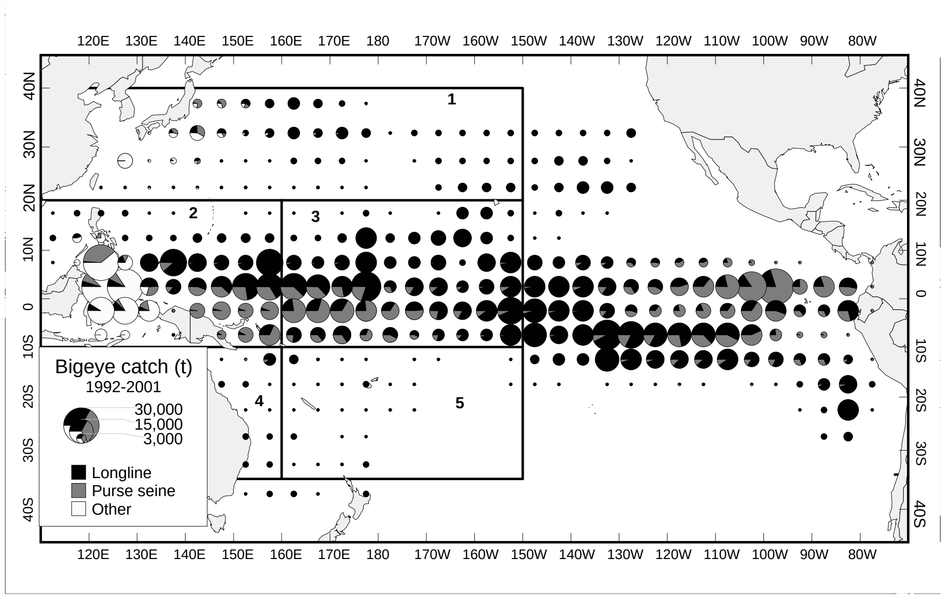


Figure 5. Distribution of bigeye tuna catch, 1992–2001. The spatial stratification used in the WCPO MULTIFAN-CL model is shown

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.

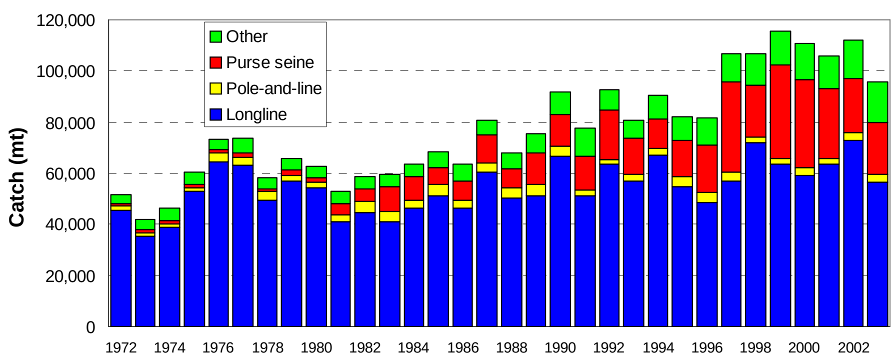


Figure 6. WCPO bigeye tuna catch by gear

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.

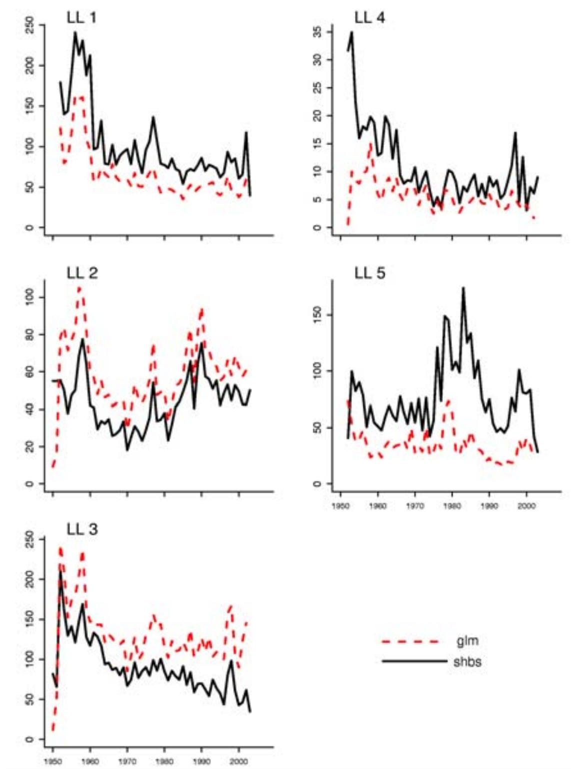


Figure 7. Catch-per-unit-effort (CPUE) for the longline fisheries LL1–LL5 standardised using two different methodologies. glm = general linear model; shbs = statistical habitat-based standardisation

Fish size

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).

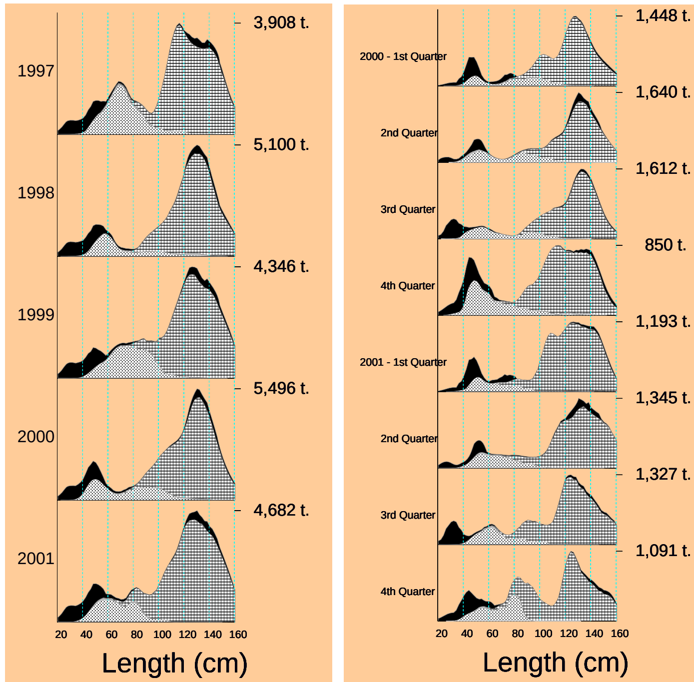


Figure 8. WCPO bigeye catch-at-size, expressed in weight. Black, dot, grey and hatched area indicate Philippine and Indonesian surface catch, associated catch by purse seine gear, unassociated catch by purse seine gear, and longline catch, respectively

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.

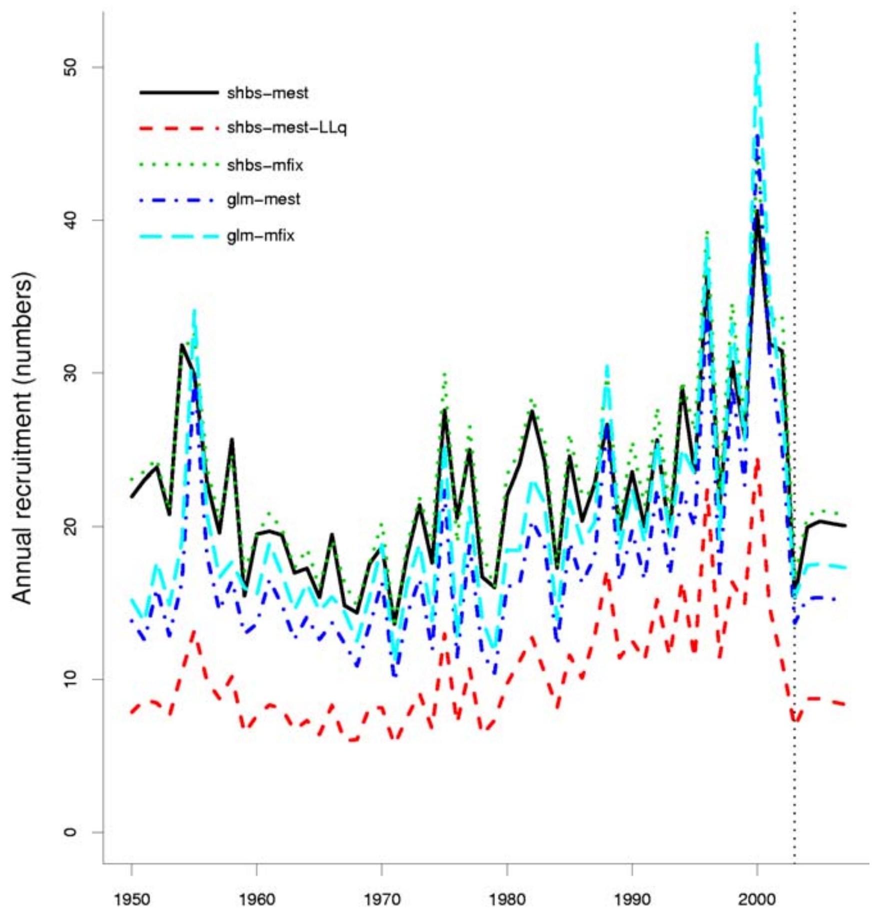


Figure 9. Estimated annual recruitment for the WCPO obtained from the separate analyses using different model options. The vertical dotted line indicates the point at which population projections are made with assumed levels of effort

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.

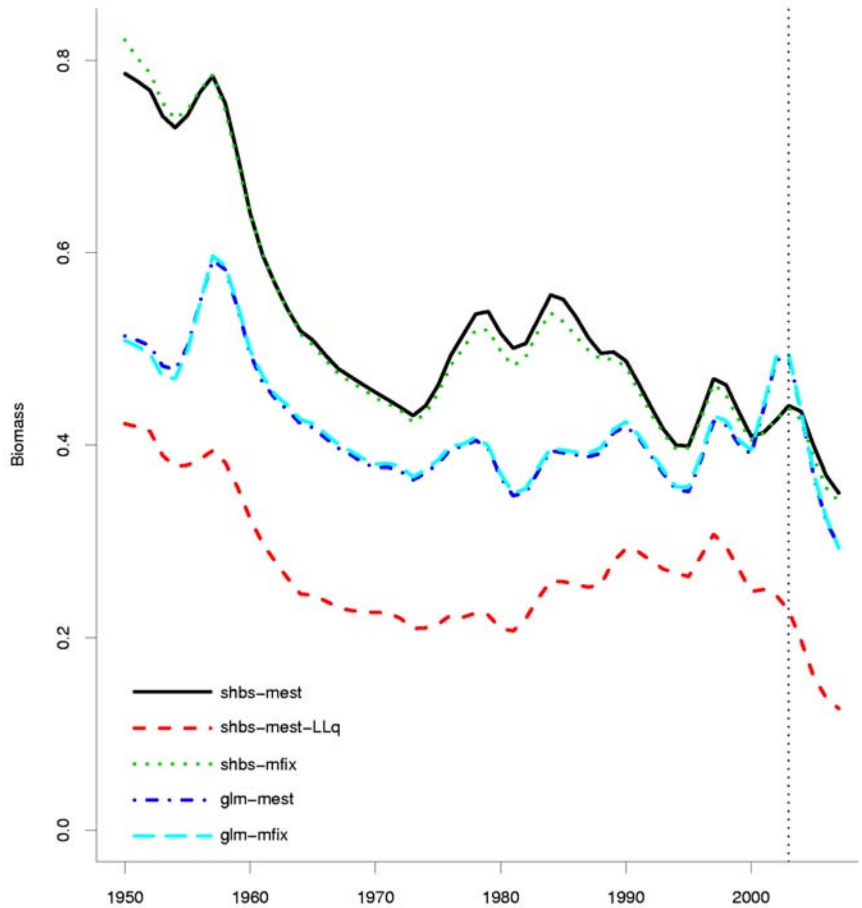


Figure 10. Estimated annual average total biomass (million t) for the WCPO obtained from the separate analyses using different model options. The vertical dotted line indicates the point at which population projections are made with assumed levels of effort

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.

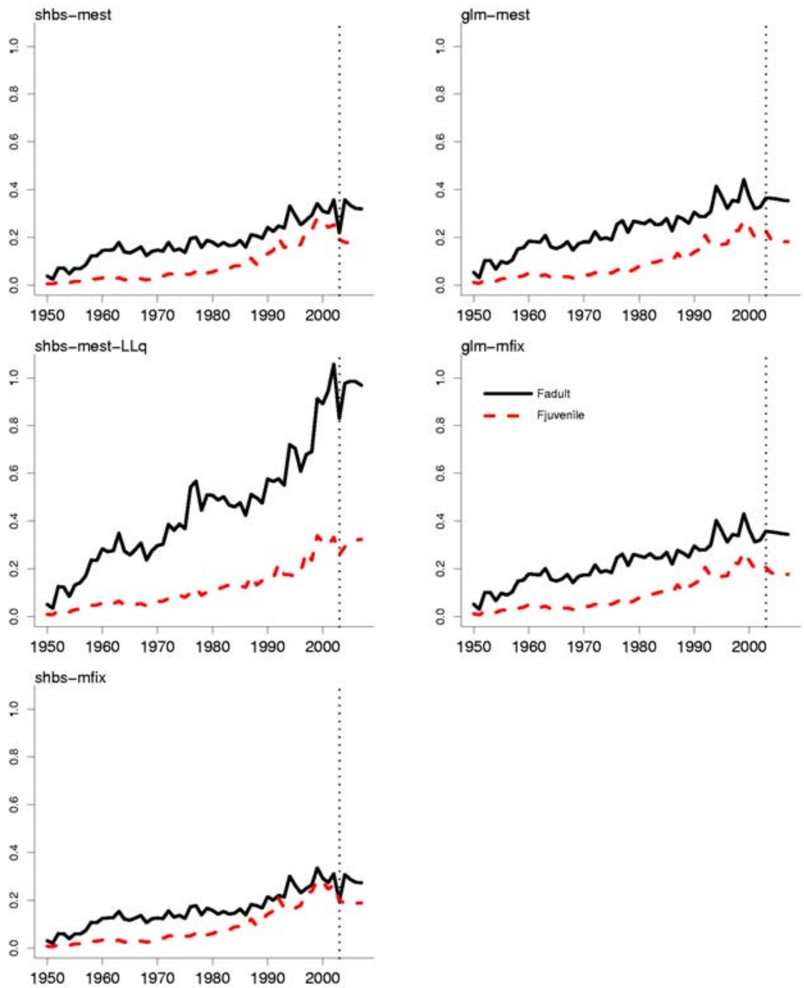


Figure 11. Estimated annual average juvenile and adult fishing mortality for the WCPO obtained from the separate analyses using different model options

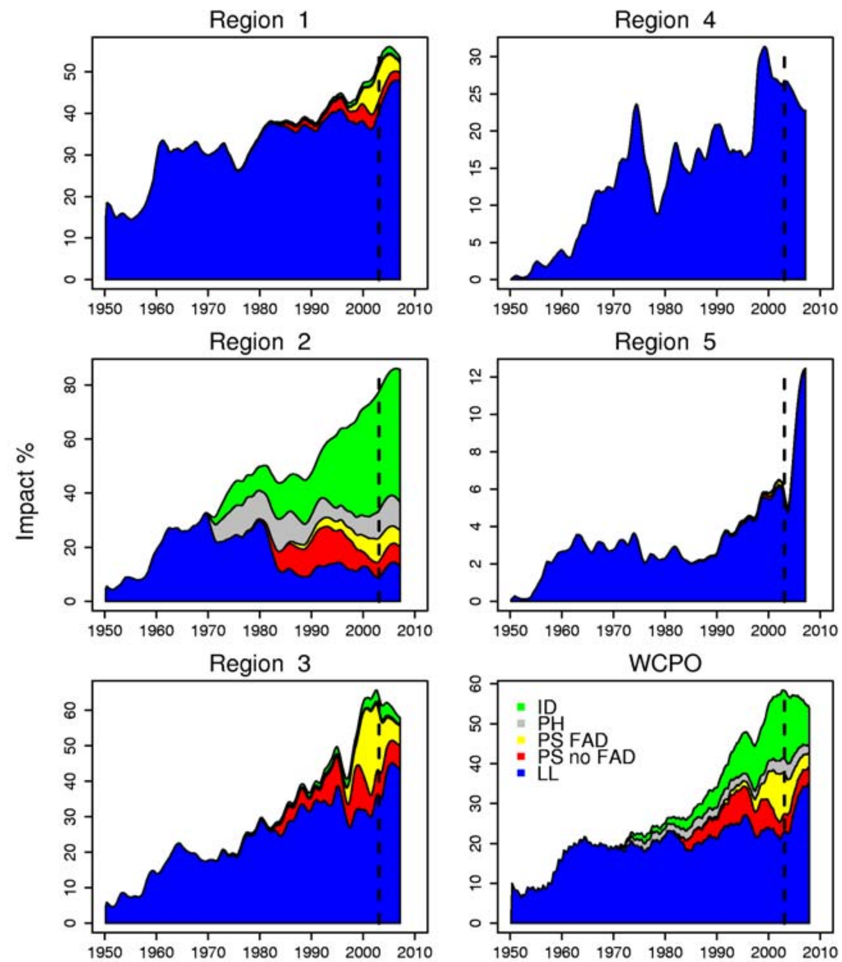


Figure 12. Estimates of reduction in total biomass due to fishing by region and for the WCPO attributed to various fishery groups. LL = all longline fisheries; ID = Indonesian domestic fishery; PH = Philippines domestic fisheries; PS FAD = purse seine FAD sets; PS non-FAD = purse seine log and school 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 SCTB17 (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

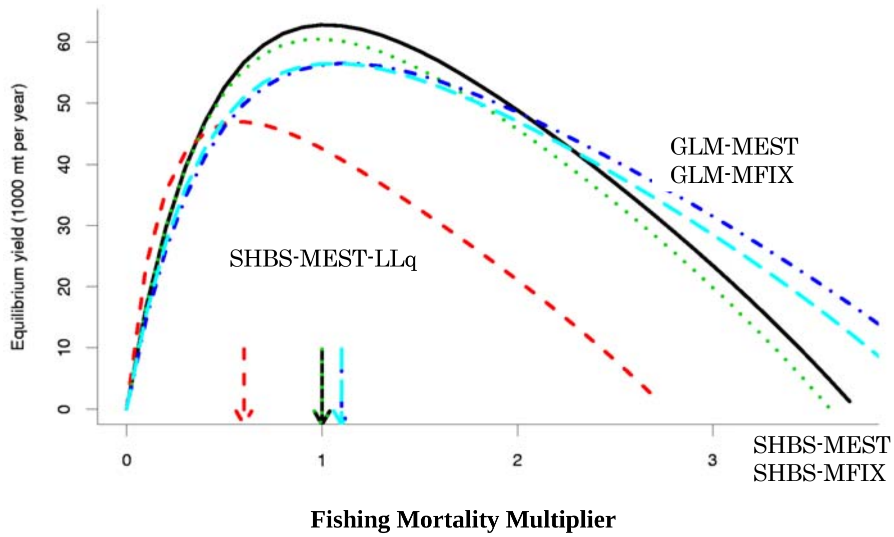


Figure 13. Yield curves estimated from the separate analyses using different model options. Arrows indicate corresponding F_{MSY} relative to the current fishing mortality multiplier

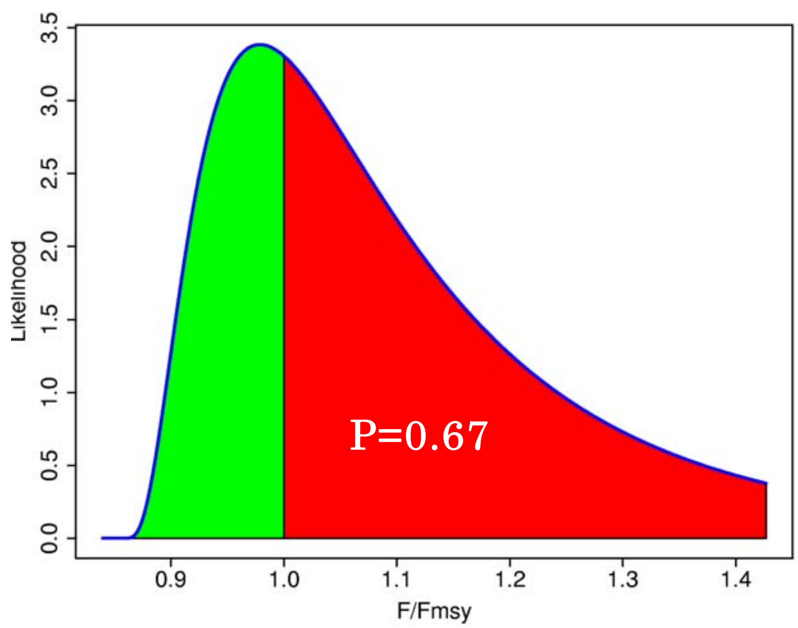


Figure 14. Probability distribution of $F_{current}$ / F_{MSY} based on the likelihood profile method (base case with steepness of mode = 0.9 and sd = 0.1)

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.

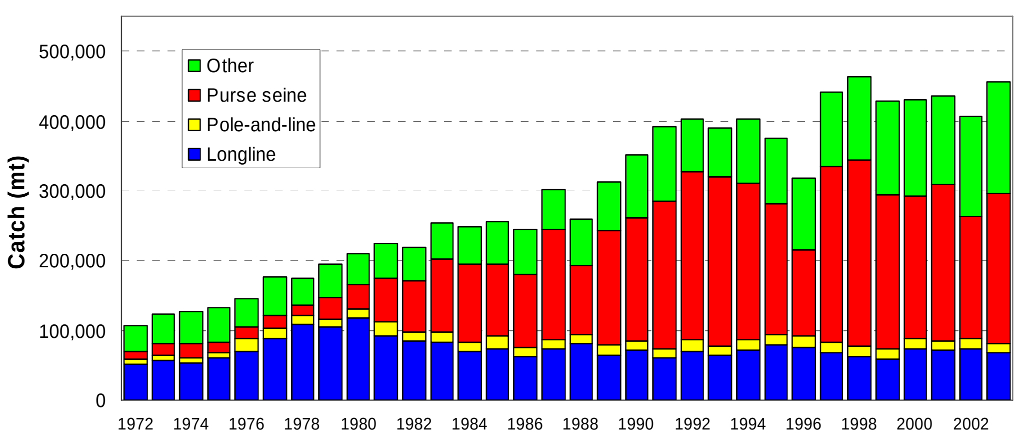


Figure 15. Annual WCPO yellowfin catch (mt) by gear

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.

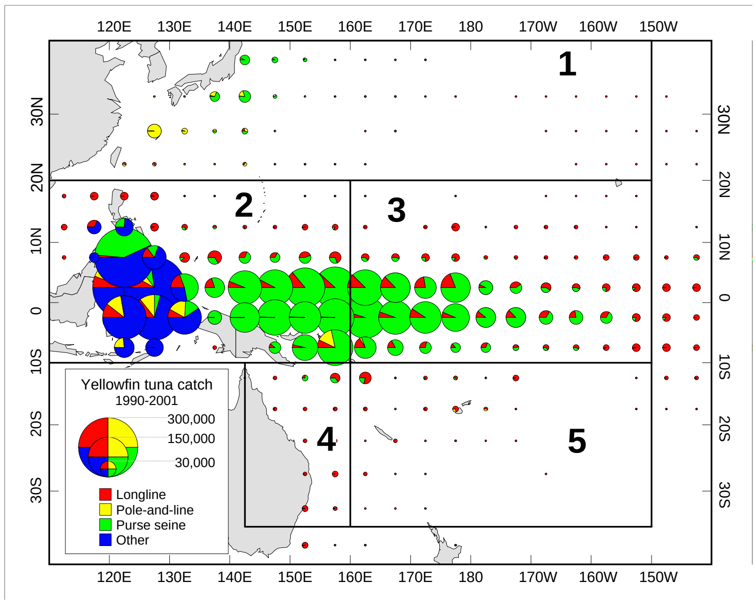


Figure 16. Distribution of yellowfin tuna catch, 1990-2001.
The five-region spatial stratification used in stock assessment is shown

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 (60–100cm) 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.

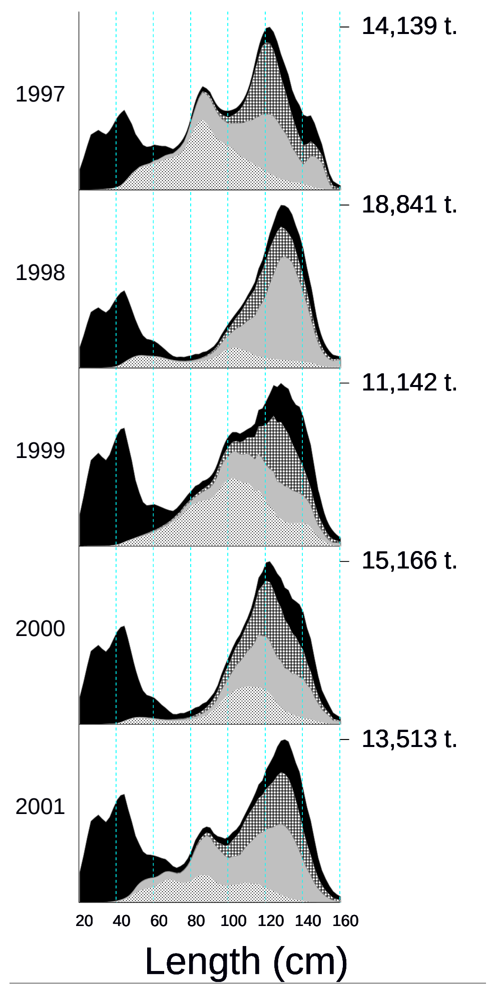


Figure 17. Annual Yellowfin tuna catch-at-size in the WCPO, 1997–2001.
The catch is broken down into the Indonesian / Philippines domestic fisheries component (black), the longline fishery component (hatched), unassociated-set catch from the purse-seine fishery (grey) and associated-set catch from purse-seine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

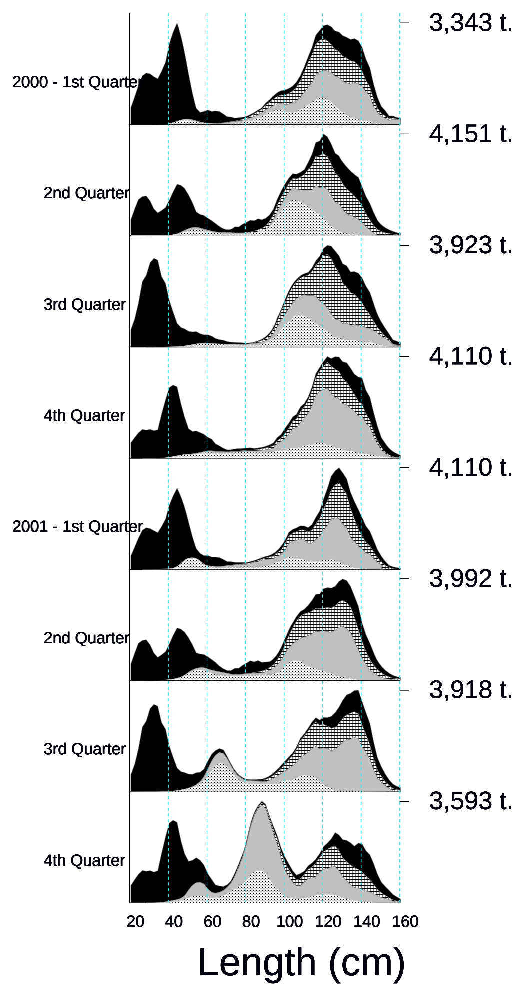


Figure 18. Quarterly Yellowfin tuna catch-at-size in the WCPO, 2000–2001.
The catch is broken down into the Indonesian / Philippines domestic fisheries component (black), the longline fishery component (hatched), unassociated-set catch from the purse-seine fishery (grey) and associated-set catch from 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.

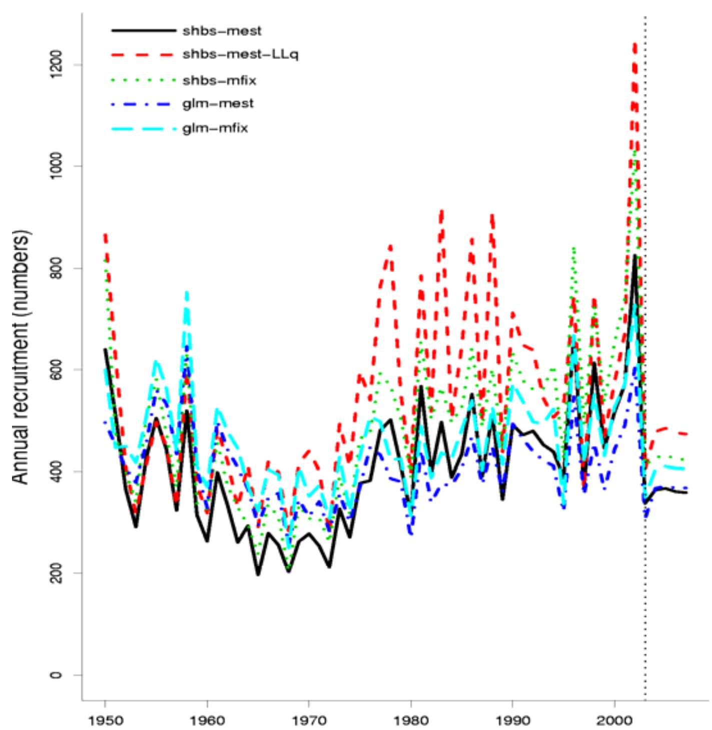


Figure 19. Estimated annual recruitment for the WCPO obtained from the five different model options. The vertical dotted line indicates the point at which population projections are made with assumed levels of effort

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.

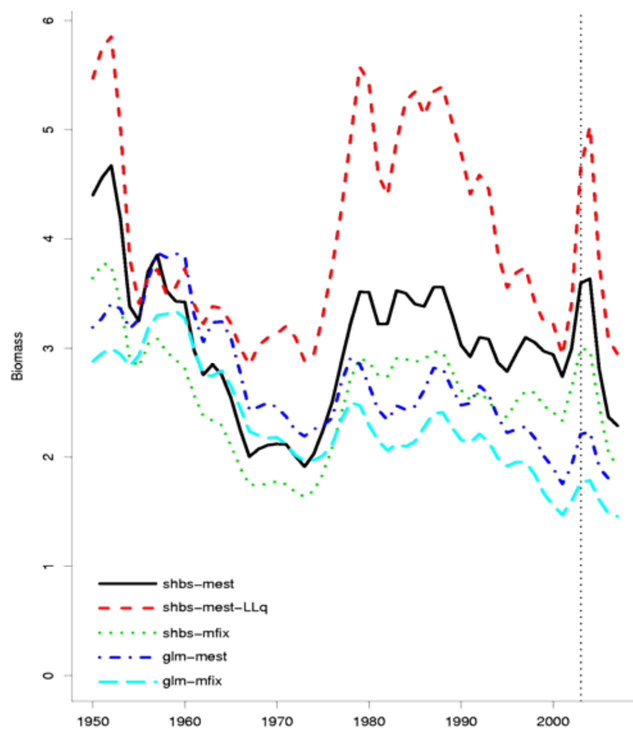


Figure 20. Estimated annual average total biomass (million t) for the WCPO obtained from the five different model options. The vertical dotted line indicates the point at which population projections are made with assumed levels of effort

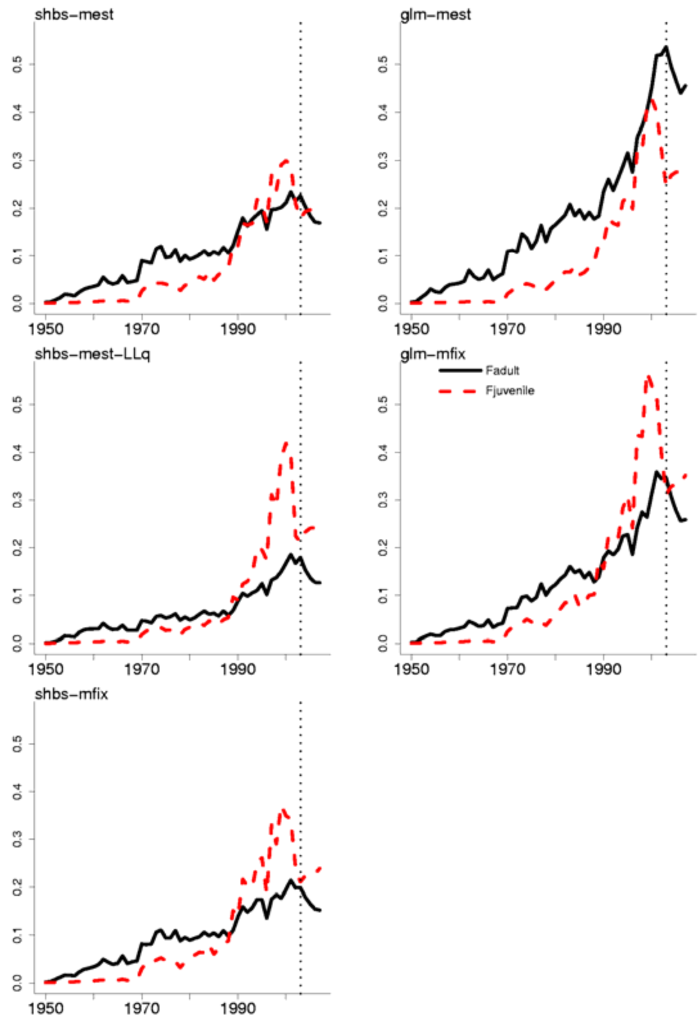


Figure 21. Estimated annual average juvenile and adult fishing mortality for the WCPO obtained from the five separate model options

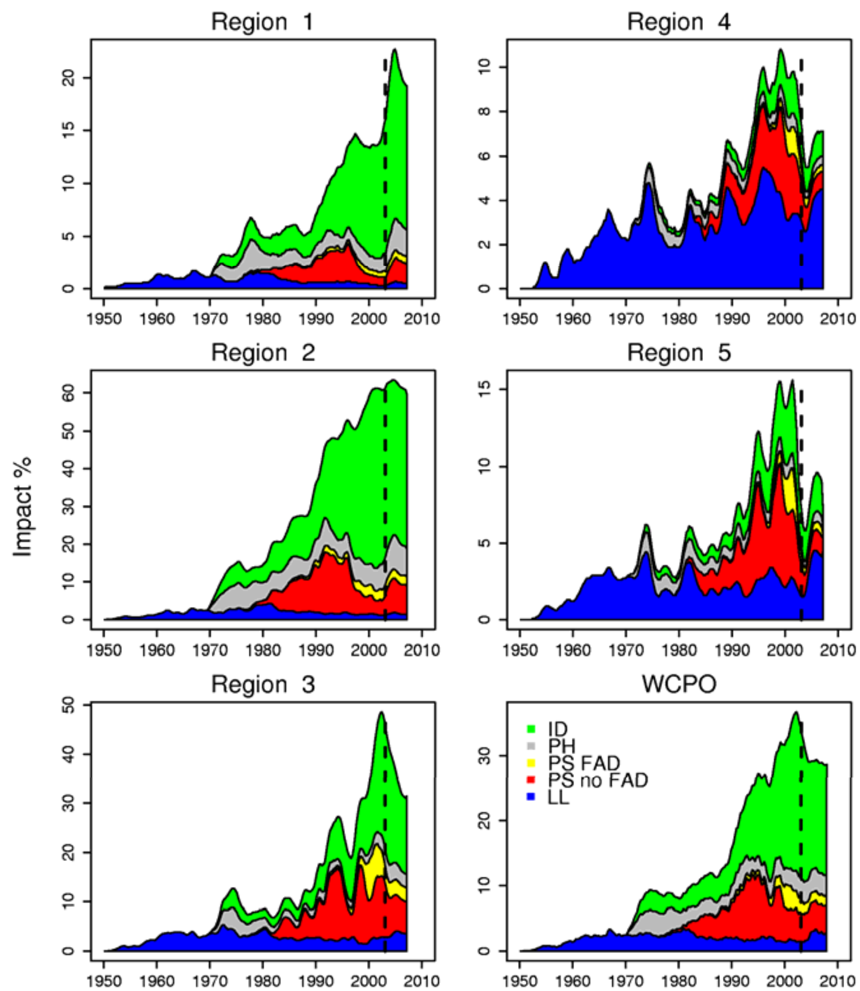


Figure 22. Estimates of reduction in total biomass due to fishing (fishery impact = 1-$B_t/B_{0,t}$) by region and for the WCPO attributed to various fishery groups. LL = all longline fisheries; ID = Indonesian domestic fishery; PH = Philippines domestic fisheries; PS FAD = purse seine FAD sets; PS non-FAD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

Stock status

The assessment (SA-1) reviewed by SCTB17 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

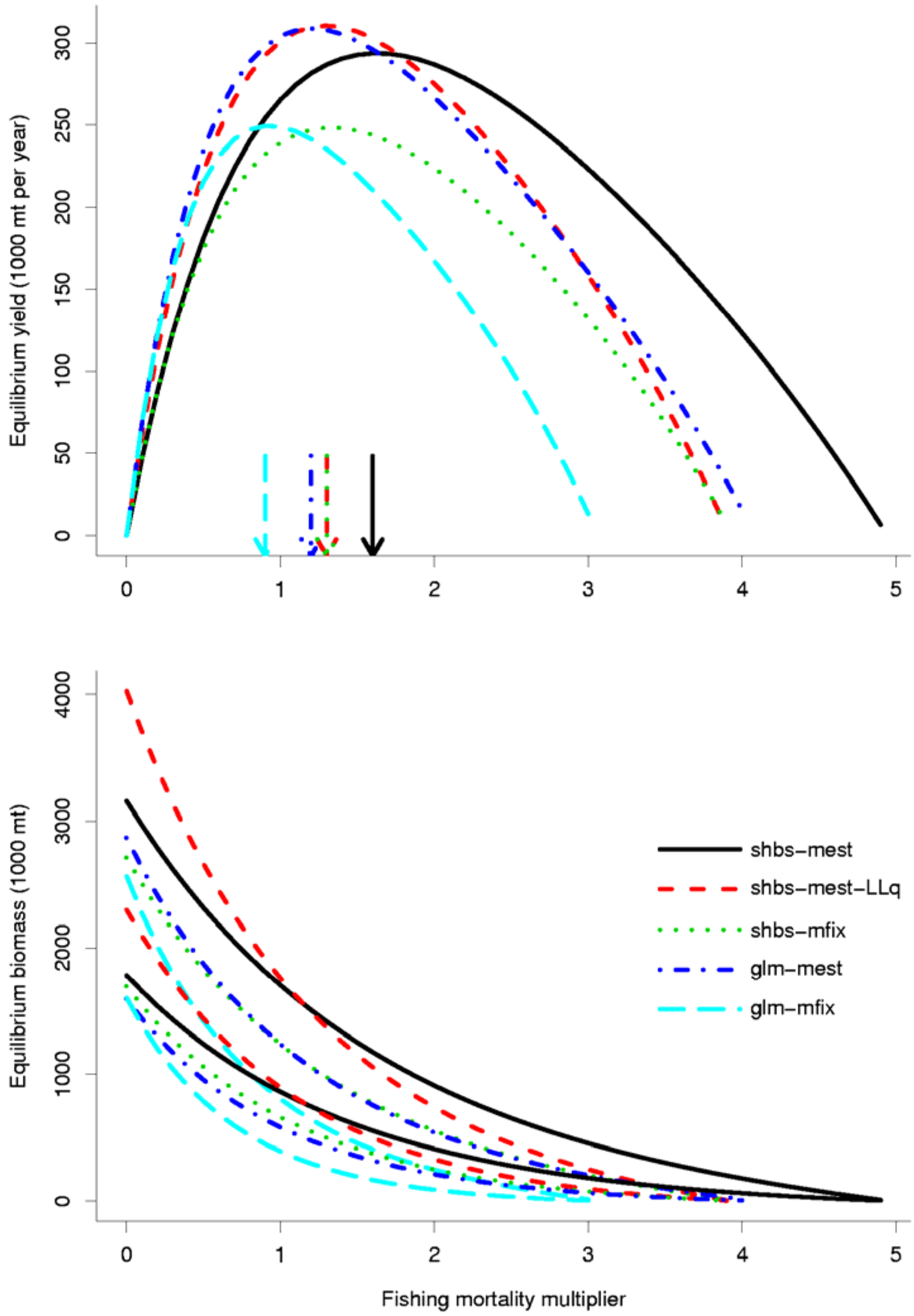


Figure 23. Yield, equilibrium biomass and equilibrium spawning biomass as a function of fishing mortality multiplier obtained from the five separate model options. In the upper panel, the arrows indicate the value of the fishing mortality multiplier at maximum yield

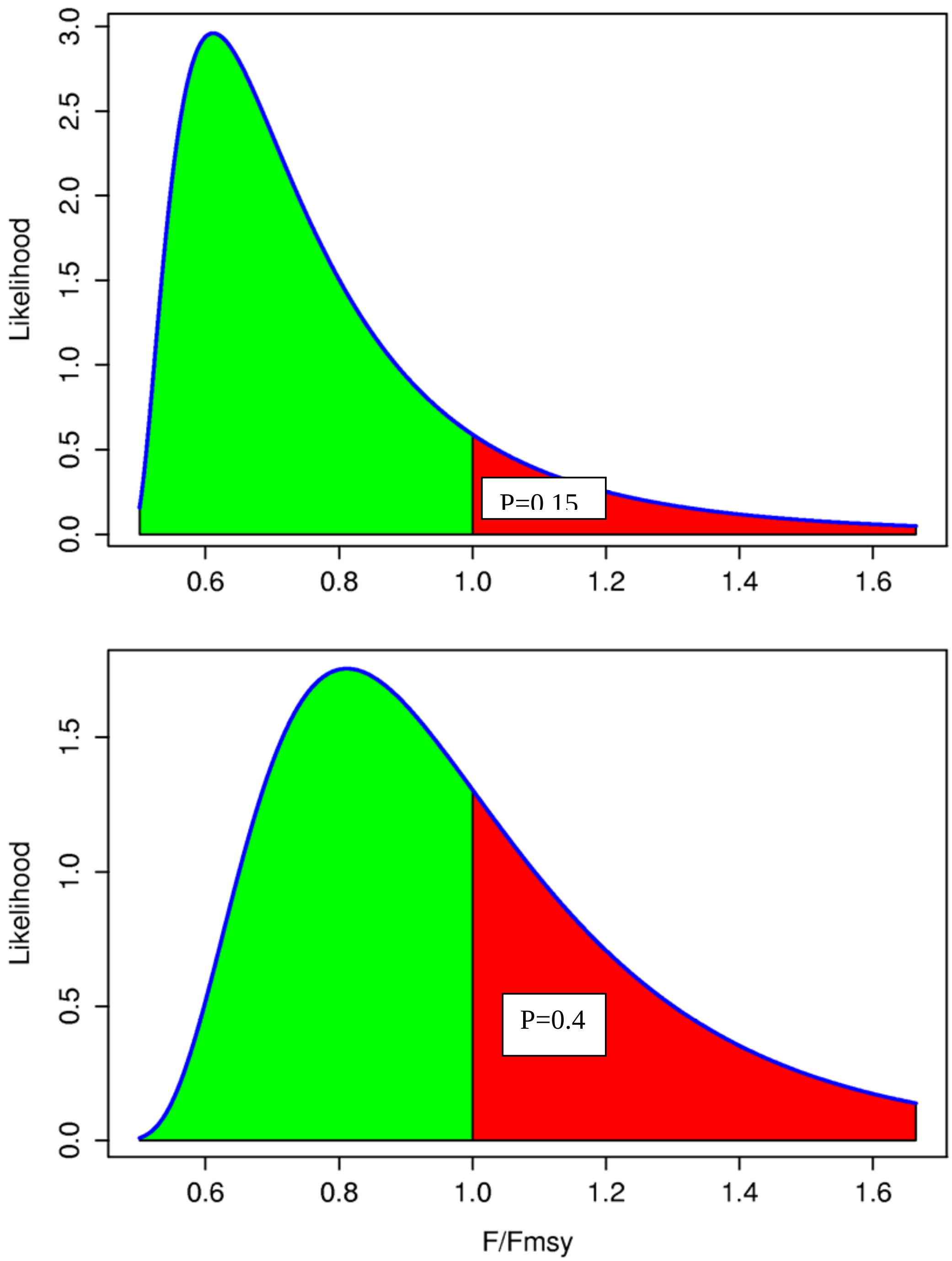


Figure 24. Probability distribution of $F_{current}$ / F_{MSY} based on the likelihood profile method with steepness priors of mode = 0.9 and sd = 0.1 (upper panel) and mode = 0.75 and sd = 0.1 (lower panel)

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.

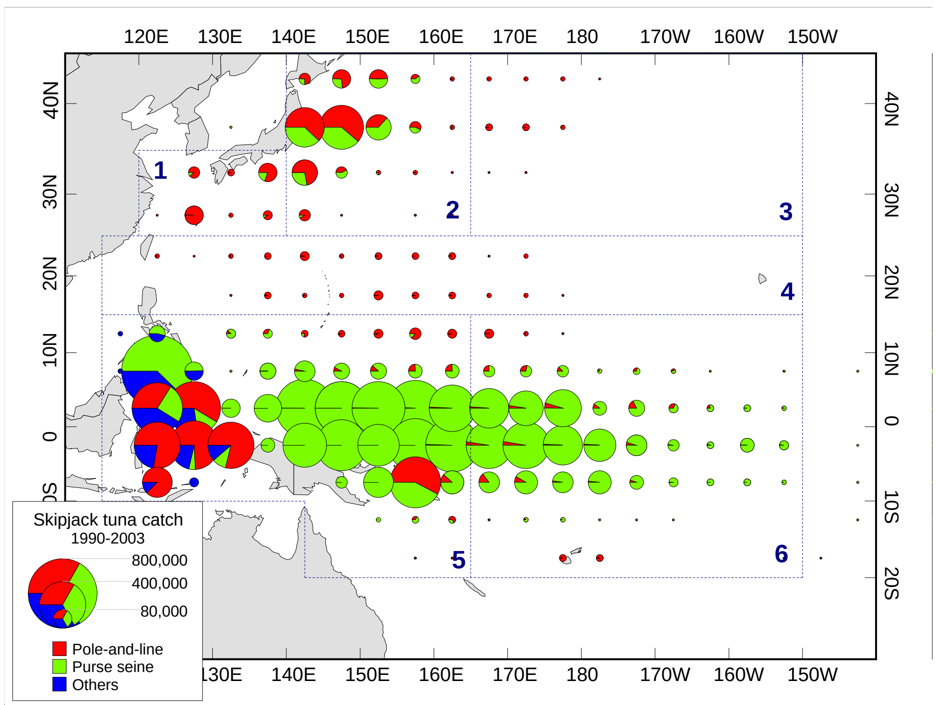


Figure 25. Distribution of skipjack tuna catch, 1990–2003

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 U.S. 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.

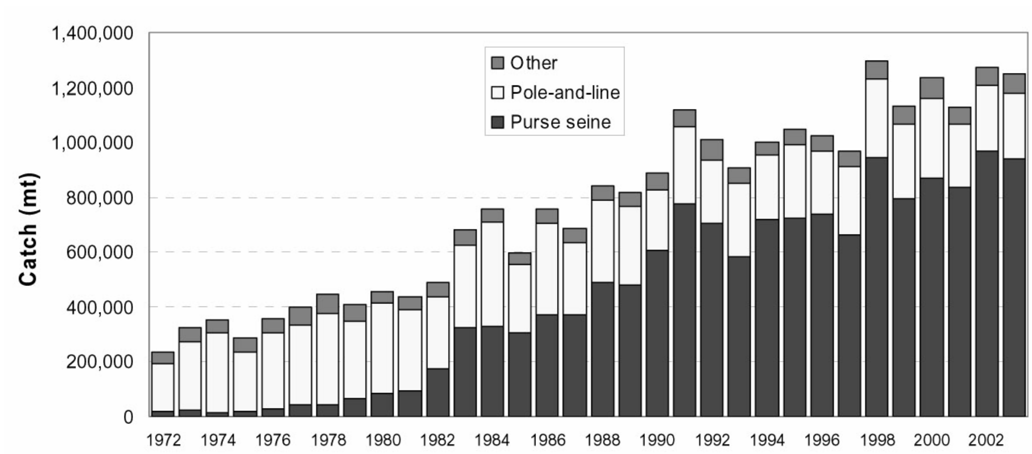


Figure 26. WCPO skipjack catch (mt) by gear for the period 1972 to 2003

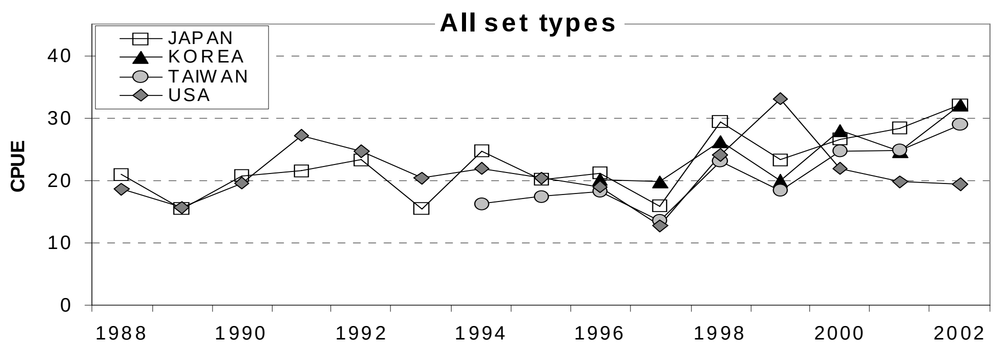


Figure 27. Nominal skipjack CPUE (mt per fishing days) for Japanese, Korean, Taiwanese and US purse seine fleets

Sizes 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.

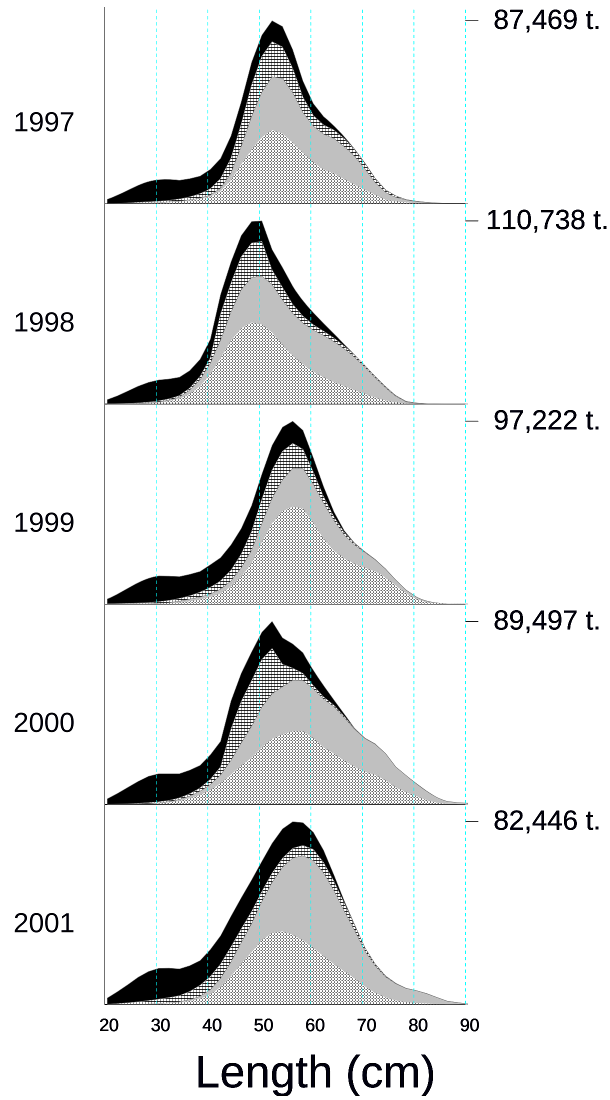
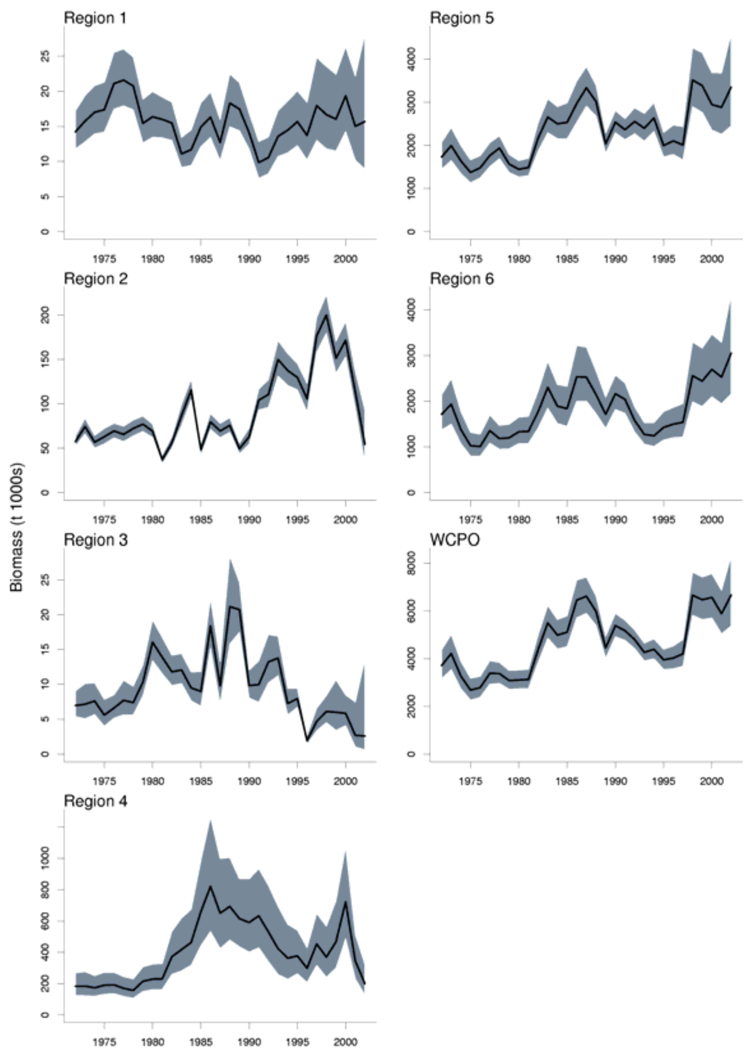


Figure 28. Annual Skipjack tuna catch-at-size in the WCPO, 1997–2001. The catch is broken down into the Indonesian/Philippines domestic fisheries (black), the pole-and-line fishery (hatched), unassociated-set catch from the purse-seine fishery (grey) and associated-set catch from purse-seine fishery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



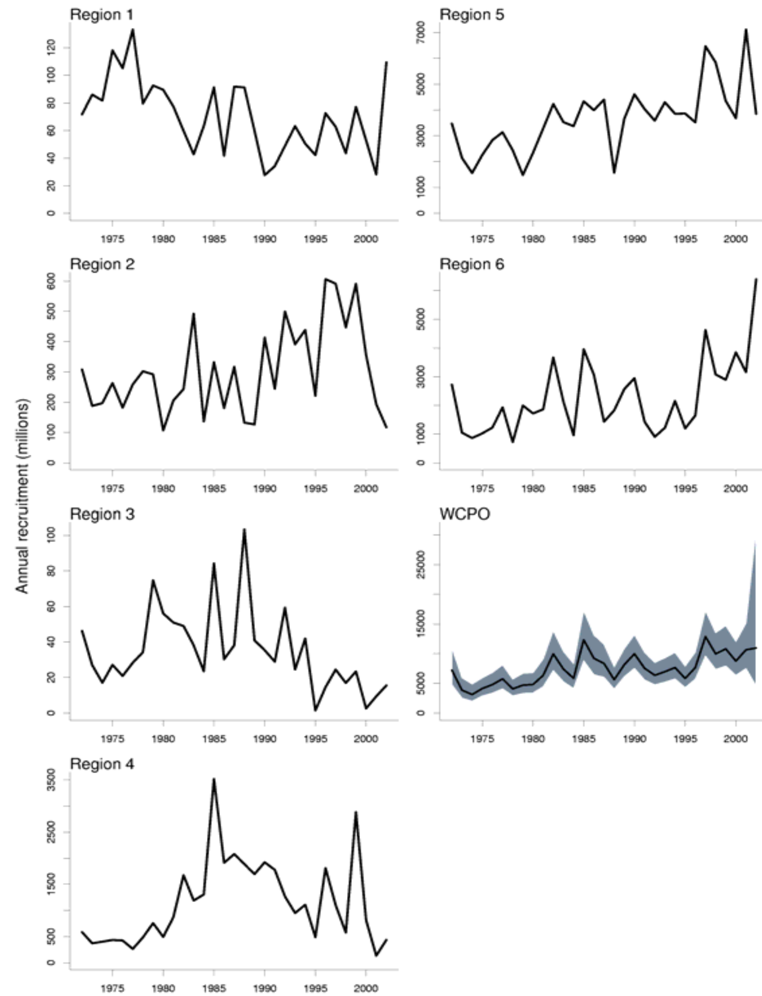


Figure 29. Estimated annual recruitment (millions) by region for the WCPO for the base-case analysis. The shaded area for the WCPO indicates the approximate 95% confidence intervals

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).

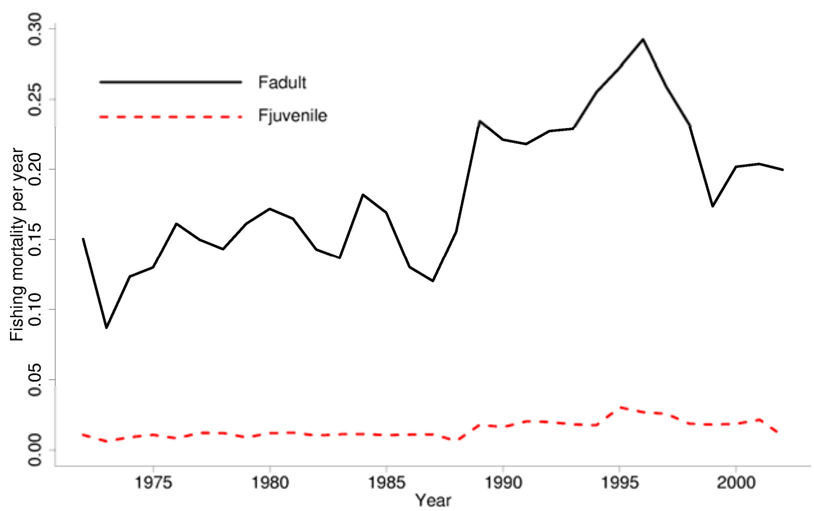


Figure 31. Estimated annual average fishing mortality rates for juvenile (age classes 1 and 2) and adult age-classes from the base-case assessment

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.

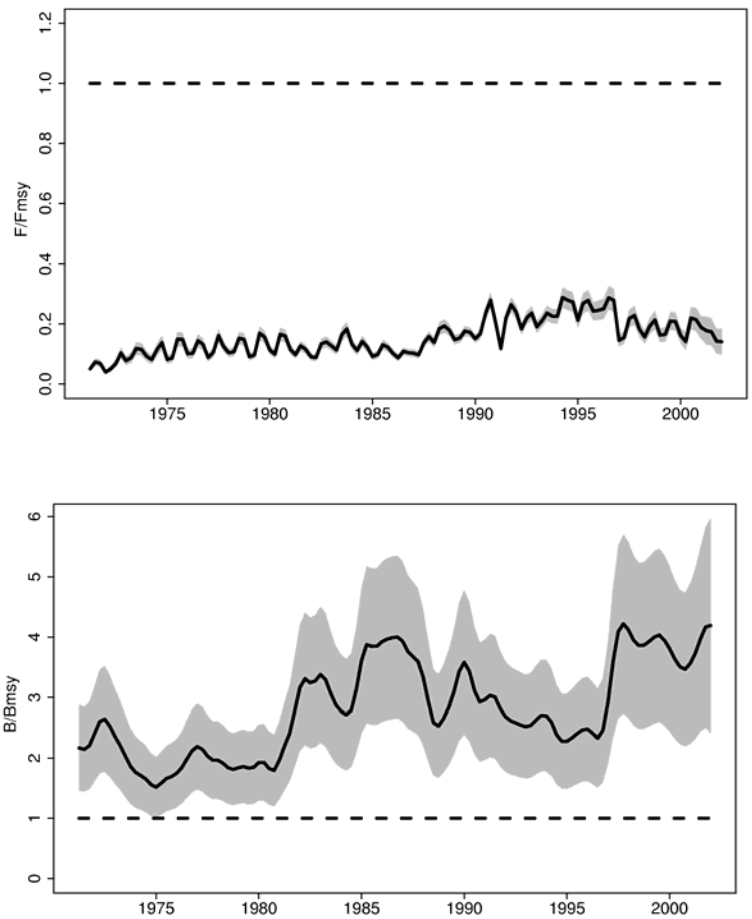


Figure 32. Ratios of F_t/F_{MSY} (top) and $B_t^{adult}/B_{MSY}^{adult}$ (bottom) with 95% confidence intervals. The horizontal lines at 1.0 in each case indicate the overfishing (a) and overfished state (b) reference points

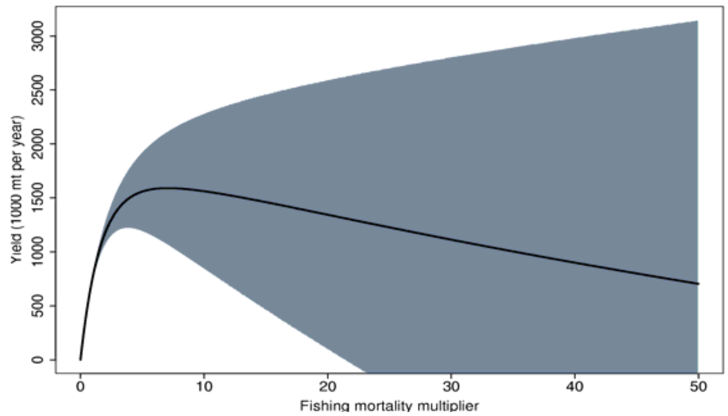


Figure 33. Predicted equilibrium yield and 95% confidence intervals as a function of fishing mortality (relative to the average fishing mortality-at-age during 1997-2001)

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).

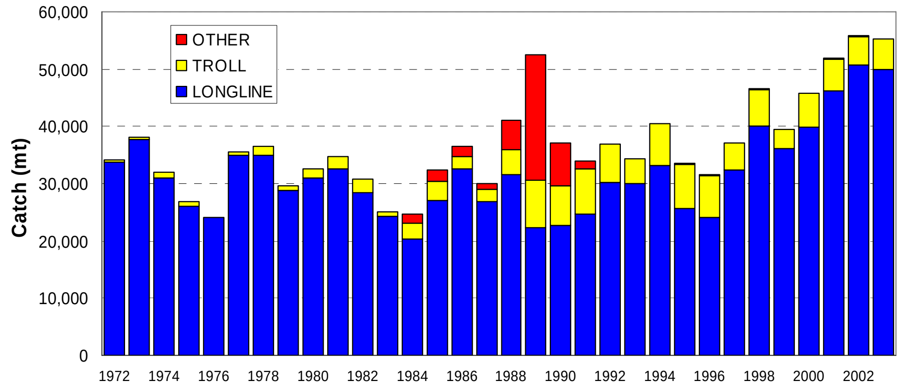


Figure 34. South Pacific albacore catch by gear type
'Other' is primarily catch by the driftnet fishery

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.

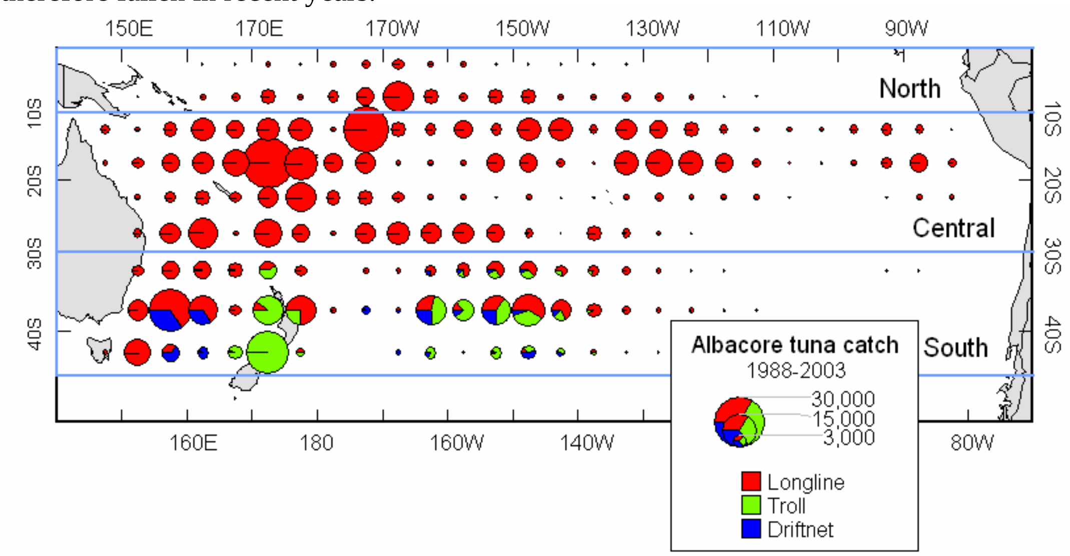


Figure 35. Distribution of South Pacific albacore tuna catch, 1988–2003

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.

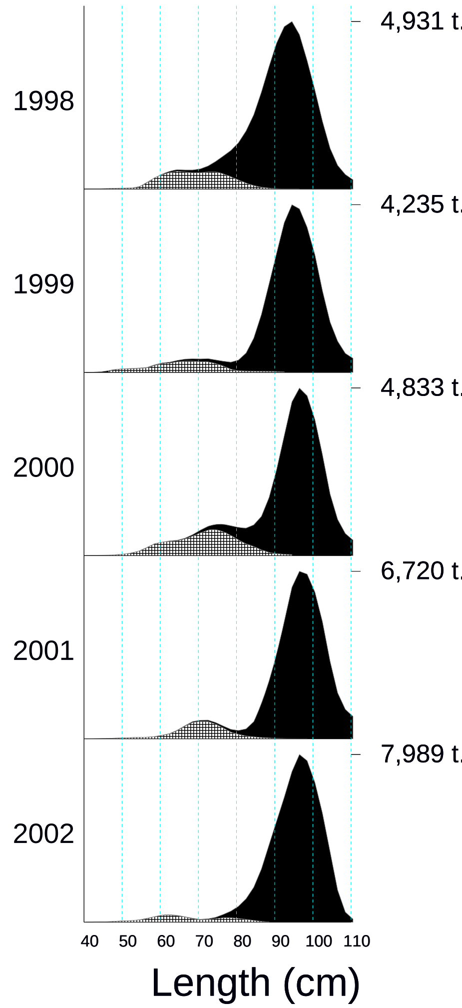


Figure 36. Annual albacore tuna catch-at-size in the south Pacific, 1998–2002. Longline = black; troll = hatched. The y-axis scale is in weight - the figures on the right indicate the catch weight in a 2-cm size class

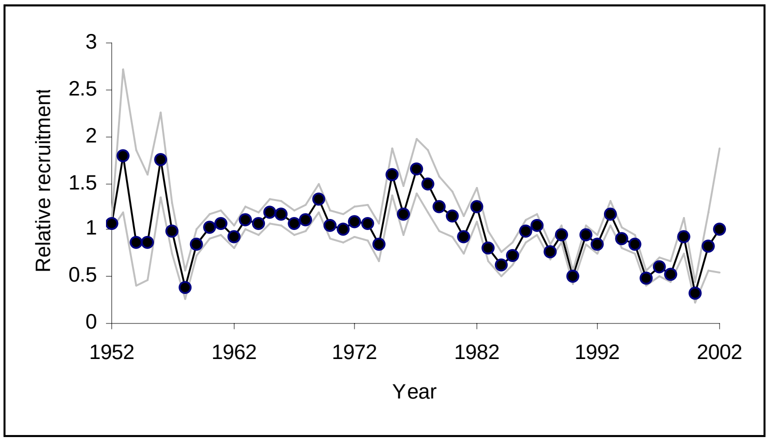


Figure 37. Estimated annual recruitment, with 95% confidence intervals, scaled to the average of the points estimates

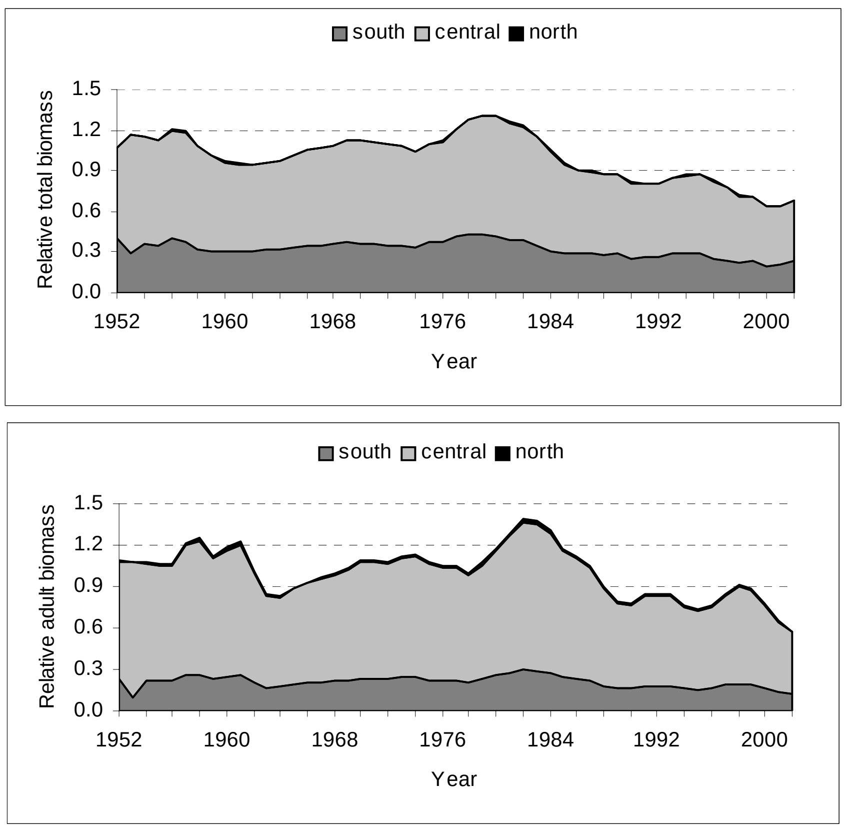


Figure 38. Estimates of relative total and adult biomass, by region

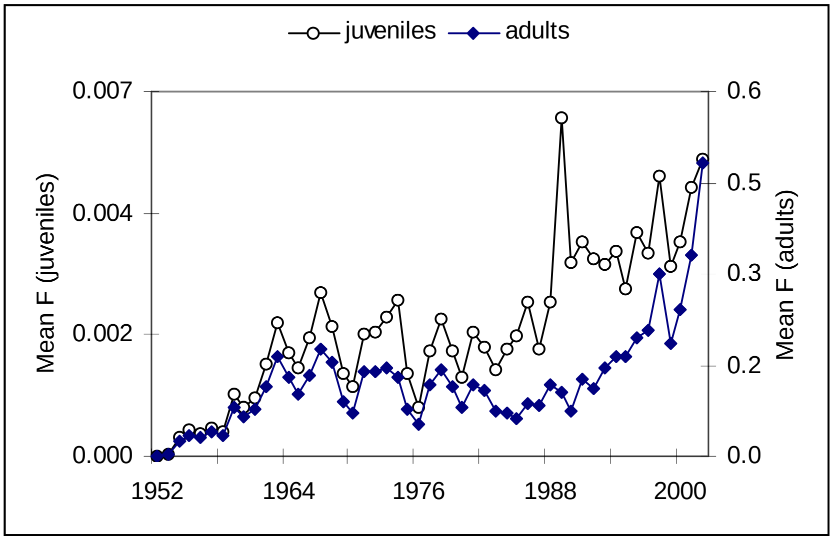


Figure 39. Estimated average annual fishing mortality rates for juveniles (ages 1-5) and adult (ages 6-12) albacore in the South Pacific

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 modeling and bycatch research.

There were five presentations under the ecosystem modeling 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 modeling 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 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 modeling 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.