

## Tuna Scientists Aggregate in Honolulu for 15th SCTB and 1st SCG

John Sibert

Honolulu recently served as the nexus of scientific information on Pacific tuna fisheries by hosting the Fifteenth Meeting of the Standing Committee on Tuna and Billfish (SCTB) from July 18–27, 2002 at the Hawai'i Convention Center. Among the conclusions of the meeting were that:

- the WCPO tuna fishery is the largest in the world, accounting for 49% of the 2001 provisional estimate of global catch (3,900,000 mt) of the four main species;
- stock assessments for yellowfin and bigeye indicate they are likely to be near full exploitation, while skipjack and south pacific albacore appear capable of sustaining current levels of exploitation;
- the catch and fishing mortality of juvenile yellowfin and bigeye have increased greatly over the past decade, arguing against further increases in mortality for these species in the WCPO;
- data collection in general, and particularly for stock assessment in the fisheries of Indonesia and the Philippines, needs to be strengthened; and,
- large-scale conventional tagging of all species is considered critical to provide better information on natural mortality, fishing mortality, movement, and stock structure, while electronic tagging of certain species is needed to provide detailed information on vertical habitat utilization.

### SCTB 15— Participants & Papers

SCTB 15 was attended by participants from Australia, Canada, the Cook Islands, the Federated States of Micronesia, Fiji, France, French Polynesia, Indonesia, Korea, the Marshall Islands, New Caledonia, New Zealand, Niue, the Northern Mariana Islands, Palau, Papua New Guinea, the Peoples Republic of China, the Philippines, Samoa, the Solomon Islands, Taiwan, the United States of America, Vanuatu, Vietnam, and Wallis and Futuna. Also attending were representatives from various regional and international organizations, including the Food and Agriculture Organization of the United Nations, the Inter-American Tropical Tuna Commission, the Indian Ocean Tuna Commission, and the Forum Fisheries Agency. SCTB 15 was hosted by the Pelagic Fisheries Research Program and co-sponsored by the Oceanic Fisheries Program of the Secretariat of the Pacific Community, the



Nearly 120 participants from 25 nations attended SCTB in July, presenting about 100 papers, including national fishing reports from 26 countries.

Western Pacific Regional Fishery Management Council, and the National Marine Fisheries Service, Honolulu Laboratory.

After an absence of several years, scientists from the Philippines and Indonesia participated once again, and SCTB 15 was pleased to welcome a new participant from Vietnam. Japanese scientists did not participate for the second consecutive year, citing

(continued on page 2)

### CONTENTS

<b>Tuna Scientists Aggregate in Honolulu for 15th SCTB and 1st SCG</b>	<b>1</b>
<b>PFRP PI's to Gather in December</b>	<b>4</b>
<b>PrepCon3 to Meet in Manila</b>	<b>4</b>
<b>Status of Yellowfin Tuna in the Western and Central Pacific</b>	<b>5</b>
<b>Fisheries Research in Brief</b>	<b>8</b>
<b>Abstract: Status of the U.S. Western Pacific Tuna Purse Seine Fleet</b>	<b>9</b>
<b>MHLC—Evaluation and Comment</b>	<b>10</b>

### SCTB and SCG: A Little History

This year's SCTB meeting was the third to be held in Honolulu; previous meetings were held in 1988 (the inaugural) and in 1997. Following on the heels of the SCTB meeting, a smaller group of scientists gathered for the first meeting of the MHLC's Scientific Coordinating Group (SCG), which was held from July 29–31 at Honolulu's East-West Center.

Since its establishment in 1988, the SCTB has provided a forum for scientists and others to discuss issues related to data, research and stock assessment in the WCPO, and has thereby become the de facto definitive source for information on regional tuna fisheries.

The SCTB also provides informed opinions on the status of stocks and on various other scientific issues. This important role has been recognized by the Preparatory Conference for the Commission on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific (PrepCon), which in its second session advocated formation of the SCG to provide scientific input for the PrepCon's third session.

their objection to the newly created Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (the MHLC convention).

Nevertheless, participants in SCTB 15 presented approximately 100 papers, including national fishing reports from 26 countries; most of these papers are available in electronic form from the PFRP web site: <http://imina.soest.hawaii.edu/PFRP>. Additional information about the SCTB, and papers from previous meetings, can be obtained from the SPC Oceanic Fisheries Programme web site: <http://www.spc.int/OceanFish/>.

### The Fishery: Catch, Supply and Prices<sup>1</sup>

The total WCPO catch of tunas during 2001 was estimated at approximately 1,900,000 metric tons (mt), slightly higher than the 2000 catch but less than the 1998 record high of more than 2,000,000 mt. The purse-seine fishery traditionally accounts for most of the catch (around 1,100,000 mt, or 56% of the total catch in 2001), with pole-and-line taking 300,000 mt (17%), the longline fishery 200,000 mt (13%, and a record for this fishery), and the remainder (14%) by troll gear and a variety of artisanal gears, mostly in eastern Indonesia and the Philippines.

The WCPO tuna fishery is the largest in the world; its catch represented 75% of the total estimated Pacific Ocean catch of 2,500,000 mt in 2001, and 49% of the provisional estimate of the global catch (3,900,000 mt) of the four species. The estimated catch in the Eastern Pacific Ocean (EPO) in 2001 was approximately

<sup>1</sup>Much of this material is abstracted from "Overview Of The Western And Central Pacific Ocean Tuna Fisheries, 2001" by Anthony D. Lewis and Peter G. Williams, SCTB15-Gen 1.

650,000 mt, the second highest on record for the region. And the provisional global catch of the four main species for 2001 was the second highest ever (after 1999), increasing by more than 500,000 mt since 1996.

Purse-seine fleets from Taiwan, Japan, Korea, the U.S. and Papua New Guinea account for the largest proportion of the total catch by a wide margin. The provisional 2001 purse-seine catch of 1,100,000 mt was the fourth consecutive annual catch in excess of 1,000,000 mt. This catch level was attained in spite of voluntary reductions in effort as a result of lower prices for cannery-bound tuna during 2000. The recently formed World Tuna Purse Seine Organization (WTPO) has implemented a catch-reduction program to address problems of over-supply and low prices. During the early months of 2001, the situation in the WCPO resulted in an unprecedented move by the entire U.S. purse-seine fleet, which voluntarily stopped fishing throughout January and a part of February. A reduction in effort was also apparent with the Korean and Taiwanese fleets during this period, but not to the extent seen with the U.S. fleet. An increase in skipjack price was achieved in the first quarter of 2001 and continued into 2002.

### Recent Trends: FADs, Vessels and Fleets

At previous meetings of the SCTB, scientists expressed concern over the large proportion of juvenile yellowfin and bigeye caught by the purse-seine fishery operating near logs and artificial drifting fish aggregation devices (FADs). Dependence on logs and drifting FADs seems to have decreased, and in 2001 the number of sets on free-swimming schools was larger than the number of sets on either logs or FADs. However, this apparent change in fishing practices may be attributable more to increased efforts to reduce the over-supply of skipjack than to concerns about stock status.

Recent trends in the longline fleet continued through 2001. This fleet is comprised of two distinct classes of vessels. The first class is the large (typically >250 GRT) distant-water freezer vessels that undertake long voyages (months) and operate over large areas of the region; these vessels may target either tropical (yellowfin, bigeye) or subtropical (albacore) species. The second class of longliners is the smaller (typically <100 GRT) offshore vessels that are usually based domestically, possess ice or chill capacity, and serve fresh or air-freight sashimi markets; these vessels operate mostly in tropical areas.

In recent years, the trend has been for contraction of the large-vessel distant-water fleets and growth in the smaller fleets, many of which are based in Pacific islands and target albacore. The 2001 longline catch (240,000 mt) was a record for the WCPO. The species composition of this catch was 35% yellowfin, 35% albacore and 30% bigeye. The bigeye (71,000 mt) and albacore (83,000 mt) catches for 2001 were records for this fishery. The 2001 yellowfin catch (82,870 mt) was the highest catch in nearly 20 years, continuing a significant recovery from the lowest catch recorded for nearly 30 years (56,520 mt in 1999, only two years earlier).

Although most of the 2001 WCPO catch was taken by the large-vessel, distant-water fleets of Japan, Korea and Taiwan, the

overall proportion of the catch by these fleets is declining. In contrast, the growth in domestic fleets in the South Pacific over recent years has been substantial, with Fiji, Samoa, American Samoa, French Polynesia and New Caledonia as examples. These small-vessel fleets target albacore, and their catch now comprises more than 40% of the South Pacific albacore longline catch.

### Condition of WCPO Stocks

Stock assessment at SCTB is handled by four species-specific research groups responsible for skipjack, yellowfin, bigeye and south pacific albacore, plus a catch-all research group for everything else: the Billfish And Bycatch Research Group (BBRG). This arrangement reflects the traditional preoccupation of SCTB with the four principle species of tuna caught in the WCPO. However, since the meeting was held in Honolulu, a substantial part of it was devoted to the BBRG, which heard presentations on by-catch species of concern to the Honolulu-based longline fleet.

In general, the status of the major stocks has changed little over the last year. Skipjack and south pacific albacore stocks both appear to be in good condition and therefore capable of comfortably sustaining current levels of exploitation. The status of yellowfin and bigeye stocks is less certain, and many participants in SCTB 15 said that these two species are close to full exploitation, and that further increases in fishing effort would not increase yield and might over-fish the stocks. SCTB 15 reiterated the recommendation of SCTB 14 that there be no further increase in fishing mortality by the purse-seine fleet for these species in the WCPO.

However, stock assessment science is fraught with uncertainty. In addition to the usual questions about the structural assumptions required by the statistical analysis, the assessments of yellowfin and bigeye are hampered by uncertainties about the data. Large catches of both species are made in Indonesia and the Philippines, but detailed statistics on species composition, size composition and geographic distribution of these catches are not available. These uncertainties emphasize the importance of the SCTB recommendation to not increase efforts that might increase mortality on juvenile yellowfin and bigeye.

### Observations and Recommendations

Stock assessments for skipjack, yellowfin and bigeye tunas continue to be hampered by the lack of adequate statistics on catch, effort, size, and species composition for some areas. In particular, data collection in the fisheries of Indonesia and the Philippines needs to be strengthened.

Observer coverage of commercial fishing operations needs to be improved in order to sample the proportion of bigeye and yellowfin in purse-seine catches, to estimate catch rates for non-target species, and to collect size-composition data.

Assessments for yellowfin and bigeye tuna indicate that both stocks are likely to be near full exploitation, in contrast with the skipjack and south pacific albacore stocks, which appear capable of sustaining current levels of exploitation. The catches and fishing mortality of juvenile yellowfin and bigeye have increased

greatly over the past decade due primarily to increased catches in Indonesia, the Philippines, and the international purse-seine fishery. SCTB 15 therefore reiterated the recommendation of SCTB 14 that there be no further increase in fishing mortality in surface fisheries for these species in the WCPO.

Increased research and monitoring in several specific areas would lead to improved understanding of WCPO tuna stocks. Considered critical for all species will be large-scale conventional tagging to provide better information on natural mortality, fishing mortality, movement, and stock structure. In addition, state-of-the-art electronic tagging of yellowfin, bigeye and albacore is needed to provide detailed information on vertical habitat utilization, which is used in CPUE standardization studies.

### SCG: Informing the Political Process

The Scientific Coordinating Group was established to provide scientific input to the MHLG PrepCon. The goals for this first SCG meeting were to establish guidelines and formats for reporting on stock status, to provide interim scientific advice to the PrepCon on the status of the four primary tuna stocks, and to determine the fisheries and scientific data needs of the PrepCon. The timing of the SCG meeting facilitated attendance by SCTB participants, which assured that the SCG received the best available scientific advice.

In general, the SCG endorsed the findings of the SCTB with respect to the status of stocks. More importantly perhaps, the SCG developed a specific proposal to help Indonesia implement a port-sampling program to supply detailed information on domestic tuna landings. The SCG also reviewed current sources of information on the status of stocks in the WCPO, and concluded that existing regional arrangements for compilation and dissemination of data, coordinated by the SCTB, are suitable for the interim.

Time did not permit the SCG to fully address the question of providing scientific advice to the Commission over the longer term. However, the SCG recognized that the priorities for fisheries data are:

- estimates of annual catches;
- data on catch and effort, preferably on an operational level (e.g. longline and purse-seine sets); and,
- data on size composition (length or weight).

These conclusions and recommendations will be transmitted to the third session of the PrepCon in Manila in November 2002. Meanwhile, the full report of the SCG can be obtained at <http://www.ocean-affairs.com/scgrp.html>.

PFPR

## PFRP PIs to Gather in December

The 2002 PFRP PI's Workshop, scheduled for December 4–6 at the University of Hawai'i, will see the debut of 15 new projects that have been funded for 2002–2003. About half of the Workshop will be devoted to presentation of results from current PFRP projects, and the remainder to presentation of the new projects and a discussion of how to “tie one on.”

The mini-workshop “Tying One On” is still in development, but will focus on secure deployment of electronic tags on pelagic animals. Kim Holland is coordinating the workshop, and notes that participants will have a range of backgrounds, including field-work with pelagics, biomaterials research, and the physiology of healing wounds; he adds that the workshop format will emphasize roundtable discussion.

Following are the new PFRP projects selected for 2002/03, organized by topic:

### Ecosystem-Based Fishery Management

- Comparisons of Catch Rates for Target and Incidentally Taken Fishes in Widely Separated Areas of the Pacific Ocean: W. Walsh and S. Pooley.
- Describing the Spatial Dynamics (Vertical and Horizontal) for Large Pelagics in the Central Pacific Ecosystem with Pop-up Satellite Archival Tags: J. Polovina and M. Seki.
- Evaluating Biochemical and Physiological Predictors of Long Term Survival in Released Pacific Blue Marlin tagged with Pop-up Satellite Archival Transmitters (PSATs): M. Musyl, C. D. Moyes, and R. W. Brill.
- Trophic Structure and Tuna Movement in the Cold Tongue/Warm Pool Pelagic Ecosystem of the Equatorial Pacific: V. Allain, B. Fry, R. Olsen, F. Galvan Magaña, and B. Popp.
- Application of a Continuous Advection-Diffusion Equation to Spatial Mixed Resolution Dynamics Population Models: P. Lehodey.
- Patterns and Causes of Declines in World Billfish Catch Rates: R. Myers and P. Ward.

### Integrated Statistical Models of Protected Species Population Dynamics

- Integrated Statistical Model for Hawaiian Albatross Populations: D. Goodman and J-D Lebreton.
- A General Bayesian Integrated Population Dynamics Model for Protected Species: M. Maunder.
- Development of a Hierarchical Model to Estimate Sea Turtle Rookery Contributions to Mixed Stocks in Foraging Habitats: B. Bolker, K. Bjørndal and A. Bolten.
- Direct Tests of the Efficacy of Bait and Gear Modifications for Reducing Interactions of Sea Turtles in Costa Rica: Y. Swimmer, R. Brill, C. Boggs, M. McCracken, and R. Arauz.

### Management of Southern Albacore Fisheries

- Ecological Characterization of American Samoa's Small-Scale Alia Albacore Longline Fishery (Sentinal Monitoring of the American Samoa Small-Scale Longline Fishery): J. Kaneko, P. Bartram, and T. Beeching.
- Oceanographic Characterization of the American Samoa Longline Fishing Grounds for Albacore, *Thunnus alalunga*: M. Seki and J. Polovina.

### Dynamics of Tuna Aggregation

- Instrumented Buoys as Autonomous Observatories of Pelagic Ecosystems: K. Holland and L. Dagorn.

### Social Sciences

- A Sociological Baseline of Hawai'i's Longline Fishery: S. Pooley and S. Allen.
- Modeling Longline Effort Dynamics and Protected Species Interaction: P. Leung, N. Pradhan, and S. Pooley.

For more details on the 2002 PFRP PI meeting, please contact Dodie Lau (dlau@soest.hawaii.edu) or John Sibert (jsibert@soest.hawaii.edu), or consult the PFRP web site (<http://imina.soest.hawaii.edu/PFRP/>).

PFRP

## PrepCon 3 to Meet in Manila

The third session of the Preparatory Conference for the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific will meet in Manila, Philippines from November 18–22, 2002— and the results of the meeting are likely to definitively shape the Commission.

To be discussed for the first time are issues related to enforcement of fisheries regulations, or MCS (monitoring control and surveillance). The scientific structure of the Commission will also be a prominent subject on the agenda, and the Conference will probably make some important decisions on how the Commission will conduct its scientific affairs. The agenda also includes discussions of budget and finance, Commission rules of procedure, and staffing.

Finally, the Conference will examine competing bids to host the Commission headquarters, submitted by the Federated States of Micronesia, the Independent State of Papua New Guinea, the Kingdom of Tonga and the Philippines. More information about the Commission and Preparatory Conference can be found at <http://www.ocean-affairs.com/>.

# Status of Yellowfin Tuna in the Western and Central Pacific

John Hampton

*Yellowfin tuna (Thunnus albacares) have a long history of exploitation in the Western and Central Pacific Ocean (WCPO). In the 1960s and 1970s, longliners (mainly Japanese) dominated the fishery. In the 1980s, purse seining began in the WCPO and catches increased dramatically (Figure 1). Also, the development of domestic fisheries in the Philippines and Indonesia (which make up the majority of the “other” component in Figures 1 and 2) have also contributed to increased catches in the past 25 years. The catch is distributed over a wide area of the WCPO, but is concentrated in the equatorial zone where the purse seine fishery operates (Figure 2). This summary report<sup>1</sup> describes a stock assessment model for yellowfin tuna in the WCPO, and outlines the assessment results obtained from a preliminary reference point analysis.*

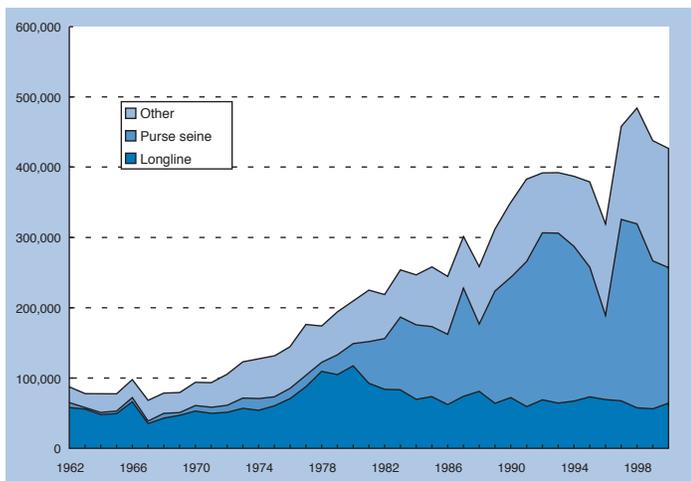


Figure 1. Catch (in tons) of yellowfin tuna in the WCPO.

## The Population Model

With funding support from the Pelagic Fisheries Research Program, a population model for yellowfin tuna has been developed using the MULTIFAN-CL approach (Hampton and Fournier 2001). The model is age and spatially structured, and is fitted to size composition data (length and weight frequency), tagging data and catch and effort data. Total fishing effort is stratified into a

<sup>1</sup>This paper is a summary of a more detailed report presented to the 15th meeting of the Standing Committee on Tuna and Billfish (Honolulu, Hawaii, 22-27 July 2002). The full report is available at: <http://www.spc.int/OceanFish/Html/SCTB/SCTB15/YFT-1.pdf>.

number of “fisheries,” each of which is allowed to have different selectivity (with respect to fish age) and catchability characteristics. Selectivity is assumed to be constant over time, but catchability is allowed to vary over time for some fisheries. The fisheries defined in the yellowfin model are as follows:

	Region	Gear
1	1	Longline
2	2	Longline
3	3	Longline
4	4	Longline
5	5	Longline
6	2	Purse seine log sets
7	2	Purse seine FAD sets
8	2	Purse seine school sets
9	3	Purse seine log sets
10	3	Purse seine FAD sets
11	3	Purse seine school sets
12	2	Philippines miscellaneous
13	2	Philippines handline
14	2	Indonesia miscellaneous
15	4	Australia longline

## Assumptions and Parameters

There is a large amount of flexibility in defining the model structure in a MULTIFAN-CL-based analysis. Some of the more important assumptions used in this yellowfin tuna analysis are:

Spatial structure:	5 regions as per Figure 2
Time stratification:	1962-2001, by quarter
Age structure:	20 quarterly age classes
Recruitment:	Occurs quarterly and in each region independently

(continued on page 6)

## Pelagic Fisheries Research Program Newsletter

Volume 7, Number 4

October–December 2002

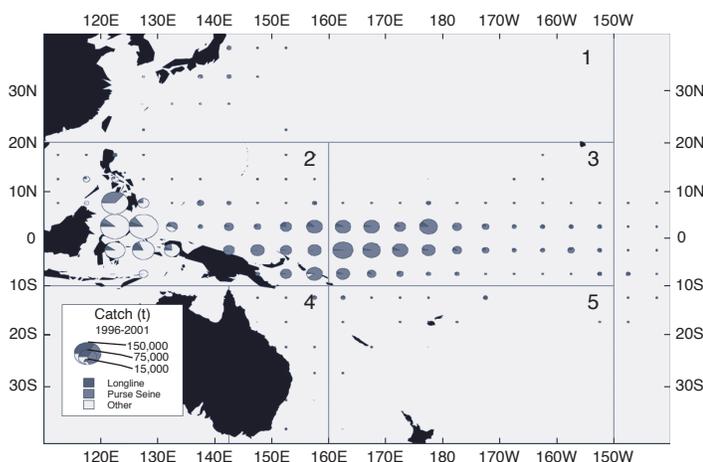
**Editors** Chris Anderson, John Sibert  
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**Layout** May Izumi

**Printing** Fisher & Pioneer Printers, Honolulu, Hawaii 96817

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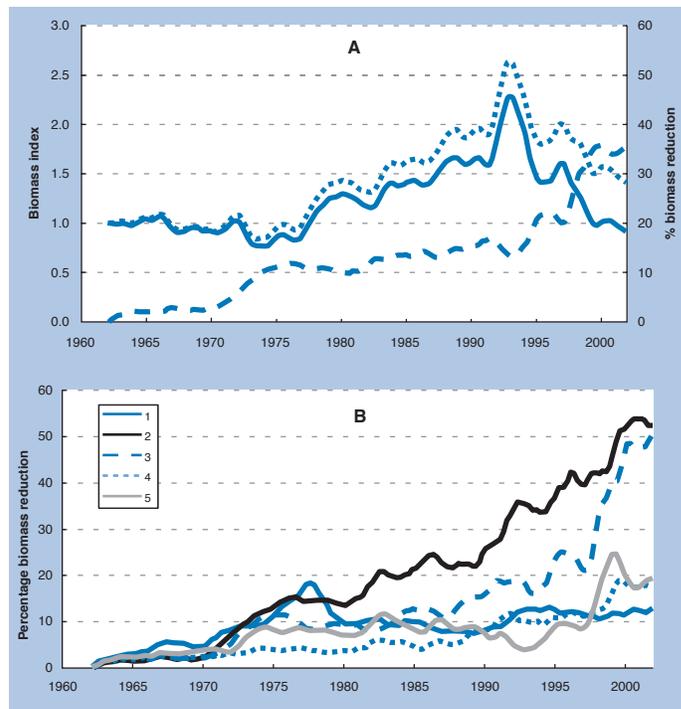
**Figure 2. Geographical distribution of yellowfin tuna catch, 1996-2001. The five regions used in the assessment model are shown.**

Growth:	Age-classes 1-8 have independent mean lengths, 9-20 follow von Bertalanffy growth; weight-length parameters specified
Catchability:	Constant over time and among regions for the longline fisheries, variable over time/regions for other fisheries
Selectivity:	Constant over time and among regions for longline fisheries and purse seine fisheries of the same set type
Stock-recruitment:	Constrained by a prior for “steepness” such that significant (>10%) recruitment decline occurs at adult biomass <20% of virgin levels
Natural mortality rates:	Age-dependent, constant among regions and over time
Movement rates:	Age- and region-dependent, constant over time

The model is parameterized by fitting to total catch estimates stratified by fishery and time period, length-frequency data (where available), weight-frequency data (where available) and tagging data. The catch data are assumed to be accurately observed and the model is forced to fit catches with high precision. The contribution of the length- and weight-frequency data to the objective function is determined largely by sample size and information on the coverage of sampling for the various fisheries. The tagging data are modeled using a negative binomial likelihood function. Additional information is introduced into the model by way of penalties and constraints on various parameters for which prior information is available.

### Stock Assessment Results

We can compile the model results in various ways in order to assess the status of the stock. The population biomass (blue line in Figure 3A) is estimated to have increased in the late 1970s, peaking



**Figure 3. (A) Estimates of biomass with and without fishing and the percentage reduction in biomass from the unfished level for the WCPO. (B) Estimates of percentage reductions in biomass for the five individual model regions.**

in the mid-1990s and declining thereafter. The current biomass is estimated at similar levels to the early period of the fishery.

The impact of the fisheries on the biomass is estimated by the difference between the biomass estimated with the observed level of fishing and the biomass estimated with fishing mortality set to zero (dotted line in Figure 3A). According to the model results, the biomass in the most recent time periods is reduced by approximately 35% from the level it would have been had fishing never occurred (dashed line in Figure 3A).

These measures of fishery impact refer to the entire stock area. However, the distribution of catches (Figure 2) suggests that impacts might be higher in the tropical regions. Indeed, the estimates of biomass reduction for the tropical regions of the model (2 and 3) are around 50% in recent periods, whereas impacts for the sub-tropical regions (4 and 5) are <20% (Figure 3B).

### MSY-Based Reference Points

The use of reference points provides a framework for quantitatively determining the status of the stock and its exploitation level. Two types of reference points are often now required for fisheries management: the fishing mortality at maximum sustainable yield ( $F_{MSY}$ ) is used as an indicator of overfishing; and the biomass at MSY ( $B_{MSY}$ ) is used as an indicator of an overfished state. It is likely that these reference points, or something similar, will be used for stock status determinations in the