CHANGES TO ROUTINE MANAGEMENT MEASURES

Section 8.3.2 in the Fishery Management Plan (FMP) for U.S. West Coast Fisheries for Highly Migratory Species (HMS) describes a biennial management cycle with decision making occurring at the June, September, and November Council meetings to establish or adjust harvest specifications for a 2-year period beginning on April 1 of the following year—the start of the next fishing year.

Based on recommendations from the HMS Management Team (HMSMT) and HMS Advisory Subpanel (HMSAS), at the June 2006 meeting the Council approved three possible regulatory changes for further consideration and directed the HMSMT to develop a range alternatives for each. These are: (1) change of vessel marking requirements applicable to recreational charter boats, (2) change the drift gillnet time/area closure off the Oregon coast, and (3) recreational fishery bag limits for albacore and bluefin tuna. The HMSMT met August 8–9, 2006, in La Jolla, California, and developed a range of alternatives for each of these potential regulatory changes, which are contained in Agenda Item E.1.b, HMSMT Report.

At this meeting, the Council task is to review the recommended range of alternatives, provide guidance and further refinements or analysis, and approve alternatives for public review. The Council is scheduled to take final action at the November 2006 meeting by choosing a preferred alternative for each of the three proposed regulatory changes. NMFS will then initiate the rulemaking process necessary to implement any regulations by April 1, 2007.

Council Task:

Adopt a Range of Alternatives for Proposed Changes to 2007-2008 Routine Management Measures for Public Review.

Reference Materials:

1. Agenda Item E.1.b, HMSMT Report.
2. Agenda Item E.1.c, WDFW Report

Agenda Order:

a. Agenda Item Overview — Kit Dahl
b. Report of the Highly Migratory Species Management Team — Michele Culver
c. Agency Comments
d. Reports and Comments of Advisory Bodies
e. Public Comment
f. **Council Action:** Adopt Proposed Changes to 2007-2008 Routine Management Measures for Public Review

PFMC
08/22/06

Agenda Item E.1.b
HMSMT Report
September 2006

HIGHLY MIGRATORY SPECIES MANAGEMENT TEAM REPORT ON CHANGES TO ROUTINE MANAGEMENT MEASURES

At the June meeting, the Council identified the following management issues to be addressed for the 2007-08 biennial management cycle. At its meeting on August 8-9, the Highly Migratory Species Management Team (HMSMT) developed management measure alternatives for those issues, which are presented in this report. In all cases, Alternative 1 (No Action) would represent status quo regulations. At this meeting, the Council would consider approving these alternatives for public review, with final action scheduled for November. If approved, the regulations implementing these changes would be effective beginning April 1, 2007 through March 31, 2009 (minimum of two years), or until changed.

Routine Management Measure Alternatives

Vessel Marking Requirements

The current HMS regulations require all commercial vessels, including charter vessels, to display their official numbers on the port and starboard sides of the deckhouse or hull, and on an appropriate weather deck (horizontal or flat surface) so as to be visible from enforcement vessels and aircraft. The official numerals must be at least 10 inches in height for vessels 25-65 feet in length, and 18 inches in height for vessels longer than 65 feet. In June, the Council requested the HMSMT develop alternatives to exempt charter vessels from this marking requirement, and the HMSMT came up with the following alternatives:

1. No Action (status quo) – All commercial vessels, including charter vessels, would have to adhere to the current HMS vessel marking requirements.

   Discussion: The current regulation as described above would remain in place. Most of the West Coast commercial passenger and charter vessels are currently out of compliance with the vessel marking requirements as written.

2. Provide a specific exemption for commercial passenger and recreational charter fishing vessels to the HMS vessel marking requirements.

   Discussion: The current regulatory language originated from the West Coast Groundfish Fishery Management Plan (FMP); however, the Groundfish FMP specifically excludes commercial passenger and charter vessels. When this regulation was developed for HMS, the intent was to place this requirement on commercial HMS vessels, but to exempt charter vessels; this alternative is consistent with that approach.

3. Do not require commercial passenger and charter vessels to display official number on port and starboard sides of deckhouse or hull, but maintain requirement to display official number on appropriate weather deck so as to be visible from enforcement vessels and aircraft.

Discussion: This alternative would exempt charter vessels from displaying numbers on the port and starboard sides of the vessel, but would still require charter vessels to display their official number on a weather deck.

4. Do not require commercial passenger and charter vessels to display official number on port and starboard sides of deckhouse or hull, but all charter vessels that are certified by the U.S. Coast Guard would be required to display the official number on the appropriate weather deck.

   Discussion: This alternative would exempt charter vessels from displaying numbers on the port and starboard sides of the vessel and would exempt smaller vessels carrying less than 7 passengers that are exempt from U.S. Coast Guard inspection. All charter vessels that are certified by the U.S. Coast Guard would still have to display their official number on a weather deck.

<u>Drift Gillnet Fishery Regulations</u>

The current leatherback turtle closure for the drift gillnet fishery was implemented beginning in 2000; it extends from Pt. Conception north to 45° N. latitude, which is off central Oregon, and applies from August 15 through November 15 and was developed to avoid a jeopardy finding on the then California/Oregon state drift gillnet (DGN) fishery. The Oregon Department of Fish and Wildlife (ODFW) is authorized to issue up to ten Developmental Fishery permits per year to harvest and land swordfish and thresher shark caught with drift gillnet gear off Oregon. Since 2004, only one permit has been issued and no fishing occurred in 2005. However, under current regulations, vessels from California may fish off Oregon (without an ODFW Developmental Fishery permit) and return to California; a few vessels have done this in recent years—four of them fishing south of 45° N. latitude, and one fishing north. In June, the Council requested that the HMSMT explore alternatives to change the northern boundary of the leatherback turtle closed area, and the HMSMT developed the following alternatives:

1. No Action (status quo) – The extent of the current leatherback turtle closure would remain in place and, within the area between 45° N. latitude and the Oregon/Washington border, the drift gillnet fishery would remain open year-round.

   Discussion: The current regulations described above would remain in place. ODFW has expressed concern about potential bycatch of protected species, especially leatherback sea turtles, in the area. As noted above, only one Oregon-permitted vessel has fished in this area in recent years, but the opportunity for increased effort is there. The one Oregon vessel that has fished this area is "unobservable"; therefore, there is no way to monitor its bycatch. In addition, one California-permitted vessel has fished in the area.

2. Extend the leatherback turtle closure boundary from 45° N. latitude to the Oregon/Washington border during the August 15-November 15 period.

   Discussion: Washington and Oregon had an experimental drift gillnet fishery in 1986-88 that targeted thresher shark; this fishery was closed off Washington waters because of bycatch concerns of marine mammals and sea turtles. At the time that the drift gillnet leatherback turtle Biological Opinion (BiOp) was written, the National Marine Fisheries Service (NMFS) used bycatch and protected species data from the federal observer program to develop the leatherback closure, but not from the states' experimental fishery. The effect of extending the closure northward is unknown—on one hand, the closure extension may be beneficial from a bycatch-reduction viewpoint, but, on the other hand, there are only two vessels that have fished here in recent years, so the amount of bycatch is expected to be minor, although without observer coverage there is no way to determine this. If the closure is extended, and the DGN exempted fishing permit (EFP) is approved by NMFS, then any vessels fishing this area would be required to have 100% observer coverage. If the area is extended and the EFP is not approved by NMFS, concerns about bycatch would be abated since fishing would be prohibited August 15 through November 15.

3. Prohibit the use of drift gillnet gear north of 45° N. latitude year-round

Discussion: While the bycatch data from the Washington/Oregon drift gillnet experimental fishery was not used in the NMFS BiOp, it was analyzed by the HMSMT and presented to the Council in the HMS FMP. At the time the HMS FMP was considered (2003), the Council also considered this alternative (Chap. 8, Section 8.5.1, Alternative 7, p. 30), but chose to adopt the status quo regulations. Since the leatherback turtle closure was implemented, there have not been any leatherback turtles observed or reported taken in the drift gillnet fishery in this northern area; therefore, there is no new fishery data or information to consider for this alternative that was not available in 2003.

State Recreational Limits for Tuna

In June, the Council requested the HMSMT develop alternatives for state recreational limits for tuna for California and Washington. Washington does not have a recreational limit for albacore (the primary HMS target species) and California's HMS bag limits are listed in Table 1. The intent is to use the Council's public process and, if state recreational bag limits were adopted for federal waters (3-200 nm), then the states would consider moving forward with amendments to current regulations that apply to state jurisdictional waters (0-3 nm), to ensure consistency between federal and state regulations.

General Discussion: There is some question as to whether state recreational limits for albacore are needed, given the overall annual catches in the recreational fisheries, as compared to the coastwide and pan-Pacific albacore landings. In recent years (2000-2005), California's recreational albacore harvest averaged about 59,000 fish (about 1,000 mt), which is 7% of the U.S. total albacore harvest, and Washington's recreational albacore harvest is about 12,000 fish (about 122 mt), which is 0.8% of the U.S. total albacore harvest. From a pan-Pacific perspective, these recreational landings represent about 1% (California is 0.9% and Washington is 0.05%) of the total albacore harvest. On the other hand, implementing a recreational albacore trip limit could be viewed as a step in support of the Inter-American Tropical Tuna Commission's albacore resolution and the U.S. commitment to not increase its current effort level on albacore.

Table 1. Current California daily and possession limits for highly migratory management unit species. Albacore and bluefin tuna shown in bold font are under consideration for bag limits.

No limit	1-fish	2-fish	10-fish
Albacore tuna **Bluefin tuna** Skipjack tuna	Striped marlin	Swordfish Blue shark Thresher sharks Mako shark	Bigeye tuna Yellowfin tuna Dorado

<u>California Recreational Daily-Bag-Limit Alternatives</u>

<u>Albacore</u>

1. No Action (status quo) – There would be no bag limit for albacore.

2. A statewide bag limit of 25 albacore per angler per day may be taken or possessed.

   Discussion: This measure would provide consistency with Oregon's daily limit. However, a preliminary bag limit analysis indicates that, since 1997, only one angler has returned with more than 25 albacore in possession, with 37 fish; therefore, a bag limit of 25 albacore would likely accommodate current fishing practices (Attachment 1, Table 2 and Figure 1).

3. An albacore bag limit of 25 fish per angler per day may be taken or possessed north of Pt. Arena (39° N. latitude) (Attachment 1, Figure 2); an albacore bag limit of 10 fish per angler per day may be taken or possessed in waters between Pt. Arena and the U.S./Mexico border.

   Discussion: This alternative would have differential bag limits north and south of Pt. Arena. The limit amounts, by area, are consistent with the public comments received by the California Department of Fish and Game. Pt. Arena also represents a good geographical break-point for regulatory differences—anglers would have to transit quite a distance to fish in one area and land in another. However, the intent would be to regulate the areas separately, rather than on a "port of landing" basis; therefore, anglers fishing south of Pt. Arena could not have more than 10 albacore in possession, even if they landed north of Pt. Arena. A preliminary bag analysis indicates most anglers catch less than 10 albacore per day (Attachment 1, Table 2 and Figure 2); however, reducing the catch from a no bag limit to a 10 fish limit may affect about 2% of the anglers.

4. An albacore bag limit of 25 fish per angler per day may be taken or possessed north of Pt. Arena (39° N. latitude); an albacore bag limit of 10 fish per angler per day may be taken or possessed in waters between Pt. Arena and Pt. Conception (34°27' N. latitude); and an albacore bag limit of 5 fish per angler per day may be taken or possessed in waters between Pt. Conception and the U.S./Mexico border (Attachment 1, Figure 2). A preliminary bag analysis indicates reducing the catch from a no bag limit to a 5 fish bag limit may affect about 10% of the anglers.

Discussion: This alternative is similar to Alternative 3, but reduces the bag limit further south of Pt. Conception to five albacore, which is consistent with the Mexican albacore bag limit. The HMSMT did not analyze the effect of the different bag limits by area in terms of catch reduction.

The HMSMT notes that for Alternatives 3 and 4, a management line at Pt. Arena would need to be specified in the HMS federal regulations.

In conjunction with any of these bag limit alternatives for albacore, the Council could also select one of the following alternatives for bluefin tuna:

Bluefin

1. No Action (status quo) – There would be no bag limit for bluefin tuna.

2. A statewide bag limit of 10 bluefin per angler per day; the possession limit would be equal to one daily-bag-limit.

   Discussion: A preliminary bag limit analysis indicates that California anglers are currently retaining five or less bluefin tuna per day (Attachment 1, Table 3 and Figure 3); therefore, this alternative is expected to accommodate current fishing practices.

Washington Recreational Limit Alternatives

The majority (90% +) of the albacore landed into Washington are caught on charter trips. Some charter vessels take "day trips," because of the size of their vessel and the preference of their customers, while other vessels take longer trips (from 1 ½ days to 2 ½ days). On multiple-day trips, with a daily-bag-limit, anglers would have to stop fishing when the daily limit was reached (and may not have the opportunity to catch fish the following day), or may not catch a daily limit the first day, but would be limited to a daily limit on the second day. If an albacore limit is adopted, having it apply on a per trip basis (rather than a daily basis) would be easier to manage, comply with, and enforce.

1. No Action (status quo) – There would be no limit for albacore tuna.

2. An albacore limit of 25 fish per angler on a per trip basis; the possession limit would be equal to one trip limit. It would be unlawful for anglers to fish for, retain, possess, or land albacore tuna in excess of the specified trip limit.

   Discussion: While Alternative 2 will affect some Washington anglers who have retained albacore in excess of the proposed limits, the average amount of albacore kept per angler is about half of the proposed limit amounts. This raises the concern that, in some cases, limits could represent "targets." While some anglers may be satisfied with 15 albacore under the current "unlimited" fishery, implementing a limit of 25 fish may actually increase catch. A preliminary trip limit analysis indicates that this would affect 2.7% of Washington albacore anglers, all of which occurred on charter trips.

3. An albacore limit of 20 fish per angler on a per trip basis; the possession limit would be equal to one trip limit. It would be unlawful for anglers to fish for, retain, possess, or land albacore tuna in excess of the specified trip limit.

   Discussion: Based on the 2005 charter albacore logbook data, the average amount of albacore retained on a charter trip is 12 fish per angler; however, some individual anglers have retained up to 35-50 fish per trip. A preliminary trip limit analysis indicates that this would affect 6% of Washington albacore anglers, all of which occurred on charter trips.

The Washington Department of Fish and Wildlife (WDFW) also considered trip limits of 10 or 15 albacore per angler. Preliminary analyses indicate that a trip limit of 15 fish would affect about 13% of Washington's albacore anglers and a limit of 10 fish would affect over 28% of tuna anglers. As the intent of a trip limit at this point is to accommodate current levels, rather than to implement a catch reduction measure, WDFW believes that limits of 15 or 10 fish would be too restrictive and are unnecessary at this time.

Management Measure Process and Documents

At the HMSMT's meeting in August, there was some discussion about the various National Environmental Policy Act (NEPA) documents, and subsequent analysis, that would be required to be completed for the different proposed management measure actions. It is the HMSMT's understanding that a 'categorical exclusion' could be approved for the proposed changes to the vessel marking requirements, as this could be viewed as a housekeeping-type measure. However, an Environmental Assessment (EA) would be required for the other proposed measures and the HMSMT proposes that two separate EA documents be completed, as the analysis and process to change the drift gillnet measures may be more complicated and time-consuming than the analyses for the recreational tuna limits. The drift gillnet alternatives will likely have implications for protected species, which could place additional workload demands on limited staff resources, whereas the recreational alternatives will primarily be analyzed by state HMSMT members.

Other Management Issues

Recreational Harvest of Thresher Shark in Southern California

In May, the issue of common thresher shark being taken in the Southern California private recreational fishery during the breeding and pupping season was brought to the HMSMT's attention; in June, the HMSMT forwarded this issue to the Council and indicated that we would provide an update in September. It is the HMSMT's understanding that the United Anglers of Southern California have proposed a reduced daily-bag-limit (from two fish to one fish) for thresher shark to the California Fish and Game Commission to address this issue. However, the HMSMT notes that the drift gillnet fishery was moved out to 75 miles during the thresher shark breeding and pupping season to provide protection during this critical period, whereas this restriction does not apply to the recreational fishery. Therefore, a bag limit reduction may not adequately address the situation (especially if anglers are currently only retaining one thresher shark).

As mentioned previously, the new California Recreational Fishing Survey (CRFS) is not able to fully access the level of catch and effort in the private recreational fishery as many of the vessels that fish thresher shark are berthed in private marinas, which samplers traditionally have not been able to access for sampling. The HMSMT discussed the need to collect information on this fishery in order to analyze the data and craft appropriate conservation measures, if needed, for Council consideration. It is our understanding that the California Department of Fish and Game (CDFG) is exploring methods to obtain additional data, such as a private boat logbook, and CDFG staff has tried to be out on the water to intercept private boaters before they reach private marinas. However, it may be some time before sufficient data is collected to form the basis for action.

There are a couple of Sea Grant proposals that are in the final round of review. One proposal is to provide angling clubs with carbon copy landing forms for documenting the catch and biological data on thresher and mako sharks. A copy of the form would be sent to an independent researcher for analysis and a web-based system would be used for angler reporting, which could potentially be used to enhance the CRFS program. The other proposal is collaborative research with Mexican biologists to identify fisheries targeting sharks and evaluate data about catches of sharks off northern Baja. The HMSMT plans to follow this issue and will update the Council accordingly.

<u>HMSMT Recommendation:</u>

1. Consider approving a suite of alternatives for public review that address the following management issues. The HMSMT would then develop draft analyses of the alternatives and present draft Environmental Assessment(s), as needed, to the Council for final adoption in November.
   a. Vessel Marking Requirements
   b. Drift Gillnet Turtle Closure Northern Boundary
   c. Recreational Limits for California and Washington

HMSMT Report
Attachment 1
California Recreational Bag Limits Analysis

Table 2. Frequency of albacore in bag sizes from 1 to 25 fish for California's recreational fishery from 1997 to 2003.

Bag Size[1]	Bag Frequency (percent)	Cumulative Frequency (percent)
1	37	37
2	20	57
3	14	71
4	10	81
5	9	90
6	3	92
7	2	95
8	2	96
9	1	97
10	1	99
11	1	99
12	< 1	99
13	< 1	99
14	< 1	99
15	< 1	99
16	<1	99
17	< 1	99
18	< 1	99
19	< 1	99
20	< 1	99
21	< 1	99
22	< 1	99
23	< 1	99
24	< 1	99
25	< 1	100

Data Source for Table 2 and Figure 1: RecFIN, bag frequency data, extracted August 3, 2006.
Summary for albacore caught in California by recreational anglers, in all marine areas, and all boat based fishing modes from January 1997 through December 2003. The types A+B1 catch data weighted by trip and catch estimates:
Found 3502 interviews targeting on selected species.
Found 480 type B1 catch (reported dead by angler) records with selected species.
Found 4191 type A (observed by sampler) catch records with selected species.
Additional information:
[1]- one bag of 37 fish was reported but not shown in table 2.

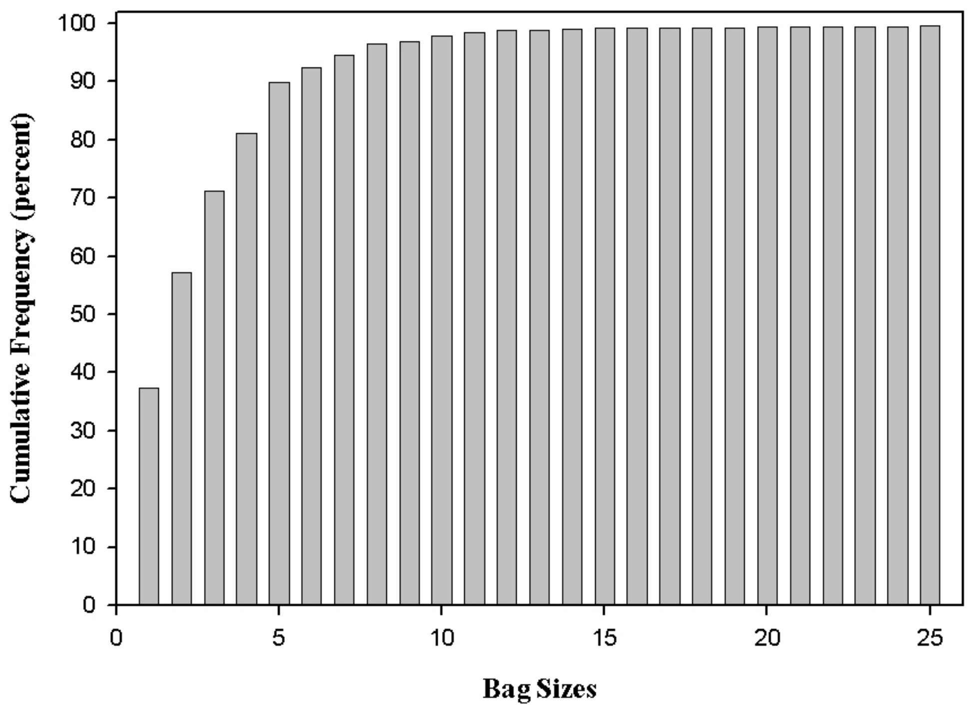


Figure 1. Cumulative percent frequency of albacore in bag sizes from 1 to 25 fish for California's recreational fishery from 1997 to 2003.

Figure 2. Proposed management lines for California bag limit alternatives 3 and 4.

Table 3. Frequency of bluefin tuna in bag sizes from 1 to 25 fish for California's recreational fishery from 1998 to 2002.

Bag Size[1]	Frequency (percent)	Cumulative Frequency (percent)
1	70	70
2	22	92
3	5	97
4	2	99
5	<1	100
6	0	100
7	0	100
8	0	100
9	0	100
10	0	100

Data Source for Table 3 and Figure 2: RecFIN, bag frequency data, extracted August 3, 2006
Summary for bluefin tuna caught in California by recreational anglers, in all marine areas, and all boat based fishing modes from January 1998 through December 2002. The type A+B1catch data weighted by trip and catch estimates:
Found 87 interviews targeting on selected species.
Found 17 type B1 (reported dead by angler) catch records with selected species.
Found 258 type A (observed by sampler) catch records with selected species.

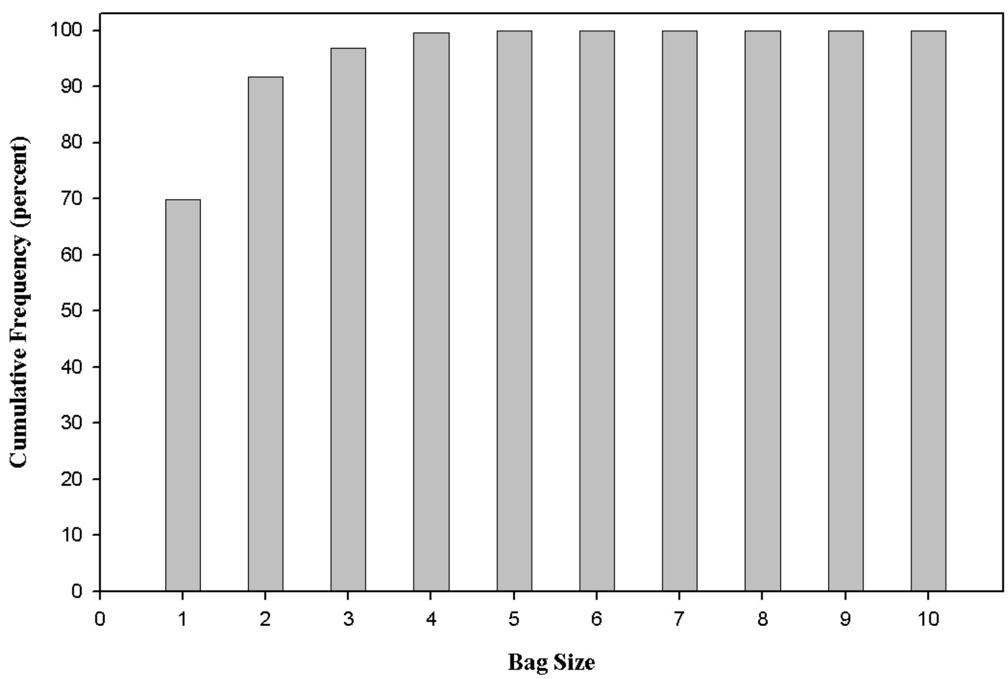


Figure 3. Cumulative frequency of occurrence for bluefin tuna in bag sizes from 1 to 10 fish for California's recreational fishery.

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE REPORT ON CHANGES TO ROUTINE MANAGEMENT MEASURES

The Washington Department of Fish and Wildlife (WDFW) has been exploring management alternatives for its recreational albacore fishery that would meet the intent of the Inter-American Tropical Tuna Commission's (IATTC) resolution to not increase current effort in the albacore tuna fishery. WDFW has met with charter boat industry members to discuss different alternatives to limit further expansion of the recreational albacore tuna fishery. There was a considerable amount of discussion as to whether a bag limit or trip limit was needed for Washington's recreational fishery and, if so, what the appropriate amount would be. Washington's recreational albacore harvest ranges from 6,000 to 12,000 fish annually; the amount of albacore effort primarily depends on the availability of albacore (i.e., how close the schools are to shore and how long they stay in the area) as well as fishing opportunities for other species. The vast majority (over 90%) of Washington's recreational albacore catch occurs on charter boats. Washington's annual recreational harvest amount represents about 0.3-0.8% of the U.S. total albacore harvest, and about 0.05% of the pan-Pacific harvest—essentially a "drop in the bucket" relative to the overall amount of albacore being harvested on the West Coast and Pacific-wide.

WDFW's preliminary bag limit analysis indicates that a trip limit of 25 albacore per angler could affect about 2.7% of Washington's albacore anglers. A bag limit or trip limit for a recreational fishery that harvests a significant amount of albacore may be a valid approach toward implementing the intent of the Resolution; however, as noted above, Washington's recreational albacore harvest represents a small portion of the total catch. Therefore, given the low amount of harvest in our fishery and the fact that the most liberal alternative could result in a catch reduction, WDFW does not support an albacore bag or trip limit for Washington's recreational fishery as a means of capping our current effort at this time.

Instead, WDFW will be working with the Westport and Ilwaco Charterboat Associations to pursue legislation, which would place a moratorium on the issuance of new non-salmon charter licenses. Currently, WDFW has a limit on the number of salmon charter licenses issued annually, and a non-salmon charter license is all that is required to fish for albacore. WDFW believes that placing a moratorium on non-salmon charter licenses would satisfy the intent of the IATTC Albacore Resolution relative to Washington's recreational fishery. WDFW will keep the Council informed as we progress through the next state legislative session.

NMFS REPORT

National Marine Fisheries Service (NMFS) notified this Council and the Western Pacific Fishery Management Council (WPFMC) that they must take action to address overfishing of bigeye tuna by June 14, 2005. In response, at the June 2005 meeting, the Council moved to begin work on Amendment 1 to the Fishery Management Plan (FMP) for U.S. West Coast Fisheries for Highly Migratory Species (HMS). NMFS Southwest Region agreed to take lead responsibility on developing the amendment package for Council consideration. A draft of the amendment was presented at the November 2005 Council meeting.

Soon after NMFS staff began the development of Amendment 1, it was determined that no regulatory action would result from an amendment since future actions depend on conservation and management measures adopted internationally. Furthermore, the U.S. contribution to bigeye tuna fishing mortality is negligible, so unilateral action by the U.S. would not meaningfully reduce it; multilateral management action is essential to end this overfishing.

In response, NMFS provided the Council with an analysis to support the development of a U.S. West Coast position on how to control fishing mortality on bigeye tuna in the Eastern Pacific Ocean (EPO). (See Agenda Item G.1.a, Attachment 1, April 2006, reproduced here as Agenda Item E.2.a, Attachment 1.) In April 2006, the Council adopted recommendations based on this management options analysis which were forwarded to the U.S. delegation to the Inter-American Tropical Tuna Commission (IATTC) in advance of the June 2006 IATTC meeting, and to the WPFMC (Agenda Item E.2.a, Attachment 2). The letter to the WPFMC supported their recommendations to address overfishing of bigeye tuna Pacific-wide, which have been subsequently incorporated into a revised version of Amendment 14 to the WPFMC's Pelagics FMP. (Agenda Item E.2.a, Attachment 3 provides the revised recommendations and management measures that the WPFMC considered at their June 2006 meeting. Agenda Item E.2.a, Attachment 4 describes WPFMC action at that meeting.) At the time, NMFS was considering whether the PFMC recommendations, along with the adoption of an FMP amendment by the WPFMC containing Pacific-wide conservation measures, could substitute for the proposed amendment to the HMS FMP.

At their June of 2006 meeting, the IATTC adopted resolution C-06-02-C, Program on the Conservation of Tuna in the Eastern Pacific Ocean for 2007 (Agenda Item E.2.a Attachment 5). This resolution changes the national quotas for longline catches of bigeye so that they are either 500 mt or equal to the 2001 national catch, whichever is greater. For the U.S. this increases the annual longline catch quota from 150 mt to 500 mt.

Subsequent to the June Council meeting, consultations between Council and NMFS staff concluded that the HMS FMP does in fact need to be amended in order to comply with the requirements of the Magnuson-Stevens Act. Under this agenda item NMFS requests the Council continue the process for developing the FMP amendment, based on the materials previously presented, the Council recommendations previously made to the IATTC and WPFMC, IATTC resolution C-06-02-C, and the elements of the WPFMC's Amendment 14 that are general recommendations or relevant to ending overfishing on bigeye tuna in the EPO. Considering previous Council discussion and recommendations sufficient to serve as an adopted range of alternatives, NMFS will prepare a draft environmental assessment (EA), including a range of alternatives for inclusion in the November 2006 Council meeting briefing book. Draft FMP amendment text will also be provided. This will serve for public review of the range of alternatives and NMFS proposes that the Council take final action to adopt a preferred alternative at the November 2006 meeting.

Agenda Item E.2.a, Attachment 6 is the stock assessment for EPO yellowfin tuna for 2005, the most recent available. It was presented at the 7th meeting of the IATTC Working Group on Stock Assessment, May 2006. (Additional materials from this meeting are available at http://iattc.org/IATTCandAIDCPMeetingMay06ENG.htm.) This assessment raises concerns about the current level of fishing mortality on EPO yellowfin tuna, which could form the basis for an overfishing declaration as required by §304(e) of the Magnuson-Stevens Act. The Science and Statistical Committee will provide the Council with a report on this stock assessment at a future meeting.

Council Task:

Provide guidance on the recommended schedule and process for adoption of Amendment 1 to the HMS FMP, addressing bigeye overfishing in the EPO; discuss yellowfin assessment, as appropriate.

Reference Materials:

1. Agenda Item E.2.a, Attachment 1: Analysis of Management Options for Development of a Plan to End Overfishing of Pacific Bigeye Tuna in the Eastern Pacific Ocean (originally Agenda Item G.1.a, Attachment 1, April 2006).
2. Agenda Item E.2.a, Attachment 2: Letters from the PFMC to the U.S. Delegation to the IATTC and to the WPFMC With Recommendations to End Overfishing of Pacific Bigeye Tuna in the Eastern Pacific Ocean.
3. Agenda Item E.2.a, Attachment 3: Issues Paper on Amendment 14: Bigeye and Yellowfin Overfishing Measures- Outstanding Issues (with email attached).
4. Agenda Item E.2.a, Attachment 4: Summary of WPFMC Action on Pelagics FMP Amendment 14, June 2006.
5. Agenda Item E.2.a, Attachment 5: IATTC Resolution C-06-02-C, Program on the Conservation of Tuna in the Eastern Pacific Ocean for 2007.
6. Agenda Item E.2.a, Attachment 6: Status of Yellowfin Tuna in the Eastern Pacific Ocean in 2004 and Outlook for 2005.

Agenda Order:

a. Activity Reports:
    1. Southwest Region — Mark Helvey
    2. Science Center — Gary Sakagawa
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. Council Discussion of Bigeye Overfishing Response and Yellowfin Assessment

PFMC
08/22/06

Analysis of Management Options for Development of a Plan to End Overfishing of Pacific Bigeye Tuna in the Eastern Pacific Ocean

PREFACE

Pacific bigeye tuna are subject to overfishing Pacific-wide and this document sets out alternatives that potentially could be used to end overfishing. Bigeye tuna, like other highly migratory species (HMS) are nomadic in behavior, thus do not recognize boundaries that management, policy, or science have established. Bigeye tuna are fished by many nations in addition the United States, thus future efforts to reduce fishing mortality on bigeye tuna in the Eastern Pacific Ocean (EPO) will require coordination and communication among all relevant regional fisheries stakeholders. The capacity for unilateral action by the United States to prevent overfishing, as required under National Standard 1 of the Magnuson-Stevens Act (16 U.S.C. 1851(a)(1), is limited, as is the capacity of the Pacific Fishery Management Council (Council), which is required to develop a plan to end overfishing, under 50 CFR 600.310(e)(4)(i)).

Pacific-wide, the U.S. annually lands approximately 10,000 metric tons (mt) (Table 3), or about five percent of the total bigeye catch. The Pacific-wide catch for bigeye tuna in the EPO between years 1999 and 2003 was between 88,000 mt and 142,000 mt. The U.S. West Coast commercial catch for this period was less than one percent; hence any unilateral action by U.S. fisheries to end overfishing would have little effect on the stock. Multilateral management action is essential to ensure that overfishing on bigeye tuna in the Pacific Ocean ends.

The current resolution that places conservation and management measures on fishing nations in the EPO for bigeye tuna is set to expire in 2006; for that reason this document provides future management options that would address overfishing of Pacific bigeye tuna in the EPO. The Council will choose a West Coast position to advance to the U.S. delegation to the Inter-American Tropical Tuna Commission (IATTC), as domestic management for 2007 and beyond depends on international management actions to reduce fishing on bigeye tuna stocks.

1.0. PURPOSE AND NEED FOR ANALYSIS

1.1 Purpose and Need

This document is intended to provide the Council with information needed to form a position on how to control fishing mortality on Pacific bigeye tuna in the EPO. Management and conservation options are a shared responsibility of both domestic and international fisheries management entities, and thus the requirement to reduce fishing mortality will dictate that the United States find an appropriate balance between protecting the resource and achieving sustainable utilization of the resource within its straddling jurisdictions. Once the Council approves a strategy to reduce fishing mortality it will be presented to the U.S. delegation for consideration by the IATTC. Any new conservation and management measures adopted by the IATTC, as a result of its June 2006 meeting will be implemented domestically.

After consideration of this document, the Council will determine its preferred strategy for the conservation and management of bigeye tuna in the EPO. In the event that regulatory action is considered, the Council will direct the preparation of a management document for public review, including environmental analysis consistent with the National Environmental Policy Act (NEPA). This will ensure adequate consideration of the impacts of a broad range of alternatives as the Council formulates recommendations.

1.2 History of Action

NOAA's National Marine Fisheries Service (NMFS) notified the Council that it must take action to address overfishing of bigeye tuna by June 14, 2005. A similar notification was given to the Western Pacific Fishery Management Council. At the June 2005 meeting, the Council moved to begin work on Amendment 1 to the FMP for U.S. West Coast Fisheries for HMS as the proper response to address this issue. NMFS Southwest Region agreed to take lead responsibility on developing the amendment package for Council consideration. At its November 2005 meeting, the Council was to have adopted a preliminary range of alternatives for public review. However, because of time constraints at that meeting, the agenda item was deferred for a future meeting. This has also allowed NMFS staff, who initiated the preparation of an environmental assessment (EA) containing the alternatives and analysis of them, to provide a more complete document for the Council to review.

Shortly after NMFS staff began the development of the EA, it was determined that no regulatory action would result from an amendment since future actions are dependent on conservation and management measures adopted internationally. Therefore, at this juncture, a management options analysis for the development of a West Coast position on how to control fishing mortality on Pacific bigeye tuna in the eastern Pacific is a more relevant approach than is an environmental effects analysis of proposed conservation and management measures. The management options analysis will provide the Council with the information needed to form a position, which has the potential to influence any new conservation and management decisions adopted by the relevant international bodies governing bigeye tuna stocks in the eastern Pacific, in future years.

1.3 Current Management Controls

Primary management of Pacific bigeye tuna occurs internationally by the IATTC in the EPO and by the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (WCPFC). The IATTC was established by international convention in 1950 and is responsible for the conservation and management of tuna fisheries and other species taken by tuna fishing activity in the EPO. The organization consists of a Commission in which each member country may be represented by up to four commissioners and a Director of Investigations, or the Director who is responsible for drafting research programs, budgets, administrative support, directing technical staff, coordination with other organizations and preparing reports to the Commission.

Staff scientists at the IATTC coordinate and conduct research, observer programs, and the collection, compilation, analysis and dissemination of fishery data and scientific findings. The work of the IATTC research staff is divided into two main groups: The IATTC Tuna-Billfish Program and the IATTC Tuna-Dolphin Program. Current membership of the IATTC includes Costa Rica, Ecuador, El Salvador, France, Guatemala, Japan, Mexico, Nicaragua, Panama, Peru, Spain, USA, Vanuatu, Venezuela, and Korea. Canada, China, the European Union, Honduras, and Chinese Taipei are Cooperating Non Parties or Cooperating Fishing Entities.

On September 5, 2000, the WCPFC was adopted. The Convention, which is subject to ratification, establishes a Commission that would adopt management measures for HMS throughout their ranges. The U.S. has yet to deposit its instrument of ratification of the Convention, but is participating as a cooperating non-member. Both Commissions affect West Coast-based HMS fisheries. Figure 1 illustrates the geographical delineation of the WCPO and the EPO.

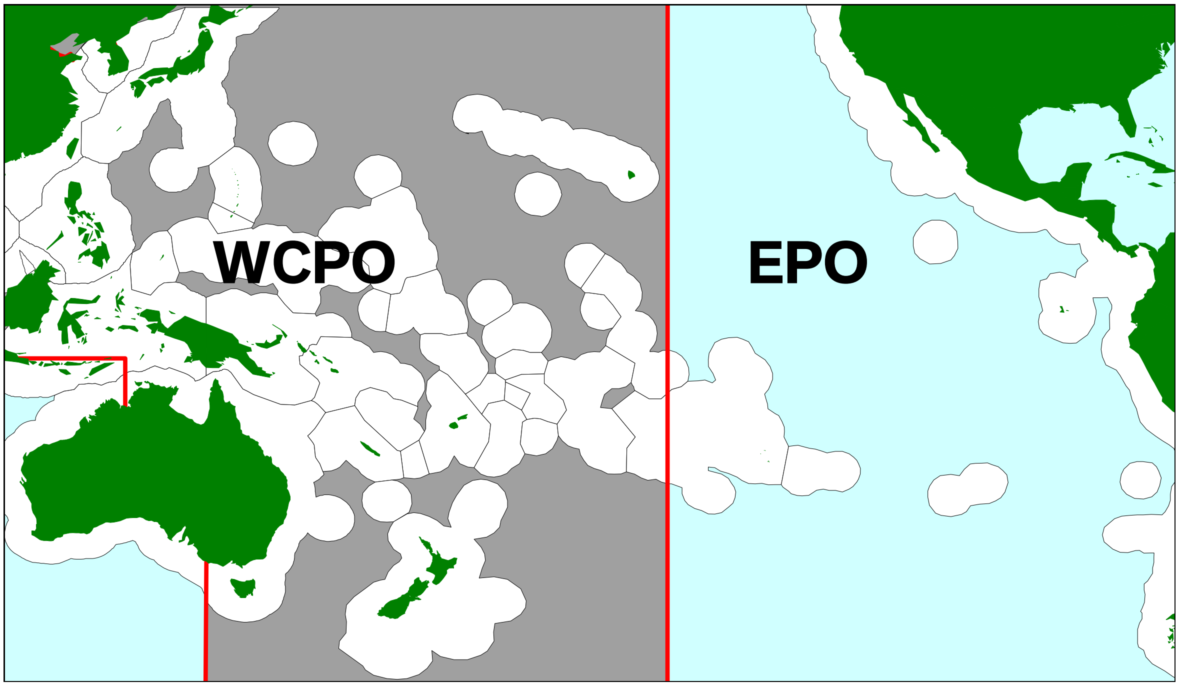


Figure 1. The geographical delineation of the Western and Central Pacific from the Eastern Pacific Ocean for statistical purposes.

The West Coast HMS FMP provides a management context to carry out recommendations of the IATTC. In particular and of interest to the FMP, regulations are in place to collect data on vessels harvesting HMS in the Convention Area, with the intent of assisting the IATTC in monitoring international fisheries as well as enforcing conservation measures. The vessels register system is also intended to assist the Council in monitoring West Coast based HMS fisheries north Pacific albacore, yellowfin, bigeye, skipjack, Pacific bluefin, common thresher shark, pelagic thresher, bigeye thresher, shortfin mako, blue shark, striped marlin, Pacific swordfish and dolphinfish.

In June of 2004, the IATTC adopted Resolution C-04-09 on Tuna Conservation Measures. The resolution established a multi-annual program to protect tuna in the EPO for years 2004 through 2006. The resolution includes conservation measures for yellowfin, bigeye, and skipjack tunas. Purse seine vessels fishing in the EPO are affected by these conservation measures. The conservation resolution includes a national choice of one of two possible six week closures of the Convention Area. The possible choices are either a six-week closure in the summer or winter. Longline vessels fishing for bigeye tuna will be restricted to a national catch not to exceed their national catch for the year 2001. The 2004 conservation resolution introduced a precedent-setting multi-year management framework with a review of the stock(s) response in 2005 and 2006. The multi-annual plan allows the industry to plan and minimize economic impacts. Pole-and-line and sportfishing vessels are not subject to this resolution. Also, members of the IATTC agreed to compliance measure prohibiting landings, transshipments, and commercial transactions involving tunas caught in contravention of the conservation measures in this resolution.

1.4 Management Option Process

March 2006 Council Meeting: Management Options for a West Coast Strategy to Address Overfishing of Bigeye Tuna in the Eastern Pacific Ocean document goes out for Council and public review. At this time the Council reports on its preferred management option.

April 2006 Council Meeting: Report on Public Comment.

April 2006 – May 15th 2006: Finalize document.
May 16th: Submission to the GAC for their review, contemplation, and consideration as an agenda item for their June 1st meeting.

The expectation here is that the GAC will embrace the Council's preferred strategy in part or whole as a part of their strategy and advice to the U.S. Section of the IATTC, which meets in late June to discuss future management options for bigeye tuna.

June 1st 2006: 5th meeting of the GAC.

June 22 – 30th 2006: IATTC meeting in Korea. Any new multi-year resolution adopted would need to be implemented via the Tuna Conventions Act or with an amendment to the West Coast HMS FMP.

2.0 SUMMARY OF THE MANAGEMENT OPTIONS

2.1 Management Objective

The Council will choose a strategy for the establishment of a West Coast position to end overfishing of bigeye tuna in the EPO. The strategy should include measures that meet requirements to end overfishing contained in the MSA as well as meet international obligations. Conservation and management measures to explore include time/area closures for fishing effort in the EPO; limits on mortality of juvenile bigeye associated with fishing on floating objects; and finally, if successful, the United States would then implement the IATTC program for bigeye tuna through quotas and/or time/area closures.

As specified in the West Coast HMS FMP, the Council has the option to provide analysis and documentation to NMFS and the Department of State supporting its recommendation for action under any new international agreement to end or prevent overfishing (Ch. 8, Pg. 4). It is expected that the Department of State and U.S. delegation, in coordination with NMFS, will consider the Council's preferred management option in developing U.S. positions for presentation to the IATTC, and will keep the Council informed of actions by the IATTC to end or prevent overfishing. These actions will be taken into account by the Council in completing its rebuilding plan, and in developing its recommendation to NMFS as to what additional U.S. regulations, if any, may be necessary to end or prevent overfishing. The Council's rebuilding plan will reflect traditional participation in the fishery, relative to other nations, by fishers of the United States, consistent with Section 304(e)(4)(C) of the Magnuson-Stevens Act, 16 U.S.C. §1854(e)(4)(C).

2.2 Description of Vessels/fleets Utilizing Tuna Fisheries in the EPO

Within the IATTC, the usage of "fleet" describes a Nation's fleet. For each nation Party to the IATTC, a fleet consists of all of that nation's vessels no matter the size or gear type. Thus far, within specific resolutions longline and purse seine vessels are defined for the tuna fisheries. The IATTC does maintain a record of each nation's fleet fishing for tropical tunas, such as bigeye. Table 1 summarizes information about national purse seine fleets.

Table 1. Active purse seine vessels targeting tropical tuna in the EPO (IATTC, 2006).

Nation	# of vessels	Range of Length (m)
Bolivia	1	32.9
Columbia	12	32.9 - 74.7 m
Ecuador	89	16.2 – 78.0 m
El Salvador	5	50.3 – 91.9 m
Guatemala	3	66.1 – 77.3 m
Honduras	4	51.6 -62.7
Mexico	73	25.0 – 79.9
Nicaragua	6	52.3 – 69.0
Panama	26	35.7 – 116.0
Spain	3	72.6 – 105.0
United States	3	22.3 – 65.2
Vanuatu	2	56.5 – 69.2
Venezuela	21	59.1 – 107.5

Additionally the IATTC adopted Resolution C-03-07 which established in 2003 a requirement to maintain a list of longline fishing vessels larger than 24 meters overall length (i.e., large-scale tuna longline fishing vessels or “the LSTLFV List”). For the purposes of this resolution, LSTLFVs not included in the LSTLFV Record are deemed not to be authorized to fish for, retain on board, transship or land tuna and tuna-like species in the eastern Pacific Ocean (EPO). Also, the initial LSTLFV List consists of the LSTLFVs of IATTC Parties, cooperating non-Parties, entities, fishing entities or regional economic integration organizations (collectively "CPCs") on the IATTC Regional Vessel Register. The LSTLFV List shall include the following information for each vessel:

1. Name of vessel, registration number, previous names (if known), and port of registry;
2. A photograph of the vessel showing its registration number; and
3. Previous flag (if known and if any);

Table 2 is a summary of the LSTLFVs targeting tropical tunas in the EPO.

Table 2. Active large longline vessels targeting tropical tuna in the EPO (IATTC, 2006).

Nation	# of Vessels	Range in Length (m)
China	89	35.1 – 50.8
Chinese Taipei	138	27.3 – 59.2
Costa Rica	11	24.0 – 27.0
Ecuador	21	24.0 – 55.2
France	14	24.8 – 33.2
Honduras	4	32.8 – 44.2
Japan	530	30.0 – 57.0
Korea	202	39.0 – 49.9
Mexico	9	24.4 – 46.8
Nicaragua	1	24.0
Panama	77	24.0 – 91.5
Peru	1	55.6
Spain	107	25.7 – 49.0
United States	25	24.0 – 50.7
Vanuatu	48	37.5 – 53.5

2.3 Management Option 1 (No Action)

NMFS and the Council would not develop and implement controls necessary to end overfishing by Pacific-wide fishermen, nor submit comments or actively participate in the development of input and recommendations on the conservation and management of Pacific bigeye to the U.S. delegation to the IATTC.

Comments and Considerations: IATTC staff scientists determined that under the current exploitation patterns, and assuming recruitment at recent average levels, yields of bigeye tuna are expected to decline in the near future to levels below the average maximum sustainable yield, potentially leading to an overfished condition.

Impact Summary

By implementing the no action management option (i.e. failure to implement measures that end overfishing) it is likely that a continued decline in Pacific bigeye stocks would result. If the Council chooses management option 1 as their strategy (no action), the stock could become overfished. Additionally, no action would be contrary to requirements in international agreements and to requirements of the MSA.

2.4 Management Option 2

The impact of purse seine and longline fisheries on Pacific bigeye is considered to be highly significant. An analysis by IATTC scientists suggests that the initial declines in stock biomass were caused by longline fishing, but accelerated declines since 2000 are mainly attributable to floating-object-based purse seine fishing. Under a current model, Spawning Biomass Ratio (SBR) levels are predicted to remain at very low levels for many years unless fishing mortality is significantly reduced or recruitment increases for several years.

IATTC scientists suggest large (50%) reductions in bigeye effort from the purse-seine fishery to allow the stock to rebuild towards the AMSY level in ten years. According to IATTC scientists, restrictions applied to a single fishery (e.g. longline or purse-seine), particularly restrictions on longline fisheries, are predicted to be insufficient to allow the stock to rebuild to levels that will support the AMSY. Therefor restrictions on both longline and purse-seine fisheries are necessary to rebuild the stock to the AMSY level in ten years. Simulations suggest that the restrictions imposed by the 2003 Resolution on the Conservation of Tuna in the EPO will not be sufficient to rebuild the stock.

IATTC scientists suggested a combination of the following management options as a means to rebuild the stock.

1) **Closure of the purse seine fishery in the EPO for six consecutive weeks**.

Comments and Considerations: The current resolution adopted by the IATTC allows member nations to choose between two different consecutive six week periods to close their purse seine fishery in the Convention Area. The closure dates begin either August 1, 2004, or November 20, 2004. The closure is intended to target fishing activity that results in high catches of juvenile tuna, and thus the closure should result in improved yields from the stock in subsequent years.

2) **Reduce the purse seine fishing effort on Pacific bigeye by 50 percent in 2007, and possibly beyond, with one or more of the following management options:**

a) Close the purse seine fishery for six consecutive months in the area between 8°N and 10°S west of 95°W (this closure would not be intended to occur simultaneously with the two month EPO closure in (1)); and/or

b) Close the purse seine fishery on floating objects for six consecutive months in the area west of 95°W (this closure is not intended to occur simultaneously with the two month EPO closure); and/or

c) Limit the total annual catch of bigeye by each purse seine vessel that is required to carry an observer to 500 metric tons, estimated either by the observer or, at the request of the fishing vessels Captain, by scientific sampling of the vessel's catch conducted by IATTC staff at the time of unloading. If this latter option is chosen, the vessel would be responsible for the costs of the sampling.

Comments and Considerations: Management Option 2 contains recommendations by IATTC scientist who have indicated that large (50%) reductions in effort (on bigeye tuna) from the purse-seine fishery will allow the stock to rebuild towards the average maximum sustainable yield (AMSY) level, but restrictions on both longline and purse-seine fisheries will be necessary to rebuild the stock to the AMSY level in ten years. Simulations suggest that the restrictions imposed by the 2003 Resolution on the Conservation of Tuna in the EPO will not be sufficient to rebuild the stock. Projections indicate that, if fishing mortality rates continue at their recent (2002 and 2003) levels, longline catches and spawning biomass ration will decrease to extremely low levels.

The particular closure contained in option (a) above is due to the high percentage of juvenile bigeye known to occur in that area and (b) is an area where a large amount of bigeye associated with floating objects are caught. Closing these areas will reduce bigeye tuna mortality.

As Table 3 illustrates, four major fleets are contributing to the majority of the longline catch in the EPO. Fishing mortality from the U.S. and other smaller fleets are an insignificant fraction of the total catch. Also, the U.S. longline fleet does not have freezers, such as those used in the lucrative Japanese sashimi market. Japanese vessels are equipped to fish at sea for many months and are not limited by having to return to port to offload fresh, iced bigeye. The fishing power of the large Asian fleets is thus enhanced by the use of vessels containing freezing capabilities.

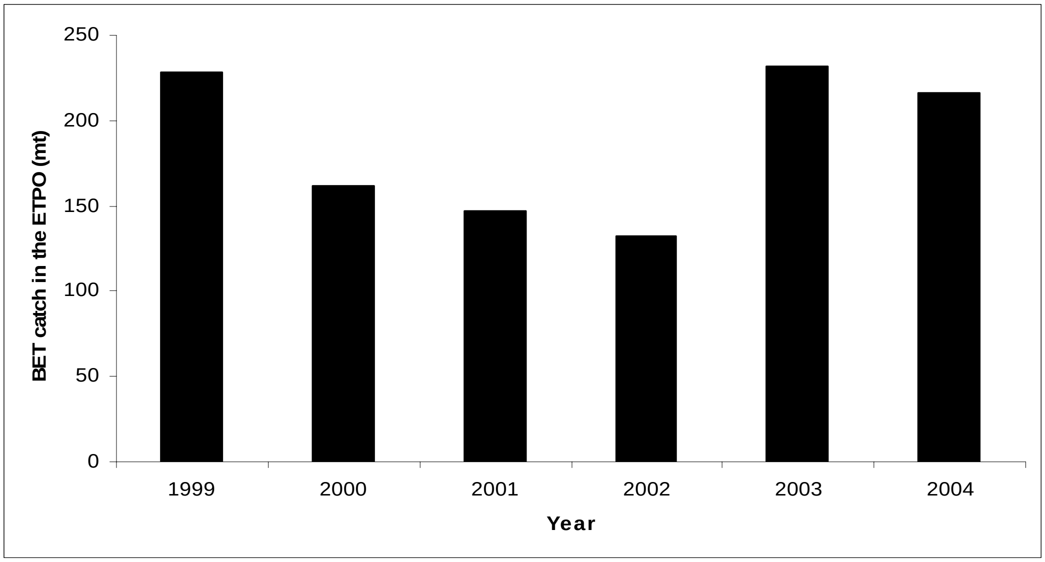
3) **Reduce longline catches in the EPO to 1999 levels.**

Comments and Considerations: Capping bigeye catches at the 1999 level would significantly reduce the volume of longline bigeye by 40-50% of present catches (see Figure 2). This would achieve significant conservation benefits to the stock. Additionally, the current bigeye quota set for U.S. vessels comes from the year 2001, which was a year when the U.S. catch level was at a lower than average, due to litigation and management measures regarding sea turtle conservation.

Impact Summary

Impacts on target and non-target stocks: As discussed previously, West Coast fisheries for bigeye tuna are small compared to other fishing nations and often are not a main target species. If management option 2 were adopted as part of the U.S. position to reduce fishing mortality of bigeye tuna, domestic fishing mortality on bigeye could be reduced through regulatory controls, such as time/area closures. Additional controls on domestic fisheries for bigeye tuna would reduce future impacts to bigeye in the EPO; however, this action may overly burden U.S. fishermen that have a relatively minor role in bigeye tuna fishing mortality.

Figure 2. Annual catch of bigeye tuna in the EPO by U.S. (Hawaii & California-based) vessels (Source: NMFS PIFSC)



Because bigeye landings by West Coast fisheries are so small relative to Pacific-wide fishing nations, none of the regulatory controls considered here would be anticipated to have measurable impacts on bigeye stocks. Similarly, because landings of all non-target species are small relative to Pacific-wide landings, and options are not expected to adversely affect the catches of any of these fisheries, they are not anticipated to result in measurable impacts on non-target stocks.

Impact Summary

Impacts on marine habitat: Purse seine and longline fisheries operations do not involve contact with the seabed, and because measures under management option 2 are not expected to alter these fishing operations, no adverse impacts on marine habitat are anticipated.

Impacts on biodiversity and ecosystem functions: The overall West Coast catch of bigeye tuna is less than 1 percent of the total Pacific-wide catch, thus adverse impacts to the tropical and subtropical pelagic ecosystems and biodiversity are not expected to occur.

Impacts to public health and safety: None of the measures contained in management option 2 are expected to require participants to fish in ways noticeably outside of historical patterns, and thus no impacts on public health and safety are anticipated.

Impacts on fishery participants and fishing communities: Anticipated impacts to affected participants would vary widely according to the severity of any new fishery management reduction in quota or fishing opportunities. However, because West Coast bigeye tuna fishery participants are not highly dependent on bigeye for a majority of their landings the effects of any fishing restrictions could potentially be offset over time with increased landings of other species.

If management option 2 were adopted it would provide for the sustained participation of fishing communities by helping to ensure the long-term availability of bigeye tuna, on the other hand there would likely be a short-term reduction in economic benefits from the fisheries until the stock recovers.

Impacts on data collection and monitoring: Under this management option no new data collection or monitoring requirements are required.

2.5 Management Option 3

Management Option 3 would include all management options contained in alternative 2, plus would exempt fleets[1] that catch 1 percent or less of the total Pacific bigeye tuna landings in the EPO and establish an annual international fishing quota (total allowable catch) of which the amount is to be divided among all nations in the EPO fishing on the stock. Each nation's quota would be based on historical effort. Additionally, this option would explore possible minimum size limitations on juvenile bigeye.

Comments and Considerations: Table 3 shows that the main contribution to EPO longline bigeye catches are made by fleets from China, Japan, Korea and Taiwan. Catches by these Asian fleets are two orders of magnitude larger than U.S. vessels landing bigeye. Catches by other South American longline fleets are comparable to the U.S. landings. Measures directed at the smaller fleets would have little conservation effect on bigeye stocks in the EPO, while at the same time incurring administrative costs that likely exceed the value of the small volume of bigeye landed.

Table 3. EPO longline catches of bigeye tuna (mt) (IATTC, 2005).

Year	Japan	South Korea	Taiwan	China	Other fleets	USA	Total
1999	22,224	9,431	910	660	961	228	34,414
2000	27,929	13,280	5,214	1,320	3,719	162	51,624
2001	37,493	12,576	7,953	2,639	4,169	147	64,977
2002	33,794	10,358	16,692	7,351	3,597	132	71,924
2003	20,517	10,272	12,501	10,065	1,292	232	54,879
Total	141,957	55,917	43,270	22,035	13,738	901	277,818
Percent of total	51.1%	15.57%	20.13%	7.93%	0.32%	4.94%	100%

Impact Summary

Impacts on target and non-target stocks: See Management Option 2 *Comments and Considerations*. Additionally, any measure that imposes minimum size limits on bigeye could potentially have a positive impact on the population by reducing fishing mortality on juvenile species. Management option 3 would also consider minimum size regulations on juvenile bigeye, which would prevent fishing nations from retaining and/or landing fish below a determined minimum size. Minimum size regulations are intended to conserve juvenile fish in three ways. First, prohibition on landing and/or sale prevents development of a commercial market for small fish, thereby discouraging fishermen from targeting them. Secondly, some of the small fish that are discarded will survive and mature to reproduce and contribute to the stock biomass. Third, a minimum size results in fewer fish being retained per mt than would be otherwise. However, to the extent that fishermen cannot control the size composition of the fish they catch, minimum sizes can result in significant discards of undersized fish. The objective to minimize bycatch and bycatch mortality, and the requirement to end overfishing should be considered when evaluating this management option.

[1] The IATTC does not define a fleet, but rather leaves it up to individual nations to impose their own fleet restrictions on a domestic basis. The current IATTC resolution applicable in 2004, 2005 and 2006 simply applies to "purse-seine vessels" fishing for yellowfin, bigeye, and skipjack tunas, and to "longline vessels." Pole-and-line and sportfishing vessels are not subject to this resolution.

Overall, greater restrictions on purse seine FAD fishing combined with minimum size limits would likely have a measurable beneficial impact on bigeye tuna conservation.

Impacts on marine habitat: See Management Option 2 *Comments and Considerations.*

Impacts on biodiversity and ecosystem function: See Management Option 2 *Comments and Considerations.*

Impacts on public health and safety: See Management Option 2 *Comments and Considerations.*

Impacts of fishery participants and fishing communities: See Management Option 2 *Comments and Considerations*. Additionally, if fleets that catch 1 percent or less of the total Pacific bigeye tuna in the EPO are exempted then the focus of management and conservation would be on the fisheries with the greatest impacts and on the regions of highest catches. An exemption recognizes the need to avoid overly burdening those fleets and countries which are peripheral in generating fishing mortality for bigeye tuna. *Impacts on data collection and monitoring*: See Management Option 2 *Comments and Considerations*.

2.6 Management Option 4

Same as Management option 3 plus either use the existing control date or re-establish a more current control date to notify present and potential participants that a limited entry and/or another management program may be considered by the Council for West Coast fisheries in the EPO so as to avoid excess capacity.

Comments and Discussion: See Management Option 2 *Comments and Discussion*.

This control date would not bind the Council to establishing limited access or other management programs for these fisheries, but it would notify current and prospective fishery participants that additional management measures may be taken by the Council for these fisheries. The implementation of a control date would be in recognition of the fact that unlimited expansion of purse seining and longline fishing is untenable with the conservation of bigeye tuna.

2.7 Management Option 5

Close all fisheries under the Council's jurisdiction that target Pacific bigeye tuna in the EPO.

Comments and Discussions: Closure of all fisheries under the Council's jurisdiction that catch bigeye tuna in the EPO would appear to address the contribution to overfishing from U.S. vessels in the eastern Pacific. However, this unilateral action would place an unfair burden on U.S. fishermen by threatening their livelihoods without any significant impact on reducing bigeye fishing mortality. This would not be consistent with the Council objective of addressing overfishing in a cost-effective and equitable manner and for that reason this alternative was not analyzed in detail.

2.8 Management Option 6

The Pacific Council adopts recommendations for international fisheries consistent with those described in Western Pacific Fishery Management Council's Pelagics FMP Amendment 14 as their Pacific-wide response to bigeye tuna overfishing. These recommendations could be adopted in addition to any adopted under options 2-4

Comments and Discussions: For additional details on Pelagics FMP Amendment 14 see Agenda Item G.1.a, Attachment 2, April 2006.

Amendment 14 creates a mechanism and a timetable for the Council to review the status of stocks, to consider and advise on impending RFMO actions, to deliberate on the Council's own proposals for conservation and management, to inform NMFS and the Department of State about the Council's positions and concerns, to participate in international meetings, and to apply their expertise in the subsequent implementation of any resultant agreements.

Specific recommendations for the Western and Central Pacific Ocean include:

a) Short term: cap and roll back fishing effort (e.g. number of vessels) to 1999 levels)

b) Long term: reduce levels of fishing mortality to sustainable levels. If quotas are established they should transferable within countries.

c) Require that fish aggregating devices used by purse seiners be registered and limited in number.

d) Give consideration to allow for the development of emerging Pacific Island fisheries.

Recommendations a-c are concerned with reducing fishing effort and hence fishing mortality. Given the volume of overfishing on bigeye and yellowfin tunas, it is unlikely that wholesale reductions in the order described above can be achieved in the short term, hence the need, as outlined in a, to establish a reasonable short term target to ensure that overfishing on bigeye and yellowfin tuna does not increase by unconstrained expansion of fishing. This should be followed by sustained reduction in fishing for bigeye, likely through attrition of fleets, although mindful that some expansion of fishing is also likely by emergent fishing nations in the Pacific Islands. As noted earlier, the use of FADs by purse seiners targeting skipjack is known to be a significant contribution to bigeye fishing mortality, especially on juvenile bigeye and yellowfin. Restricting FAD use will therefore have significant reduction of fishing mortality on the bigeye and yellowfin stock as a whole. Allowing for expansion of emerging Pacific Islands fisheries appears to be at odds with the overall conservation objectives that need to be adopted for bigeye and yellowfin tuna. However, the text of the convention establishing the WCPFC explicitly recognizes the aspirations of the Pacific Islands to participate in tuna fisheries, rather than simply be resource owners. Balancing these aspirations and the expansion of Pacific Island fisheries (which is already happening) will be difficult challenge for the new Commission. However, it may be possible to match this expansion with controlling the additional deployment of FADs to minimize the volumes of juvenile bigeye and yellow tuna catch.

The Council recommendations regarding quotas include a provision that would allow quotas to be transferred within countries between fishing vessels or fleets, this allows countries to implement and allocate their quotas according to domestic objectives and conditions.

Specific recommendations for the Eastern Pacific Ocean include:

a) Set EPO bigeye tuna longline catch quotas at 1999 levels.

b) Exempt fleets that take less than 1 percent of the total bigeye tuna catch in the EPO.

c) Exempt fleets that catch less than 550 mt of bigeye tuna annually in the EPO.

d) Provide the U.S. longline fleet with a quota of 250 mt of EPO bigeye tuna.

e) All recommendations include a provision in whatever management measures are adopted to permit the landing of a small volume of bigeye (e.g. 20-25 fish) when quotas are exceeded to minimize bycatch and waste by longliners not targeting bigeye. They also include a provision that whatever management measures are adapted should incorporate flexibility for nations to administer the longline quota in accordance with national legislation and sovereignty. This will allow the Council to apply their expertise to the allocation and implementation of domestic quotas as they apply to vessels operating under or in the Council's management authority.

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Dear ~~Mr. McInnis~~ Rod –:

As you are aware, both the Pacific Fishery Management Council (Pacific Council) and the Western Pacific Fishery Management Council (Western Pacific Council) were notified by the National Marine Fisheries Service (NMFS) (69 FR, page 78397-78398) of their need to take action to address Pacific-wide overfishing of Pacific bigeye tuna. The Councils have since moved forward with respective responses aimed at meeting international (Inter-American Tropical Tuna Commission [IATTC] Resolution C-04-09) and domestic (Magnuson-Stevens Fishery Conservation and Management Act [MSA]) requirements to end overfishing of Pacific bigeye. We understand the Western Pacific Council has proceeded with Amendment 14 to their Pelagics Fishery Management Plan. The Pacific Council submitted comments to the Western Pacific Council on Amendment 14, which are intended to facilitate a consistent position between the two Councils. Additionally, the Pacific Council has recently adopted a U.S. West Coast position for international consideration (described below). The purpose of this letter is to request that the U.S. delegation consider the Pacific Council's position in the development of a U.S. position on future management measures for Pacific bigeye during the upcoming IATTC meeting.

At the March 2006 Pacific Council meeting, NMFS provided the Council with an Analysis of Management Options for Development of a Plan to End Overfishing of Pacific Bigeye Tuna in the Eastern Pacific Ocean (EPO) (attachment 1). The goal of this document was to provide the Council with information necessary to help develop a position that has the potential to influence future conservation and management decisions adopted by the IATTC, in the EPO.

At its April 2006 meeting, the Pacific Council considered additional analysis (attachments 2 and 3) as well as public comments to assist in the final process of developing a position. Based on the open public process that took place at its March and April 2006 meetings, the Pacific Council adopted a position composed of a suite of measures to end overfishing in the EPO, including actions to reduce fishing mortality on juvenile bigeye by purse seine fleets.

The Pacific Council believes that the recommendations below can form an important component of the Pacific-wide response to bigeye overfishing and for that reason would like such measure to be considered when developing the United States position for a multi-annual program on the conservation of tuna in the EPO. The Pacific Council position calls for the following actions:

- The actions described in Management Option 3 with the exclusion of an exemption for fleets that catch one percent or less of the total Pacific bigeye tuna landings described under that Option. The Pacific Council may reconsider application of such an exemption, but believes that at this point there is insufficient information available to define the full necessities of such an exemption.
- Establish a definition for a nation's fleet which includes all of the vessels fishing under one nation regardless of area, or gear type.
- Establish an exemption for small purse seine vessels (less than 400-short ton carrying capacity) that fish in the nearshore environment off the coast of California. These vessels primarily target coastal pelagic species (anchovy, sardine, mackerel), but occasionally fish for tropical tunas when these species enter West Coast waters during the months of May through October. A similar exemption could be applied to other gear types or sectors that incidentally catch negligible amounts of bigeye tuna.
- Support international action (as opposed to unilateral action) that would end bigeye tuna overfishing in the EPO.

The Pacific Council requests that the U.S. delegation to the IATTC consider the Pacific Council position when making recommendations on tuna conservation measures for 2007 through 2009. Any new actions taken at the upcoming meeting by the IATTC to end or prevent overfishing will be considered by the Council when developing its recommendation to NMFS as to what additional U.S. regulations, if any, may be necessary to end or prevent overfishing domestically. The Council's plan to end overfishing will reflect traditional participation in the fishery, relative to other nations, by fishers of the United States, consistent with Section 304(e)(4)(C) of the MSA.

Sincerely,

D. O. McIsaac, Ph.D.
Executive Director

HLT:rdd

Attachments: Analysis of Management Options for Development of a Plan to End Overfishing of Pacific Bigeye Tuna in the Eastern Pacific Ocean

Highly Migratory Species Management Team Report on Bigeye Tuna Overfishing Response

Highly Migratory Species Advisory Subpanel Report on Bigeye Tuna Overfishing Response

c: Mr. Scott Burns
Dr. John Coon
Dr. Kit Dahl
Mr. Robert Fletcher
Mr. Peter Flournoy
Mr. William Gibbons-Fly
Mr. Mark Helvey
Mr. Dave Hogan
Mr. William Robinson
Mr. Patrick Rose
Ms. Kitty Simmons
Ms. Heidi Taylor
Highly Migratory Species Management Team
Highly Migratory Species Advisory Subpanel

PACIFIC FISHERY MANAGEMENT COUNCIL

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May 8, 2006

Ms. Kitty Simonds, Executive Director
Western Pacific Fishery Management Council
1164 Bishop Street, Suite 1400
Honolulu, HI 96813-2856

Dear ~~Ms. Simonds~~ Kitty:

Thank you for your March 30, 2006, letter regarding matters of mutual interest to our respective Councils with regard to highly migratory species. The purpose of this letter is to describe the Pacific Fishery Management Council's (Pacific Council's) position on the subject of bigeye tuna overfishing in the Eastern Pacific Ocean (EPO) and to reply to your suggestion for future collaboration between the Pacific and the Western Pacific Councils on pelagic fisheries management. We have also sent Mr. Rod McInnis a letter containing additional material on the development of the Pacific Council's position, for use in the upcoming negotiations at Inter-American Tropical Tuna Commission's (IATTC's) June meeting; you will receive a copy of that letter and attachments.

Based on the open public process that took place at its March and April 2006 meetings, the Pacific Council adopted a position composed of a suite of measures to end overfishing in the EPO, including actions to reduce fishing mortality on juvenile bigeye by purse seine fleets. The Pacific Council position calls for the following actions:

- The actions described in Management Option 3 with the exclusion of an exemption for fleets that catch one percent or less of the total Pacific bigeye tuna landings described under that Option. The Pacific Council may reconsider application of such an exemption, but believes that at this point there is insufficient information available to define the full necessities of such an exemption.
- Establish a definition for a nation's fleet which includes all of the vessels fishing under one nation regardless of area, or gear type.
- Establish an exemption for small purse seine vessels (less than 400-short ton carrying capacity) that fish in the nearshore environment off the coast of California. These vessels primarily target coastal pelagic species (anchovy, sardine, mackerel), but occasionally fish for tropical tunas when these species enter West Coast waters during the months of May through October. A similar exemption could be applied to other gear types or sectors that incidentally catch negligible amounts of bigeye tuna.
- Support international action (as opposed to unilateral action) that would end bigeye tuna overfishing in the EPO.

The Pacific Council agrees with you that a joint Council plan addressing bigeye tuna overfishing can send a compelling message of support for creating an international consensus on ending overfishing of bigeye tuna Pacific-wide. For that reason, the Council requests that the Western Pacific Council consider incorporating the above measures into the Pelagics Fishery Management Plan (FMP) Amendment 14. Should National Marine Fisheries Service (NMFS) approve essentially identical content in the FMPs for both Councils and the State Department also agree, this could serve as a U.S. Pacific-wide response to bigeye tuna overfishing.

With regard to the component of your March 30, 2006, letter recommending a joint council colloquium or its equivalent, we agree and want to encourage increased cooperation between our two Councils. Ms. Heidi Taylor of NMFS Southwest Region is now on detail to the Pacific Council, and I have asked her to take the lead in coordinating an initial meeting to accomplish this goal. Please advise as to who on your staff she should work with in developing logistical and content alternatives for our joint consideration.

Sincerely,

D. O. McIsaac, Ph.D.
Executive Director

HLT:ckc

c: Dr. John Coon
Dr. Christopher Dahl
Mr. Mark Helvey
Mr. William Robinson
Ms. Heidi Taylor
Highly Migratory Species Management Team
Highly Migratory Species Advisory Subpanel

WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

Issues Paper on Amendment 14: Bigeye and yellowfin overfishing measures- outstanding issues

1.0 Introduction

In response to the identification of overfishing by the Secretary of Commerce, at its 126th meeting held March 14-17, 2005 in Honolulu the Council reviewed a background document on Pacific bigeye fisheries, listened to public comments and took initial action to direct its staff to continue its development of Amendment 14 to the Pelagics FMP. This amendment contains comprehensive background information and analyses as well as recommendations for international management and a range of alternatives for the management of domestic fisheries. As stated in the notice of overfishing published in the Federal Register (FR Vol 69 No 250, 78397), "Pacific bigeye tuna occurs in the waters of multiple nations and the high seas and is fished by the fleets of other nations in addition to those of the U.S. The capacity for unilateral action by the U.S. to prevent overfishing, as required under National Standard 1 of the Magnuson-Stevens Act (16 U.S.C. 1851(a)(1)), is limited, as is the capacity for action taken by the Councils to end overfishing, as required under 50 CFR 600.310(e)(4)(i). Multilateral management action is essential to ensure that overfishing on bigeye tuna in the Pacific Ocean ends. NMFS will work with the Department of State, the regional fishery management councils, industry, and other interests to promote conservation and management measures in international and regional fishery management organizations to prevent further overfishing and ensure that bigeye tuna in the Pacific Ocean does not become overfished."

Following extensive review by the Council's Pelagics Plan Team, Science and Statistical Committee and Advisory Panels, as well as public comment solicited at meetings through out Hawaii. The Council took final action in June 2005 to recommend a suite of non-regulatory measures for the international management of fisheries which harvest bigeye tuna. The Council also reviewed and recommended a range of regulatory and non-regulatory measures for fisheries managed under the Pelagics FMP.

Subsequently, in August 2005, the Scientific Committee of the Western and Central Pacific Fishery Commission reviewed stock assessments for Western and Central Pacific bigeye, yellowfin and skipjack tunas, and South Pacific albacore tuna. The conclusion for bigeye tuna remained more or less unchanged, but yellowfin was found to be likely being subjected to overfishing, although the biomass of the stock was still well above the biomass at maximum sustainable yield (MSY). Subsequently, National Marine Fisheries Service (NMFS) Pacific Islands Fisheries Science Center (PIFSC) advised the NMFS Pacific Islands Regional Office (PIRO) that yellowfin tuna was being subjected to unsustainably high levels of fishing mortality in the Western and Central Pacific Ocean (WCPO). Consequently, at its 129th Council meeting in Guam in November 2005, the Council recommended applying to fishing for yellowfin tuna the management measures in draft Amendment 14 to the Pelagics FMP that the Council recommended for bigeye tuna.

The Council transmitted the initial draft of Amendment 14 accordingly to the NMFS Pacific Islands Regional Office for review and approval in November 2005. Reviews received in may 2006 NMFS PIRO and the NOAA Office of General Counsel, indicate that Amendment 14 must address the following issues:

1. **The amendment objectives need to be quantified where possible**

2. **The recommended management measures in Amendment 14 need to be grouped as alternatives**

3. **A recommendation for EPO purse-seiners needs to be included**

This issues paper is intended to provide the Council with the required information to take action on these changes to Amendment 14 at its 133rd meeting in June 2006.

2.0 Summary of Measures Currently Contained in Amendment 14

2.1 General Recommendations for International Fisheries

The Council recommended that the United States promote the following measures in the international arena.

General Recommendations for the Management, Monitoring and Research of Bigeye and Yellowfin Tunas in the Pacific Ocean

General recommendations for management and monitoring:

i. **Use science-based measures that consider historical participation, and provide for sustained participation by local communities.**
ii. **Strive for consistent measures (e.g. WCPO and EPO) where possible.**
iii. **Focus on fisheries with greatest impacts.**
iv. **Focus on regions of highest catches and spawning areas.**
v. **Reduce surplus capacity.**
vi. **Restrict the use of purse seine FADs.**
vii. **Consider exempting fleets that catch less than 1% of the total from some or all measures.**
viii. **Improve species specific fishery monitoring.**
ix. **Establish standardized vessel registry system for the WCPO.**
x. **To the extent practicable the U.S. should seek RFMO decisions that are consistent with National Standard 1 of the MSA and its guidelines as codified.**

General recommendations for research:

i. **Determine consistent science-based reference points that are appropriate for management use. In the absence of international reference points, promote the establishment and application of MSY based reference points and associated control rules with respect to preventing and ending overfishing.**
ii. **Improve stock assessments that provide region specific information and understanding of recruitment.**
iii. **Promote pan-Pacific assessments that provide region specific information.**
iv. **Improve understanding of responses to FADs.**
v. **Investigate gear and fishing characteristics of vessels with above-average CPUE.**
vi. **Collect and define vessel and gear attributes useful for effort standardization for all fleets.**
vii. **Define total costs of management on governments and participants.**

2.2 Council Management Protocol for Pacific Bigeye and Yellowfin Tunas

The Council recommended the following protocol to ensure that both the Western Pacific Regional Fishery Management Council (WPRFMC) and Pacific Fishery Management Council (PFMC) are informed and afforded the opportunity to substantively participate in all of the activities leading up to the development and implementation of U.S. proposals for international management:

a. **The Council participates on U.S. delegations to Regional Fishery Management Organizations (RFMOs e.g. IATTC and WCPFC) in the Pacific Ocean and is included in all pre and post meetings and negotiations.**

b. The Council and NMFS monitor RFMO meetings and actions and relevant fisheries, Council becomes aware of a need for management action or receives notice from NMFS or the RFMO directly of a need for such action, with supporting documentation.

c. The Council reviews information from RFMO, NMFS, and other sources concerning stock assessment, area of consideration, fishery issues and data supporting determinations, and the role of U.S. fisheries in causing or contributing to overfishing.

d. NMFS provides formal notice and time frame for Council action within MSA and RFMO frameworks.

e. The Council refers information to its Pelagics Plan Team, Advisory Panel(s), SSC and other advisors for review and advice with focus on:

- **Definition and condition of the stock or other fishery management unit, and the issue of concern (e.g., overfishing, bycatch, allocation, etc.),**
- **Possible reasons for the situation including fishery and environmental conditions that may be relevant to the stock condition or other management concern,**
- **Relative role of U.S. fisheries in overall stock harvests and management situation,**
- **Existing conservation and management measures of the RFMO with jurisdiction over the stock or fishery involved,**
- **Possible multi-lateral measures to avoid or end overfishing, rebuild the stock, or resolve other management concerns.**

f. The Council's PPT, AP, SSC and other advisory bodies recommend possible domestic and international fishery conservation and management measures, including a comparison and evaluation of alternative measures including distinctions between Pacific-wide, regional, and local measure's effects and effectiveness.

g. The Council makes initial decision on how to address problem (initial action).

h. The Council distributes a draft background and action document for public review and advice.

i. The Council makes formal recommendations to NMFS and the Department of State on:

- **domestic regulations,**
- **international actions.**

j. The Council drafts a position paper on how RFMOs should address the situation (the position paper should clearly and forcefully state the Council's recommendation on every substantial issue).

k. The Council presents its position within the U.S. delegation to the RFMO.

l. The RFMO meets and acts on fishery conservation and management needs in the international arena.

m. The Council considers the RFMO's actions, U.S. government positions and requirements under applicable treaties and the MSA.

n. The Council determines its appropriate regulatory response for domestic fisheries consistent with international agreements and the MSA.

o. The Council takes final action (if any) to recommend regulations for NMFS' approval and implementation.

p. NMFS implements approved recommendations.

2.3 Management for the WCPO and EPO

The Council recommended the following management measures purse seine and longline fishing in the WCPO:

a. Short term: cap and roll back fishing effort (e.g. number of vessels) to 1999 levels)[1]

b. Long term: reduce levels of fishing mortality to sustainable levels. If quotas are established they should transferable within countries[2].

c. Require that fish aggregating devices used by purse seiners be registered and limited in number[3].

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[1] The WCPFC decided at its second meeting in December 2005 not to set caps for longline effort, electing instead to cap catches for the period 2006-2008 at the 2004 levels for China and the U.S. and the annual average of 2001-2004 catches for the other CCMs. The WCPFC required CCMs to ensure that purse seine effort levels between 2006 and 2008 do not exceed either 2004 levels or the average of 2001-2004 levesl in waters under their national jurisdiction. The WCPFC undertook to implement compatible measures to ensure that purse seine do not exceed 2004 levels on the high seas in the Convention Area or the total fishing capacity will not increase in the Convention Area. Pacific Islands countries who are Parties to the Nauru Agreement (PNA), will implant the purse seine effort limits by a Vessel Day Scheme that will limit days fished to a level no greater than 2004 levels and will be fully implemented by 1 December 2007. Other non-PNA member countries will implement similar measures to limit purse seine effort in waters under their jurisdiction to no greater than 2004 levels, or to the average of 2001 to 2004 levels. Further, in order to achieve the overall reduction in catch and effort required for bigeye and yellowfin tuna, in accordance with advice and recommendations received from the Scientific Committee, the WCPFC Executive Director will work with CCMs during 2006 to develop a proposal for consideration at the Third Session of the Commission that is consistent with the IATTC arrangements that allow for a system of temporary purse seine closures.

[2] The longline catch limits set for bigeye by WCPFC in 2005 and IATTC in 2004 were at the national level and it is each country's prerogative how these might be divided up between national fleets.

[3] At the WCPFC meeting in December 2005, the WCPFC also required CCMs to develop management plans for the use of FADs (anchored and drifting) within waters under national jurisdiction which shall be submitted to the Commission, which will include registration and may include limits on numbers deployed. However, this falls far short of the management advice given to WCPFC from the Science Committee meeting in August 2005, which recommended major redirection of purse seine effort from FAD sets to unassociated schools.

d. Give consideration to allow for the development of emerging Pacific Island fisheries[4].

The Council recommended the following management measures for longline fishing in the EPO:

a. Set EPO bigeye tuna longline catch quotas at 1999 levels.

b. Exempt fleets that take less than 1% of the total bigeye tuna catch in the EPO.

c. Exempt fleets that catch less than 550 mt of bigeye tuna annually in the EPO.

d. Provide the U.S. longline fleet with a quota of 250 mt. of EPO bigeye tuna.

e. All recommendations include a provision in whatever management measures are adopted to permit the landing of a small volume of bigeye (e.g. 20-25 fish)[5] when quotas are exceeded to minimize bycatch and waste by longliners not targeting bigeye. They also include a provision that whatever management measures are adapted should incorporate flexibility for nations to administer the longline quota in accordance with national legislation and sovereignty. This will allow the Council to apply their expertise to the allocation and implementation of domestic quotas as they apply to vessels operating under or in the Council's management authority.

2.4 Management Recommendations for Domestic WPRFMC Fisheries

The Council made additional recommendations for the management of domestic longline, purse seine and small boat pelagic fisheries.

2.4.1 Recommendations for WPRFMC Pelagic Longline and Purse Seine Fisheries

Establish a control date of June 2, 2005 for domestic longline and purse seiners fishing in U.S. EEZ waters in the Western Pacific region, including developing longline fisheries in Guam and CNMI.[6]

[4] The conservation and management decisions adopted by the WCPFC in December 2005 for bigeye, yellowfin and albacore tunas contain language which states that nothing in the language of these measures prejudice the legitimate rights and obligations of those small island state Members and participating territories in the Convention Area seeking to develop their own domestic fisheries.

[5] An average of 24 bigeye tuna were caught per swordfish trip by Hawaii-based longline vessels. Source: Ito, R.Y. & W.A. Machado. 2001. Annual report of the Hawaii-based longline fishery for 2000. NMFS SWFSC Admin. Rep. H-01-07.

[6] Notification of this control date was published in the Federal Register, Vol. 70, No. 156 Monday, August 15, 2005 / 47782 – 47783.

2.4.2 Recommendations for Other WPRFMC Pelagic Fisheries

1. No action

2. Implement management measures (quotas and bag limits, minimum sizes, gear restrictions) for small boat pelagic fisheries in the Western Pacific region.

3. Implement a federal permit and reporting program for all Hawaii-based pelagic small boat fishermen.

4. Implement a federal permit and reporting program for Hawaii-based offshore (Cross Seamount, NOAA Moorings, FADs) mixed-line pelagic small boat fishermen.

5. Implement a federal permit and reporting program for Hawaii-based recreational pelagic small boat fishermen.

6. Expand the Hawaii Marine Recreational Fisheries Survey for Hawaii-based boats.

7. Assist the State of Hawaii to improve its fishermen and dealer reporting systems.

8. Implement a targeted survey of all Hawaii-based pelagic small boat owners/ operators to obtain information on their fishing effort and catches (preferred).

9. Implement a voluntary reporting system for Hawaii-based recreational pelagic small boat fishermen (preferred).

10. Implement a federal permit and reporting program for Hawaii-based commercial pelagic small boat fishermen (preferred).

11. Establish a control date of June 2, 2005 for commercial pelagic Hawaii-based small boat fisheries (preferred).[7]

Although the Council considered the above alternatives in a comprehensive context (i.e. wherever such vessels operate) legal counsel has stated that the Council's authority does not extend into state waters and thus any resultant regulations would not apply in those areas.

3.0 Review of Outstanding Issues for Council Action

[7] Notification of this control date was published in the Federal Register, Vol. 70, No. 156 Monday, August 15, 2005, 47781 – 47782.

3.1 Quantification of Amendment Objectives

Council staff and Pelagic Plan Team members have examined the latest available information and offer the following for consideration by the Council:

Objectives for measures to address overfishing in the WCPO:

- reduce longline and purse seine bigeye fishing mortality by 20% as compared to 2001-2003 fishing levels (WCPFC 2005)
- reduce longline and purse seine yellowfin fishing mortality by 20% as compared to 2001-2003 fishing levels (WCPFC 2005)
-

Objectives for measures to address overfishing in the EPO:

- reduce longline and purse seine bigeye fishing mortality by 32% as compared to 2003-2004 fishing levels (Maunder & Hoyle IATTC 2006)

Objectives for measures to address overfishing in Hawaii small boat fisheries

- Implement mechanisms to cap effort if necessary
- Increase data collection and availability

3.2 Grouping of the Measures as Alternatives

3.2.1 International Measures

Council staff have drafted the following alternatives and summaries of their associated impacts for consideration by the Council

3.2.1.1 Alternative 1: No Action

Under this alternative neither the WCPFC and IATTC would take action to end overfishing of Pacific BET, nor would the WCPFC move to end overfishing of WCPO YFT.

Biological impacts

The no-action alternative is the current baseline but would be inconsistent with requirements in international agreements, and the Magnuson-Stevens Act, and would not achieve the Council's objectives for addressing overfishing. Fishing mortality (F) would not be expected to decline on either tuna stock, and even if F did not increase, it is likely that the biomass (B) of either species would decline below the B_{msy} and potentially below the Minimum Stock Size Thresholds (MSSTs). If this occurred then the Council would be obliged to develop a rebuilding plan for Pacific BET and WCPO YFT. Maintenance of present effort levels or subsequent expansion would also likely threaten the sustainable exploitation of other tunas and associated stocks such as billfish and pelagic sharks, leading to the need for additional action.

Expansion of fishing effort would also increase the levels of fish bycatch and the potential for interactions with protected species such as turtles, marine mammals and seabirds. The impact of fish bycatch in terms of the Council's overfishing control rule are likely to remain unknown since stock assessments for most pelagic species are unavailable, but there may be long term ecosystem-wide impacts, especially if the mean trophic level of the catch was reduced through fishing down the larger species of tunas, billfish and sharks..

Socio-economic impacts

Unfettered expansion of fishing effort in Pacific pelagic fisheries for BET and WCPC YFT is not sustainable, nor is it likely that present levels of fishing effort can be sustained indefinitely. Impacts from these scenarios are likely to be different across fisheries. In the WCPO, purse seine and pole and line fisheries focus primarily on skipjack tuna, which appears to be very resilient to the current levels of fishing effort. Consequently the WCPO purse seine and pole and line fleets may only be lightly impacted by further decline of BET and YFT. By contrast, the longline fleets targeting BET and YFT in the WCPO and BET in the EPO would likely find it more difficult to maintain profitable levels of catches.

As such, social and economic impacts would be expected to be widespread across the Asia-Pacific region in the cities and towns heavily reliant on longline fisheries, as fishing conditions progressively worsened. At the local level the Hawaii longline fleet is primarily focused on BET catches, now landing about 10 million pounds annually. Although fishing effort, and hence fishing mortality is not spatially homogenous across the Pacific, it is likely that as the BET stock declined in total, there will be increasingly poor CPUEs for BET in the Hawaii-based longline fishery. Given the fishing constraints on the other high value fish in the Hawaii fishery, i.e. swordfish, longliners may have to target other species, some of which like yellowfin tuna are also subject to overfishing. More likely, is the decline in the fishery and the less successful vessels leave the fishery. The contraction of the Hawaii fleet would have a knock-on effect through the whole seafood industry in Hawaii, leading to less employment and higher prices for fresh fish.

Administrative impacts

Should the Council continue to persist in taking no action, it is likely Secretary of Commerce would be forced to develop a Secretarial amendment to be consistent with the requirements of the MSA. Such action might ultimately involve closure of longline and other US fisheries targeting WCPO YFT and Pacific BET. While unilateral Council action would not end overfishing, the Council would be derelict in its stated policy of fully engaging in the international management of pelagic fisheries in the Pacific. Pursuit of a 'no action' alternative would also provide a poor example to other countries participating in pelagic fisheries in the Pacific Ocean, possibly leading to RFMO policies that do little to address overfishing of BET and YFT.

3.2.1.2 Alternative 2: End Overfishing Immediately

Under this alternative the WCPFC and IATTC would take action to immediately end overfishing of Pacific BET, and the WCPFC would move to immediately end overfishing of WCPO YFT as follows:

Measures to address overfishing in the WCPO (bigeye and yellowfin)

- Immediately reduce longline tuna effort by 20%
- Immediately reduce purse seine effort on floating FADs by 20%

Measures to address overfishing in the EPO (bigeye)

- Immediately reduce longline tuna effort 30%
- Immediately reduce purse seining effort on floating FADS by 30%

All measures must consider traditional participation as specified in the MSA and emerging island fisheries as specified in the convention which established the WCPFC.

Biological impacts

This alternative would likely provide the greatest possibility of recovering Pacific BET and WCPO YFT stocks if the reductions in effort and targeting were indeed effected immediately. Moreover, there would be additional benefits to reducing purse seine fishing on floating FADs by reducing the level of bycatch of other species, including turtles, associated with FAD sets. However, in the EPO, a return to fishing on unassociated sets my increase the bycatch of marine mammals, particularly dolphins, found in association with free-swimming yellowfin schools

Socio-economic impacts

There would be high social and economic costs of this alternative. The immediate cutting of longline fishing effort between 20 and 30% would mean either reductions in fleet sizes or constraints on the operations of existing fleets. Either way, there would be a loss of income for longline fleets, with subsequent knock-on effects in the seafood industries around the Pacific and elsewhere.

Reduction of purse seine effort on floating FADs by 20-30% would also likely compromise those purse seine operations highly dependent on FAD sets, such as in the EPO and in countries such Papua New Guinea in the WCPO. The inability to use FADs and inexperience with catching unassociated sets would likely lead to uneconomic operations and a contraction of purse seine fleets, which would ultimately lead to a decreased volume to canneries, and higher prices for canned tuna.

Administrative impacts

The administrative impacts from an immediate reduction in fishing effort as described above would be substantial. Fleets across the Pacific would have to be monitored to ensure that the 20-30% reductions were being effected. This would be less serious for the US fleets which have a high level of observer coverage, but would be more substantial for other fleets. Nonetheless, a 20% reduction of longline effort would require the Council to develop rules governing the Hawaii and American Samoa longline fleets, possibly through some form of set allocation, number of hooks set or days at sea schemes, and the costs would be substantial.

3.2.1.3 Alternative 3: Phase Out Overfishing In No More Than 10 years

Under this alternative the WCPFC and IATTC would take action to end overfishing of Pacific BET, and the WCPFC move to end overfishing of WCPO YFT as described below. In both instances these actions would be phased in no more than 10 years.

Implementation of output controls

- WCPO (bigeye and yellowfin):
    - If necessary, implement quotas on a country level basis with domestic allocation left to each country (WPRFMC)
- EPO (bigeye)
    - Implement EPO bigeye longline quota equal to 1999 harvests (WPRFMC)
    - Provide U.S. longline fleet with EPO quota of 250 mt (WPRFMC)
    - Exempt fleets that take less than 1% or 550 mt of annual EPO bigeye catch (WPRFMC)

Gradually (over 10 years) quotas would be reduced to achieve objectives. However, all measures must consider traditional participation as specified in the MSA and emerging island fisheries as specified in the convention which established the WCPFC.

Implementation of input controls

- WCPO (bigeye and yellowfin)
    - Gradually decrease longline fishing effort (# of vessels), starting with rollback to 1999 levels (WPRFMC)
    - Register and limit the use of purse seine FADs (WPRFMC)
- EPO (bigeye)
    - Allow non-bigeye target longline trips to retain 20-25 incidentally caught bigeye (WPRFMC)
    - Gradually reduce EPO purse seining on bigeye by 20% (IATTC 2006)

Gradually (over 10 years) input controls would be increased to achieve objectives. However, all measures must consider traditional participation as specified in the MSA and emerging island fisheries as specified in the convention which established the WCPFC.

Biological impacts

Clearly, some form of phased approach to reducing longline and purse seine fishing effort would mean that stocks of WCPO YFT and Pacific BET would recover more slowly from excessive fishing mortality. However, it would still achieve the same objective. Moreover, there would be the same additional benefits to reducing purse seine fishing on floating FADs by reducing the level of bycatch of other species, including turtles, associated with FAD sets. Further, while in the EPO, a return to fishing on unassociated sets may increase the interactions of marine mammals, a phased approach may provide sufficient time to ensure that any interactions are minimized.

Socio-economic impacts

There would be still be some social and economic costs of this alternative. However, a phased-in programmed approach would allow participants to adjust to downward shifts in fishing effort through adaptive management. Ultimately, as stocks recovered catch rates should improve over the long term in the fishery, making it more profitable for the remaining participants in the fishery.

Administrative impacts

Similarly, there would still be administrative impacts from a phased approach to fishing effort reduction, but as noted above there would be a greater 'window' for participants to adjust. In particular, it would provide a better opportunity both domestically and through the RFMOs to develop equitable mechanisms for reducing effort and ensuring the reductions continue to be observed by participants.

3.2.2 Measures for Hawaii Small Boats

Council staff have drafted the following groupings of the Council's recommended measures as alternatives, as well as summaries of their associated impacts, for consideration by the Council.

3.2.2.1 Alternative 1 No action

Under this alternative the Council would take no action regarding Hawaii's small boat fisheries that fish for bigeye or yellowfin tuna.

Biological impacts

The no-action alternative is the current baseline but would be inconsistent with requirements in international agreements, and the Magnuson-Stevens Act, and would not achieve the Council's objectives for Hawaii's small boat fisheries. In the short-run there would not be expected to be any discernable biological impacts as these fisheries constitute a very small part of Pacific bigeye and yellowfin catches. In the longer run these fisheries could grow in size and begin to have significant impacts that could be difficult to address if participants feel that they have a historical "right" to continue fishing.

Socio-economic impacts
This alternative is unlikely to have any short-term socio-economic impacts but if Hawaii's small boat fisheries grow in size they may begin to contribute significantly to the overfishing problem and catches and catch rates may decline, leading to adverse social and economic impacts for both recreational and commercial fisheries. At the same time, the lack of complete and timely data from Hawaii's small boat fisheries would hamper efforts by scientists and managers to understand these changes.

Administrative impacts
The no action alternative would have no immediate administrative impacts however a lack of positive action by the Council could ultimately lead to the unilateral implementation of a Secretarial amendment. Such action could result in management measures for Hawaii's small boat fisheries. In addition, although unilateral Council action would not end overfishing, the Council would be derelict in its stated policy of fully engaging in this issue. Pursuit of a 'no action' alternative would also provide a poor example to other countries participating in pelagic fisheries in the Pacific Ocean, possibly leading to RFMO policies that do little to address overfishing of BET and YFT.

3.2.2.2 Implement fishery controls

Under this alternative the Council would recommend the establishment of fishery controls such as quotas, trip limits or limited entry programs for Hawaii's small boat fisheries that harvest bigeye or yellowfin tuna.

Biological impacts
This alternative would not be expected to have any discernable short-run biological impacts as these fisheries constitute a very small part of Pacific bigeye and yellowfin catches. If these fisheries grow in size and begin to have significant impacts, such controls would be valuable in addressing those impacts.

Socio-economic impacts
This alternative would be expected to have negative socio-economic impacts on fishery participants, with the force of those impacts obviously varying with the amount of controls implemented. Given the limited impact of these fisheries on Pacific tuna stocks it is unlikely that there would be associated positive impacts such as increased catch rates.

Administrative impacts
This alternative would have administrative impacts, with the force of those impacts again varying with the amount of controls actually implemented.

3.2.2.3 Establish control dates

Under this alternative control dates would be established to notify new entrants to Hawaii's small boat fisheries who enter the fishery after the control date may be regulated or not allowed to participate in the fishery pending further action by the Council. (Note that these control dates were already published by NMFS.)

Biological impacts
This alternative would have no immediate biological impacts however it would smooth and speed the implementation of future fishery controls to roll back effort if they become necessary.

Socio-economic impacts
This alternative would have no immediate socio-economic impacts as it does not affect fishing or other activities. In the longer term it would have positive impacts as new entrants to the fisheries would be aware that their operations could be limited or prohibited as a result of further action by the Council. This would allow them to carefully consider their levels of investment in the fisheries and prevent over investment in what may turn out to be a limited opportunity. Impacts on long term fishery participants could also be positive if roll backs in effort are required and implemented and these should eventually result in improved catch rates for remaining participants.

Administrative impacts
This alternative would have little immediate administrative impact beyond publication of the appropriate Federal Register notice. In the longer term it would smooth the implementation of future fishery controls to roll back effort if they become necessary.

3.2.2.4 Increase data collection from Hawaii small boats

This alternative would address the current gaps in data collection and the problems with the timely processing and availability of data to fishery scientists and managers.

Biological impacts
There would be no immediate biological impact under this alternative however the collection and analysis of information on bigeye and yellowfin tuna from fishery participants would increase our understanding of the overfishing problem and would allow the Council to implement finely tuned, adaptive and informed fishery controls should they become necessary.

Socio-economic impacts
This alternative could have mixed socio-economic impacts as the permitting and reporting burden might be offset by the increased understanding of the importance of data reporting and good stewardship by fishery participants who to date have not had to report their catches.

Administrative impacts
This alternative would have high administrative impacts as it would require NMFS to establish permit and reporting programs for Hawaii's small boat fisheries.

Summary of Western Pacific Fishery Management Council (WPFMC) Action on Pelagics FMP Amendment 14, June 2006

The WPFMC made the following recommendation regarding international (high seas) fisheries. They did not change their previous recommendations for domestic (small boat, non-longline, non-purse seine) fisheries.

- The IATTC immediately reduce the bigeye catch in the purse seine fishery by 38% as recommended by the IATTC staff.
- If additional longline catch reductions are considered by IATTC, countries catching less than 1 percent on average of the bigeye catch should be allocated an annual quota of 500 mt for the 2007-2009 period.
- Exempt U.S. longline vessels not targeting bigeye tuna in the EPO from the annual bigeye quota.
- The Western and Central Pacific Fisheries Commission (WCPFC) should immediately reduce fishing mortality of yellowfin and bigeye by 20% in the WCPFC convention area utilizing capacity controls, fishing effort controls, limits on purse seine fishing around FADs, and national quotas.
- Countries which have increased their longline and purse seine fishing effort since 1999 should reduce their fishing effort in proportion to this increase. All measures must consider traditional participation and emerging island fisheries.
- NMFS assist the WCPFC in procuring the funding necessary to obtain better catch data from some segments of the Western and Central Pacific Ocean pelagic fishery, particularly Indonesia and the Philippines.

INTER-AMERICAN TROPICAL TUNA COMMISSION

74TH MEETING

BUSAN (KOREA)
26-30 JUNE 2006

RESOLUTION C-06-02

RESOLUTION FOR A PROGRAM ON THE CONSERVATION OF TUNA IN THE EASTERN PACIFIC OCEAN FOR 2007

The Inter-American Tropical Tuna Commission (IATTC):

Recognizing that, based on past experience in the fishery, the potential production from the resource can be reduced by excessive fishing effort;

Recalling the Resolution C-04-09 for a Multi-Annual Program on the Conservation of Tuna in the Eastern Pacific Ocean for 2004, 2005 and 2006;

Taking into account the best scientific information available, as reflected in the recommendation of the staff and the report of the meeting of the Working Group on Stock Assessments in May 2006;

Considering that the studies of yellowfin and bigeye tuna presented at this meeting show that bigeye stocks are below the level that would produce the average maximum sustainable yield (AMSY) and that yellowfin stocks will decline below the AMSY level unless additional management measures are applied; and

Recognizing the importance of urging the Western and Central Pacific Fisheries Commission to adopt appropriate measures to conserve the tuna stocks in that region;

Resolves as follows:

1. That this resolution is applicable in 2007 to purse-seine vessels fishing for yellowfin, bigeye, and skipjack tunas, and to longline vessels.
2. Pole-and-line and sportfishing vessels are not subject to this resolution.
3. That the fishery for tunas by purse seine vessels in the EPO, defined as the area bounded by the coastline of the Americas, the 40°N parallel, the 150°W meridian, and the 40°S parallel, shall for 2007 be closed from either (1) 0000 hours on 1 August to 2400 hours on 11 September; or (2) from 0000 hours on 20 November to 2400 hours on 31 December.
4. Each IATTC Party, cooperating non-party, fishing entity or regional economic integration organization (collectively "CPCs") shall for each year concerned, choose which of the two specified periods will be closed to purse-seine fishing by all of its vessels, and notify the Director by 15 July. All the vessels of a national fleet must stop purse-seine fishing during the period selected.
5. Every vessel that fishes in 2007, regardless of the flag under which it operates or whether it changes flag during the year, must observe the closure period to which it committed on 15 July of each year.
6. To prohibit landings, transshipments and commercial transactions in tuna or tuna products that have been positively identified as originating from fishing activities that contravene this resolution. The Director may provide relevant information to the Parties to assist them in this regard. The Commission shall develop transparent and non-discriminatory criteria and procedures to adopt trade restrictive measures consistent with international law and the provisions of the World Trade Organization to promote compliance in the EPO.
7. Each CPCs shall, for purse seine fisheries:

7.1. No later than 45 days before the date of entry into force of a closure:

7.1.1. take the legal and administrative measures necessary to implement the closure;

7.1.2. inform all interested parties in its national tuna industry of the closure;

7.1.3. inform the Director that these steps have been taken.

7.2. Ensure that at the time the closures begins, and for the entire duration of the closures, all purse-seine vessels fishing for yellowfin, bigeye and skipjack tunas flying its flag in the EPO are in port, except that vessels carrying an observer from the AIDCP On-Board Observer Program may remain at sea provided they do not fish in the EPO. The only other exception to this provision shall be that vessels carrying an observer from the AIDCP On-Board Observer Program may leave port during the closure, provided they do not fish in the EPO.

8. China, Japan, Korea, and Chinese Taipei, shall take the measures necessary to ensure that their total annual longline catch of bigeye tuna in the EPO during 2007 will not exceed the following catch levels.

China	2,639 metric tons
Japan	34,076 metric tons
Korea	12,576 metric tons
Chinese Taipei	7,953 metric tons

Other CPCs shall take the measures necessary to ensure that their total annual longline catch of bigeye tuna in the EPO during 2007 will not exceed 500 metric tons or their respective 2001 catch levels, whichever is higher.[1] CPCs whose annual catches have exceeded 500 metric tons shall provide monthly catch reports to the Director.

9. The IATTC Scientific Working Group will analyze, in 2007, the effect of these measures on the stocks, and will propose, if necessary, appropriate measures to the Commission to be applied in 2008 and thereafter for its consideration.

10. Each CPC shall comply with this resolution.

11. This resolution replaces Resolution C-04-09.

[1] The Parties acknowledge that France, as a coastal State, is developing a tuna longline fleet on behalf of its overseas territories situated in the EPO.

STATUS OF YELLOWFIN TUNA IN THE EASTERN PACIFIC OCEAN IN 2004 AND OUTLOOK FOR 2005

by

Simon D. Hoyle and Mark N. Maunder

CONTENTS

1. EXECUTIVE SUMMARY

This report presents the most current stock assessment of yellowfin tuna (*Thunnus albacares*) in the eastern Pacific Ocean (EPO). An age-structured, catch-at-length analysis (A-SCALA) was used to assess yellowfin tuna in the eastern Pacific Ocean (EPO). The methods of analysis are described in IATTC Bulletin, Vol. 22, No. 5, and readers are referred to that report for technical details.

The assessment reported here is based on the assumption that there is a single stock of yellowfin tuna in the EPO. Yellowfin are distributed across the Pacific Ocean, but the bulk of the catch is made in the east and west. The purse-seine catches of yellowfin tuna are less in the vicinity of the western boundary of the EPO. The movements of tagged yellowfin tuna are generally over hundreds, rather than thousands, of kilometers, and exchange between the eastern and western Pacific Ocean appears to be limited. This is consistent with the fact that longline catch-per-unit-of-effort (CPUE) trends differ among areas. It is likely that there is a continuous stock throughout the Pacific Ocean, with exchange of individuals at a local level, although there is some genetic evidence for local isolation. Movement rates between the EPO and the western Pacific cannot be estimated with currently available tagging data.

The stock assessment requires substantial amounts of information, including data on retained catches, discards, fishing effort, and the size compositions of the catches of the various fisheries. Assumptions have been made about processes such as growth, recruitment, movement, natural mortality, fishing mortality, and stock structure. The assessment for 2005 differs from that of 2004 in the following ways. The catch and length-frequency data for the purse-seine and pole-and-line fisheries have been updated to include new data for 2004 and revised data for 2000-2003. The effort data for these fisheries have been updated to include new data for 2004 and revised data for 1975-2003. The catch data for the Japanese longline fisheries have been updated for 1999-2002, and new data for 2003 have been added. The catch data for the longline fisheries of Chinese Taipei have been updated to include new data for 2002. The catch data for the longline fisheries of the People's Republic of China have been updated to include new data for 2003 and revised data for 2001 and 2002. The longline catch-at-length data for 2001-2002 have been updated, and new data for 2003 have been added. The longline effort data have been standardized by means of a generalized linear model standardization of the CPUE, using data for 1975-2003, rather than the neural network that was used previously. The growth model likelihood has been adjusted to account for sampling at length, rather than assuming random sampling.

Significant levels of fishing mortality have been observed in the yellowfin tuna fishery in the EPO. These levels are highest for middle-aged yellowfin. Both recruitment and exploitation have had substantial impacts on the yellowfin biomass trajectory. Most of the yellowfin catch is taken in schools associated with dolphins, and, accordingly, this method has the greatest impact on the yellowfin tuna population, although it has almost the least impact per unit of weight captured of all fishing methods. It appears that the yellowfin population has experienced two different productivity regimes (1975-1983 and 1984-2004), with greater recruitment during the second regime. The two recruitment regimes correspond to two regimes in biomass, the high-recruitment regime corresponding to greater biomasses. The spawning biomass ratio (the ratio of the current spawning biomass to that for the unfished stock; SBR) of yellowfin in the EPO was below the level corresponding to the average maximum sustainable yields (AMSYs) during the low-recruitment regime, but close to that level during the high-recruitment regime. The two different productivity regimes may support two different levels of AMSY and associated SBRs, and the AMSY reported here is an average for the 1975-2004 period. The current SBR is below the SBR level corresponding to the AMSY. However, there is substantial uncertainty in the most recent estimate of SBR, and there is a moderate probability that the current SBR is above the level corresponding to the AMSY. The effort levels are estimated to be greater than those corresponding to the AMSY (based on the recent (2002-2003) distribution of effort among the different fisheries). Because of the flat yield curve, however, the recent effort levels are estimated to be capable of producing, under average conditions, catch that is only slightly less than the AMSY. Future projections under the current effort levels and average recruitment indicate that the population is likely to remain at approximately the same level over the next 5 years. These simulations were carried out using the average recruitment for the 1975-2004 period. If they had been carried out using the average recruitment for the 1984-2004 period, the projected trend in SBR and catches would have been more positive. Both the purse-seine and longline catches are expected to remain close to 2004 levels.

The AMSY has been stable during the assessment period, which suggests that the overall pattern of selectivity has not varied a great deal through time. However, the overall level of fishing effort has varied with respect to the AMSY multiplier.

The analysis indicates that strong cohorts entered the fishery during 1998-2000, and that these cohorts increased the biomass during 1999-2000. However, these cohorts have now moved through the population, so the biomass decreased during 2002-2004.

The overall average weights of yellowfin tuna that are caught have consistently been much less than those that would maximize the AMSY, indicating that, from the yield-per-recruit standpoint, the yellowfin in the EPO are not harvested at the optimal size. There is substantial variability in the average weights of the yellowfin taken by the different fisheries, however. In general, the floating-object, unassociated, and pole-and-line fisheries capture younger, smaller fish than do the dolphin-associated and longline fisheries. The longline fisheries and the purse-seine sets in the southern area on yellowfin associated with dolphins capture older, larger yellowfin than do the coastal and northern dolphin-associated fisheries. The AMSY calculations indicate that the yield levels could be increased if the fishing effort were diverted to the fisheries that catch larger yellowfin, and would be diminished if the fishing effort were diverted to catching smaller fish. Any such changes would also affect the SBR levels in a similar way.

The conservation measures imposed in 2004 under IATTC Resolution C-04-09 are predicted to result in slightly greater biomasses and SBRs than would otherwise have been the case. However, it is likely that the stock is below the AMSY level.

A sensitivity analysis was carried out to estimate the effect of a stock-recruitment relationship. The results suggest that the model with a stock-recruitment relationship fits the data slightly better than the base case, but this result could also be explained by the regime shift, since the spawning biomass is relatively low during the period of low recruitment and relatively high during that of high recruitment. The results from the analysis with a stock-recruitment relationship, suggesting that the effort level is greater than that corresponding to the AMSY; however, the yield at this effort level is still only 6% less than the AMSY. The biomass is estimated to have been less than the biomass that would produce the AMSY for most of the modeling period, except for most of the 2000-2002 period.

The assessment results are similar to those from the previous assessments. The major differences occur, as expected, in the most recent years. The current assessment, and those for 2002, 2003, and 2004, indicate that the biomass increased in 2000, whereas the earlier assessments indicated a decline. In addition, SBR and the SBR corresponding to the AMSY have increased compared to the 2004 assessment because of changes in estimates of growth and recent age-specific fishing mortality.

Summary

1. The results are similar to those of the previous five assessments, except that the SBR corresponding to AMSY is greater than in those assessments.
2. The biomass is estimated to have declined very slightly in 2004.
3. There is uncertainty about recent and future recruitment and biomass levels.
4. The estimate of the current SBR is less than that corresponding to the AMSY, but its confidence intervals encompass the AMSY.
5. The recent fishing mortality rates are 20% above those corresponding to the AMSY.
6. Increasing the average weight of the yellowfin caught could substantially increase the AMSY.
7. There have been two different productivity regimes, and the levels of AMSY and the biomasses corresponding to the AMSY may differ between the regimes.
8. The results are more pessimistic if a stock-recruitment relationship is assumed.

2. DATA

Catch, effort, and size-composition data for January 1975-December 2004 were used to conduct the stock assessment of yellowfin tuna, *Thunnus albacares*, in the eastern Pacific Ocean (EPO). The data for 2004, which are preliminary, include records that had been entered into the IATTC databases before or on April 1, 2005. All data are summarized and analyzed on a quarterly basis.

2.1. Definitions of the fisheries

Sixteen fisheries are defined for the stock assessment of yellowfin tuna. These fisheries are defined on the basis of gear type (purse seine, pole and line, and longline), purse-seine set type (sets on schools associated with floating objects, unassociated schools, and dolphin-associated schools), and IATTC length-frequency sampling area or latitude. The yellowfin fisheries are defined in Table 2.1, and their spatial extents are shown in Figure 2.1. The boundaries of the length-frequency sampling areas are also shown in Figure 2.1.

In general, fisheries are defined so that, over time, there is little change in the size composition of the catch. Fishery definitions for purse-seine sets on floating objects are also stratified to provide a rough distinction between sets made mostly on fish-aggregating devices (FADs) (Fisheries 1-2, 4, 13-14, and 16), and sets made on mixtures of flotsam and FADs (Fisheries 3 and 15).

2.2. Catch and effort data

To conduct the stock assessment of yellowfin tuna, the catch and effort data in the IATTC databases are stratified according to the fishery definitions described in Section 2.1 and shown in Table 2.1. The three definitions relating to catch data (landings, discards, and catch) used by Maunder (2002a) and Maunder and Watters (2001 and 2002) are described by Maunder and Watters (2001). The terminology for this report, and those of Maunder and Harley (2004, 2005), has been changed to be consistent with the terminology used in other IATTC reports. "Landings" is catch landed in a given year even if the fish were not caught in that year. Previously, landings referred to retained catch taken in a given year. This catch will now be termed retained catch. Throughout the document the term "catch" will be used to reflect both total catch (discards plus retained catch) and retained catch, and the reader is referred to the context to determine the appropriate definition.

All three of these types of data are used to assess the stock of yellowfin. Removals by Fisheries 10-12 are simply retained catch (Table 2.1). Removals by Fisheries 1-4 are retained catch plus some discards resulting from inefficiencies in the fishing process (see Section 2.2.2) (Table 2.1). The removals by Fisheries 5-9 are retained catch, plus some discards resulting from inefficiencies in the fishing process and from sorting the catch. Removals by Fisheries 13-16 are only discards resulting from sorting the catch taken by Fisheries 1-4 (see Section 2.2.2) (Table 2.1).

New and updated catch and effort data for the surface fisheries (Fisheries 1-10 and 13-16) have been incorporated into the current assessment. The effort data for 1975-2003 have been updated, and catch and effort data for 2004 are new.

The species-composition method (Tomlinson 2002) was used to estimate catches of the surface fisheries. Comparisons of catch estimates from different sources show consistent differences between cannery and unloading data and the results of species composition sampling. Comparing the two sets of results is complex, as the cannery and unloading data are collected at the trip level, while the species-composition samples are collected at the well level, and represent only a small subset of the data. Differences in catch estimates could be due to the proportions of small tunas in the catch, differing efforts to distinguish the tuna species at the cannery, or even biases introduced in the species-composition algorithm in determining the species composition in strata for which no species-composition samples are available. In this assessment we calculated average quarterly and fishery-specific scaling factors for 2000-2004 and applied these to the cannery and unloading estimates for 1975-1999. Harley and Maunder (2005) compared estimates of the catches of bigeye obtained by sampling catches with estimates of the catches obtained from cannery data. Maunder and Watters (2001) provide a brief description of the method that is used to estimate fishing effort by surface gears (purse seines and pole-and-line vessels).

Updates and new catch and effort data for the longline fisheries (Fisheries 11 and 12) have also been incorporated into the current assessment. New catch data are available for Japan (2003), Chinese Taipei (2002), the Peoples Republic of China (2003), and updated data for Japan (1999-2002) and the Peoples Republic of China (2001-2002). Monthly reporting of catch data for the longline fishery provided, at the time of the assessment, full 2004 catch for Japan and the Republic of Korea and partial year catch for the other nations. As in the previous assessments of yellowfin in the EPO (Maunder and Watters 2001, 2002; Maunder 2002a; Maunder and Harley 2004, 2005), the amount of longlining effort was estimated by dividing standardized estimates of the catch per unit of effort (CPUE) from the Japanese longline fleet into the total longline landings. In previous assessments estimates of standardized CPUE were obtained with regression trees (Watters and Deriso 2000, Maunder and Watters 2001, 2002, Maunder 2002a), or neural networks (Maunder and Harley 2004, 2005). In this assessment CPUE was standardized using a delta gamma generalized linear model (Stefansson 1996) that took into account latitude, longitude, and numbers of hooks between floats.

2.2.1. Catch

No longline catch data for 2004 were available, so effort data was assumed (see section 2.2.2) and the catch was estimated by the stock assessment model. Therefore, the total 2004 longline catch is a function of the assumed 2004 longline effort, the estimated number of yellowfin of catchable size in the EPO in 2004, and the estimated selectivities and catchabilities for the longline fisheries. Catches for the other longline fisheries for the recent years for which the data were not available were estimated, using the ratio, by quarter, of the catch to the Japanese catch for the last year for which data were available for that fishery.

Trends in the catch of yellowfin tuna in the EPO during each quarter from January 1975 to December 2004 are shown in Figure 2.2. It should be noted that there were substantial surface and longline fisheries for yellowfin prior to 1975 (Shimada and Schaefer 1956; Schaefer 1957; Okamoto and Bayliff 2003). The majority of the catch has been taken by purse-seine sets on yellowfin associated with dolphins and in unassociated schools. One main characteristic of the catch trends is the increase in catch taken since about 1993 by purse-seine sets on fish associated with floating objects.

Although the catch data in Figure 2.2 are presented as weight, the catches in numbers of fish were used to account for longline removals of yellowfin in the stock assessment.

2.2.2. Effort

Maunder and Watters (2001, 2002a), Maunder (2002a), and Maunder and Harley (2004, 2005) discuss the historic fishing effort. For the surface fisheries, this assessment includes updated effort data for 1975-2003 and new effort data for 2004.

A complex algorithm, described by Maunder and Watters (2001), was used to estimate the amount of fishing effort, in days fished, exerted by purse-seine vessels. The longline effort data for yellowfin have been estimated from standardized CPUE data, as follows. Detailed data on catch, effort, and hooks between floats from the Japanese longline fleet, provided by Mr. Adam Langley of the Secretariat of the Pacific Community, were used in a generalized linear model with a delta gamma link function to produce an index of standardized CPUE (E.J. Dick, NOAA Santa Cruz, personal communication; see Stefansson (1996) for a description of the method). The Japanese effort data were scaled by the ratio of the Japanese catch to the total catch to compensate for the inclusion of catch data from the other nations into the assessment. This allows inclusion of all the longline catch data into the assessment, while using only the Japanese effort data to provide information on relative abundance.

The IATTC databases do not contain catch and effort information from longlining operations conducted in the EPO during 2004. To conduct the stock assessment of yellowfin tuna, the amount of longlining effort exerted during each quarter of 2004 was assumed to be equal to the estimated effort exerted during the corresponding quarter of 2003.

Trends in the amount of fishing effort exerted by the 16 fisheries defined for the stock assessment of yellowfin tuna in the EPO are plotted in Figure 2.3. Fishing effort for surface gears (Fisheries 1-10 and 13-16) is in days fishing. The fishing effort in Fisheries 13-16 is equal to that in Fisheries 1-4 (Figure 2.3) because the catches taken by Fisheries 13-16 are derived from those taken by Fisheries 1-4 (see Section 2.2.3). Fishing effort for longliners (Fisheries 11 and 12) is in standardized units.

2.2.3. Discards

For the purposes of stock assessment, it is assumed that yellowfin tuna are discarded from catches made by purse-seine vessels because of inefficiencies in the fishing process (*e.g.* when the catch from a set exceeds the remaining storage capacity of the fishing vessel) or because the fishermen sort the catch to select fish that are larger than a certain size. In either case, the amount of yellowfin discarded is estimated with information collected by IATTC or national observers, applying methods described by Maunder and Watters (2003a). Regardless of why yellowfin are discarded, it is assumed that all discarded fish die. Maunder and Watters (2001) describe how discards are implemented in the yellowfin assessment. One difference from the method described by Maunder and Watters (2001) is that the discard rates are not smoothed over time, which should allow for a better representation of recruitment in the model. Discard data for 2004 were not available for the analysis, so it was assumed that the discard rate by quarter was the same as for 2003.

2.3. Size-composition data

The fisheries of the EPO catch yellowfin tuna of various sizes. The average size composition of the catch from each fishery defined in Table 2.1 is shown in Figure 2.4. Maunder and Watters (2001) describe the sizes of yellowfin caught by each fishery. In general, floating-object, unassociated, and pole-and-line fisheries catch smaller yellowfin, while dolphin-associated and longline fisheries catch larger ones. New purse-seine length-frequency data were included for 2004. New longline length-frequency data were available for the Japanese fleet for 2003, and data for 2001 to 2002 were updated. Size composition data for the other longline fleets are not used in the assessment.

The length frequencies of the catches during 2004 from the four floating-object fisheries were similar to those observed over the whole modeling period (compare Figures 4.2 and 4.8a). However, in the dolphin-associated fishery additional large modes may be observed at about 140-160 cm during quarters 1 and 2. This may be related to the strong cohort that was observed in the floating-object fisheries during 1998 and 1999 (Maunder and Watters 2001), which moved through the unassociated fisheries during 1999 and 2000 (Maunder and Watters 2002) and entered the dolphin-associated fisheries in 2000. This cohort can be seen moving through the dolphin-associated fisheries during 2001 (Maunder and Harley 2004: Figure 4.8c). The appearance, disappearance, and subsequent reappearance of strong cohorts in the length-frequency data is a common phenomenon for yellowfin in the EPO. This may indicate spatial movement of cohorts or fishing effort, and the limitations in the length-frequency sampling. Groups of tagged fish have also disappeared and then reappeared (Bayliff 1971), suggesting, among other things, that vulnerability to capture fluctuates.

The length frequencies of the catch during 2002 and 2003 for the longline fisheries (Figure 4.8e) were available in adequate sample sizes only for the southern fishery. These data showed a mode moving through the longline fishery, starting at about 110 cm in the first quarter of 2002 and reaching 130-140 cm in the second quarter of 2003. This cohort was not predicted by the model; this may be related to the strong cohort observed in the dolphin-associated fishery.

2.4. Auxiliary data

Age-at-length estimates (Wild 1986) calculated from otolith data are integrated into the stock assessment model to provide information on mean length at age and variation in length at age. His data consisted of ages and lengths for 196 fish collected between 1977 and 1979. The sampling design involved collecting 15 yellowfin in each 10-cm interval in the length range of 30 to 170 cm. The model has been altered to take this sampling scheme into account (see Section 3.1.1).

3. ASSUMPTIONS AND PARAMETERS

3.1. Biological and demographic information

3.1.1. Growth

The growth model is structured so that individual growth increments (between successive ages) can be estimated as free parameters. These growth increments can be constrained to be similar to a specific growth curve (perhaps taken from the literature) or fixed so that the growth curve can be treated as something that is known with certainty. If the growth increments are estimated as free parameters they are constrained so that the mean length is a monotonically increasing function of age. The growth model is also designed so that the size and age at which fish are first recruited to the fishery must be specified. For the current assessment, it is assumed that yellowfin are recruited to the discard fisheries (Fisheries 13-16) when they are 30 cm long and two quarters old.

The growth of yellowfin tuna was estimated by Wild (1986), who used the Richards growth equation and counts of daily increments in yellowfin otoliths (L_∞ = 188.2 cm, annual k = 0.724, t_0 = 1.825 years, m = 1.434). In the assessment for yellowfin, the growth model is fitted to data from Wild (1986) (Figure 3.1).

An important component of growth used in age-structured statistical catch-at-length models is the variation in length at age. Age-length information contains information about variation of length at age, in addition to information about mean length at age. Unfortunately, as in the case of the data collected Wild (1986), sampling is usually aimed at getting fish of a range of lengths. Therefore, variation in length at a particular age from this sample is not a good representation of the variation of length at age. However, by applying conditional probability the appropriate likelihood can be developed.

The model used in this assessment was changed so that variation in length at age could be estimated from the data. Both the sampling scheme and the fisheries and time periods in which data were collected were taken into account. The mean lengths of older yellowfin were assumed to be close to those indicated by the growth curve of Wild (1986).

The following weight-length relationship, from Wild (1986), was used to convert lengths to weights in this stock assessment:

$$w = 1.387 \times 10^{-5} \cdot l^{3.086}$$

where w = weight in kilograms and l = length in centimeters.

A more extensive unpublished data set of length and weight data gives a slightly different relationship, but inclusion of this alternative data set in the stock assessment model gives essentially identical results.

3.1.2. Recruitment and reproduction

The A-SCALA method allows a Beverton-Holt (1957) stock-recruitment relationship to be specified. The Beverton-Holt curve is parameterized so that the relationship between spawning biomass and recruitment is determined by estimating the average recruitment produced by an unexploited population (virgin recruitment) and a parameter called steepness. Steepness is defined as the fraction of virgin recruitment that is produced if the spawning stock size is reduced to 20% of its unexploited level, and it controls how quickly recruitment decreases when the size of the spawning stock is reduced. Steepness can vary between 0.2 (in which case recruitment is a linear function of spawning stock size) and 1.0 (in which case recruitment is independent of spawning stock size). In practice, it is often difficult to estimate steepness because of the lack of contrast in spawning stock size and the high inter-annual (and inter-quarter) variation in recruitment. The base case assessment assumes that there is no relationship between stock size and recruitment. This assumption is the same as that used in the 2000, 2001, 2002, and 2003 assessments (Maunder and Watters 2001, 2002, Maunder 2002a, Maunder and Harley 2004). The influence of a Beverton-Holt stock-recruitment relationship is investigated in a sensitivity analysis.

It is assumed that yellowfin tuna can be recruited to the fishable population during every quarter of the year. Hennemuth (1961) reported that there are two peaks of spawning of yellowfin in the EPO, but it is assumed in this study that recruitment may occur more than twice per year because individual fish can spawn almost every day if the water temperatures are in the appropriate range (Schaefer 1998). It is also assumed that recruitment may have a seasonal pattern.

An assumption is made about the way that recruitment can vary around its expected level, as determined from the stock-recruitment relationship. It is assumed that recruitment should not be less than 25% of its expected level and not greater than four times its expected level more often than about 1% of the time. These constraints imply that, on a quarterly time step, extremely small or large recruitments should not occur more than about once every 25 years.

Yellowfin tuna are assumed to be recruited to the discard fisheries in the EPO at about 30 cm (about 2 quarters old) (Section 3.1.1). At this size (age), the fish are vulnerable to capture by fisheries that catch fish in association with floating objects (*i.e.* they are recruited to Fisheries 13-16).

The spawning potential of the population is estimated from the numbers of fish, proportion of females, percent mature, batch fecundity, and spawning frequency (Schaefer 1998). These quantities (except numbers) are estimated for each age class, based on the mean length at age given by the von Bertalanffy growth equation fitted to the otolith data of Wild (1986); see Maunder and Watters (2002). The spawning potential of the population is used in the stock-recruitment relationship and to determine the ratios of spawning biomass to that for the unfished stock (spawning biomass ratios; SBRs). The relative fecundity at age and the sex ratio at age are shown in Figures 3.2 and 3.3, respectively.

3.1.3. Movement

The evidence of yellowfin tuna movement in the EPO is summarized by Maunder and Watters (2001). For the purposes of the current assessment, it is assumed that movement does not bias the stock assessment results.

3.1.4. Natural mortality

For the current stock assessment, it is assumed that, as yellowfin tuna grow older, the natural mortality rate (M) changes. This assumption is similar to that made in previous assessments, for which the natural mortality rate was assumed to increase for females after they reached the age of 30 months (*e.g.* Anonymous 1999: 38). Males and females are not treated separately in the current stock assessment, and M is treated as a rate for males and females combined. The values of quarterly M used in the current stock assessment are plotted in Figure 3.4. These values were estimated by making the assumptions described above, fitting to sex ratio data (Schaefer 1998), and comparing the values with those estimated for yellowfin in the western and central Pacific Ocean (Hampton 2000; Hampton and Fournier 2001). Maunder and Watters (2001) describe in detail how the age-specific natural mortality schedule for yellowfin in the EPO is estimated.

3.1.5. Stock structure

The exchange of yellowfin between the EPO and the central and western Pacific has been studied by examination of data on tagging, morphometric characters, catches per unit of effort, sizes of fish caught, *etc.* (Suzuki *et al.* 1978), and it appears that the mixing of fish between the EPO and the areas to the west of it is not extensive. Therefore, for the purposes of the current stock assessment, it is assumed that there is a single stock, with little or no mixing with the stock(s) of the western and central Pacific.

3.2. Environmental influences

Recruitment of yellowfin in the EPO has tended to be greater after El Niño events (Joseph and Miller 1989). Previous stock assessments have included the assumption that oceanographic conditions might influence recruitment of yellowfin tuna in the EPO (Maunder and Watters 2001, 2002; see Maunder and Watters 2003b for a description of the methodology). This assumption is supported by observations that spawning of yellowfin is temperature dependent (Schaefer 1998). To incorporate the possibility of an environmental influence on recruitment of yellowfin in the EPO, a temperature variable was incorporated into previous stock assessment models to determine whether there is a statistically-significant relationship between this temperature variable and estimates of recruitment. The previous assessments (Maunder and Watters 2001, 2002) showed that estimates of recruitment were essentially identical with or without the inclusion of the environmental data. Maunder (2002a) correlated recruitment with the environmental time series outside the stock assessment model. For candidate variables, Maunder (2002) used the sea-surface temperature (SST) in an area consisting of two rectangles from 20°N-10°S and 100°W-150°W and 10°N-10°S and 85°W-100°W, the total number of 1°x1° areas with average SST ≥24°C, and the Southern Oscillation Index. The data were related to recruitment, adjusted to the period of hatching. However, no relationship with these variables was found. No investigation using environmental variables was carried out in this assessment.

In previous assessments it has also assumed that oceanographic conditions might influence the efficiency of the various fisheries described in Section 2.1 (Maunder and Watters 2001, 2002). It is widely recognized that oceanographic conditions influence the behavior of fishing gear, and several different environmental indices have been investigated. However, only SST for the southern longline fishery was found to be significant. Therefore, because of the use of standardized longline CPUE, environmental effects on catchability were not investigated in this assessment.

4. STOCK ASSESSMENT

A-SCALA, an age-structured statistical catch-at-length analysis model (Maunder and Watters 2003a) and information contained in catch, effort, and size-composition data are used to assess the status of yellowfin tuna in the EPO. The A-SCALA model is based on the method described by Fournier *et al.* (1998). The term "statistical" indicates that the model implicitly recognizes that data collected from fisheries do not perfectly represent the population; there is uncertainty in our knowledge about the dynamics of the system and about how the observed data relate to the real population. The model uses quarterly time steps to describe the population dynamics. The parameters of the model are estimated by comparing the predicted catches and size compositions to data collected from the fishery. After these parameters have been estimated, the model is used to estimate quantities that are useful for managing the stock.

The A-SCALA method was first used to assess yellowfin tuna in the EPO in 2000 (Maunder and Watters, 2001) and modified and used for the 2001 assessment (Maunder and Watters 2002). The main changes in the method from 2000 to 2001 were the inclusion of a Beverton-Holt (1957) stock-recruitment relationship (as a sensitivity analysis), the omission of the random-walk component of catchability, the estimation of mean length at age and the standard deviation of length at age, and shortening of the modeling period (July 1980 to January 2001). In the 2001 assessment (Maunder 2002a) the main changes were the increase in the modeling period (January 1975 to January 2002), inclusion of otolith data, and removal of environmental indices for recruitment and catchability. The main changes in the 2002 assessment (Maunder and Harley 2004) were the choice of weighting factors for the selectivity smoothness penalties based on cross validation and the iterative reweighting of the length-frequency sample size in a sensitivity analysis. The main change in the 2004 assessment (Maunder and Harley 2005) was the removal of the seasonal effect in recruitment to allow for the new method used for future projections. The main change in this assessment was revision of the growth model to take into account the sampling strategy used to obtain the length-at-age data.

The following parameters have been estimated for the current stock assessment of yellowfin tuna in the EPO:

1. recruitment to the fishery in every quarter from the first quarter of 1975 through the last quarter of 2004;
2. quarterly catchability coefficients for the 16 fisheries that take yellowfin from the EPO;
3. selectivity curves for 12 of the 16 fisheries (Fisheries 13-16 have an assumed selectivity curve);
4. initial population size and age-structure;
5. mean length at age (Figure 3.1);
6. amount of variation in length at age.

The values of the following parameters are assumed to be known for the current stock assessment of yellowfin in the EPO:

1. fecundity of females at age (Figure 3.2);
2. sex ratio at age (Figure 3.3);
3. natural mortality at age (Figure 3.4);
4. selectivity curves for the discard fisheries (Fisheries 13-16);
5. steepness of the stock-recruitment relationship (steepness = 1 for the base case assessment).

Yield and catchability estimates for estimations of the average maximum sustainable yield (AMSY) or future projections were based on estimates of quarterly fishing mortality or catchability (mean catchability plus effort deviates) for 2002 and 2003, so the most recent estimates were not included in these calculations. It was determined by retrospective analysis (Maunder and Harley 2004) that the most recent estimates were uncertain and should not be considered. Sensitivity of estimates of key management quantities to this assumption was tested.

There is uncertainty in the results of the current stock assessment. This uncertainty arises because the observed data do not perfectly represent the population of yellowfin tuna in the EPO. Also, the stock assessment model may not perfectly represent the dynamics of the yellowfin population nor of the fisheries that operate in the EPO. As in previous assessments (Maunder and Watters 2001, 2002; Maunder 2002a; Maunder and Harley 2004, 2005), uncertainty is expressed as (1) approximate confidence intervals around estimates of recruitment (Section 4.2.2), biomass (Section 4.2.3), and the spawning biomass ratio (Section 5.1), and (2) coefficients of variation (CVs). The confidence intervals and CVs have been estimated under the assumption that the stock assessment model perfectly represents the dynamics of the system. Since it is unlikely that this assumption is satisfied, these values may underestimate the amount of uncertainty in the results of the current assessment.

4.1. Indices of abundance

CPUEs have been used as indices of abundance in previous assessments of yellowfin tuna in the EPO (*e.g.* Anonymous 1999). It is important to note, however, that trends in the CPUE will not always follow trends in the biomass or abundance. There are many reasons why this could be the case. For example, if a fishery became more or less efficient at catching yellowfin tuna while the biomass was not changing, due to changes in technology or targeting, the CPUEs would increase or decrease despite the lack of trend in biomass. Fisheries may also show hyper- or hypo-stability, in which the relationship between CPUE and abundance is non-linear (Hilborn and Walters 1992; Maunder and Punt 2004). The CPUEs of the 16 fisheries defined for the current assessment of yellowfin in the EPO are shown in Figure 4.1. Trends in longline CPUE are based only on the Japanese data. As mentioned in Section 2.2.2, CPUE for the longline fisheries was standardized using general linear modeling. Discussions of historical catch rates can be found in Maunder and Watters (2001, 2002), Maunder (2002a), and Maunder and Harley (2004, 2005), but trends in CPUE should be interpreted with caution. Trends in estimated biomass are discussed in Section 4.2.3.

4.2. Assessment results

The A-SCALA method provides a reasonably good fit to the catch and size-composition data for the 16 fisheries that catch yellowfin tuna in the EPO. The assessment model is constrained to fit the time series of catches made by each fishery almost perfectly. The 16 predicted time series of yellowfin catches are almost identical to those plotted in Figure 2.2. It is important to predict the catch data closely, because it is difficult to estimate biomass if reliable estimates of the total amount of fish removed from the stock are not available.

It is also important to predict the size-composition data as accurately as possible, but, in practice, it is more difficult to predict the size composition than to predict the total catch. Accurately predicting the size composition of the catch is important because these data contain most of the information necessary for modeling recruitment and growth, and thus for estimating the impact of fishing on the stock. A description of the size distribution of the catch for each fishery is given in Section 2.3. Predictions of the size compositions of yellowfin tuna caught by Fisheries 1-12 are summarized in Figure 4.2, which simultaneously illustrates the average observed and predicted size compositions of the catches for these 12 fisheries. (Size-composition data are not available for discarded fish, so Fisheries 13-16 are not included in this discussion.) The predicted size compositions for all of the fisheries with size-composition data are good, although the predicted size compositions for some fisheries have lower peaks than the observed size compositions (Figure 4.2). The model also tends to over-predict larger yellowfin in some fisheries. However, the fit to the length-frequency data for individual time periods shows much more variation (Figure 4.8).

The results presented in the following section are likely to change in future assessments because (1) future data may provide evidence contrary to these results, and (2) the assumptions and constraints used in the assessment model may change. Future changes are most likely to affect estimates of the biomass and recruitment in recent years.

4.2.1. Fishing mortality

There is variation in fishing mortality exerted by the fisheries that catch yellowfin tuna in the EPO, with fishing mortality being higher before 1984, during the lower productivity regime (Figure 4.3a). Fishing mortality changes with age (Figure 4.3b). The fishing mortalities for younger and older yellowfin are low (except for the few oldest fish). There is a peak at around ages of 14-15 quarters, which corresponds to peaks in the selectivity curves for fisheries on unassociated and dolphin-associated yellowfin (Figures 4.3b and 4.4). The fishing mortality on young fish has not greatly increased in spite of the increase in effort associated with floating objects that has occurred since 1993 (Figure 4.3b).

The fishing mortality rates vary over time because the amount of effort exerted by each fishery changes over time, because different fisheries catch yellowfin tuna of different ages (the effect of selectivity), and because the efficiencies of various fisheries change over time (the effect of catchability). The first effect (changes in effort) was addressed in Section 2.2.1 (also see Figure 2.3); the latter two effects are discussed in the following paragraphs.

Selectivity curves estimated for the 16 fisheries defined in the stock assessment of yellowfin tuna are shown in Figure 4.4. Purse-seine sets on floating objects select mostly yellowfin that are about 4 to 14 quarters old (Figure 4.4, Fisheries 1-4). Purse-seine sets on unassociated schools of yellowfin select fish similar in size to those caught by sets on floating objects (about 5 to 15 quarters old, Figure 4.4, Fisheries 5 and 6), but these catches contain greater proportions of fish from the upper portion of this range. Purse-seine sets on yellowfin associated with dolphins in the northern and coastal regions select mainly fish 7 to 15 quarters old (Figure 4.4, Fisheries 7 and 8). The dolphin-associated fishery in the south selects mainly yellowfin 12 or more quarters old (Figure 4.4, Fishery 9). Longline fisheries for yellowfin also select mainly older individuals about 12 or more quarters old (Figure 4.4, Fisheries 11 and 12). Pole-and-line gear selects yellowfin about 4 to 8 quarters old (Figure 4.4, Fishery 10). The southern dolphin-associated fishery is highly selective for the oldest individuals. Because few fish survive to this age, these large selectivities are most likely an artifact of the model, and do not influence the results.

Discards resulting from sorting purse-seine catches of yellowfin tuna taken in association with floating objects are assumed to be composed only of fish recruited to the fishery for three quarters or less (age 2-4 quarters, Figure 4.4, Fisheries 13-16). (Additional information regarding the treatment of discards is given in Section 2.2.3.)

The ability of purse-seine vessels to capture yellowfin tuna in association with floating objects has generally declined over time (Figure 4.5a, Fisheries 1-4). These fisheries have also shown high temporal variation in catchability. Changes in fishing technology and behavior of the fishermen may have decreased the catchability of yellowfin during this time.

The ability of purse-seine vessels to capture yellowfin tuna in unassociated schools has also been highly variable over time (Figure 4.5a, Fisheries 5 and 6).

The ability of purse-seine vessels to capture yellowfin tuna in dolphin-associated sets has been less variable in the northern and coastal areas than in the other fisheries (Figure 4.5a, Fisheries 7 and 8). The catchability in the southern fishery (Fishery 9) is more variable. All three dolphin-associated fisheries have had increases in catchability during 2001-2003.

The ability of pole-and-line gear to capture yellowfin tuna has been highly variable over time (Figure 4.5a, Fishery 10). There are multiple periods of high and low catchability.

The ability of longline vessels to capture yellowfin tuna has been more variable in the northern fishery (Fishery 11), which catches fewer yellowfin, than in the southern fishery (Fishery 12).

The catchabilities of small yellowfin tuna by the discard fisheries (Fisheries 13-16) are shown in Figure

4.5b.

In previous assessments catchability for the southern longline fishery has shown a highly significant correlation with SST (Maunder and Watters 2002). Despite its significance, the correlation between SST and catchability in that fishery did not appear to be a good predictor of catchability (Maunder and Watters 2002), and therefore it is not included in this assessment.

4.2.2. Recruitment

In a previous assessment, the abundance of yellowfin tuna recruited to fisheries in the EPO appeared to be correlated to SST anomalies at the time that these fish were hatched (Maunder and Watters 2001). However, inclusion of a seasonal component in recruitment explained most of the variation that could be explained by SST (Maunder and Watters 2002). No environmental time series was investigated for this assessment.

Over the range of predicted biomasses shown in Figure 4.9, the abundance of yellowfin recruits appears to be related to the relative potential egg production at the time of spawning (Figure 4.6). The apparent relationship between biomass and recruitment is due to an apparent regime shift in productivity (Tomlinson 2001). The increased productivity caused an increase in recruitment, which, in turn, increased the biomass. Therefore, in the long term, high recruitment is related to high biomass and low recruitment to low biomass. The two regimes of recruitment can be seen as two clouds of points in Figure 4.6.

A sensitivity analysis was carried out, fixing the Beverton-Holt (1957) steepness parameter at 0.75 (Appendix A). This means that recruitment is 75% of the recruitment from an unexploited population when the population is reduced to 20% of its unexploited level. (The best estimate of steepness in a previous assessment was 0.66 (Maunder and Watters 2002).) Given the current information and the lack of contrast in the biomass since 1985, the hypothesis of two regimes in recruitment is as plausible as a relationship between population size and recruitment. The results when a stock-recruitment relationship is used are described in Section 4.5.

The estimated time series of yellowfin recruitment is shown in Figure 4.7, and the estimated annual total recruitment is presented in Table 4.1. The large recruitment that entered the discard fisheries in the third quarter of 1998 (6 months old) was estimated to be the strongest cohort of the 1975-2003 period. A sustained period of high recruitment was estimated for 1999-2000. In the 2004 assessment (Maunder and Harley 2005) a strong recruitment, similar in size to the large 1998 cohort, was estimated for the second quarter of 2003. However, there was substantial uncertainty associated with this estimate, and the current assessment estimates it to be close to the average recruitment level. A moderately large cohort has been estimated for the first quarter of 2004, but this estimate is similarly uncertain.

Another characteristic of the recruitment, which was also apparent in previous assessments, is the regime change in the recruitment levels, starting during the second quarter of 1983. The recruitment was, on average, consistently greater during 1983 and in subsequent years than it was before 1983. This change in recruitment levels produces a similar change in biomass (Figure 4.9a). The confidence intervals for recruitment are relatively narrow, indicating that the estimates are fairly precise, except for that of the most recent year (Figure 4.7). The standard deviation of the estimated recruitment deviations (on the logarithmic scale) is 0.53, which is close to the 0.6 assumed in the penalty applied to the recruitment deviates. The average coefficient of variation (CV) of the estimates is 0.16. The estimates of uncertainty are surprisingly small, considering the inability of the model to fit modes in the length-frequency data (Figure 4.8). These modes often appear, disappear, and then reappear.

The estimates of the most recent recruitments are highly uncertain, as can be seen from the large confidence intervals (Figure 4.7), due to the limited time period of the data available for these cohorts. In addition, the floating-object fisheries, which catch the youngest fish, account for only a small portion of the total catch of yellowfin.

4.2.3. Biomass

Biomass is defined as the total weight of yellowfin tuna that are 1.5 or more years old. The trends in the biomass of yellowfin in the EPO are shown in Figure 4.9a, and estimates of the biomass at the beginning of each year in Table 4.1. Between 1975 and 1983 the biomass of yellowfin declined to about 190,000 metric tons (t); it then increased rapidly during 1983-1986, and reached about 470,000 t in 1986. Since then it has been relatively constant at about 350,000-500,000 t, except for a peak in 2001. The confidence intervals for the biomass estimates are relatively narrow, indicating that the biomass is well estimated. The average CV of the estimates of the biomass is 0.05.

The spawning biomass is defined as the relative total egg production of all the fish in the population. The estimated trend in spawning biomass is shown in Figure 4.9b, and estimates of the spawning biomass at the beginning of each year in Table 4.1. The spawning biomass has generally followed a trend similar to that for biomass, described in the previous paragraph. The confidence intervals on the spawning biomass estimates indicate that it is also well estimated. The average CV of the estimates of the spawning biomass is 0.05.

It appears that trends in the biomass of yellowfin tuna can be explained by the trends in fishing mortality and recruitment. Simulation analysis is used to illustrate the influence of fishing and recruitment on the biomass trends (Maunder and Watters, 2001). The current method differs from that of Maunder and Watters (2001) in that the unfished biomass trajectory starts from a virgin population in 1975, instead of the estimated fished state in 1975. The simulated biomass trajectories with and without fishing are shown in Figure 4.10a. The large difference in the two trajectories indicates that fishing has a major impact on the biomass of yellowfin in the EPO. The large increase in biomass during 1983-1984 was caused initially by an increase in average size (Anonymous 1999), followed by an increase in average recruitment (Figure 4.7), but increased fishing pressure prevented the biomass from increasing further during the 1986-1990 period.

The impact of each major type of fishery on the yellowfin tuna stock is shown in Figures 4.10b and 4.10c. The estimates of biomass in the absence of fishing were computed as above, and then the biomass trajectory was estimated by setting the effort for each fisheries group, in turn, to zero. The biomass impact for each fishery group at each time step is derived as this biomass trajectory minus the biomass trajectory with all fisheries active. When the impacts of individual fisheries calculated by this method are summed, they are greater than the combined impact calculated when all fisheries are active. Therefore, the impacts are scaled so that the sum of the individual impacts equals the impact estimated when all fisheries are active. These impacts are plotted as a proportion of unfished biomass (Figure 4.10b) and in absolute biomass (Figure 4.10c).

4.2.4. Average weights of fish in the catch

The overall average weights of the yellowfin tuna caught in the EPO predicted by the analysis have been consistently around 10 to 20 kg for most of the 1975-2003 period (Figure 5.2), but have differed considerably among fisheries (Figures 4.11). The average weight was greatest during the 1985-1992 period (Figure 5.2), when the effort for the floating-object and unassociated fisheries was less (Figure 2.3). The average weight was also greater in 1975-1977 and in 2001-2003. The average weight of yellowfin caught by the different gears varies widely, but remains fairly consistent over time within each fishery (Figure 4.11). The lowest average weights (about 1 kg) are produced by the discard fisheries, followed by the pole-and-line fishery (about 4-5 kg), the floating-object fisheries (about 5-10 kg for Fishery 3, 10 kg for Fisheries 2 and 4, and 10-15 kg for Fishery 1), the unassociated fisheries (about 15 kg), the northern and coastal dolphin-associated fisheries (about 20-30 kg), and the southern dolphin-associated fishery and the longline fisheries (each about 40-50 kg).

4.3. Comparisons to external data sources

No external data were used as a comparison in the current assessment.

4.4. Diagnostics

We present diagnostic in three sections; (1) residual plots, (2) parameter correlations, and (3) retrospective analysis.

4.4.1. Residual plots

Residual plots show the differences between the observations and the model predictions. The residuals should show characteristics similar to the assumptions used in the model. For example, if the likelihood function is based on a normal distribution and assumes a standard deviation of 0.2, the residuals should be normally distributed with a standard deviation of about 0.2.

The estimated annual effort deviations, which are one type of residual in the assessment and represent temporal changes in catchability, are shown plotted against time in Figure 4.5a. These residuals are assumed to be normally distributed (the residual is exponentiated before multiplying by the effort so the distribution is actually lognormal) with a mean of zero and a given standard deviation. A trend in the residuals indicates that the assumption that CPUE is proportional to abundance is violated. The assessment assumes that the longline fisheries (Fisheries 11 and 12) provide the most reasonable information about abundance (standard deviation (sd) = 0.2) while the dolphin-associated and unassociated fisheries have less information (sd = 0.3), the floating-object and the pole-and-line fisheries have the least information (sd = 0.4), and the discard fisheries have no information (sd = 2). Therefore, a trend is less likely in the longline fisheries (Fisheries 11 and 12) than in the other fisheries. The trends in effort deviations are estimates of the trends in catchability (see Section 4.2.1). Figure 4.5a shows no overall trend in the southern longline fishery effort deviations, but there are some consecutive residuals that are all above or all below the average. The standard deviation of the residuals is about 80% greater than the 0.2 assumed for this fishery. For the other fisheries, except for the discard fisheries, the standard deviations of the residuals are greater than those assumed. These results indicate that the assessment gives more weight to the CPUE information than it should. The effort residuals for the floating-object fisheries have a declining trend over time, while the effort residuals for the dolphin-associated and unassociated fisheries have slight increasing trends over time. These trends may be related to true trends in catchability.

The observed proportion of fish caught in a length class is assumed to be normally distributed around the predicted proportion, with the standard deviation equal to the binomial variance, based on the observed proportions, divided by the square of the sample size (Maunder and Watters 2003a). The length-frequency residuals appear to be less than the assumed standard deviation (Figures C.1-C.3) (*i.e.* the assumed sample size is too small; see Section 4.5 for a sensitivity analysis for the length-frequency sample size). They have a negative bias (Figure C.1), and are more variable for some lengths than for others (Figure C.1), but tend to be consistent over time (Figure C.2). The negative bias is due to the large number of zero observations. The zero observation causes a negative residual, and also causes a small standard deviation, which inflates the normalized residual.

4.4.2. Parameter correlation

Often quantities, such as recent estimates of recruitment deviates and fishing mortality, can be highly correlated. This information indicates a flat solution surface, which implies that alternative states of nature had similar likelihoods.

There is negative correlation between the current estimated effort deviates for each fishery and estimated recruitment deviates lagged to represent cohorts entering each fishery. The negative correlation is most obvious for the discard fisheries. Earlier effort deviates are positively correlated with these recruitment deviates.

Current spawning biomass is positively correlated with recruitment deviates lagged to represent cohorts entering the spawning biomass population. This correlation is greater than for earlier spawning biomass estimates. Similar correlations are seen for recruitment and spawning biomass.

4.4.3. Retrospective analysis

Retrospective analysis is a useful method to determine how consistent a stock assessment method is from one year to the next. Inconsistencies can often highlight inadequacies in the stock assessment method. The estimated biomass and SBR (defined in Section 3.1.2) from the previous assessment and the current assessment are shown in Figure 4.12. However, the model assumptions and data differ between these assessments, so differences would be expected (see Section 4.6). Retrospective analyses are usually carried out by repeatedly eliminating one year of data from the analysis while using the same stock assessment method and assumptions. This allows the analyst to determine the change in estimated quantities as more data are included in the model. Estimates for the most recent years are often uncertain and biased. Retrospective analysis and the assumption that more data improves the estimates can be used to determine if there are consistent biases in the estimates. Retrospective analysis carried out by Maunder and Harley (2004) suggested that the peak in biomass in 2001 had been consistently underestimated, but this assessment estimates a slightly lower peak in 2001.

4.5. Sensitivity to assumptions

A sensitivity analyses was carried out to investigate the incorporation of a Beverton-Holt (1957) stock-recruitment relationship (Appendix B). The base case analysis assumed no stock-recruitment relationship, and an alternative analysis was carried out with the steepness of the Beverton-Holt stock-recruitment relationship fixed at 0.75. This implies that when the population is reduced to 20% of its unexploited level, the expected recruitment is 75% of the recruitment from an unexploited population. As in a previous assessment, (Maunder and Watters 2002) the analysis with a stock-recruitment relationship fits the data better than the analysis without the stock-recruitment relationship. However, the regime shift in recruitment could also explain the result, since the period of high recruitment is associated with high spawning biomass, and vice versa. When a Beverton-Holt stock recruitment relationship (steepness = 0.75) is included, the estimated biomass (Figure A.1) and recruitment (Figure A.2) are almost identical to those of the base case assessment.

There have been several other sensitivity analyses carried out in previous yellowfin tuna assessments. Increasing the sample size for the length frequencies based on iterative reweighting to determine the effective sample size gave similar results, but narrower confidence intervals (Maunder and Harley 2004). The use of cannery and landings data to determine the surface fishery catch and different size of the selectivity smoothness penalties (if set at realistic values) gave similar results (Maunder and Harley 2004).

4.6. Comparison to previous assessments

The estimated biomass and SBR trajectories are similar to those from the previous assessments presented by Maunder and Watters (2001, 2002), Maunder (2002a), and Maunder and Harley (2004, 2005) (Figure 4.12). These results are also similar to those obtained using cohort analysis (Maunder 2002b). This indicates that estimates of absolute biomass are robust to the assumptions that have been changed as the assessment procedure has been updated. The recent increases and decreases in biomass are similar to those indicated by the most recent previous assessment.

4.7. Summary of the results from the assessment model

In general, the recruitment of yellowfin tuna to the fisheries in the EPO is variable, with a seasonal component. This analysis and previous analyses have indicated that the yellowfin population has experienced two different recruitment regimes (1975-1983 and 1984-2001) and that the population has been in the high-recruitment regime for approximately the last 19 years. The two recruitment regimes correspond to two regimes in biomass, the higher-recruitment regime producing greater biomass levels. A stock-recruitment relationship is also supported by the data from these two regimes, but the evidence is weak, and is probably an artifact of the apparent regime shift. Biomass increased during 1999 and 2000, but is estimated to have decreased during 2001-2004.

The average weights of yellowfin tuna taken from the fishery have been fairly consistent over time (Figure 5.2, lower panel), but vary substantially among the different fisheries (Figure 4.11). In general, the floating-object (Fisheries 1-4), unassociated (Fisheries 5 and 6), and pole-and-line (Fishery 10) fisheries capture younger, smaller yellowfin than do the dolphin-associated (Fisheries 7-9) and longline (Fisheries 11 and 12) fisheries. The longline fisheries and the dolphin-associated fishery in the southern region (Fishery 9) capture older, larger yellowfin than do the northern region (Fishery 7) and coastal (Fishery 8) dolphin-associated fisheries.

5. STATUS OF THE STOCK

The status of the stock of yellowfin tuna in the EPO is assessed by considering calculations based on the spawning biomass, yield per recruit, and AMSY.

Precautionary reference points, as described in the FAO Code of Conduct for Responsible Fisheries and the United Nations Fish Stocks Agreement, are being widely developed as guides for fisheries management. The IATTC has not adopted any target or limit reference points for the stocks it manages, but some possible reference points are described in the following five subsections. Possible candidates for reference points are:

1. S_{AMSY}, the spawning biomass corresponding to the AMSY, as a target reference point;
2. F_{AMSY}, the fishing mortality corresponding to the AMSY, as a limit reference point;
3. S_{min}, the minimum spawning biomass seen in the model period, as a limit reference point.

Maintaining tuna stocks at levels corresponding to the AMSY is the management objective specified by the IATTC Convention. The S_{min} reference point is based on the observation that the population has recovered from this population size in the past (*e.g.* the levels estimated in 1983). A technical meeting on reference points was held in La Jolla, California, USA, in October 2003. The outcome from this meeting was (1) a set of general recommendations on the use of reference points and research and (2) specific recommendations for the IATTC stock assessments. Several of the recommendations have been included in this assessment. Development of reference points that are consistent with the precautionary approach to fisheries management will continue.

5.1. Assessment of stock status based on spawning biomass

The spawning biomass ratio, SBR, defined in Section 3.1.2, is useful for assessing the status of a stock. The equation defining the SBR is

$$\mathrm{SBR}_t = \frac{S_t}{S_{F=0}}$$

where S_t is the spawning biomass at any time (t) during a period of exploitation, and $S_{F=0}$ is the spawning biomass that would be present if there were no fishing for a long period (*i.e.* the equilibrium spawning biomass if $F = 0$). The SBR has a lower bound of 0. If the SBR is 0, or slightly greater than that, the population has been severely depleted and is probably overexploited. If the SBR is 1, or slightly less than that, the fishery has probably not reduced the spawning stock. If the SBR is greater than 1, it is possible that the stock has entered a regime of increased production.

The SBR has been used to define reference points in many fisheries. Various studies (*e.g.* Clark 1991, Francis 1993, Thompson 1993, Mace 1994) suggest that some fish populations can produce the AMSY when the SBR is in the range of about 0.3 to 0.5, and that some fish populations are not able to produce the AMSY if the spawning biomass during a period of exploitation is less than about 0.2. Unfortunately, the types of population dynamics that characterize tuna populations have generally not been considered in these studies, and their conclusions are sensitive to assumptions about the relationship between adult biomass and recruitment, natural mortality, and growth rates. In the absence of simulation studies that are designed specifically to determine appropriate SBR-based reference points for tunas, estimates of SBR_t can be compared to an estimate of SBR for a population that is producing the AMSY ($SBR_{AMSY} = S_{AMSY}/S_{F=0}$).

Estimates of quarterly SBR_t for yellowfin tuna in the EPO have been computed for every quarter represented in the stock assessment model (the first quarter of 1975 to the first quarter of 2005). Estimates of the spawning biomass during the period of harvest (S_t) are discussed in Section 4.2.3 and presented in Figure 4.9b. The equilibrium spawning biomass after a long period with no harvest ($S_{F=0}$) was estimated by assuming that recruitment occurs at an average level expected from an unexploited population. SBR_{AMSY} is estimated to be about 0.38.

At the beginning of 2005 the spawning biomass of yellowfin tuna in the EPO had increased from early 2004, which was its lowest point since at least 1999. The estimate of SBR at this time was about 0.38, with lower and upper 95% confidence limits of 0.29 and 0.47, respectively (Figure 5.1). It is important to note that the estimate of the upper confidence limit is greater than the estimate of SBR_{AMSY} (0.44), indicating that, although the spawning biomass of yellowfin in the EPO at the beginning of 2005 was estimated to be below the level corresponding to the AMSY level, it may have been above that level.

A time series of SBR estimates for yellowfin tuna in the EPO is shown in Figure 5.1. The historical trends in SBR are similar to those described by Maunder and Watters (2001, 2002), Maunder (2002a), and Maunder and Harley (2004, 2005; Figure 4.12b). However, the SBR and SBR_{AMSY} have increased compared to the estimates of Maunder and Harley (2004, 2005). The estimates of SBR have increased because of differences in the estimates of growth and changes in fishing mortality, and those of SBR_{AMSY} have increased because of changes in fishing mortality.

In general, the SBR estimates for yellowfin tuna in the EPO are reasonably precise; the average CV of these estimates is about 0.07. The relatively narrow confidence intervals around the SBR estimates suggest that for most quarters during 1985-2001 the spawning biomass of yellowfin in the EPO was close to or slightly below the level currently corresponding to the AMSY (see Section 5.3). This level is shown as the dashed horizontal line drawn at 0.44 in Figure 5.1. For most of the early period (1975-1984), however, the spawning biomass was estimated to be below the AMSY level.

5.2. Assessment of stock status based on yield per recruit

Yield-per-recruit calculations, which are also useful for assessing the status of a stock, are described by Maunder and Watters (2001). The critical weight for yellowfin tuna in the EPO has been estimated to be about 35.2 kg (Figure 5.2). This value is greater than the value of 32 kg reported by Anonymous (2000). The difference is due to the time step of the calculation (quarterly versus monthly) and differences in weight at age. This value is less than a previous estimate of 49 kg (Maunder 2002a) because of differences in estimates of the weight at age.

The average weight of yellowfin tuna in the combined catches of the fisheries operating in the EPO was only about 9 kg at the end of 2004 (Figure 5.2), which is considerably less than the critical weight. The average weight of yellowfin in the combined catches has, in fact, been substantially less than the critical weight since 1975 (Figure 5.2).

The various fisheries that catch yellowfin tuna in the EPO take fish of different average weights (Section 4.2.4). The longline fisheries (Fisheries 11 and 12) and the dolphin-associated fishery in the southern region (Fishery 9) catch yellowfin with average weights greater than the critical weight (Figure 4.11), and all the remaining fisheries catch yellowfin with average weights less than the critical weight. Of the fisheries that catch the majority of yellowfin (unassociated and dolphin-associated fisheries, Fisheries 5-8), the dolphin-associated fisheries perform better under the critical-weight criterion.

5.3. Assessment of stock status based on AMSY

One definition of AMSY is the maximum long-term yield that can be achieved under average conditions, using the current, age-specific selectivity pattern of all fisheries combined. AMSY calculations are described by Maunder and Watters (2001). The calculations differ from those of Maunder and Watters (2001) in that the present calculations include the Beverton-Holt (1957) stock-recruitment relationship when applicable.

At the start of 2004, the biomass of yellowfin tuna in the EPO appears to have been slightly below the level corresponding to the AMSY, and the recent catches have been very close to the AMSY level (Table 5.1).

If the fishing mortality is proportional to the fishing effort, and the current patterns of age-specific selectivity (Figure 4.4) are maintained, the current (average of 2002-2003) level of fishing effort is greater than that estimated to produce the AMSY. The effort at AMSY is 83% of the current level of effort. It is important to note, however, that the curve relating the average sustainable yield to the long-term fishing mortality (Figure 5.3, upper panel) is very flat around the AMSY level. Therefore, changes in the long-term levels of effort will only marginally change the catches, while considerably changing the biomass. The spawning stock biomass changes substantially with changes in the long-term fishing mortality (Figure 5.3, lower panel). Decreasing the effort would increase CPUE and thus might also reduce the cost of fishing. Reduction below AMSY would provide only a marginal decrease in the long-term average yield, with the benefit of a relatively large increase in the spawning biomass.

The apparent regime shift in productivity that began in 1984 may require a different approach to estimating the AMSY, as different regimes will give rise to different values for the AMSY (Maunder and Watters 2001).

The estimation of the AMSY, and its associated quantities, is sensitive to the age-specific pattern of selectivity that is used in the calculations. To illustrate how AMSY might change if the effort is reallocated among the various fisheries (other than the discard fisheries) that catch yellowfin tuna in the EPO, the previously-described calculations were repeated, using the age-specific selectivity pattern estimated for groups of fisheries. If the management objective is to maximize the AMSY, the longline fisheries will perform the best, followed by the dolphin-associated fisheries, and then the unassociated fisheries. The fisheries that catch yellowfin by making purse-seine sets on floating objects would perform the worst (Table 5.2a). If an additional management objective is to maximize the S_{AMSY}, the order is the same. It is not known, however, whether the fisheries that would produce greater AMSYs would be efficient enough to catch the full AMSYs predicted. However, it is estimated that the effort for dolphin-associated fisheries would have to be increased by only 50%.

AMSY and S_{AMSY} have been very stable during the modeled period (Figure 4.12c). This suggests that the overall pattern of selectivity has not varied a great deal through time. The overall level of fishing effort, however, has varied with respect to the AMSY multiplier (Fscale).

5.4. Lifetime reproductive potential

One common management objective is the conservation of spawning biomass. Conservation of spawning biomass allows an adequate supply of eggs, so that future recruitment is not adversely affected. If reduction in catch is required to protect the spawning biomass, it is advantageous to know at which ages to avoid catching fish to maximize the benefit to the spawning biomass. This can be achieved by estimating the lifetime reproductive potential for each age class. If a fish of a given age is not caught, it has an expected (average over many fish of the same age) lifetime reproductive potential (*i.e.* the expected number of eggs that fish would produce over its remaining lifetime). This value is a function of the fecundity of the fish at the different stages of its remaining life and the natural and fishing mortality. The higher the mortality, the less likely the individual is to survive and continue reproducing.

Younger individuals may appear to have a longer period in which to reproduce, and therefore a higher lifetime reproductive potential. However, because the rate of natural mortality of younger individuals is greater, their expected lifespan is shorter. An older individual, which has already survived through the ages for which mortality is high, has a greater expected lifespan, and thus may have a greater lifetime reproductive potential. Mortality rates may be greater at the greatest ages and reduce the expected lifespan of these ages, thus reducing lifetime reproductive potential. Therefore, the maximum lifetime reproductive potential may occur at an intermediate age.

The lifetime reproductive potential for each quarterly age class was estimated, using the average fishing mortality at age for 2002 and 2003. Because current fishing mortality is included, the calculations are based on marginal changes (*i.e.* the marginal change in egg production if one individual or one unit of weight is removed from the population), and any large changes in catch would produce somewhat different results because of changes in the future fishing mortality rates.

The calculations based on avoiding capturing a single individual indicated that the greatest benefit to the spawning biomass would be achieved by avoiding an individual at age 12 quarters (Figure 5.4, upper panel). This suggests that restricting the catch from fisheries that capture intermediate-aged yellowfin (ages 10-15 quarters) would provide the greatest benefit to the spawning biomass. However, the costs of forgoing catch are better compared in terms of weight rather than numbers, and an individual of age 11 quarters is much heavier than a recent recruit aged 3 quarters. The calculations based on avoiding capturing a single unit of weight indicated that the greatest benefit to the spawning biomass would be achieved by avoiding catching fish aged 3 quarters (Figure 5.4, lower panel). This suggests that restricting catch from fisheries that capture young yellowfin would provide the greatest benefit to the spawning biomass. The results also suggest that reducing catch by 1 ton of young yellowfin would protect approximately the same amount of spawning biomass as reducing the catch of middle-aged yellowfin by about 2.6 tons.

5.5. MSY_{ref} and SBR_{ref}

Section 5.3 discusses how AMSY and the SBR at AMSY are dependent on the selectivity of the different fisheries and the effort distribution among these fisheries. AMSY can be increased or decreased by applying more or less effort to the various fisheries. If the selectivity of the fisheries could be modified at will, there is an optimum yield that can be obtained (Global MSY, Beddington and Taylor 1973; Getz 1980; Reed 1980). Maunder (2002b) showed that the optimal yield can be approximated (usually exactly) by applying a full or partial harvest at a single age. He termed this harvest MSY_{ref}, and suggested that two-thirds of MSY_{ref} might be an appropriate limit reference point (*i.e.* effort allocation and selectivity patterns should produce AMSY that is at or above $^2/_3 MSY_{ref}$). The two-thirds suggestion was based on analyses in the literature indicating that the best practical selectivity patterns could produce 70-80% of MSY_{ref}, that the yellowfin assessment at the time (Maunder and Watters 2002a) estimated that the dolphin fisheries produce about this MSY, and that two-thirds is a convenient fraction.

MSY_{ref} is associated with a SBR (SBR_{ref}) that may also be an appropriate reference point. SBR_{ref} does not depend on the selectivity of the gear or the effort allocation among gears. Therefore, SBR_{ref} may be more appropriate than SBR_{AMSY} for stocks with multiple fisheries, and should be more precautionary because SBR_{ref} is usually greater than SBR_{AMSY}. However, when recruitment is assumed to be constant (*i.e.* no stock-recruitment relationship), SBR_{ref} may still be dangerous to the spawning stock because it is possible that MSY_{ref} occurs before the individuals become fully mature. SBR_{ref} may be a more appropriate reference point than the generally-suggested $SBR_{x\%}$ (*e.g.* $SBR_{30\%}$ to $SBR_{50\%}$ see section 5.1) because SBR_{ref} is estimated using information on the biology of the stock. However, SBR_{ref} may be sensitive to uncertainty in biological parameters, such as the steepness of the stock-recruitment relationship, natural mortality, maturity, fecundity, and growth.

MSY_{ref} is estimated to be 470,541 t (Figure 5.5, upper panel) and SBR_{ref} is estimated to be 0.44 (Figure 5.5, lower panel). If the total effort in the fishery is scaled, without changing the allocation among gears, so that the SBR at equilibrium is equal to SBR_{ref}, the equilibrium yield is estimated to be almost identical to AMSY based on the current effort allocation (Figure 5.3). This indicates that the SBR_{ref} reference point can be maintained without any substantial loss to the fishery. However, AMSY at the current effort allocation is only 63% of MSY_{ref}. More research is needed to determine if reference points based on MSY_{ref} and SBR_{ref} are useful.

5.6. Sensitivity analysis

When the Beverton-Holt (1957) stock-recruitment relationship is included in the analysis with a steepness of 0.75, the SBR is reduced and the SBR level corresponding to the AMSY is increased (Figure A.3). The SBR is estimated to be less than that at AMSY for most of the model period, except for the period 2000-2002. The current effort level is estimated to be above the AMSY level (Figure A.4, Table 5.1), and current catch slightly below AMSY (Table 5.1). In contrast to the analysis without a stock-recruitment relationship, the addition of this relationship implies that catch may be moderately reduced if effort is increased beyond the level required for AMSY. The analysis without a stock-recruitment relationship has a relative yield curve equal to the relative yield-per-recruit curve because recruitment is constant. The yield curve bends over slightly more rapidly when the stock-recruitment relationship is included (Figure A.4) than when it is not included (Figure 5.3). The equilibrium catch under the current effort levels is estimated to be 94% of AMSY, indicating that reducing effort would not greatly increase the catch.

5.7. Summary of stock status

Historically, the SBR of yellowfin tuna in the EPO was below the level corresponding to the AMSY during the lower productivity regime of 1975-1983 (Section 4.2.1), but above that level for most of the last 19 years. The increase in the SBR is attributed to the regime change. The two different productivity regimes may support two different AMSY levels and associated SBR levels. The effort levels are estimated to be greater than those that would support the AMSY (based on the current distribution of effort among the different fisheries). However, due to the large number of recruits that entered the fishery during 1998-2000, the catch levels are close to the corresponding values at AMSY. Because of the flat yield curve (Figure 5.3, upper panel), the average equilibrium yield at current effort levels is only slightly less than AMSY.

If a stock-recruitment relationship is assumed, the outlook is more pessimistic, and current biomass is estimated to be below the level corresponding to the AMSY for most of the model period, except for a period from the start of 2000 to the end of 2002.

The current average weight of yellowfin in the catch is much less than the critical weight, and, therefore, from a yield-per-recruit standpoint, yellowfin in the EPO are probably overfished. The AMSY calculations indicate that, theoretically, at least, catches could be greatly increased if the fishing effort were directed toward longlining and purse-seine sets on yellowfin associated with dolphins. This would also increase the SBR levels.

6. SIMULATED EFFECTS OF FUTURE FISHING OPERATIONS

A simulation study was conducted to gain further understanding as to how, in the future, hypothetical changes in the amount of fishing effort exerted by the surface fleet might simultaneously affect the stock of yellowfin tuna in the EPO and the catches of yellowfin by the various fisheries. Several scenarios were constructed to define how the various fisheries that take yellowfin in the EPO would operate in the future, and also to define the future dynamics of the yellowfin stock. The assumptions that underlie these scenarios are outlined in Sections 6.1 and 6.2.

A new method based on the normal approximation to the likelihood profile has been applied. The previously-used method (Maunder and Watters 2001) considered uncertainty about future recruitment, but not parameter uncertainty. A substantial part of the total uncertainty in predicting future events is caused by uncertainty in the estimates of the model parameters and current status, so this should be considered in any forward projections. Unfortunately, the appropriate methods are often not applicable to models as large and computationally-intense as the yellowfin stock assessment model. Therefore, we have used a normal approximation to the likelihood profile that allows for the inclusion of both parameter uncertainty and uncertainty about future recruitment. This method is implemented by extending the assessment model an additional 5 years with effort data equal to that for 2004, by quarter, scaled by the average catchability for 2002 and 2003. No catch or length-frequency data are included for these years. The recruitments for the five years are estimated as in the assessment model with a lognormal penalty with a standard deviation of 0.6. Normal approximations to the likelihood profile are generated for SBR, surface catch, and longline catch.

6.1. Assumptions about fishing operations

6.1.1. Fishing effort

Several future projection studies were carried out to investigate the influence of different levels of fishing effort on the stock biomass and catch. The quarterly catchability was assumed to be equal to the average catchability in 2002 and 2003. The average was weighted by the effort to ensure that extreme values of catchability for years in which effort was restricted due to management did not overly influence the catchability used in the future projections.

The scenarios investigated were:

1. Quarterly effort for each year in the future equal to the quarterly effort in 2004;
2. Quarterly effort for each year in the future and for 2004 was set equal to the effort in 2004 adjusted for the effect of the conservation measures. The effort for the purse-seine fishery in the fourth quarter was increased by 86%, and the southern longline fishery effort was increased by 39%.

6.2. Simulation results

The simulations were used to predict future levels of the SBR, total biomass, the total catch taken by the primary surface fisheries that would presumably continue to operate in the EPO (Fisheries 1-10), and the total catch taken by the longline fleet (Fisheries 11 and 12). There is probably more uncertainty in the future levels of these outcome variables than suggested by the results presented in Figures 6.1-6.5. The amount of uncertainty is probably underestimated because the simulations were conducted under the assumption that the stock assessment model accurately describe the dynamics of the system, and because no account is taken for variation in catchability.

6.2.1. Current effort levels

Under 2004 levels of effort the biomass is predicted to not decline significantly over the next five years (Figure 6.1). SBR is predicted to remain below the level corresponding to the AMSY in the future (Figure 6.2). Due to the wide confidence intervals, and despite the fact that the best prediction of SBR is below the level corresponding to AMSY, there is a moderate probability that the SBR is above this level. Both surface and longline catches are predicted to be similar to 2004 levels for the projected period (Figure 6.3).

6.2.2. No management restrictions

The 2004 Resolution on a Multi-Annual Program on the Conservation of Tuna in the Eastern Pacific Ocean for 2004, 2005, and 2006 (Resolution C-04-09) called for restrictions on purse-seine effort and longline catches for 2004: a 6-week closure during the third or fourth quarter of the year for purse-seine fisheries, and longline catches not to exceed 2001 levels. To assess the utility of these management actions, we projected the population forward five years, assuming that these conservation measures had not been implemented.

Comparison of the SBR predicted with and without the restrictions from the resolution show some difference (Figure 6.5). Without the restrictions, SBR would decline to slightly lower levels (0.32).

7. FUTURE DIRECTIONS

7.1. Collection of new and updated information

The IATTC staff intends to continue its collection of catch, effort, and size-composition data for the fisheries that catch yellowfin tuna in the EPO. New data collected during 2005 and updated data for previous years will be incorporated into the next stock assessment.

7.2. Refinements to the assessment model and methods

The IATTC staff intends to continue to develop the A-SCALA method and further refine the stock assessment of yellowfin tuna in the EPO. In particular, the staff plans to extend the model so that information obtained from the tagging studies can be incorporated into the A-SCALA analyses. The staff also intends to reinvestigate indices of yellowfin abundance from the CPUEs of purse seiners fishing in the EPO. If this work is successful, the results will, as far as possible, be integrated into future stock assessments.

Development of reference points that are consistent with the precautionary approach to fisheries management will continue.

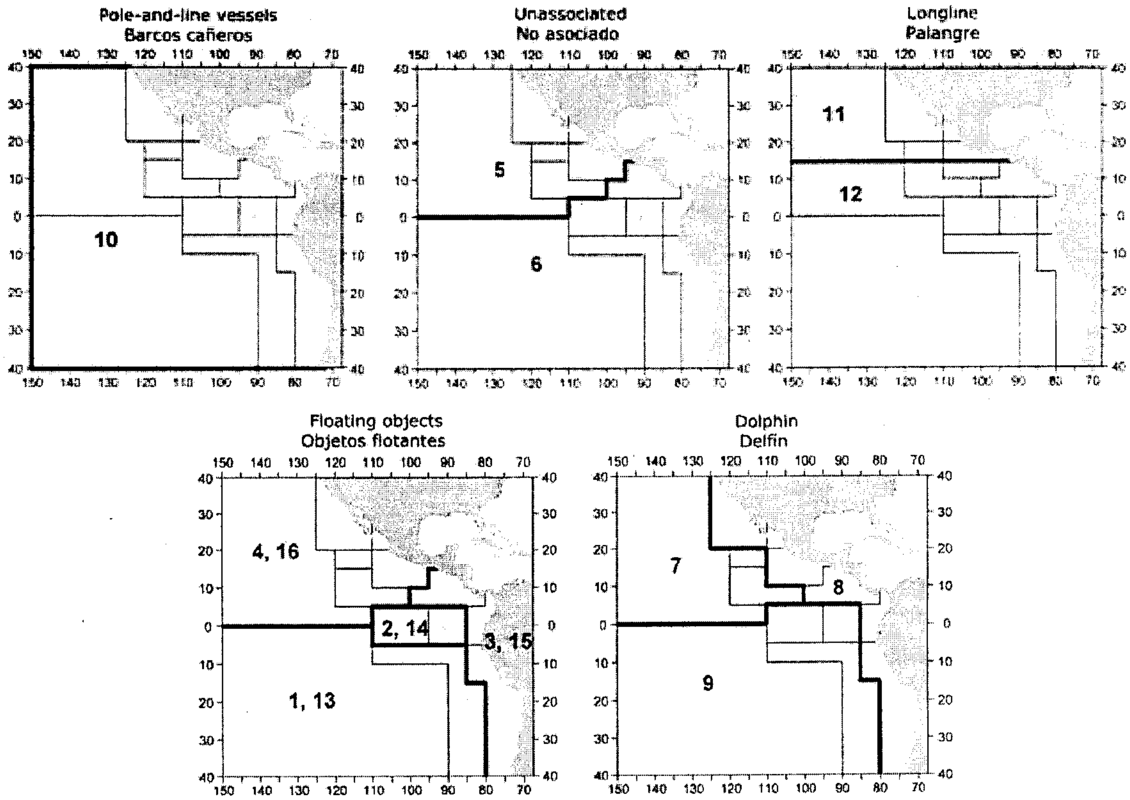


FIGURE 2.1. Spatial extents of the fisheries defined by the IATTC staff for the stock assessment of yellowfin tuna in the EPO. The thin lines indicate the boundaries of 13 length-frequency sampling areas, the bold lines the boundaries of each fishery defined for the stock assessment, and the bold numbers the fisheries to which the latter boundaries apply. The fisheries are described in Table 2.1.

FIGURA 2.1. Extensión espacial de las pesquerías definidas por el personal de la CIAT para la evaluación del atún aleta amarilla en el OPO. Las líneas delgadas indican los límites de 13 zonas de muestreo de frecuencia de tallas, las líneas gruesas los límites de cada pesquería definida para la evaluación del stock, y los números en negritas las pesquerías correspondientes a estos últimos límites. En la Tabla 2.1 se describen las pesquerías.

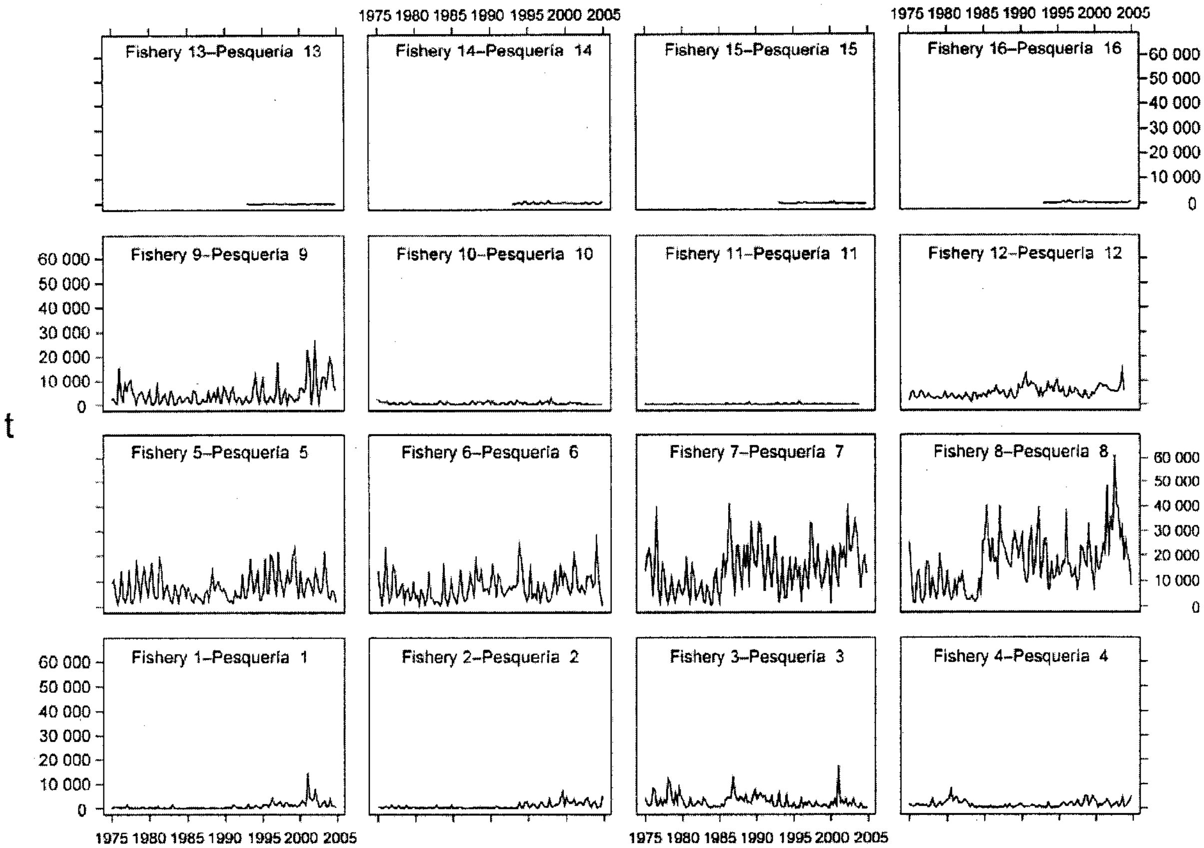


FIGURE 2.2. Catches by the fisheries defined for the stock assessment of yellowfin tuna in the EPO (Table 2.1). Since the data were analyzed on a quarterly basis, there are four observations of catch for each year. Although all the catches are displayed as weights, the stock assessment model uses catches in numbers of fish for Fisheries 11 and 12. Catches in weight for Fisheries 11 and 12 are estimated by multiplying the catches in numbers of fish by estimates of the average weights. t = metric tons.

FIGURA 2.2. Capturas de las pesquerías definidas para la evaluación del stock de atún aleta amarilla en el OPO (Tabla 2.1). Ya que se analizaron los datos por trimestre, hay cuatro observaciones de captura para cada año. Se expresan todas las capturas en peso, pero el modelo de evaluación del stock usa captura en número de peces para las Pesquerías 11 y 12. Se estiman las capturas de las Pesquerías 11 y 12 en peso multiplicando las capturas en número de peces por estimaciones del peso promedio. t = toneladas métricas.

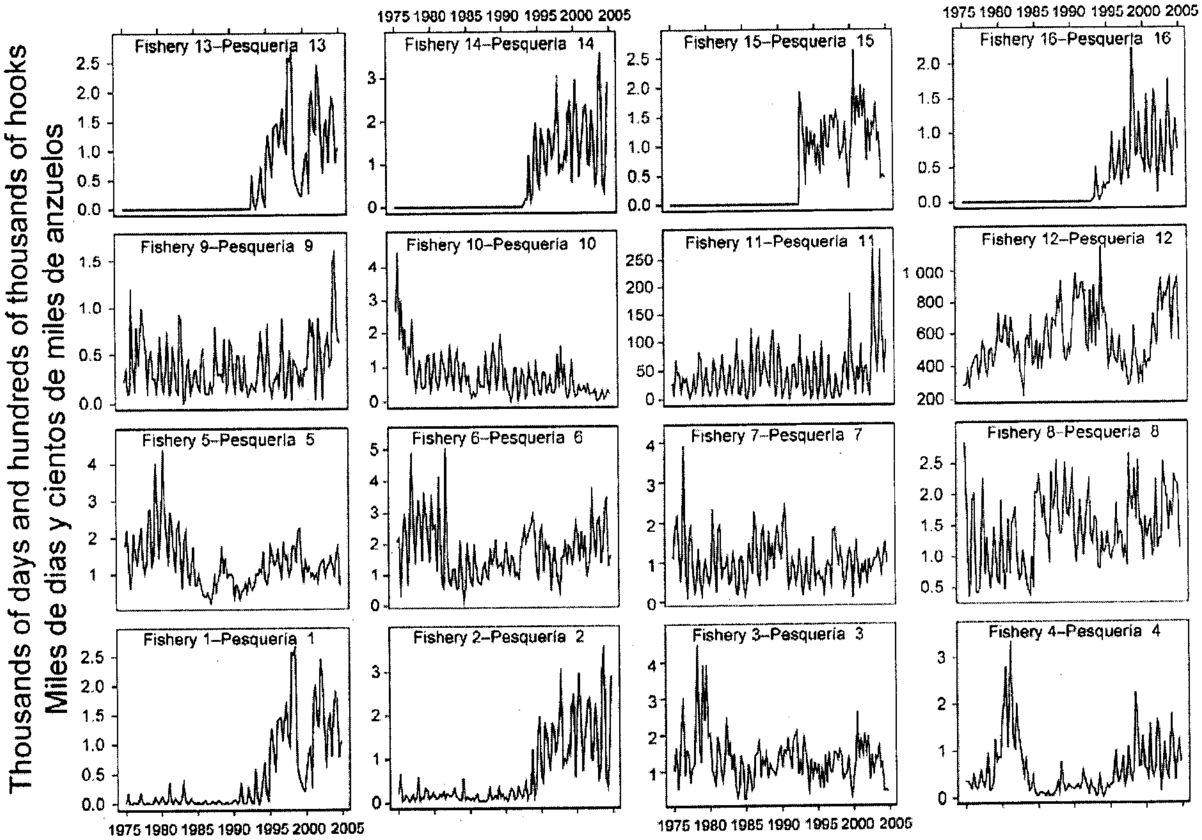


FIGURE 2.3. Fishing effort exerted by the fisheries defined for the stock assessment of yellowfin tuna in the EPO (Table 2.1). Since the data were summarized on a quarterly basis, there are four observations of effort for each year. The effort for Fisheries 1-10 and 13-16 is in days fished, and that for Fisheries 11 and 12 is in standardized numbers of hooks. Note that the vertical scales of the panels are different.

FIGURA 2.3. Esfuerzo de pesca ejercido por las pesquerías definidas para la evaluación del stock de atún aleta amarilla en el OPO (Tabla 2.1). Ya que se analizaron los datos por trimestre, hay cuatro observaciones de esfuerzo para cada año. Se expresa el esfuerzo de las Pesquerías 1-10 y 13-16 en días de pesca, y el de las Pesquerías 11 y 12 en número estandardizado de anzuelos. Nótese que las escalas verticales de los recuadros son diferentes.

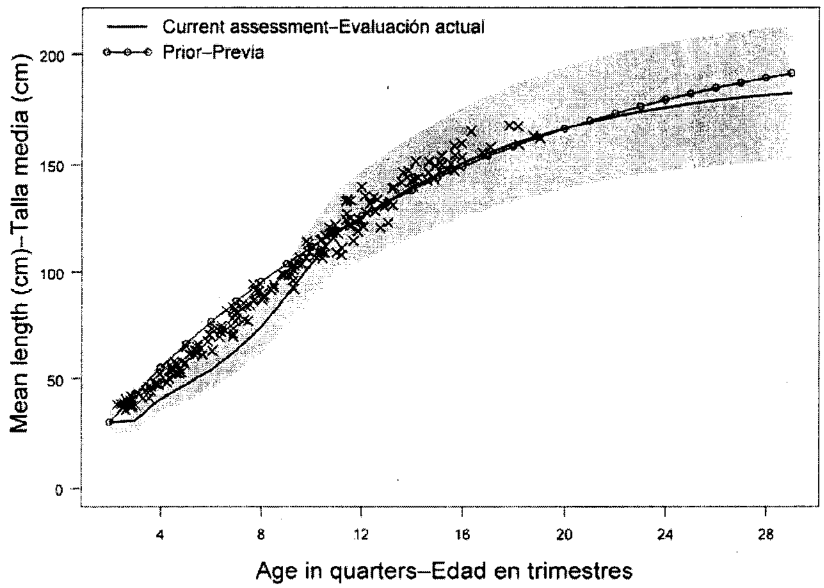


FIGURE 3.1. Growth curve estimated for the assessment of yellowfin tuna in the EPO (solid line). The connected points represent the mean length-at-age prior used in the assessment. The crosses represent length-at-age data from otoliths (Wild 1986). The shaded region represents the variation in length at age (± 2 standard deviations).

FIGURA 3.1. Curva de crecimiento usada para la evaluación del atún aleta amarilla en el OPO (línea sólida). Los puntos conectados representan la distribución previa (*prior*) de la talla a edad usada en la evaluación. Las cruces representan datos de otolitos de talla a edad (Wild 1986). La región sombreada representa la variación de la talla a edad (± 2 desviaciones estándar).

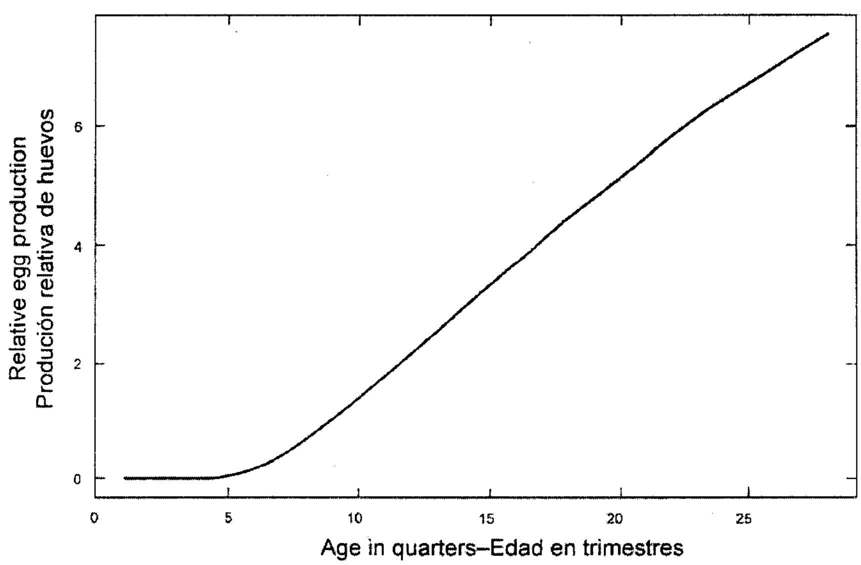


FIGURE 3.2. Relative fecundity-at-age curve (from Schaefer 1998) used to estimate the spawning biomass of yellowfin tuna in the EPO.

FIGURA 3.2. Curva de madurez relativa a edad (de Schaefer 1998) usada para estimar la biomasa reproductora de atún aleta amarilla en el OPO.

FIGURE 3.3. Sex ratio curve (from Schaefer 1998) used to estimate the spawning biomass of yellowfin tuna in the EPO.
FIGURA 3.3. Curva de proporciones de sexos (de Schaefer 1998) usada para estimar la biomasa reproductora de atún aleta amarilla en el OPO.

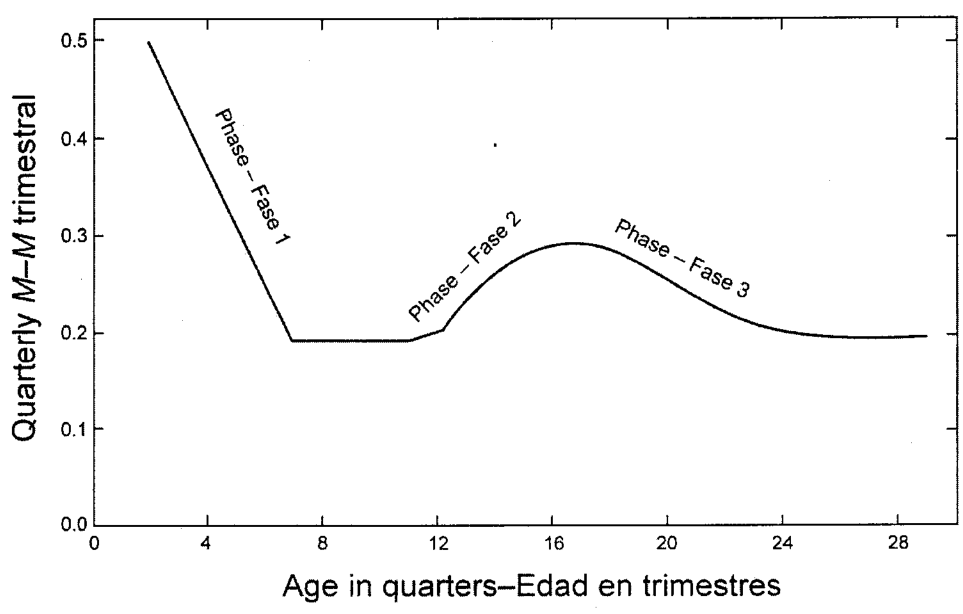


FIGURE 3.4. Natural mortality (*M*) rates, at quarterly intervals, used for the assessment of yellowfin tuna in the EPO. Descriptions of the three phases of the mortality curve are provided in Section 3.1.4.
FIGURA 3.4. Tasas de mortalidad natural (*M*), a intervalos trimestrales, usadas para la evaluación del atún aleta amarilla en el OPO. En la Sección 3.1.4 se describen las tres fases de la curva de mortalidad.

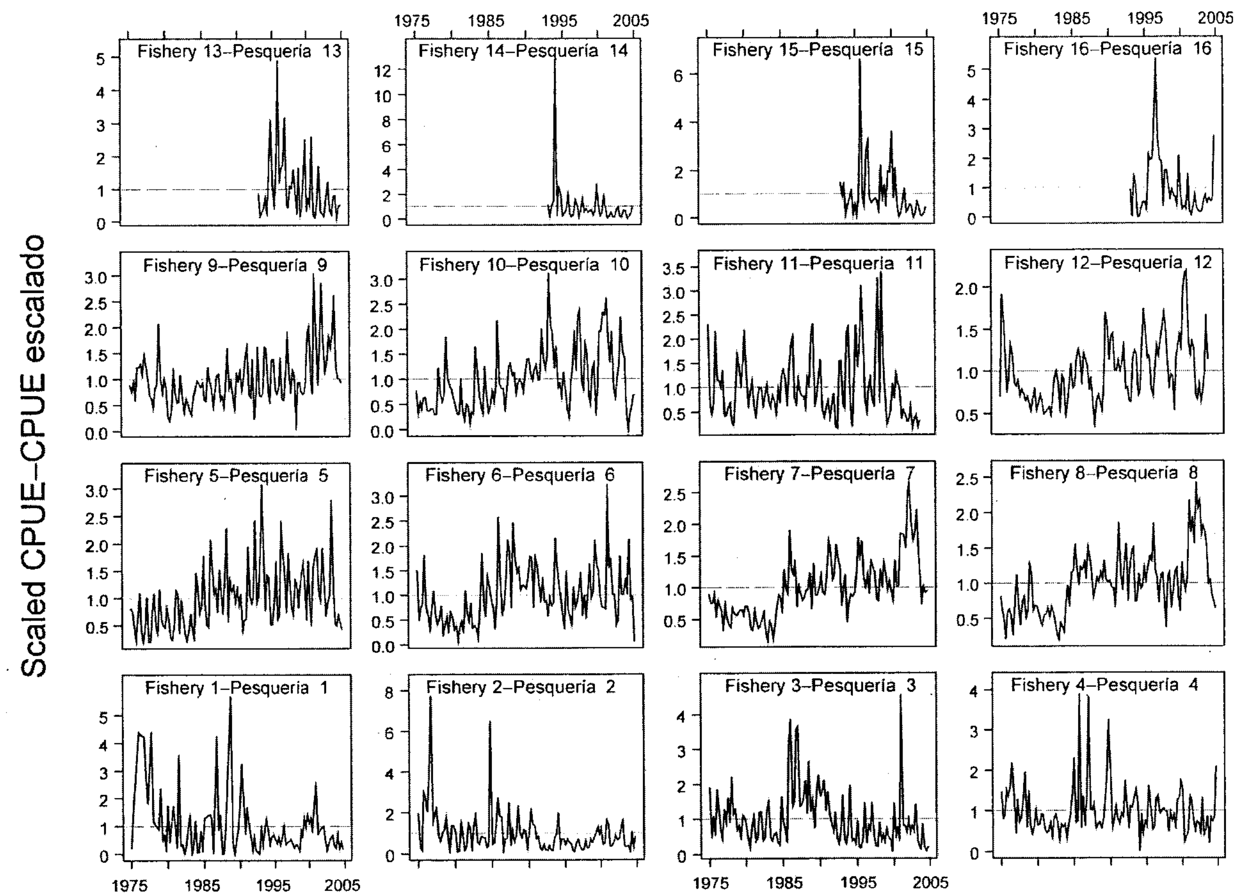


FIGURE 4.1. CPUEs for the fisheries defined for the stock assessment of yellowfin tuna in the EPO (Table 2.1). Since the data were summarized on a quarterly basis, there are four observations of CPUE for each year. The CPUEs for Fisheries 1-10 and 13-16 are in kilograms per day fished, and those for Fisheries 11 and 12 are standardized units based on numbers of hooks. The data are adjusted so that the mean of each time series is equal to 1.0. Note that the vertical scales of the panels are different.

FIGURA 4.1. CPUE de las pesquerías definidas para la evaluación del stock de atún aleta amarilla en el OPO (Tabla 2.1). Ya que se resumieron los datos por trimestre, hay cuatro observaciones de CPUE para cada año. Se expresan las CPUE de las Pesquerías 1-10 y 13-16 en kilogramos por día de pesca, y las de las Pesquerías 11 y 12 en unidades estandarizadas basadas en número de anzuelos. Se ajustaron los datos para que el promedio de cada serie de tiempo equivalga a 1,0. Nótese que las escalas verticales de los recuadros son diferentes.

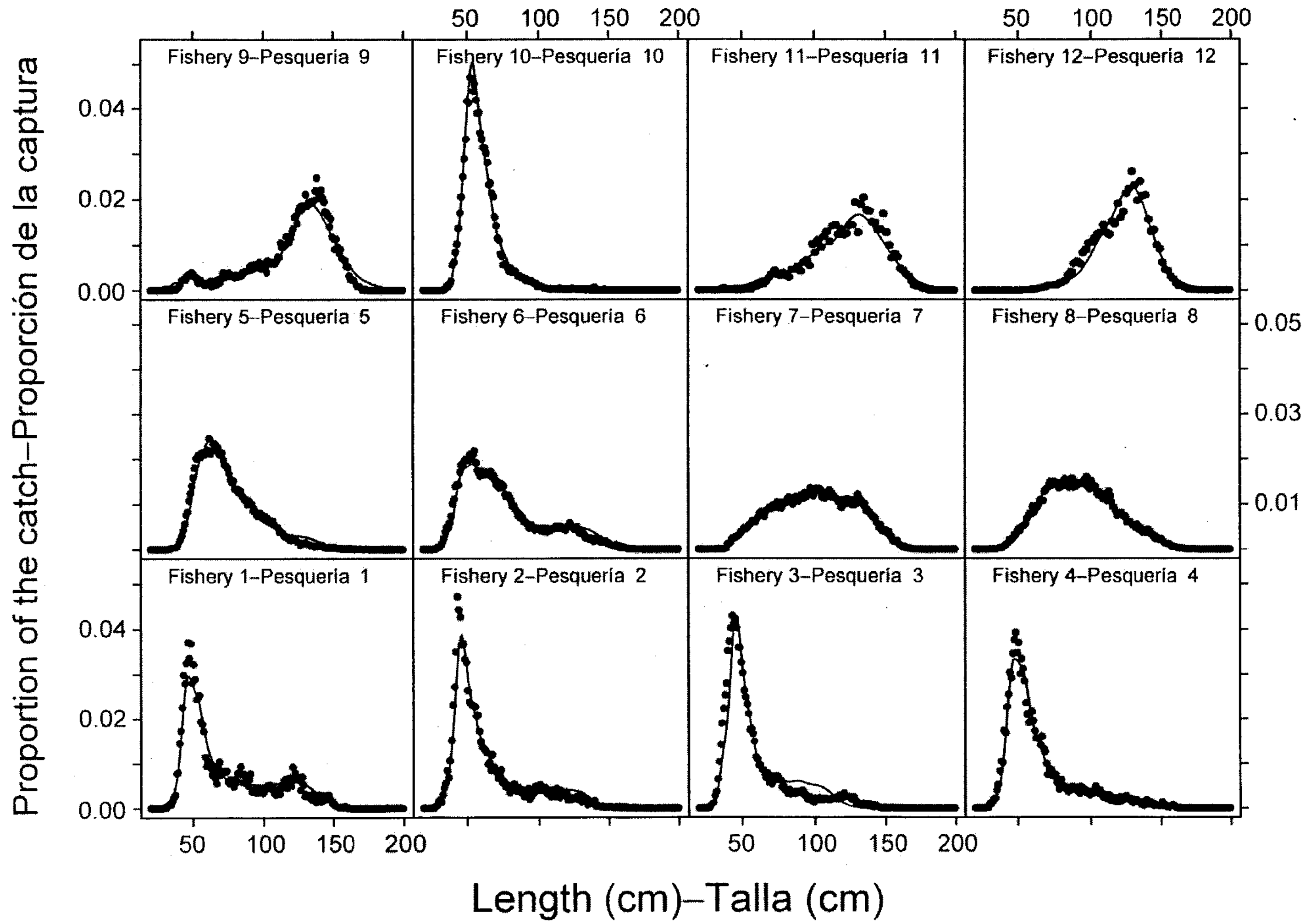


FIGURE 4.2. Average observed (dots) and predicted (curves) size compositions of the catches taken by the fisheries defined for the stock assessment of yellowfin tuna in the EPO.

FIGURA 4.2. Composición media por tamaño observada (puntos) y predicha (curvas) de las capturas realizadas por las pesquerías definidas para la evaluación de la población de atún aleta amarilla en el OPO.

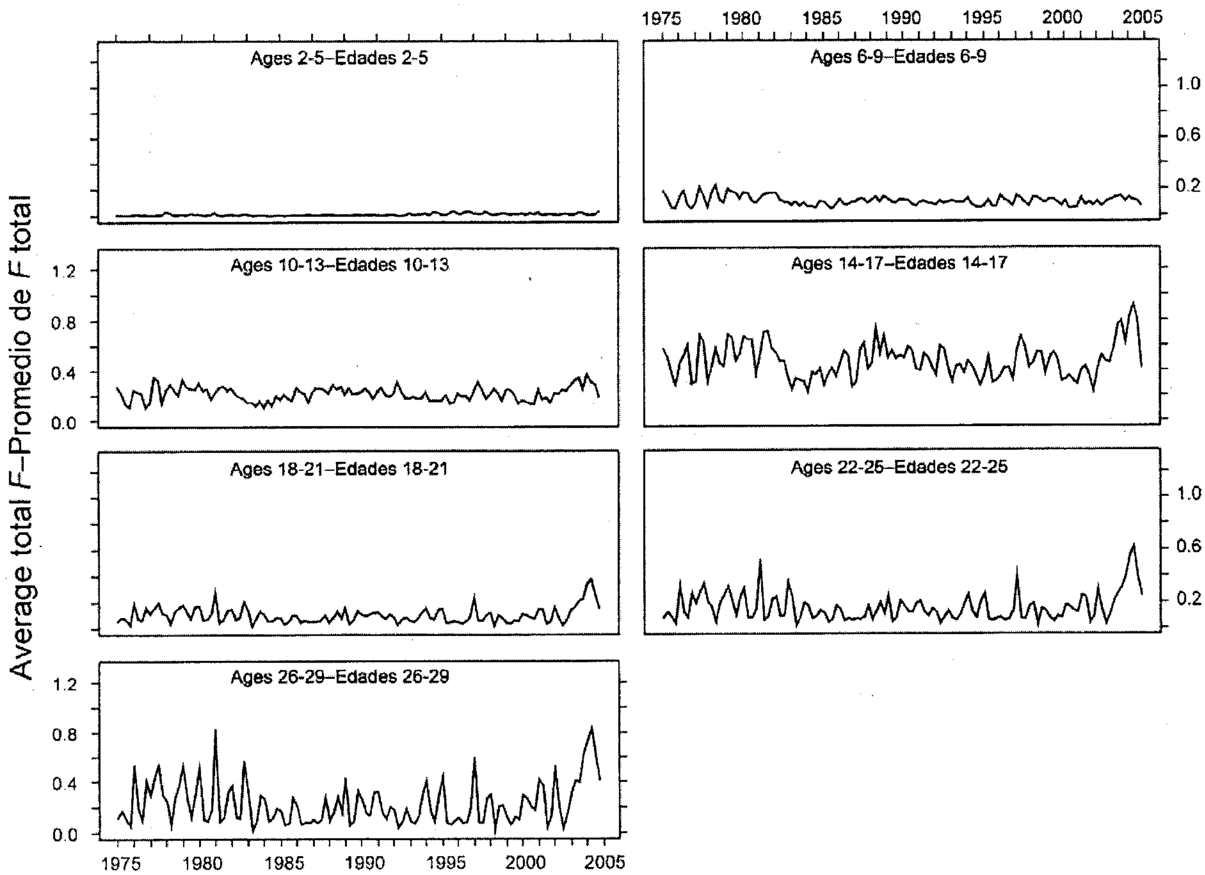


FIGURE 4.3a. Average quarterly fishing mortality at age, by all gears, on yellowfin tuna recruited to the fisheries of the EPO. Each panel illustrates an average of four quarterly fishing mortality vectors that affected the fish within the range of ages indicated in the title of each panel. For example, the trend illustrated in the upper-left panel is an average of the fishing mortalities that affected the fish that were 2-5 quarters old.

FIGURA 4.3a. Mortalidad por pesca trimestral media a edad, por todos los artes, de atún aleta amarilla reclutado a las pesquerías del OPO. Cada recuadro ilustra un promedio de cuatro vectores trimestrales de mortalidad por pesca que afectaron los peces de la edad indicada en el título de cada recuadro. Por ejemplo, la tendencia ilustrada en el recuadro superior izquierdo es un promedio de las mortalidades por pesca que afectaron a los peces de entre 2 y 5 trimestres de edad.

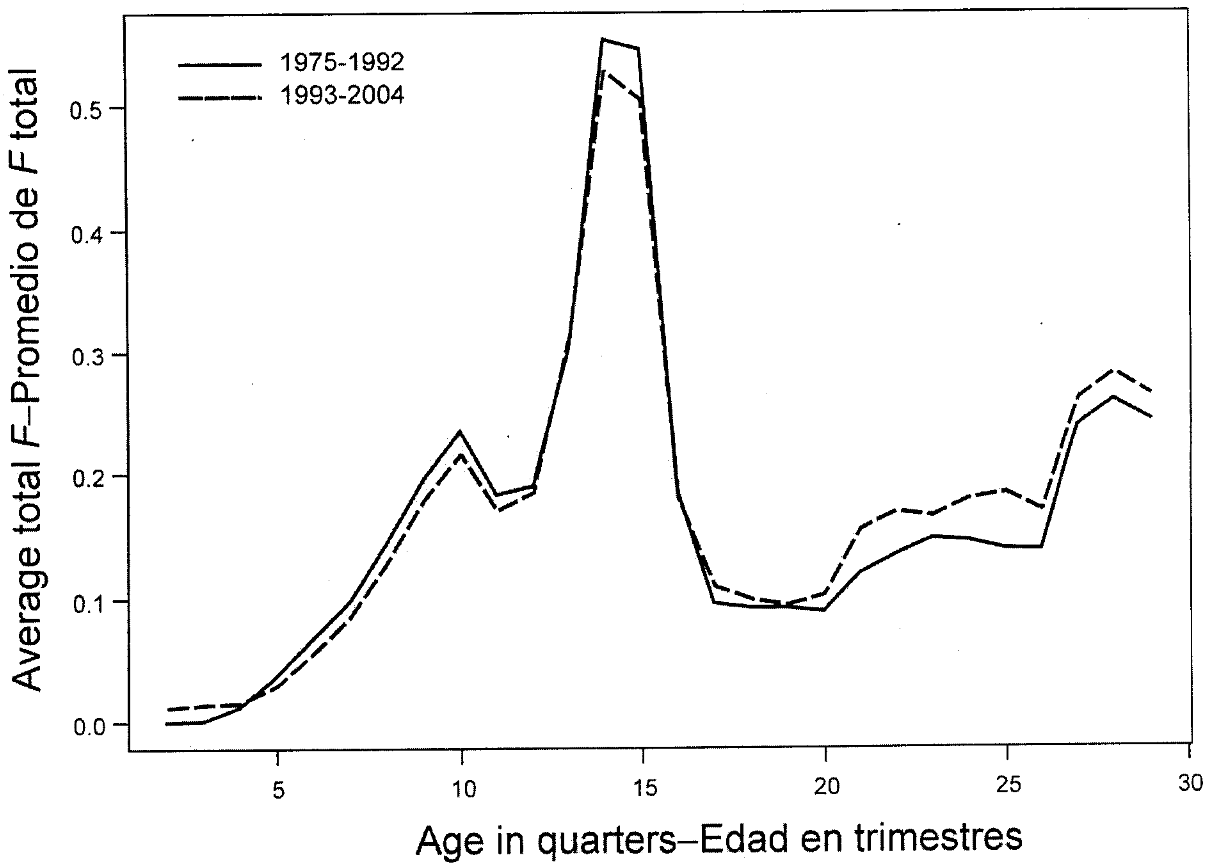


FIGURE 4.3b. Average quarterly fishing mortality by age of yellowfin tuna, by all gears, in the EPO. The estimates are presented for two periods, the latter period relating to the increase in effort associated with floating objects.

FIGURA 4.3b. Mortalidad por pesca trimestral media por edad de atún aleta amarilla, por todos los artes, en el OPO. Se presentan estimaciones para dos períodos, el segundo relacionado con aumento en el esfuerzo asociado con objetos flotantes.

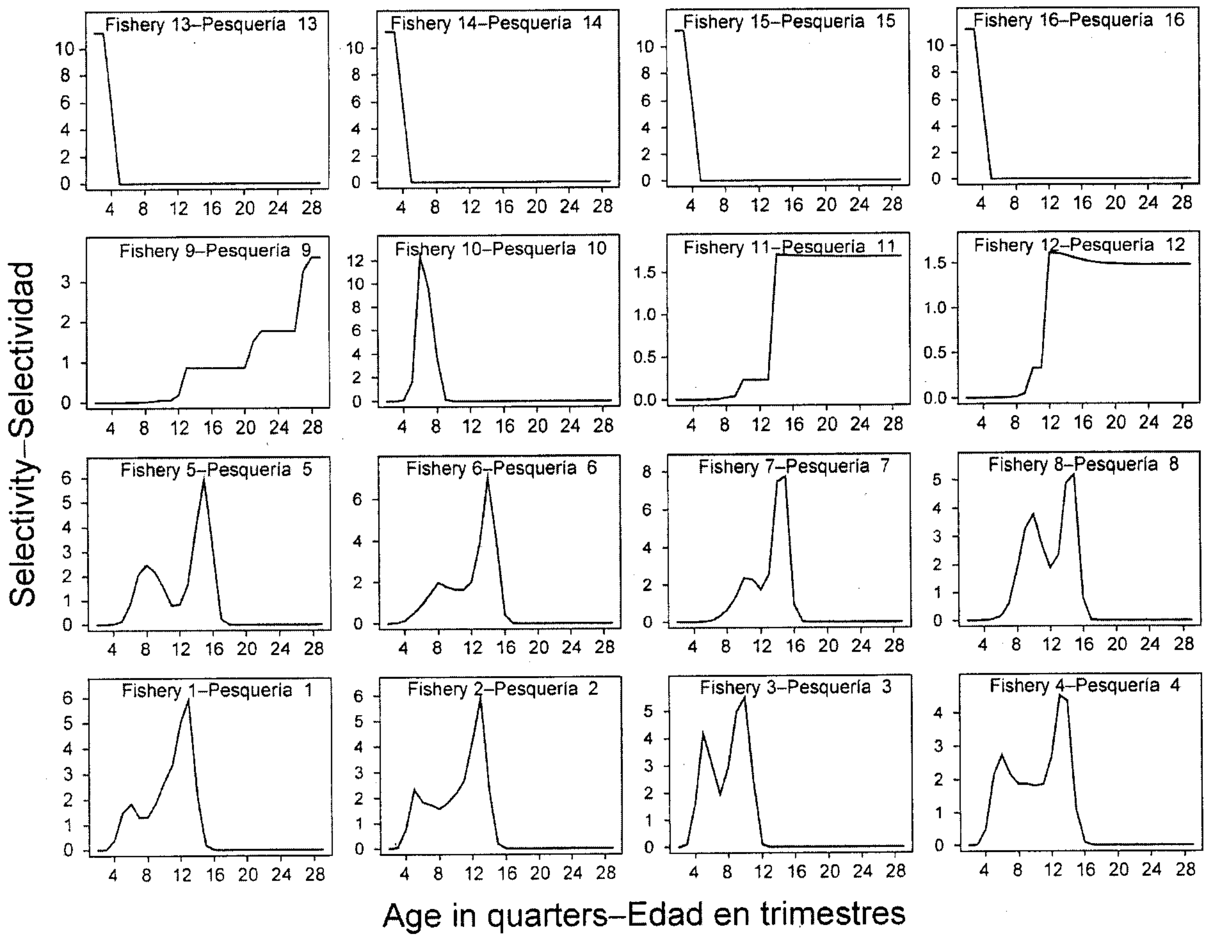


FIGURE 4.4. Selectivity curves for the 16 fisheries that take yellowfin tuna in the EPO. The curves for Fisheries 1-12 were estimated with the A-SCALA method, and those for Fisheries 13-16 are based on assumptions. Note that the vertical scales of the panels are different.

FIGURA 4.4. Curvas de selectividad para las 16 pesquerías que capturan atún aleta amarilla en el OPO. Se estimaron las curvas de las Pesquerías 1-12 con el método A-SCALA, y las de la Pesquerías 13-16 se basan en supuestos. Nótese que las escalas verticales de los recuadros son diferentes.

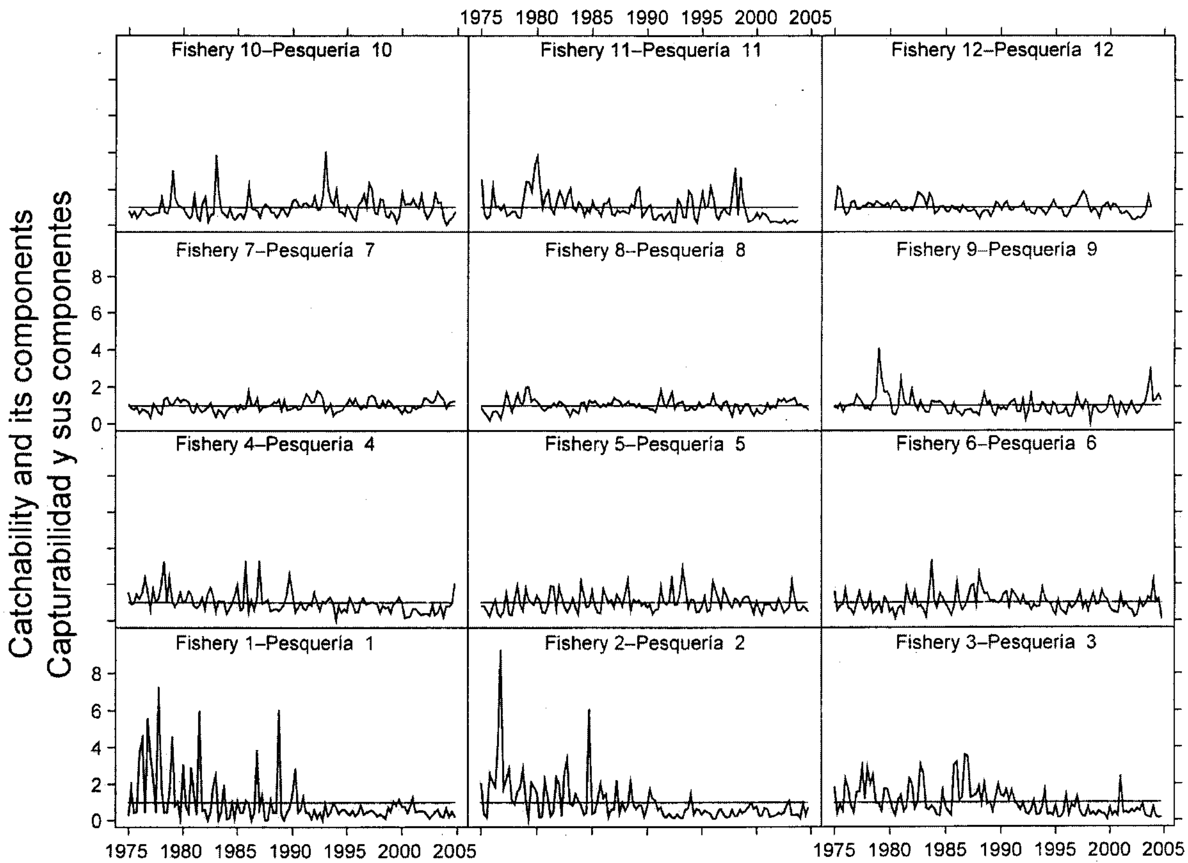


FIGURE 4.5a. Trends in catchability (*q*) for the 12 retention fisheries that take yellowfin tuna in the EPO. The estimates are scaled to average 1.

FIGURA 4.5a. Tendencias en capturabilidad (*q*) para las 12 pesquerías de retención que capturan atún aleta amarilla en el OPO. Se escalan las estimaciones a un promedio de 1.

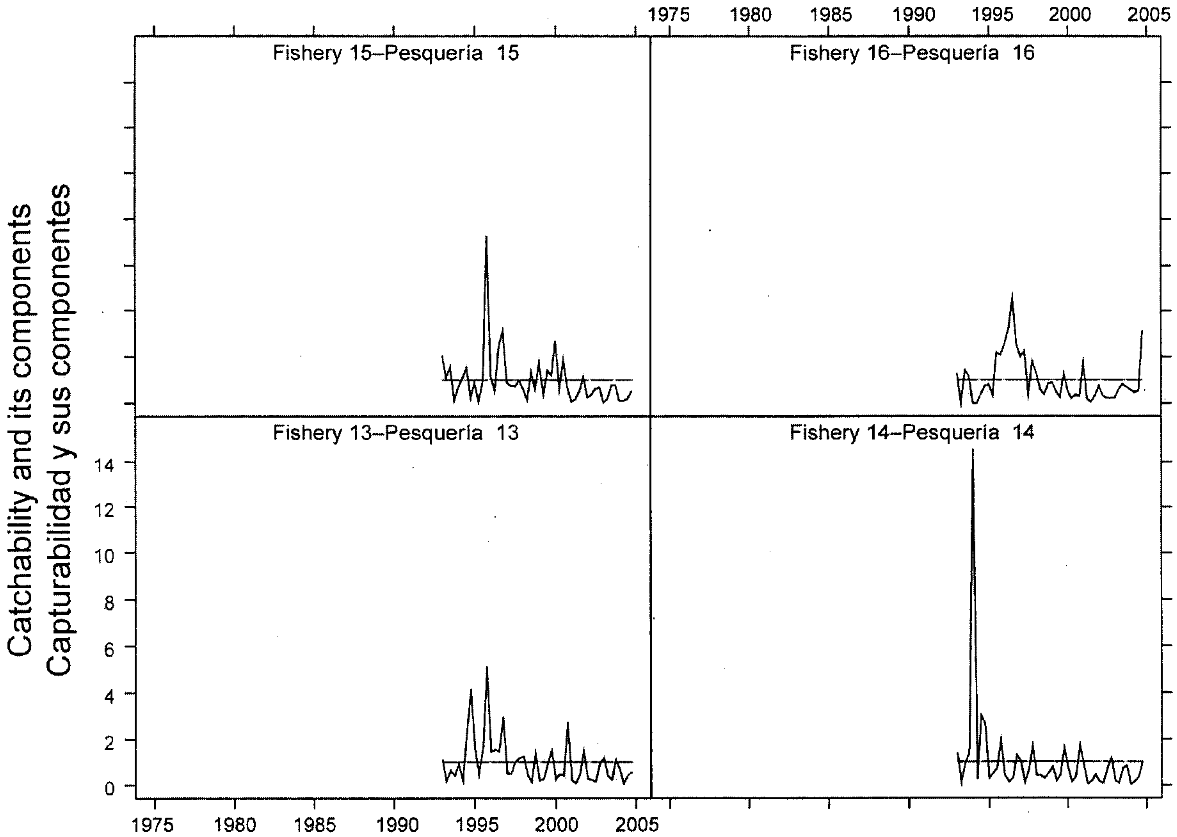


FIGURE 4.5b. Trends in catchability (q) for the four discard fisheries that take yellowfin tuna in the EPO. The estimates are scaled to average 1.

FIGURA 4.5b. Tendencias en capturabilidad (q) para las cuatro pesquerías de descarte que capturan atún aleta amarilla en el OPO. Se escalan las estimaciones a un promedio de 1.

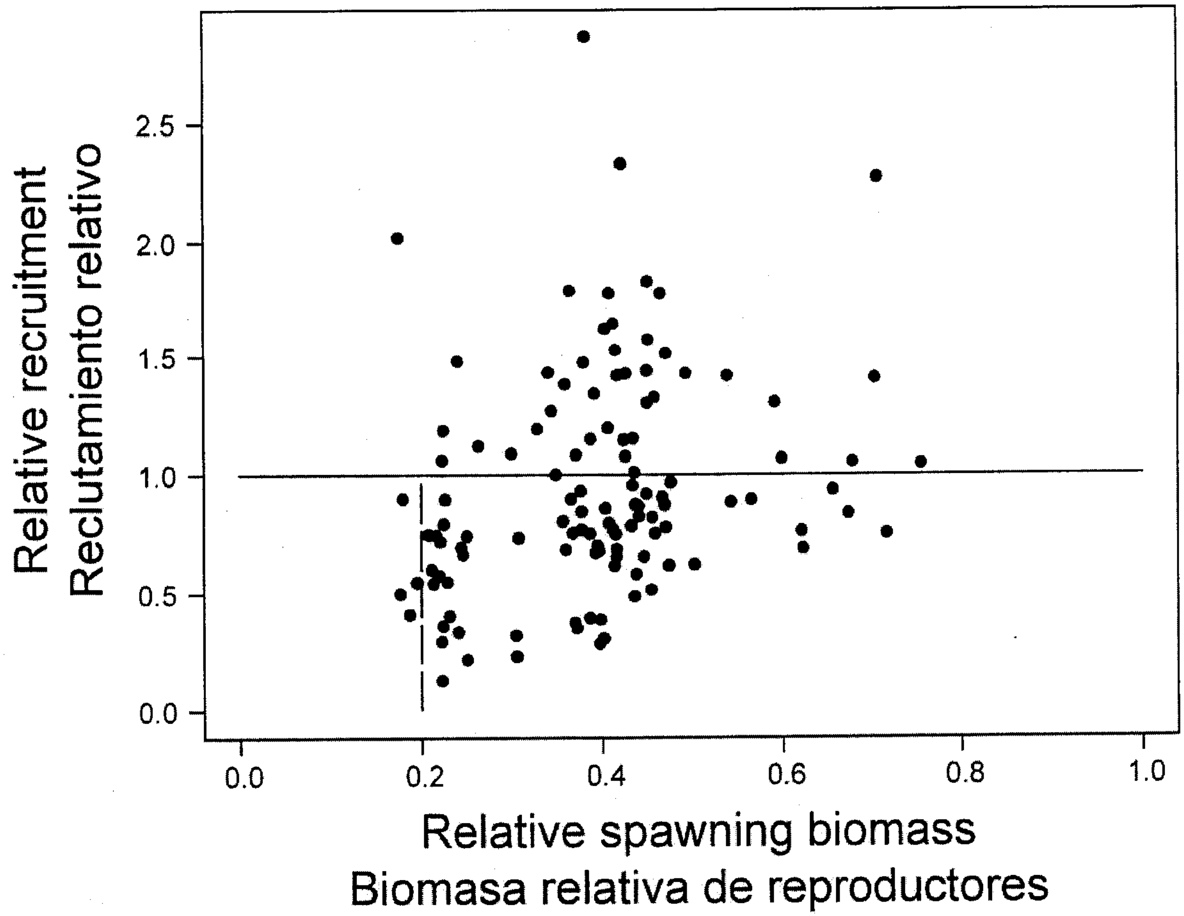


FIGURE 4.6. Estimated relationship between recruitment of yellowfin tuna and spawning biomass. The recruitment is scaled so that the average recruitment is equal to 1.0. The spawning biomass is scaled so that the average unexploited spawning biomass is equal to 1.0.

FIGURA 4.6. Relación estimada entre reclutamiento de atún aleta amarilla y biomasa reproductora. Se escala el reclutamiento para que el reclutamiento medio equivalga a 1,0. Se escala la biomasa reproductora para que la biomasa reproductora media no explotada equivalga a 1,0.

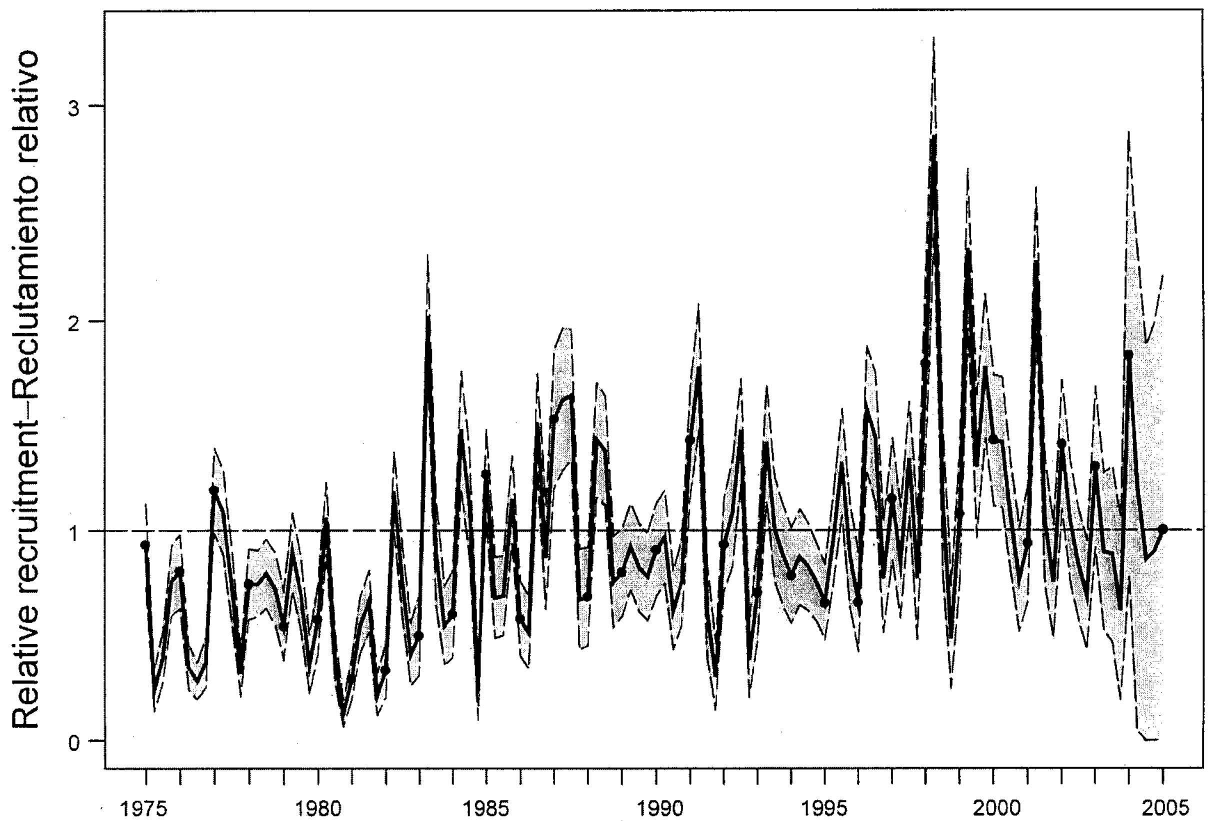


FIGURE 4.7. Estimated recruitment of yellowfin tuna to the fisheries of the EPO. The estimates are scaled so that the average recruitment is equal to 1.0. The bold line illustrates the maximum likelihood estimates of recruitment, and the shaded area indicates the approximate 95% confidence intervals around those estimates. The labels on the time axis are drawn at the start of each year, but, since the assessment model represents time on a quarterly basis, there are four estimates of recruitment for each year.

FIGURA 4.7. Reclutamiento estimado de atún aleta amarilla a las pesquerías del OPO. Se escalan las estimaciones para que el reclutamiento medio equivalga a 1,0. La línea gruesa ilustra las estimaciones de probabilidad máxima del reclutamiento, y el área sombreada los intervalos de confianza de 95% aproximados de esas estimaciones. Se dibujan las leyendas en el eje de tiempo al principio de cada año, pero, ya que el modelo de evaluación representa el tiempo por trimestres, hay cuatro estimaciones de reclutamiento para cada año.

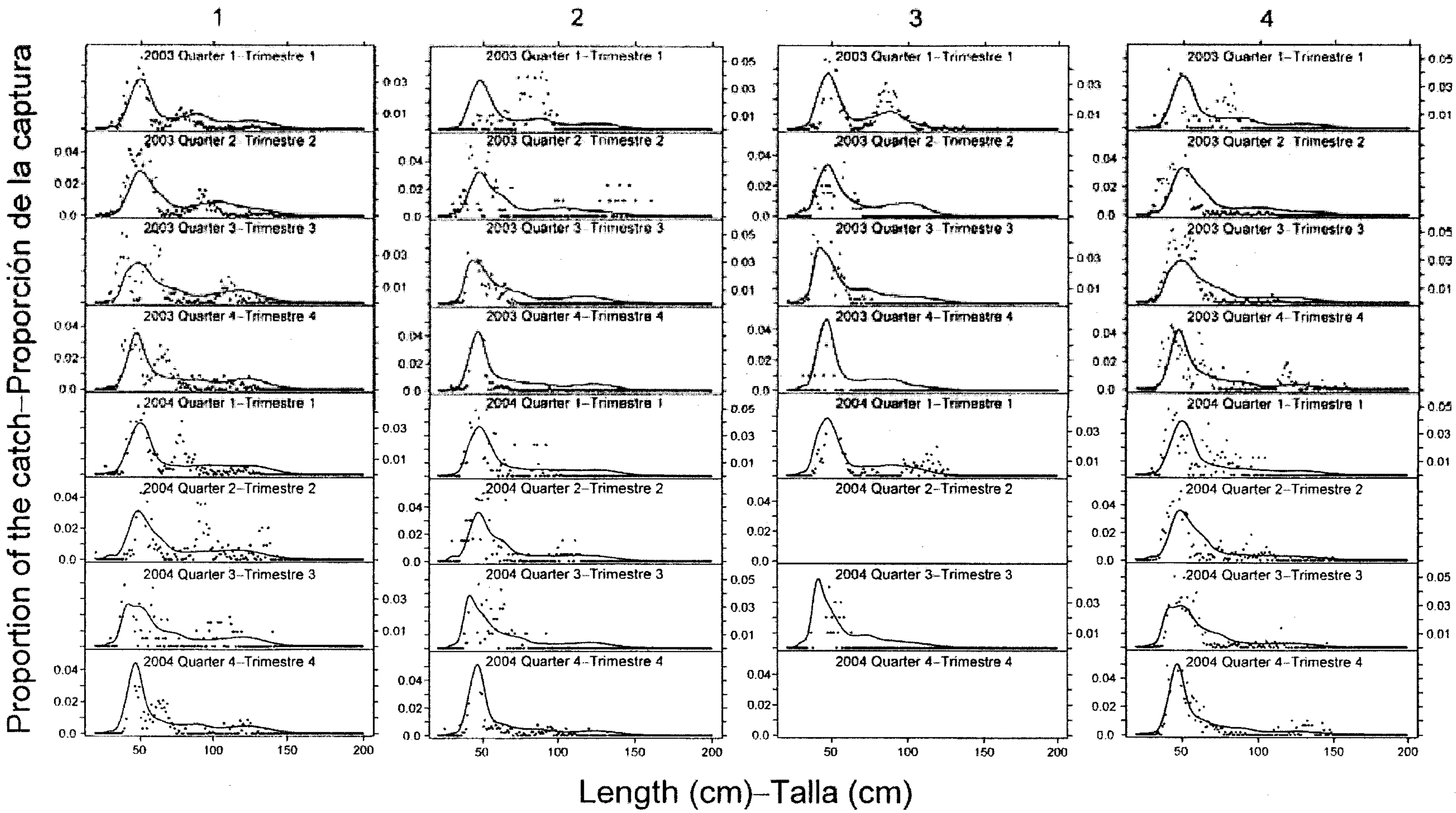


FIGURE 4.8a. Observed (dots) and predicted (curves) size compositions of the recent catches of yellowfin by the fisheries that take tunas in association with floating objects (Fisheries 1-4).
FIGURA 4.8a. Composiciones por tamaño observadas (puntos) y predichas (curvas) de las capturas recientes de aleta amarilla por las pesquerías que capturan atún en asociación con objetos flotantes (Pesquerías 1-4).

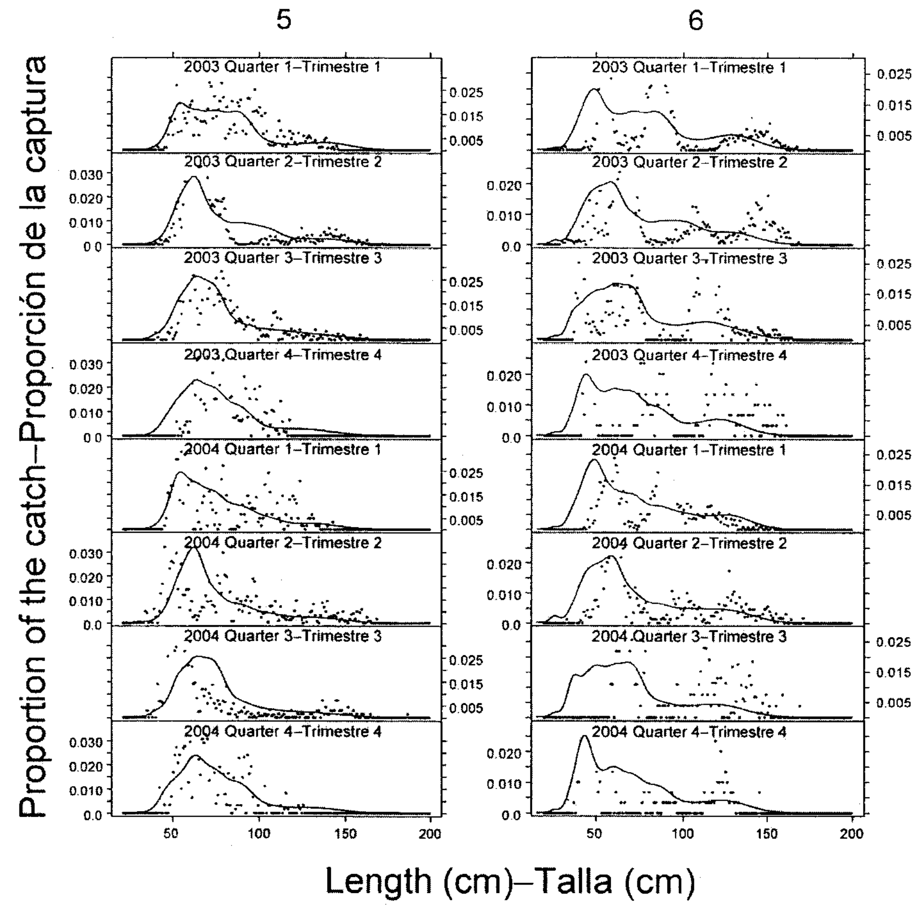


FIGURE 4.8b. Observed (dots) and predicted (curves) size compositions of the recent catches of yellowfin tuna by the fisheries that take tunas in unassociated schools (Fisheries 5 and 6).

FIGURA 4.8b. Composiciones por tamaño observadas (puntos) y predichas (curvas) de las capturas recientes de atún aleta amarilla por las pesquerías que capturan atún en cardúmenes no asociados (Pesquerías 5 y 6).

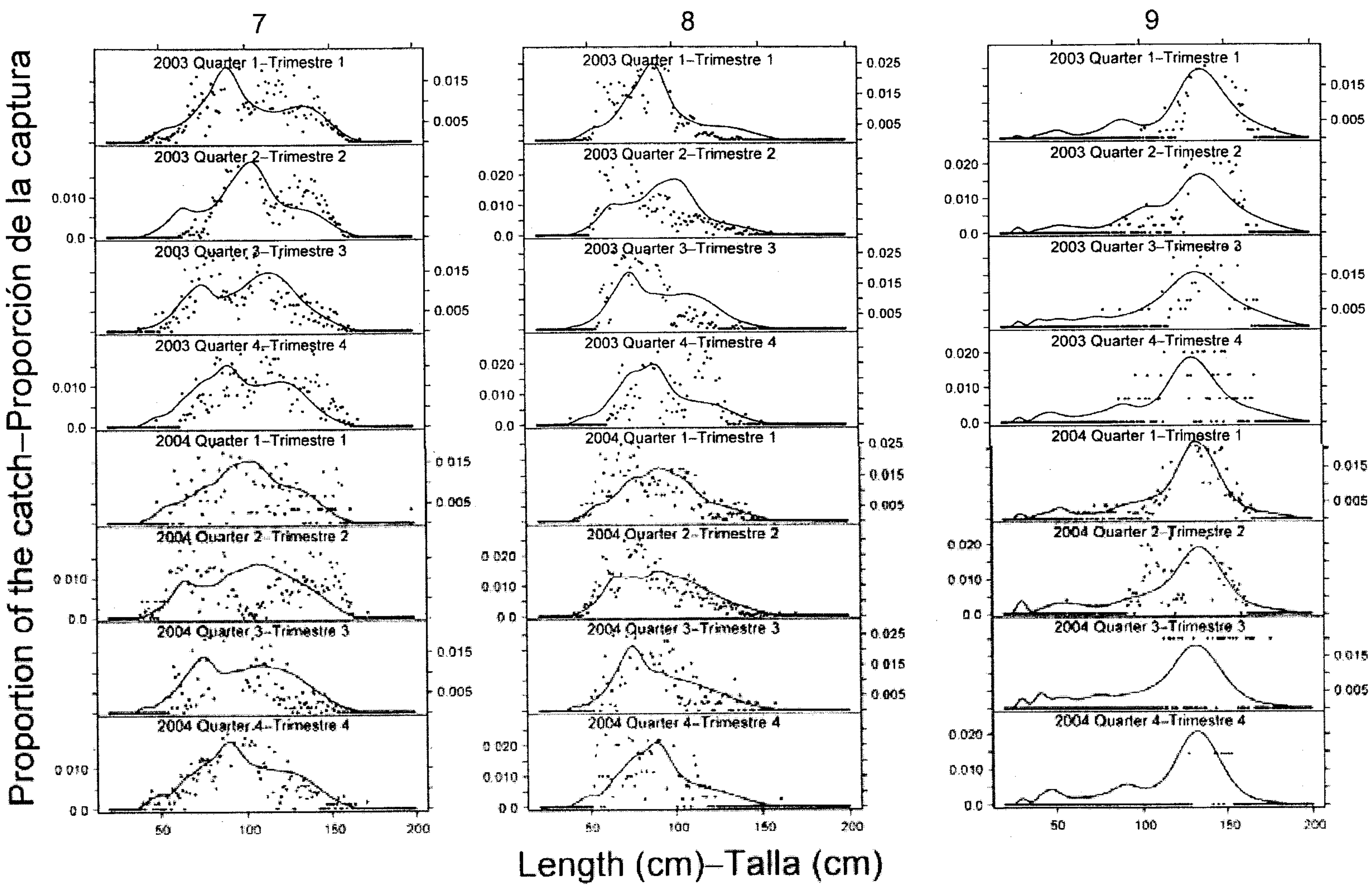


FIGURE 4.8c. Observed (dots) and predicted (curves) size compositions of the recent catches of yellowfin tuna by the fisheries that take tunas in association with dolphins (Fisheries 7-9).

FIGURA 4.8c. Composiciones por tamaño observadas (puntos) y predichas (curvas) de las capturas recientes de atún aleta amarilla por las pesquerías que capturan atún en asociación con delfines (Pesquerías 7-9).

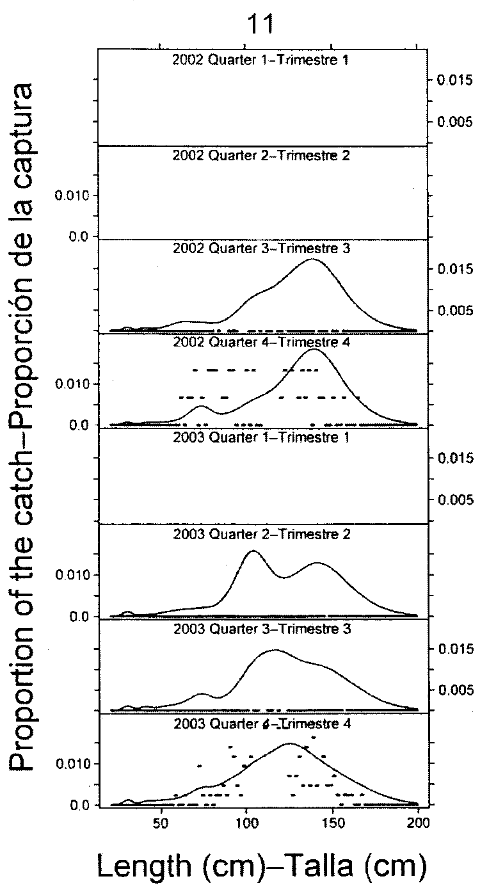


FIGURE 4.8d. Observed (dots) and predicted (curves) size compositions of the recent catches of yellowfin tuna by the pole-and-line fishery (Fishery 11).
FIGURA 4.8d. Composiciones por tamaño observadas (puntos) y predichas (curvas) de las capturas recientes de atún aleta amarilla por las pesquería cañera (Pesquería 11).

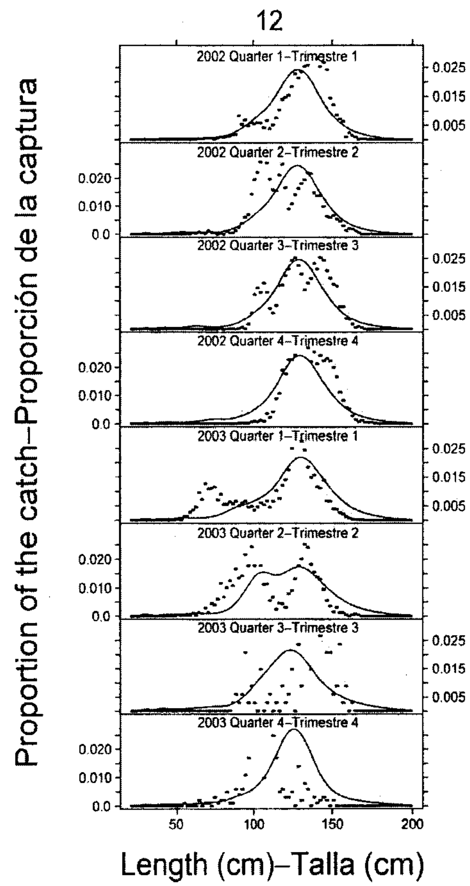


FIGURE 4.8e. Observed (dots) and predicted (curves) size compositions of the recent catches of yellowfin tuna by the longline fishery (Fishery 12).
FIGURA 4.8e. Composiciones por tamaño observadas (puntos) y predichas (curvas) de las capturas recientes de atún aleta amarilla por las pesquería palangrera (Pesquería 12).

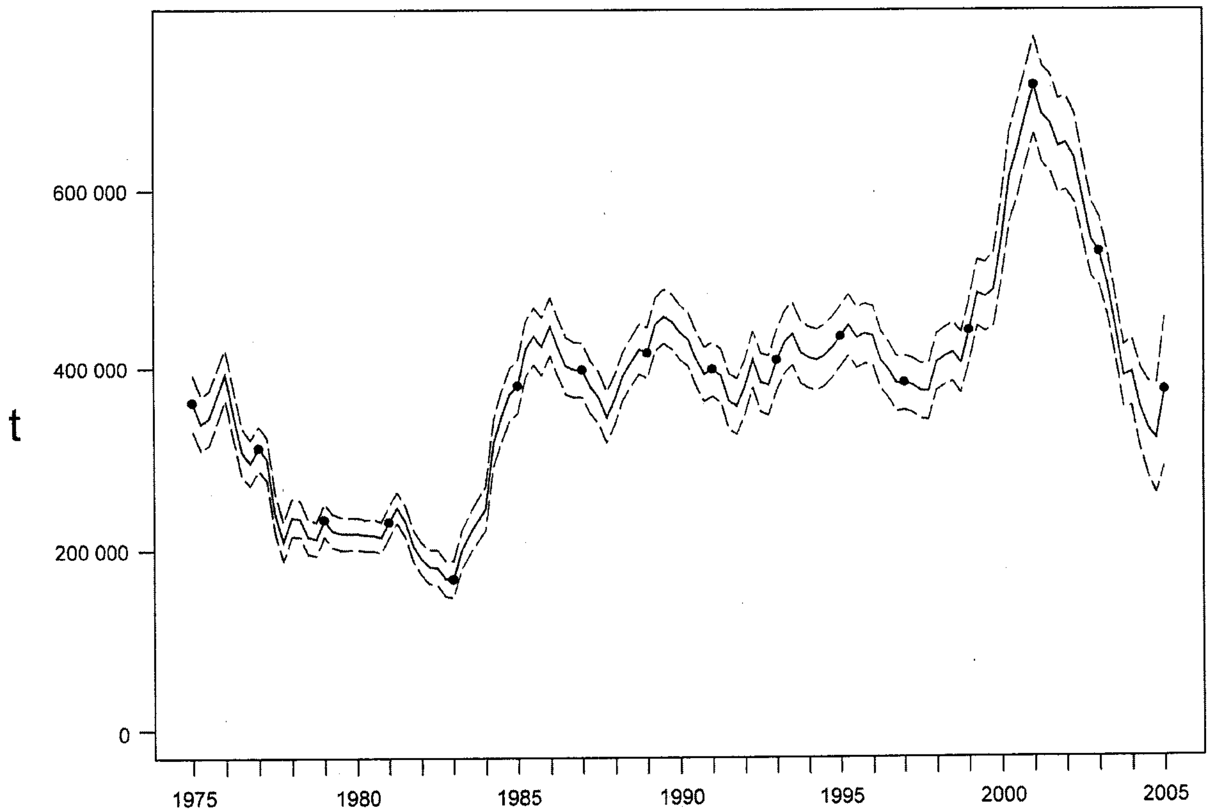


FIGURE 4.9a. Estimated biomass of yellowfin tuna in the EPO. The bold line illustrates the maximum likelihood estimates of the biomass, and the thin dashed lines the approximate 95% confidence intervals around those estimates. Since the assessment model represents time on a quarterly basis, there are four estimates of biomass for each year. t = metric tons.

FIGURA 4.9a. Biomasa estimada de atún aleta amarilla en el OPO. La línea gruesa ilustra las estimaciones de probabilidad máxima de la biomasa, y las líneas delgadas de trazos los límites de confianza de 95% aproximados de las estimaciones. Ya que el modelo de evaluación representa el tiempo por trimestres, hay cuatro estimaciones de biomasa para cada año. t = toneladas métricas.

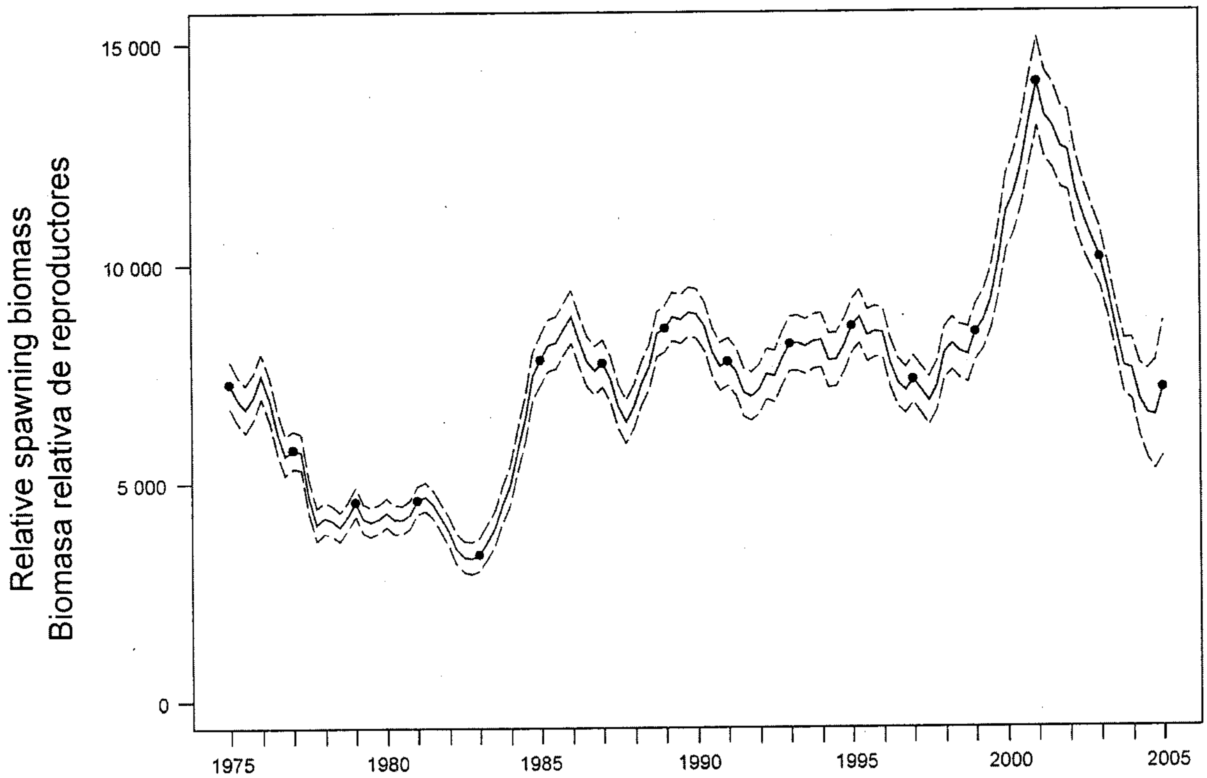


FIGURE 4.9b. Estimated relative spawning biomass of yellowfin tuna in the EPO. The bold line illustrates the maximum likelihood estimates of the biomass, and the thin dashed lines the approximate 95% confidence intervals around those estimates. Since the assessment model represents time on a quarterly basis, there are four estimates of biomass for each year.

FIGURA 4.9b. Biomasa relativa estimada de reproductores de atún aleta amarilla en el OPO. La línea gruesa ilustra las estimaciones de probabilidad máxima de la biomasa, y las líneas delgadas de trazos los límites de confianza de 95% aproximados de las estimaciones. Ya que el modelo de evaluación representa el tiempo por trimestres, hay cuatro estimaciones de biomasa para cada año.

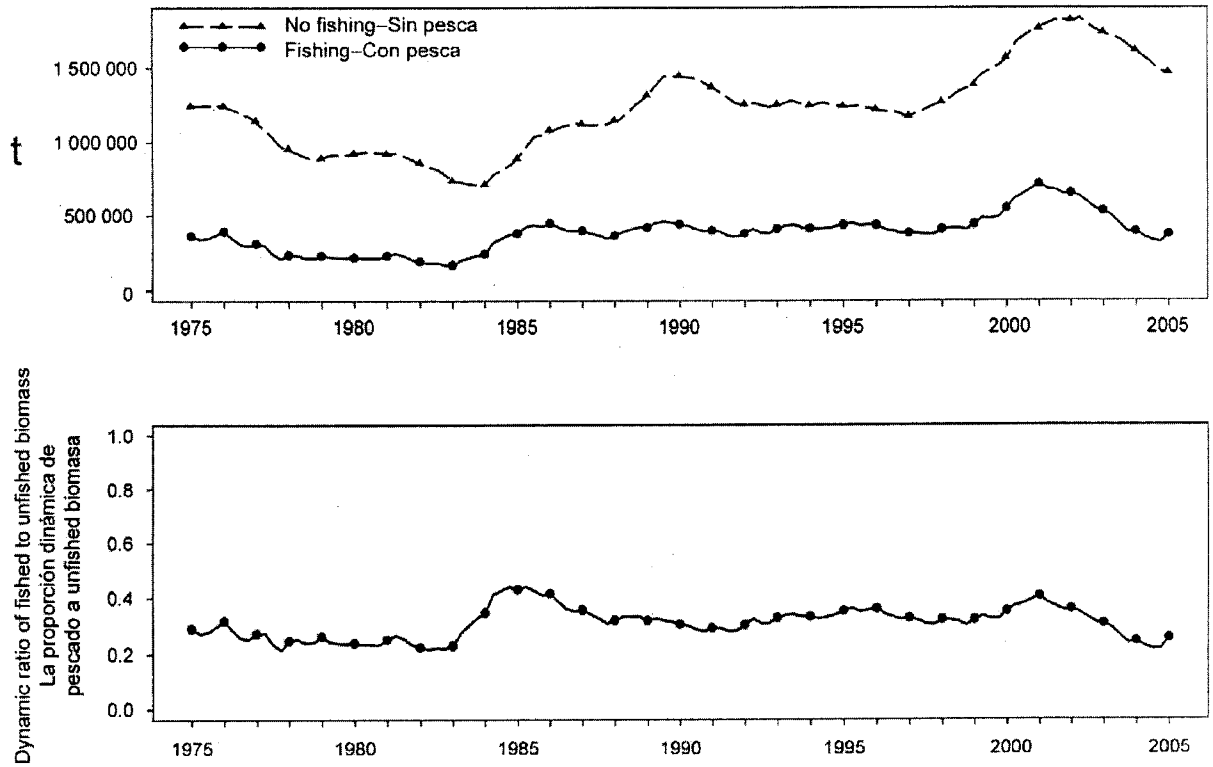


FIGURE 4.10a. Biomass trajectory of a simulated population of yellowfin tuna that was not exploited during 1975-2004 ("no fishing") and that predicted by the stock assessment model ("fishing"). t = metric tons.

FIGURA 4.10a. Trayectoria de biomasa de una población simulada de atún aleta amarilla no explotada durante 1975-2003 ("sin pesca") y la predicha por el modelo de evaluación de la población ("con pesca"). t = toneladas métricas.

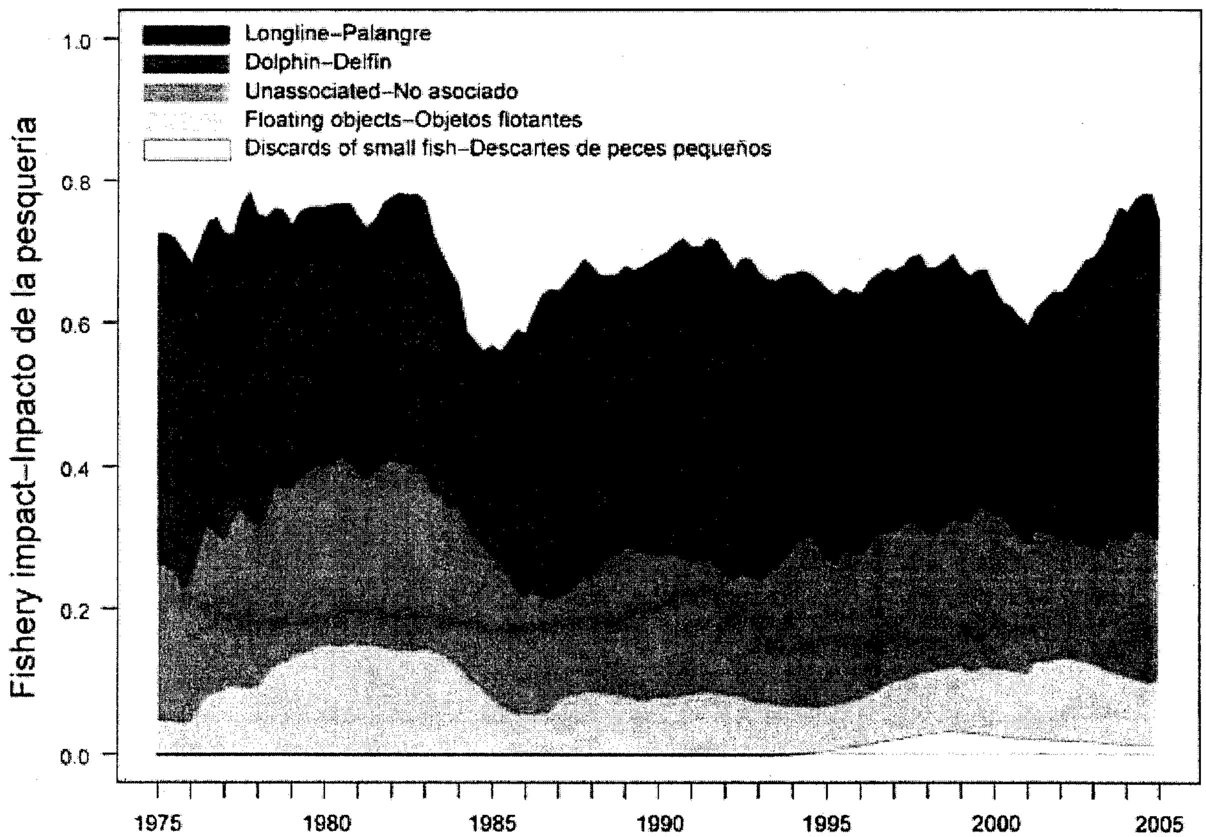


FIGURE 4.10b. Comparison of the relative impacts of the major fisheries on the biomass of yellowfin tuna in the EPO.

FIGURA 4.10b. Comparación de los impactos relativos de las pesquerías mayores sobre la biomasa de atún aleta amarilla en el OPO.

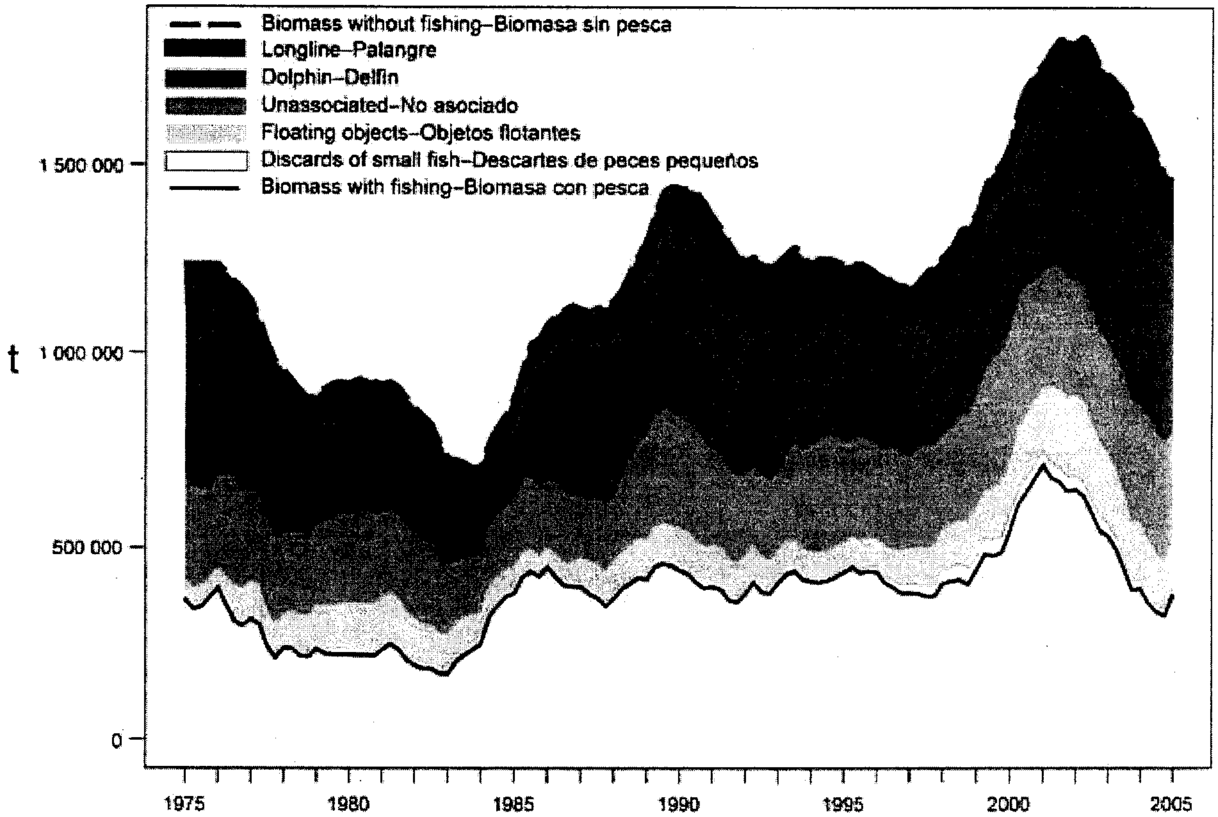


FIGURE 4.10c. Biomass trajectory of a simulated population of yellowfin tuna that was not exploited during 1975-2005 (dashed line) and that predicted by the stock assessment model (solid line). The shaded areas between the two lines show the portions of the fishery impact attributed to each fishing method. t = metric tons.

FIGURA 4.10c. Trayectoria de la biomasa de una población simulada de atún aleta amarilla no explotada durante 1975-2005 (línea de trazos) y la que predice el modelo de evaluación (línea sólida). Las áreas sombreadas entre las dos líneas representan la porción del impacto de la pesca atribuida a cada método de pesca. t = toneladas métricas.

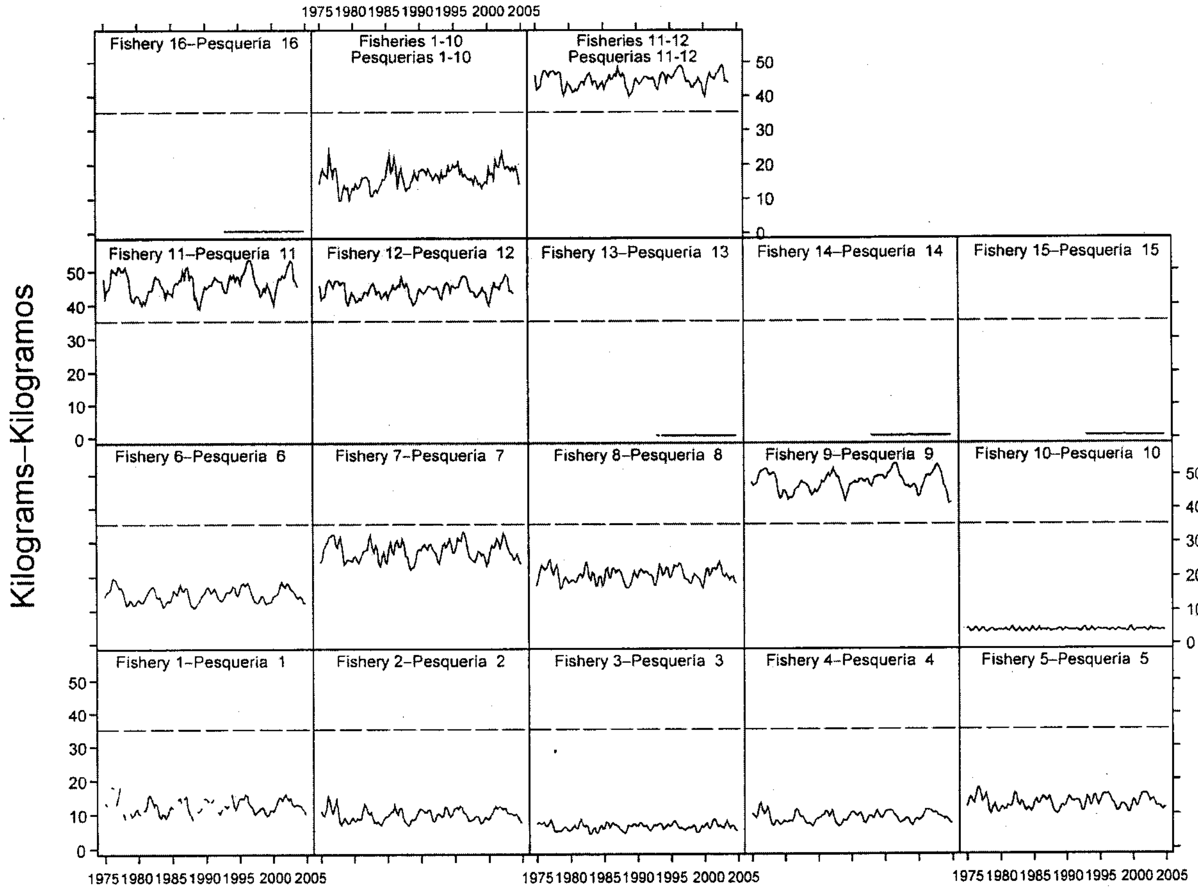


FIGURE 4.11. Estimated average weights of yellowfin tuna caught by the fisheries of the EPO. The time series for "Fisheries 1-10" is an average of Fisheries 1 through 10, and that for "Fisheries 11-12" is an average of Fisheries 11 and 12. The dashed line identifies the critical weight (35.2 kg).

FIGURA 4.11. Peso medio estimado de atún aleta amarilla capturado en las pesquerías del OPO. La serie de tiempo de "Pesquerías 1-10" es un promedio de las Pesquerías 1 a 10, y la de "Pesquerías 11-12" un promedio de las Pesquerías 11 y 12. La línea de trazos identifica el peso crítico (35,2 kg).

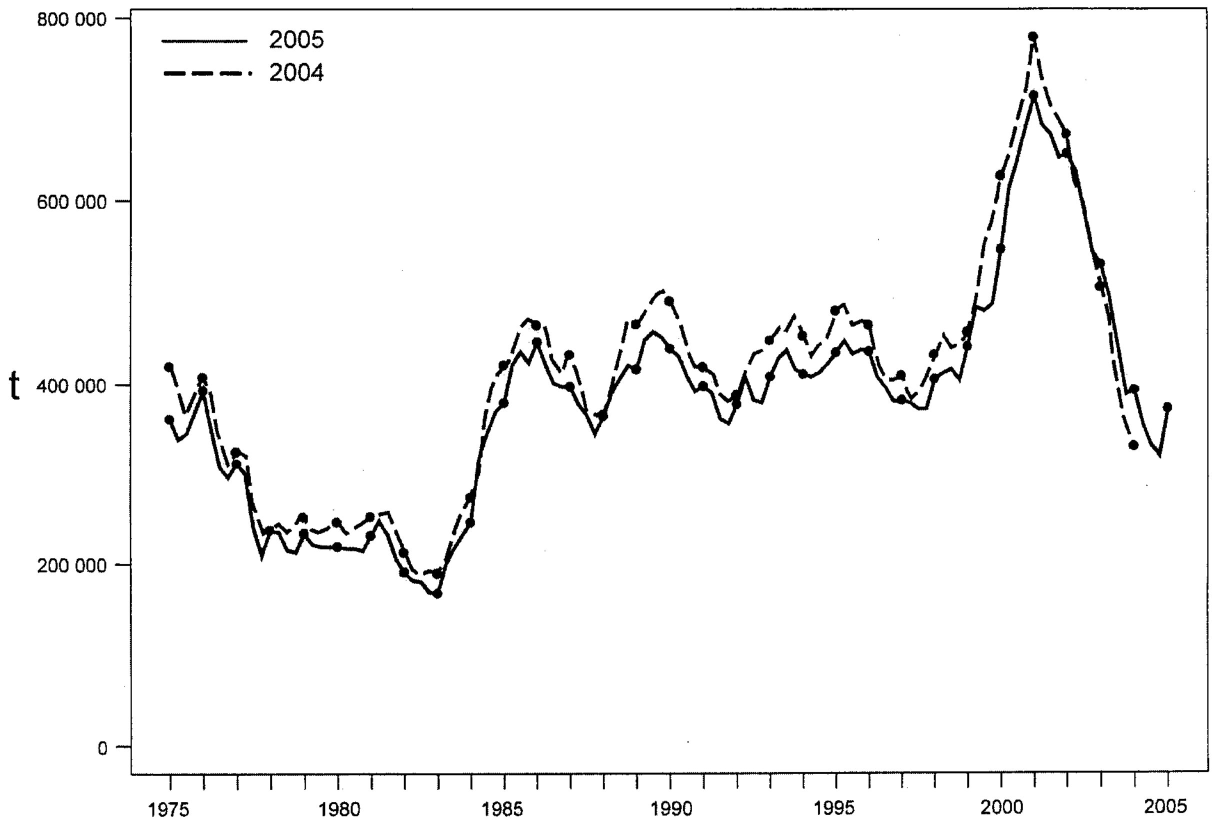


FIGURE 4.12a. Comparison of estimated biomasses of yellowfin tuna in the EPO from the most recent previous assessment and the current assessment. t = metric tons.

FIGURA 4.12a. Comparación de la biomasa estimada de atún aleta amarilla en el OPO de la evaluación previa más reciente y de la evaluación actual. t = toneladas métricas.

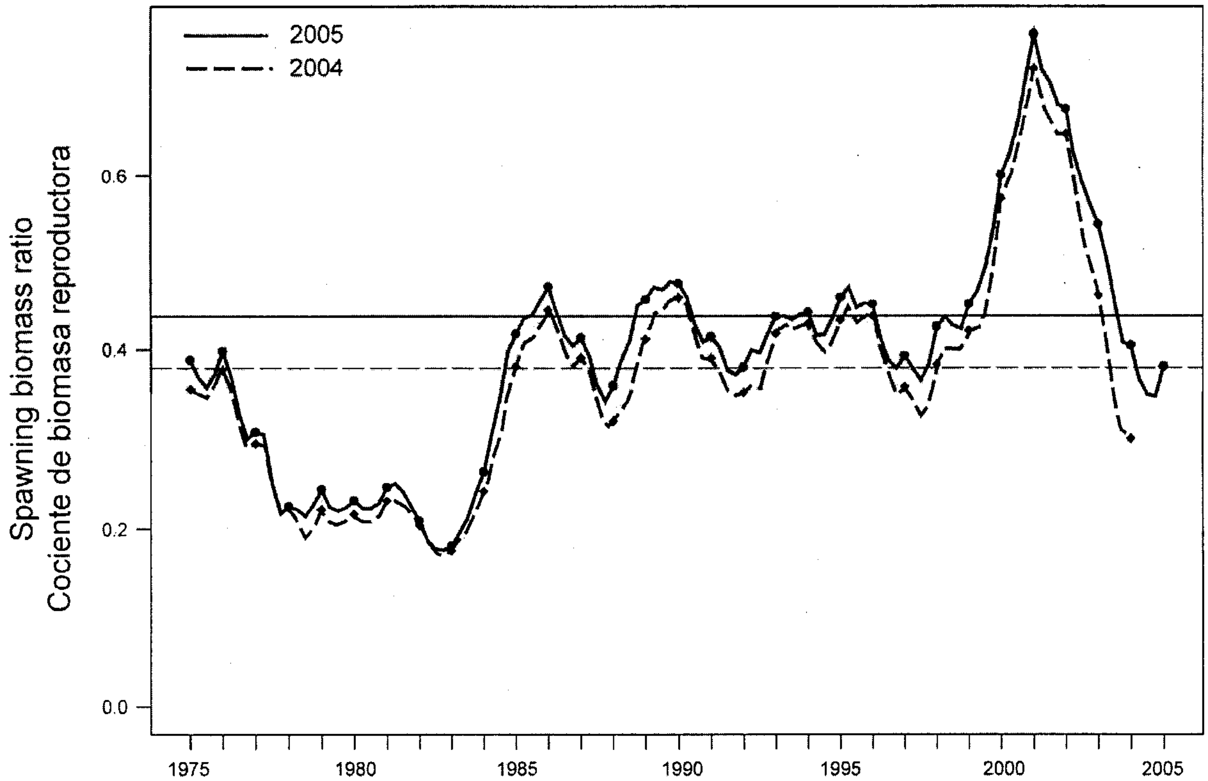


FIGURE 4.12b. Comparison of estimated spawning biomass ratios (SBRs) of yellowfin tuna from the most recent previous assessment and the current assessment. The horizontal lines identify the SBRs at AMSY.

FIGURA 4.12b. Comparación de cociente estimado de biomasa reproductora (SBR) de atún aleta amarilla de la evaluación previa más reciente y de la evaluación actual. La línea horizontal identifica el SBR en RMSP.

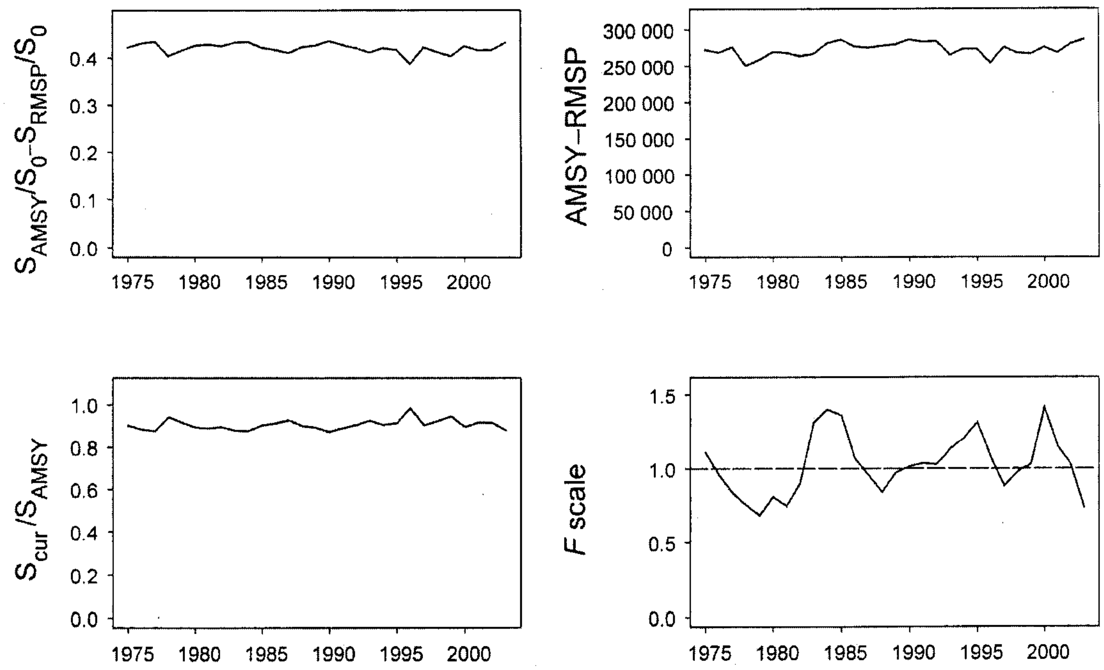


FIGURE 4.12c. Estimates of AMSY-related quantities calculated using the average age-specific fishing mortality for each year. (S_{cur} is the spawning biomass at the start of 2005). See the text for definitions.
FIGURA 4.12c. Estimaciones de cantidades relacionadas con el RMSP calculadas a partir de la mortalidad media por pesca por edad para cada año. (S_{cur} es la biomasa reproductora al principio de 2005). Ver definiciones en el texto.

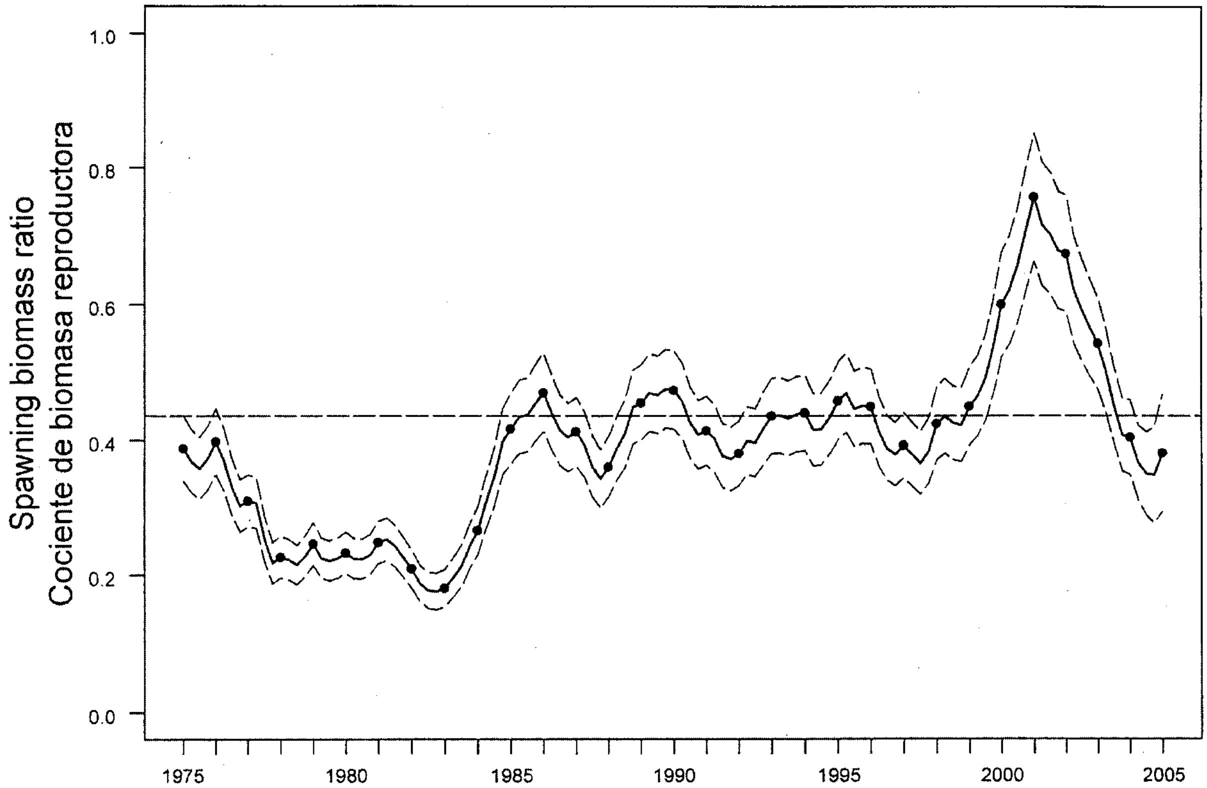


FIGURE 5.1. Estimated spawning biomass ratios (SBRs) for yellowfin tuna in the EPO. The thin dashed lines represent approximate 95% confidence intervals. The dashed horizontal line (at about 0.44) identifies the SBR at AMSY.

FIGURA 5.1. Cocientes de biomasa reproductora (SBR) estimadas para atún aleta amarilla en el OPO. Las líneas delgadas de trazos representan los intervalos de confianza de 95% aproximados. La línea de trazos horizontal (en aproximadamente 0,38) identifican el SBR en RMSP.

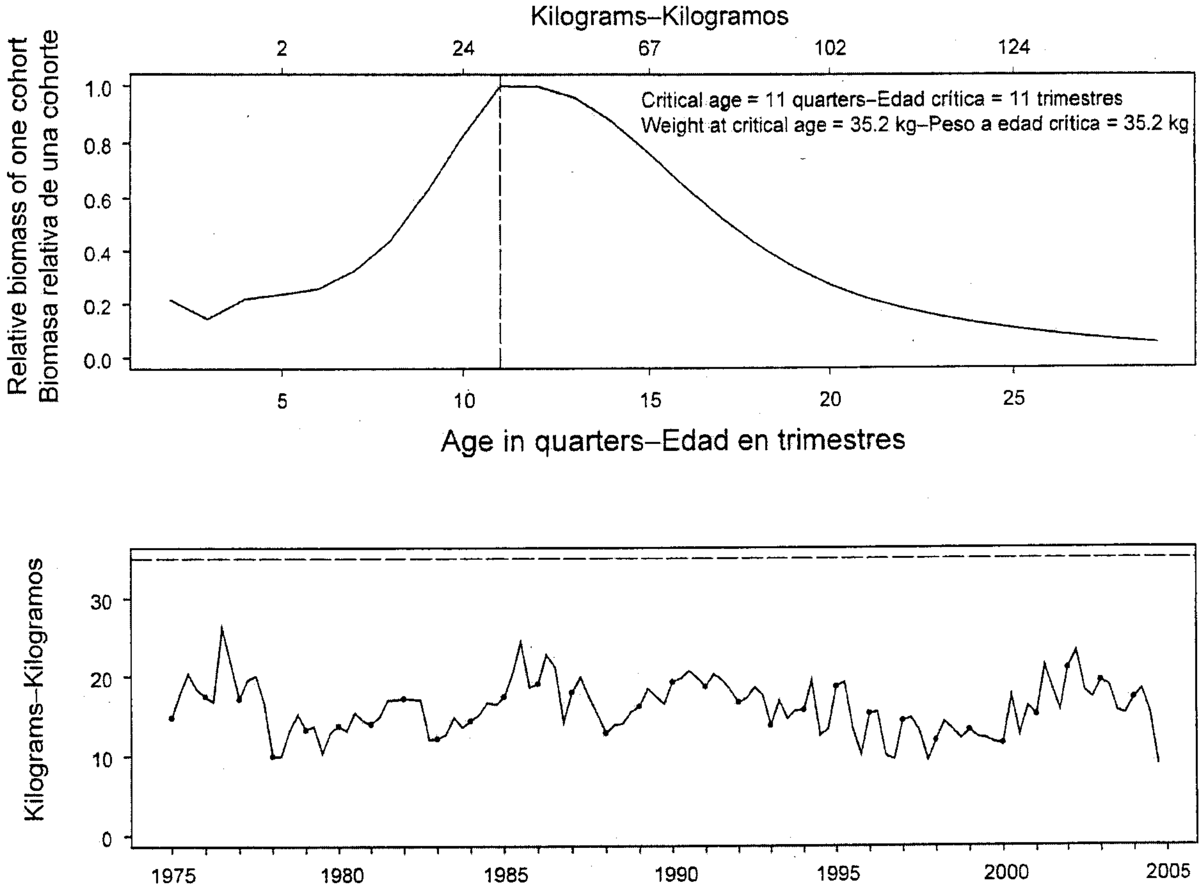


FIGURE 5.2. Combined performance of all fisheries that take yellowfin tuna in the EPO at achieving the maximum yield per recruit. The upper panel illustrates the growth (in weight) of a single cohort of yellowfin, and identifies the critical age and critical weight (Section 5). The lower panel illustrates the estimated average weight of yellowfin tuna caught in all fisheries combined. The critical weight is drawn as the dashed horizontal line in the lower panel, and is a possible reference point for determining whether the fleet has been close to maximizing the yield per recruit.

FIGURA 5.2. Desempeño combinado de todas las pesquerías que capturan atún aleta amarilla en el OPO con respecto al rendimiento por recluta máximo. El recuadro superior ilustra el crecimiento (en peso) de una sola cohorte de aleta amarilla, e identifica la edad crítica y el peso crítico (Sección 5). El recuadro inferior ilustra el peso medio estimado del atún aleta amarilla capturado en todas las pesquerías combinadas. El peso crítico es representado por la línea de trazos horizontal en el recuadro inferior, y constituye un posible punto de referencia para determinar si la flota estuvo cerca de maximizar el rendimiento por recluta.

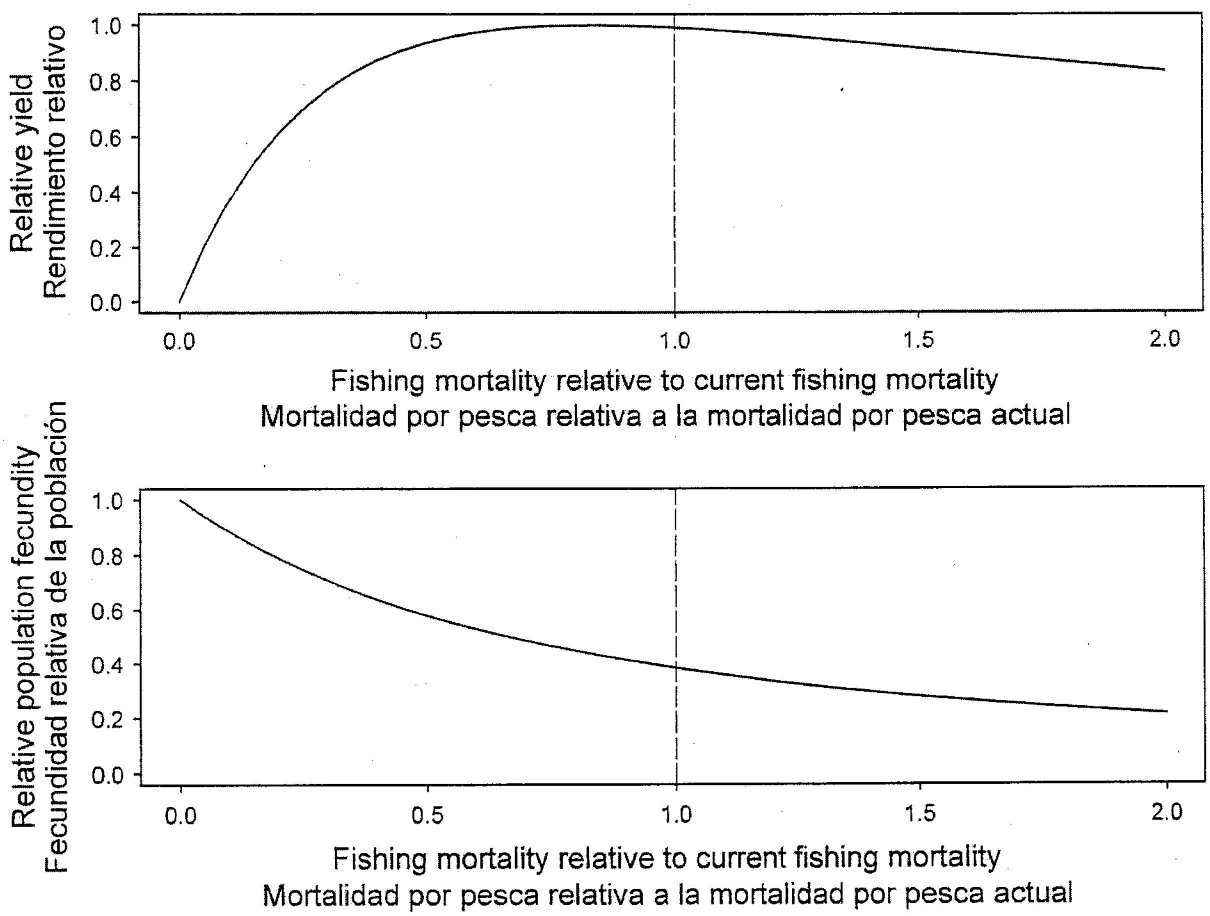
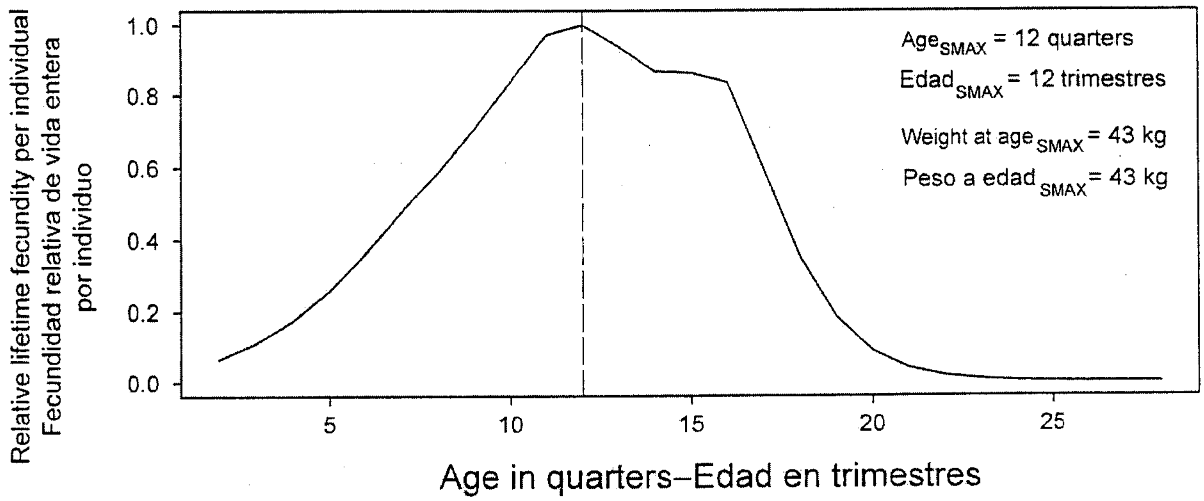


FIGURE 5.3. Predicted effects of long-term changes in fishing effort on the yield (upper panel) and spawning biomass (lower panel) of yellowfin tuna under average environmental conditions, constant recruitment, and the current age-specific selectivity pattern of all fisheries combined. The yield estimates are scaled so that the AMSY is at 1.0, and the spawning biomass estimates so that the spawning biomass is equal to 1.0 in the absence of exploitation.

FIGURA 5.3. Efectos predichos de cambios a largo plazo en el esfuerzo de pesca sobre el rendimiento (recuadro superior) y la biomasa reproductora (recuadro inferior) de atún aleta amarilla bajo condiciones ambientales medias, reclutamiento constante, y el patrón actual de selectividad por edad de todas las pesquerías combinadas. Se escalan las estimaciones de rendimiento para que el RMSP esté en 1,0, y las de biomasa reproductora para que ésta equivalga a 1,0 en ausencia de explotación.



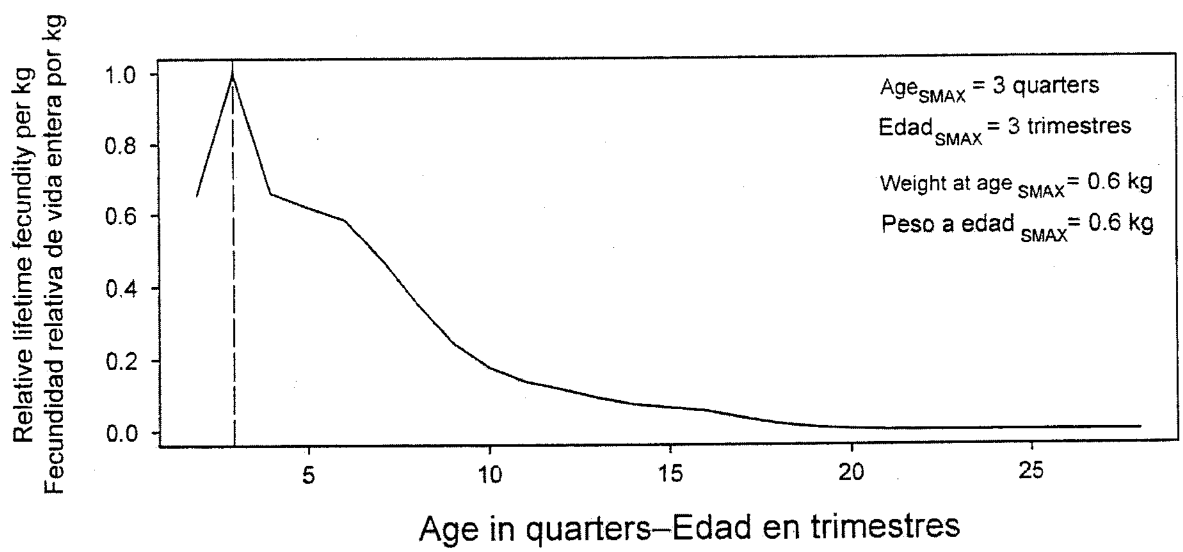


FIGURE 5.4. Marginal relative lifetime reproductive potential of yellowfin tuna at age based on individuals (upper panel) and weight (lower panel). Age_{SMAX} is the age at which the maximum marginal relative lifetime reproductive potential is realized. The vertical lines indicate the locations of Age_{SMAX}.
FIGURA 5.4. Potencial de reproducción relativo marginal de atún aleta amarilla a edad basado en individuos (recuadro superior) y peso (recuadro inferior). $Edad_{SMAX}$ es la edad a la cual se logra el potencial de reproducción relativo marginal máximo. Las líneas verticales señalan la posición de $Edad_{SMAX}$.

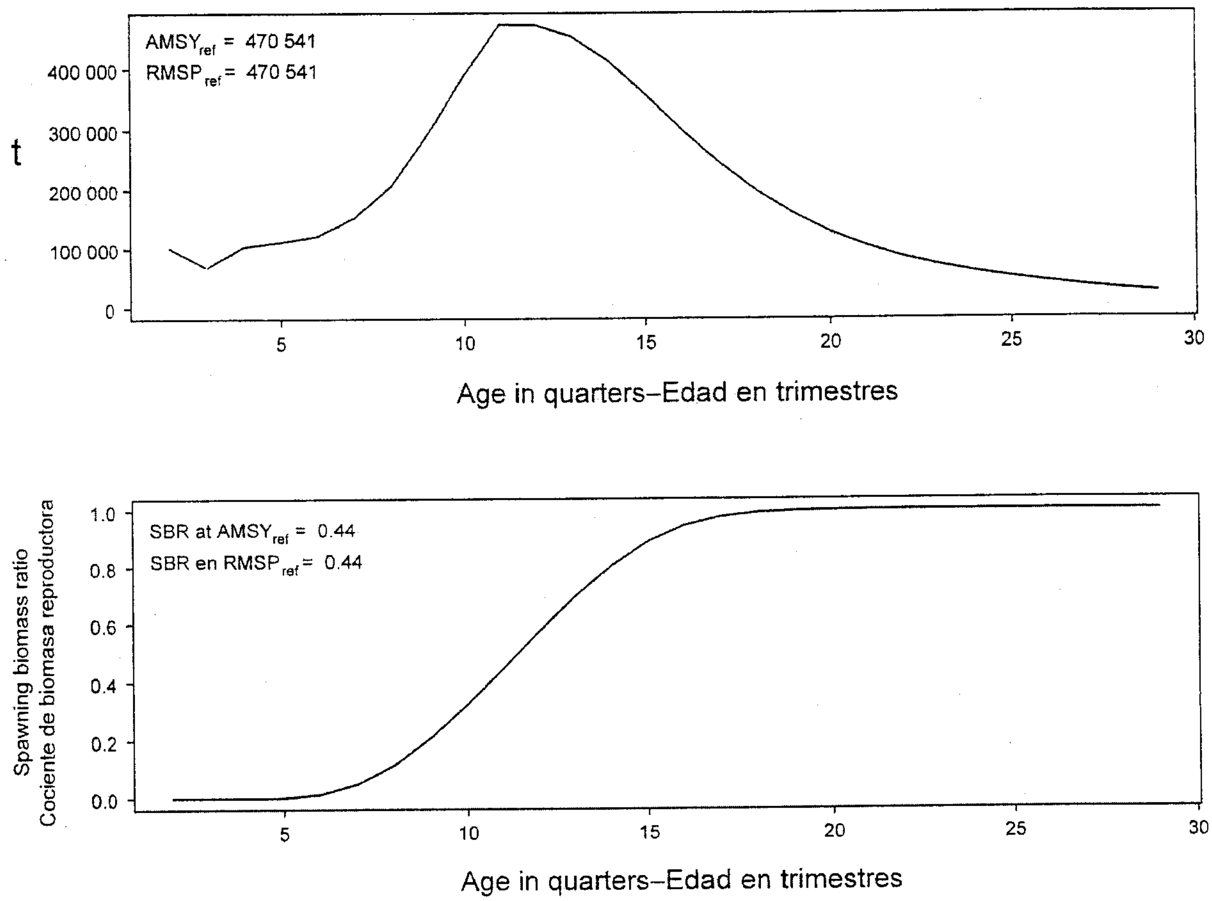


FIGURE 5.5. Yield calculated when catching only individual yellowfin tuna at a single age (upper panel) and the associated spawning biomass ratio (lower panel). t = metric tons.

FIGURA 5.5. Rendimiento calculado si se capturaran atunes aleta amarilla individuales de una edad solamente (recuadro superior) y el cociente de biomasa reproductora asociado (recuadro inferior). t = toneladas métricas.

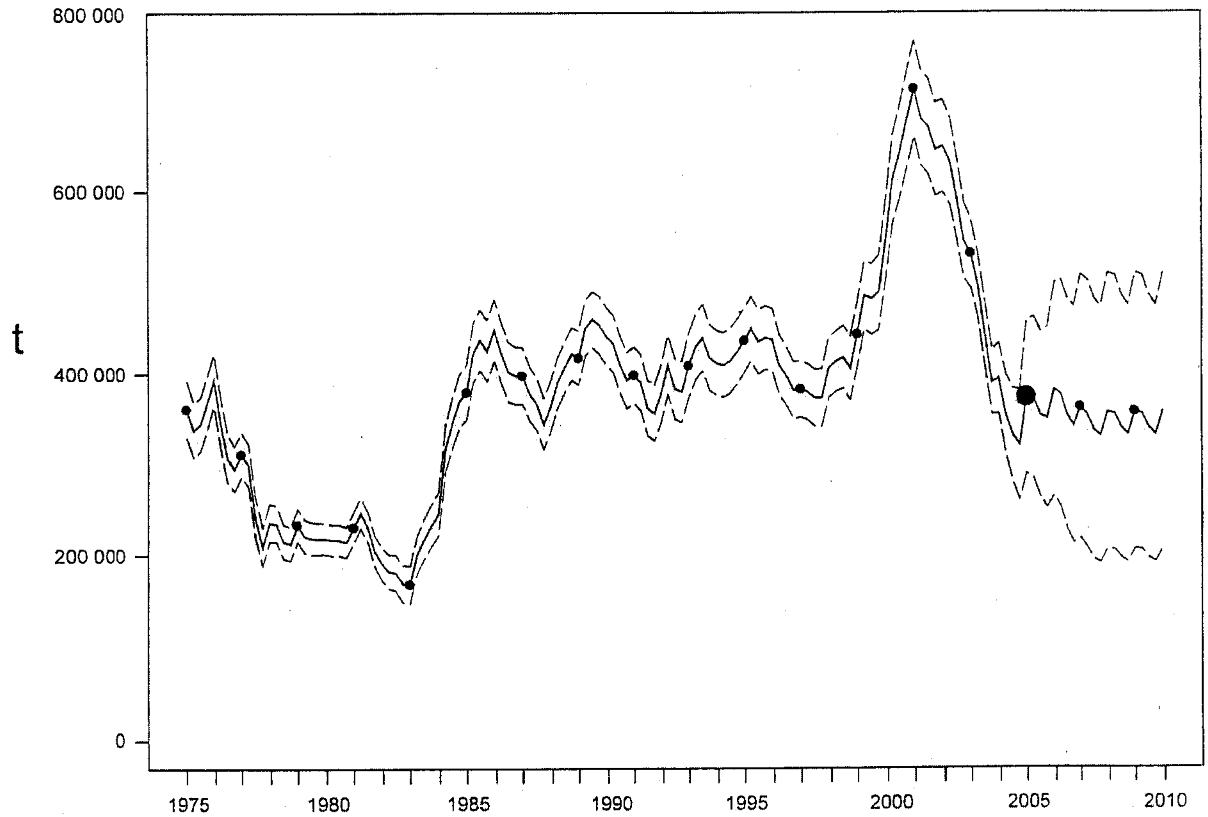


FIGURE 6.1. Biomasses projected during 2005-2009 for yellowfin tuna in the EPO under current effort. The thin dashed lines represent the 95% confidence intervals. The estimates after 2005 (the large dot) indicate the biomasses predicted to occur if the effort continues at the average of that observed in 2004, catchability (with effort deviates) continues at the average of that observed in 2002 and 2003, and average environmental conditions occur during the next 5 years. t = metric tons.

FIGURA 6.1. Biomasa predicha durante 2004-2008 de atún aleta amarilla con esfuerza corriente. Las líneas delgadas de trazos representan los intervales de confianza de 95%. Las estimaciones a partir de 2004 (el punto grande) señalan la biomasa predicho si el esfuerzo continúa en el nivel promedio de 2003, la capturabilidad (con desvíos de esfuerzo) continúa en el promedio de 2001 y 2002, y con condiciones ambientales promedio en los 10 próximos años. t = toneladas métricas.

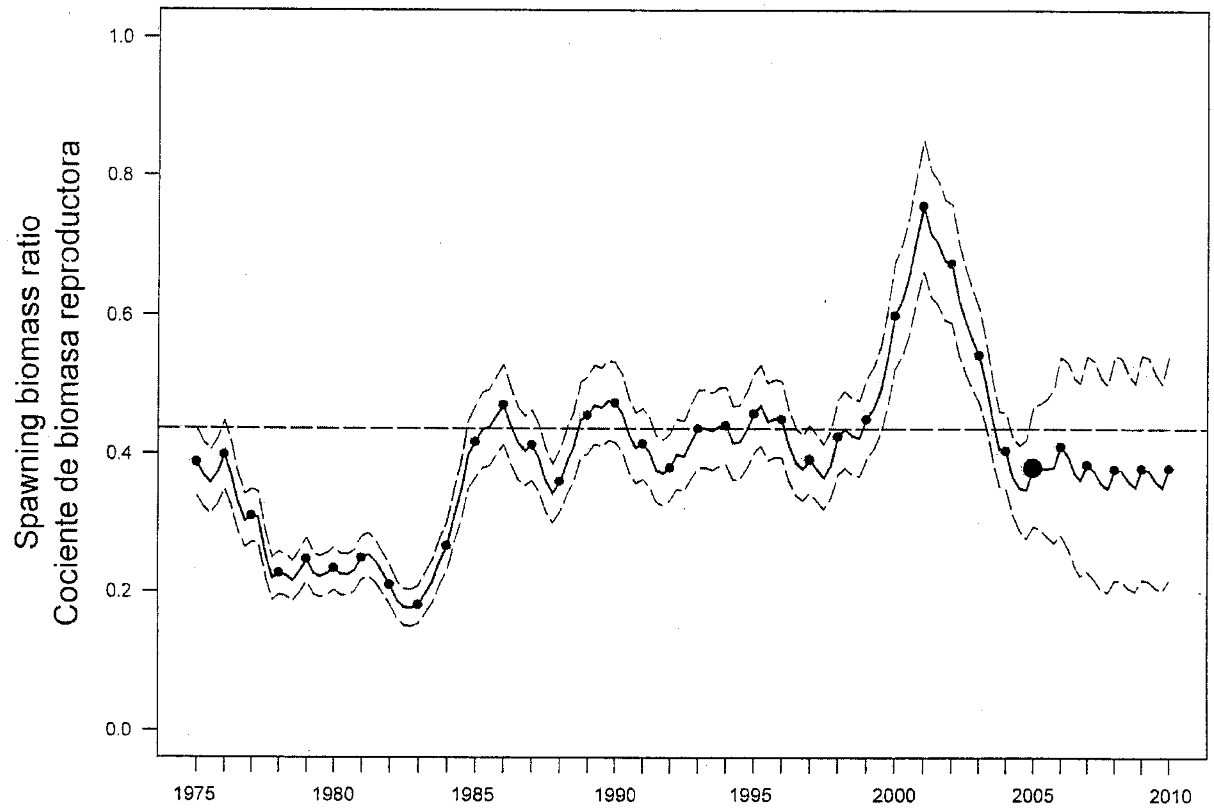


FIGURE 6.2. Spawning biomass ratios (SBRs) for 1975-2004 and SBRs projected during 2005-2009 for yellowfin tuna in the EPO by the likelihood profile approximation method. The dashed horizontal line (at 0.44) identifies SBR_{AMSY} (Section 5.3), and the thin dashed lines represent the 95% confidence intervals of the estimates. The estimates after 2005 (the large dot) indicate the SBR predicted to occur if the effort continues at the average of that observed in 2003, catchability (with effort deviates) continues at the average of that observed in 2002 and 2003, and average environmental conditions occur during the next 5 years.

FIGURA 6.2. Cocientes be biomasa reproductora (SBR) para 1975-2003 y SBRs proyectados durante 2004-2009 para el atún aleta amarilla en el OPO por el método de aproximación de perfil de verosimilitud. La línea de trazos horizontal (en 0.38) identifica SBR_{RMSP} (Sección 5.3), y las líneas delgadas de trazos representan los intervalos de confianza de 95% de las estimaciones. Las estimaciones a partir de 2004 (el punto grande) señalan el SBR predicho si el esfuerzo continúa en el nivel promedio de 2003, la capturabilidad (con desvíos de esfuerzo) continúa en el promedio de 2001 y 2002, y con condiciones ambientales promedio en los 10 próximos años.

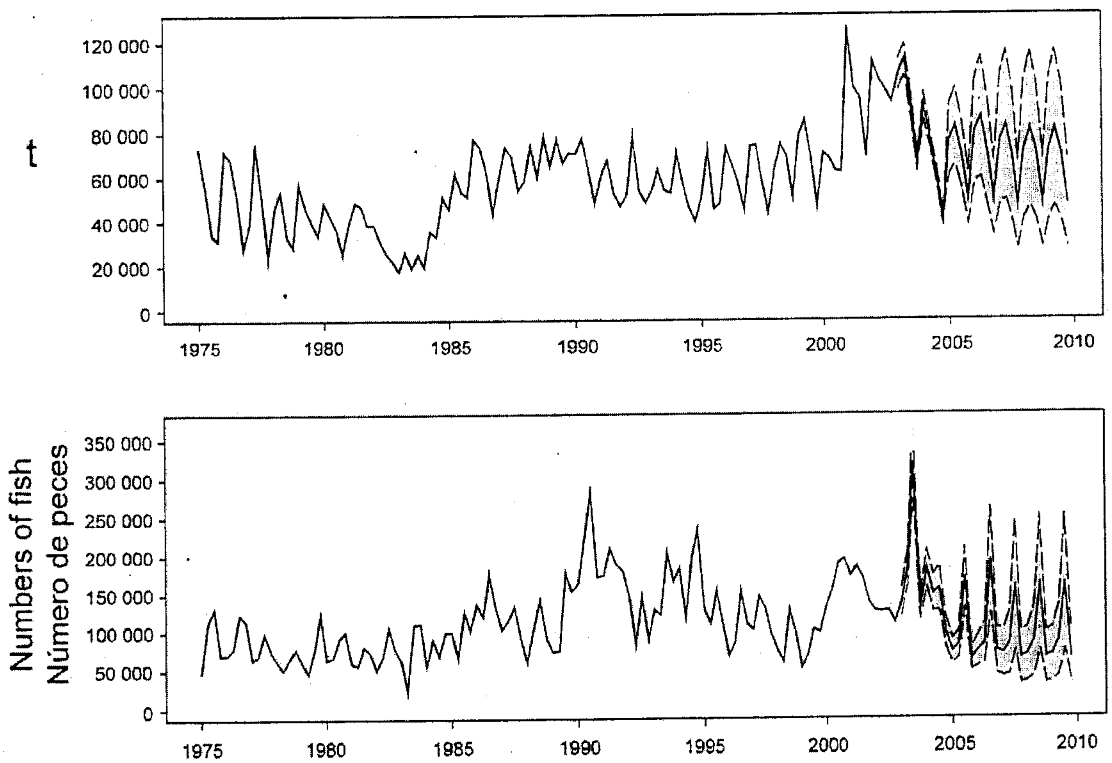


FIGURE 6.3. Catches of yellowfin tuna during 1975-2004 and simulated catches of yellowfin tuna during 2005-2009 by the purse-seine and pole-and-line fleets (upper panel) and the the longline fleet (lower panel), using the likelihood profile method. The thin dashed lines represent the estimated 95% confidence limits of the estimates. The estimates after 2005 indicate the catches predicted to occur if the effort continues at the average of that observed in 2004, catchability (with effort deviates) continues at the average of that observed in 2002 and 2003, and average environmental conditions occur during the next 5 years. t = metric tons.

FIGURA 6.3. Capturas de atún aleta amarilla durante 1975-2003 y capturas simuladas de atún aleta amarilla durante 2004-2008 por las flotas de cerco y caña (recuadro superior) y la flota palangrera (recuadro inferior), usando el método de aproximación de perfil de verosimilitud. Las líneas delgadas de trazos representan los intervalos de confianza de 95% de las estimaciones. Las estimaciones a partir de 2004 señalan las capturas predichas si el esfuerzo continúa en el nivel promedio de 2003, la capturabilidad (con desvíos de esfuerzo) continúa en el promedio de 2001 y 2002, y con condiciones ambientales promedio en los 10 próximos años. t = toneladas métricas.

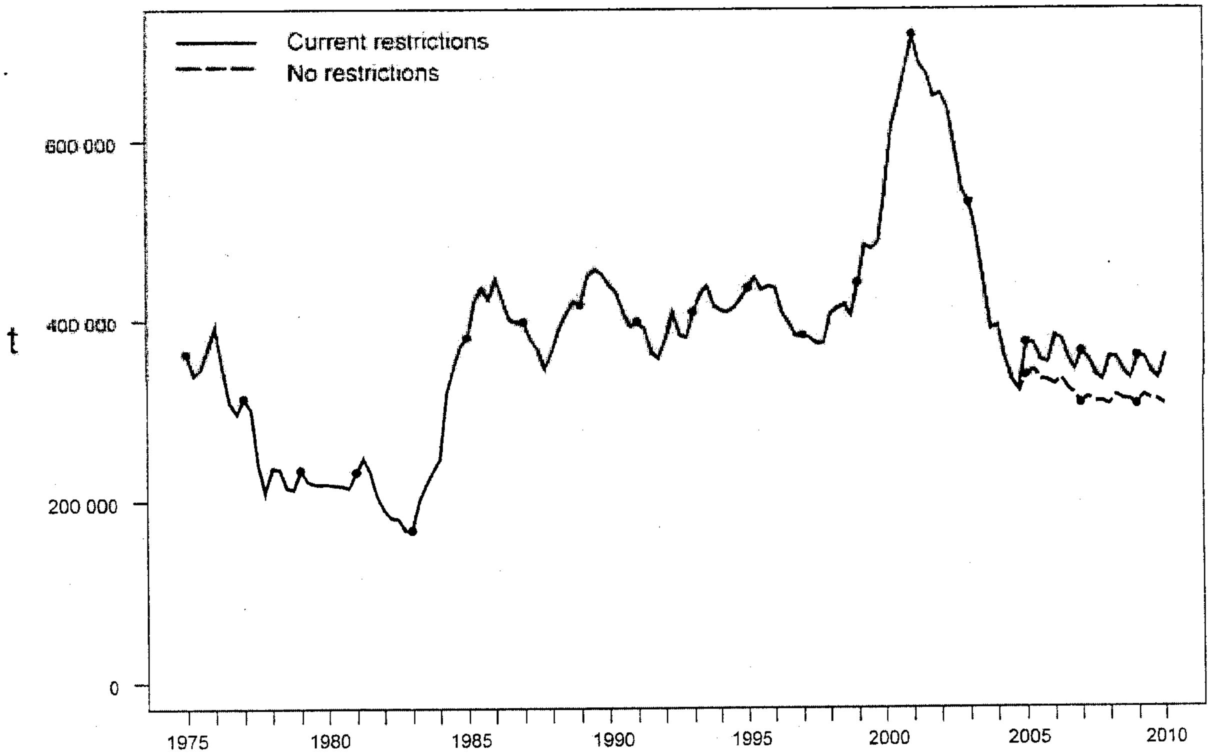


FIGURE 6.4. Biomass projected during 2004-2010 for yellowfin tuna in the EPO under the current resolution and under effort projected without the current resolution. t = metric tons.

FIGURA 6.4. Proyección de la biomasa de atún aleta amarilla en el OPO durante 2004-2008, con el esfuerzo actual y una veda de seis semanas de la pesquería de superficie en el tercer trimestre. t = toneladas métricas.

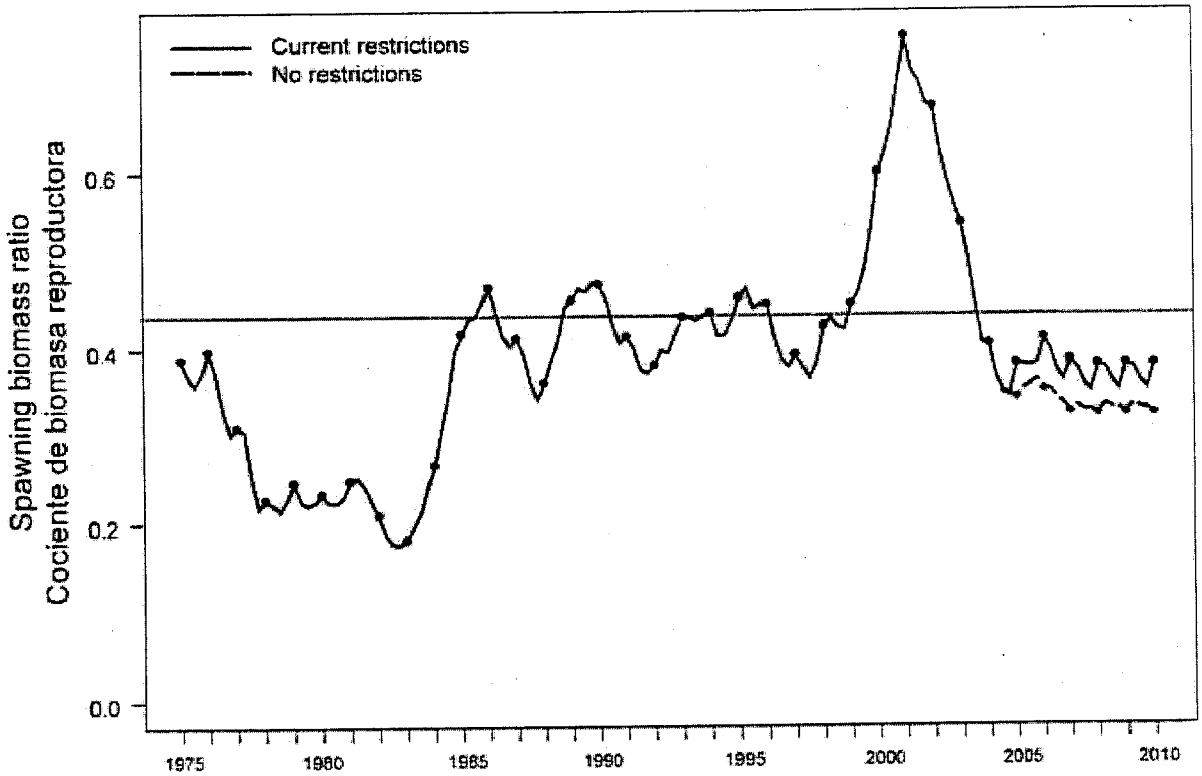


FIGURE 6.5. Spawning biomass ratios (SBRs) projected during 2004-2010 for yellowfin tuna in the EPO under the current resolution and under effort projected without the current resolution. The horizontal line (at 0.38) identifies SBR_{AMSY} (Section 5.3).

FIGURA 6.5. Cocientes de biomasa reproductora (SBR) de atún aleta amarilla en el OPO proyectados durante 2004-2008, con el esfuerzo actual y una veda de seis semanas de la pesquería de superficie en el tercer trimestre. La línea horizontal (en 0.38) identifica SBR_{RMSP} (Sección 5.3).

TABLE 2.1. Fisheries defined by the IATTC staff for the stock assessment of yellowfin tuna in the EPO. PS = purse seine; LP = pole and line; LL = longline; OBJ = sets on floating objects; NOA = sets on unassociated fish; DEL = sets on dolphin-associated schools. The sampling areas are shown in Figure 3.1, and descriptions of the discards are provided in Section 2.2.2.

TABLA 2.1. Pesquerías definidas por el personal de la CIAT para la evaluación del stock de atún aleta amarilla en el OPO. PS = red de cerco; LP = caña; LL = palangre; OBJ = lances sobre objeto flotante; NOA = lances sobre atunes no asociados; DEL = lances sobre delfines. En la Figura 3.1 se ilustran las zonas de muestreo, y en la Sección 2.2.2 se describen los descartes.

Fishery	Gear type	Set type	Years	Sampling areas	Catch data
Pesquería	**Tipo de arte**	**Tipo de lance**	**Año**	**Zonas de muestreo**	**Datos de captura**
1	PS	OBJ	1975-2004	11-12	retained catch + discards from inefficiencies in fishing process–captura retenida + descartes de ineficacias en el proceso de pesca
2	PS	OBJ	1975-2004	7, 9	
3	PS	OBJ	1975-2004	5-6, 13	
4	PS	OBJ	1975-2004	1-4, 8, 10	
5	PS	NOA	1975-2004	1-4, 8, 10	retained catch + discards–captura retenida + descartes
6	PS	NOA	1975-2004	5-7, 9, 11-13	
7	PS	DEL	1975-2004	2-3, 10	
8	PS	DEL	1975-2004	1, 4-6, 8, 13	
9	PS	DEL	1975-2004	7, 9, 11-12	
10	LP		1975-2004	1-13	retained catch only— captura retenida solamente
11	LL		1975-2004	N of-de 15°N	
12	LL		1975-2004	S of-de 15°N	
13	PS	OBJ	1993-2004	11-12	discards of small fish from size-sorting the catch by Fishery 1–descartes de peces pequeños de clasificación por tamaño en la Pesquería 1
14	PS	OBJ	1993-2004	7, 9	discards of small fish from size-sorting the catch by Fishery 2–descartes de peces pequeños de clasificación por tamaño en la Pesquería 2
15	PS	OBJ	1993-2004	5-6, 13	discards of small fish from size-sorting the catch by Fishery 3–descartes de peces pequeños de clasificación por tamaño en la Pesquería 3
16	PS	OBJ	1993-2004	1-4, 8, 10	discards of small fish from size-sorting the catch by Fishery 4–descartes de peces pequeños de clasificación por tamaño en la Pesquería 4

TABLE 4.1. Estimated total annual recruitment to the fishery at the age of two quarters (thousands of fish), initial biomass (metric tons present at the beginning of the year), and spawning biomass (relative to maximum spawning biomass) of yellowfin tuna in the EPO. Biomass is defined as the total weight of yellowfin one and half years of age and older; spawning biomass is estimated with the maturity schedule and sex ratio data of Schaefer (1998) and scaled to have a maximum of 1.

TABLA 4.1. Reclutamiento anual total estimado a la pesquería a la edad de dos trimestres (en miles de peces), biomasa inicial (toneladas métricas presentes al principio de año), y biomasa reproductora relativa del atún aleta amarilla en el OPO. Se define la biomasa como el peso total de aleta amarilla de año y medio o más de edad; se estima la biomasa reproductora con el calendario de madurez y datos de proporciones de sexos de Schaefer (1998) y la escala tiene un máximo de 1.

Year	Total recruitment	Biomass of age-1.5+ fish	Relative spawning biomass
Año	**Reclutamiento total**	**Biomasa de peces de edad 1.5+**	**Biomasa reproductora relativa**
1975	115,589	361,562	0.51
1976	90,494	393,454	0.53
1977	165,954	311,763	0.41
1978	149,665	236,243	0.30
1979	124,309	233,452	0.32
1980	107,929	218,601	0.31
1981	86,037	230,970	0.33
1982	133,313	191,249	0.28
1983	197,404	168,026	0.24
1984	170,785	245,485	0.35
1985	188,284	379,797	0.55
1986	173,106	447,594	0.62
1987	271,933	397,949	0.55
1988	211,366	364,913	0.48
1989	165,330	417,240	0.60
1990	161,520	440,361	0.63
1991	205,429	398,445	0.55
1992	192,850	378,480	0.50
1993	199,256	408,890	0.58
1994	161,156	411,785	0.58
1995	189,557	435,620	0.61
1996	220,907	436,551	0.60
1997	204,236	382,579	0.52
1998	312,539	406,164	0.56
1999	322,583	441,992	0.60
2000	232,415	547,965	0.79
2001	249,089	714,010	1.00
2002	198,357	650,888	0.89
2003	184,396	531,481	0.72
2004	237,874	393,843	0.53
2005		373,357	0.50

TABLE 4.2. Estimates of the average sizes of yellowfin tuna. The ages are expressed in quarters after hatching.

TABLA 4.2. Estimaciones del tamaño medio de atún aleta amarilla. Se expresan las edades en trimestres desde la cría.

Age (quarters)	Average length (cm)	Average weight (kg)	Age (quarters)	Average length (cm)	Average weight (kg)
Edad (trimestres)	**Talla media (cm)**	**Peso medio (kg)**	**Edad (trimestres)**	**Talla media (cm)**	**Peso medio (kg)**
2	30.00	0.51	16	150.74	74.74
3	30.87	0.56	17	155.44	82.17
4	40.89	1.33	18	159.62	89.19
5	47.41	2.1	19	163.32	95.71
6	54.04	3.15	20	166.58	101.73
7	63.27	5.13	21	169.44	107.23
8	74.47	8.48	22	171.96	112.22
9	88.89	14.65	23	174.16	116.72
10	103.97	23.76	24	176.08	120.74
11	118.11	35.2	25	177.76	124.33
12	125.98	42.96	26	179.22	127.51
13	133.12	50.93	27	180.50	130.33
14	139.6	58.98	28	181.60	132.81
15	145.47	66.97	29	182.56	134.99

TABLE 5.1. AMSY and related quantities for the base case and the stock-recruitment relationship sensitivity analysis.
TABLA 5.1. RMSP y cantidades relacionadas para el caso base y los análisis de sensibilidad a la relación población-reclutamiento.

	Base case	**h = 0.75**
	Caso base	**h = 0.75**
AMSY–RMSP	284,707	306,775
B_{AMSY}–B_{rm2}	419,598	531,276
S_{AMSY}—S_{rm2}	8,144	10,141
C_{RECENT}/AMSY—C_{2002}/RMSP	1.04	0.97
B_{RECENT}/B_{AMSY}–B_{2003}/B_{RMSP}	0.89	0.72
S_{RECENT}/S_{AMSY}–S_{2003}/S_{RMSP}	0.87	0.71
$S_{AMSY}/S_{F=0}$–$S_{RMSP}/S_{F=0}$	0.44	0.45
F multiplier—Multiplicador de *F*	0.83	0.67

TABLE 5.2a. Estimates of the AMSY and its associated quantities, obtained by assuming that each fishery maintains its current pattern of age-specific selectivity (Figure 4.4) and that each fishery is the only fishery operating in the EPO. The estimates of the AMSY and B_{AMSY} are expressed in metric tons. OBJ = sets on floating objects; NOA = sets on unassociated fish; DEL = sets on dolphin-associated fish; LL = longline.
TABLA 5.2a. Estimaciones del RMSP y sus cantidades asociadas, obtenidas suponiendo que cada pesquería mantiene su patrón actual de selectividad por edad (Figure 4.4) y que cada pesquería es la única operando en el OPO. Se expresan las estimaciones de RMSP y B_{RMSP} en toneladas métricas. OBJ = lance sobre objeto flotante; NOA = lance sobre atunes no asociados; DEL = lances sobre delfines; LL = palangre.

Fishery	AMSY	B_{AMSY}	S_{AMSY}	$B_{AMSY}/B_{F=0}$	$S_{AMSY}/S_{F=0}$	F multiplier
Pesquería	**RMSP**	B_{RMSP}	S_{RMSP}	$B_{RMSP}/B_{F=0}$	$S_{RMSP}/S_{F=0}$	**Multiplicador de F**
All—Todos	284,707	419,598	8,144	0.34	0.44	0.83
OBJ	167,534	321,446	5,513	0.26	0.30	8.35
NOA	241,677	386,264	7,203	0.31	0.39	4.08
DEL	312,582	420,757	8,299	0.34	0.45	1.47
LL	397,336	467,831	9,495	0.38	0.51	25.37

TABLE 5.2b. Estimates of the AMSY and its associated quantities, obtained by assuming that each fishery maintains its current pattern of age-specific selectivity (Figure 4.4) and that one fishery is not operating in the EPO. The estimates of the AMSY and B_{AMSY} are expressed in metric tons. FLT = = sets on floating objects; UNA = sets on unassociated fish; DOL = sets on dolphin-associated fish; LL = longline.
TABLA 5.2b. Estimaciones del RMSP y sus cantidades asociadas, obtenidas suponiendo que cada pesquería mantiene su patrón actual de selectividad por edad (Figure 4.4) y que cada pesquería es la única operando en el OPO. Se expresan las estimaciones de RMSP y B_{RMSP} en toneladas métricas. FLT = lance sobre objeto flotante; UNA = lance sobre atunes no asociados; DOL = lances sobre delfines; LL = palangre.

Fishery	AMSY	B_{AMSY}	S_{AMSY}	$B_{AMSY}/B_{F=0}$	$S_{AMSY}/S_{F=0}$	F multiplier
Pesquería	**RMSP**	B_{RMSP}	S_{RMSP}	$B_{RMSP}/B_{F=0}$	$S_{RMSP}/S_{F=0}$	**Multiplicador de F**
All—Todos	284,707	419,598	8,144	0.34	0.44	0.83
No FLT	294,097	420,315	8,195	0.34	0.44	1.32
No UNA	281,202	412,575	7,993	0.33	0.43	1.32
No DOL	229,561	385,841	7,171	0.31	0.38	2.43
No LL	268,528	403,271	7,730	0.33	0.41	1.12

APPENDIX A: SENSITIVITY ANALYSIS FOR THE STOCK-RECRUITMENT RELATIONSHIP

ANEXO A: ANALISIS DE SENSIBILIDAD A LA RELACIÓN POBLACIÓN-RECLUTAMIENTO

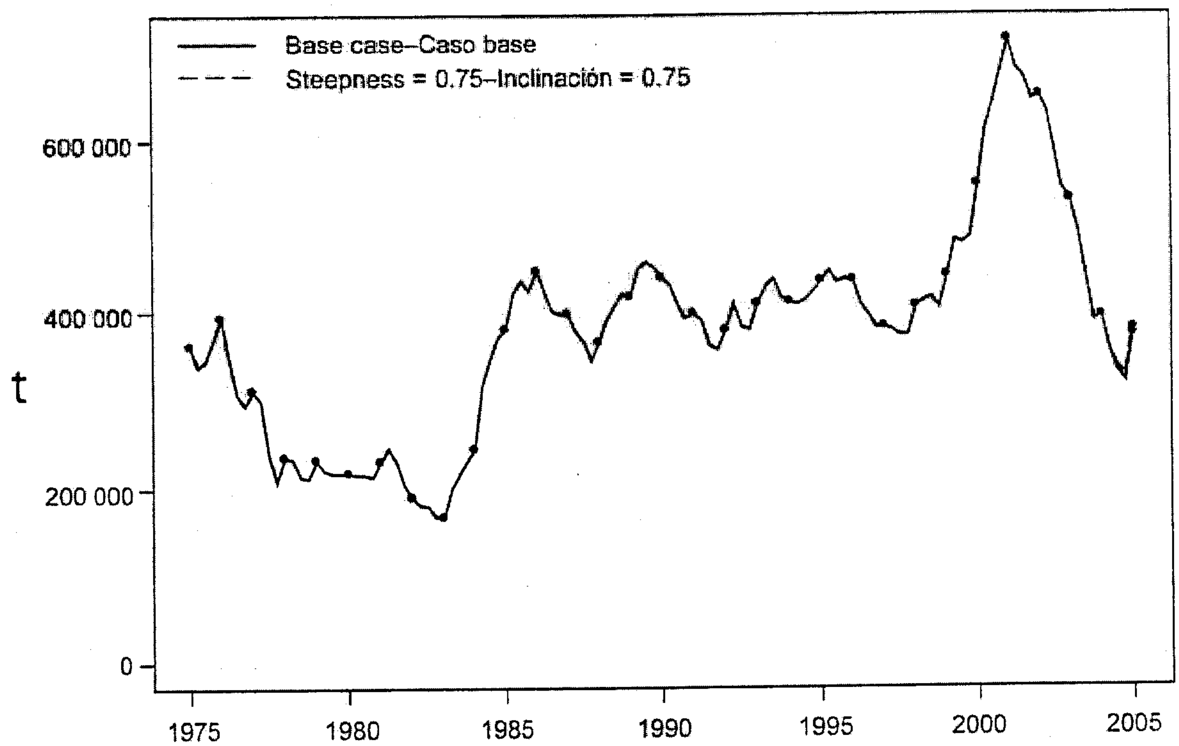


FIGURE A.1. Comparison of the estimates of biomass of yellowfin tuna from the analysis without a stock-recruitment relationship (base case) and with a stock-recruitment relationship (steepness = 0.75).
FIGURA A.1. Comparación de las estimaciones de la biomasa de atún aleta amarilla del análisis sin relación población-reclutamiento (caso base) y con relación población-reclutamiento (inclinación = 0,75).

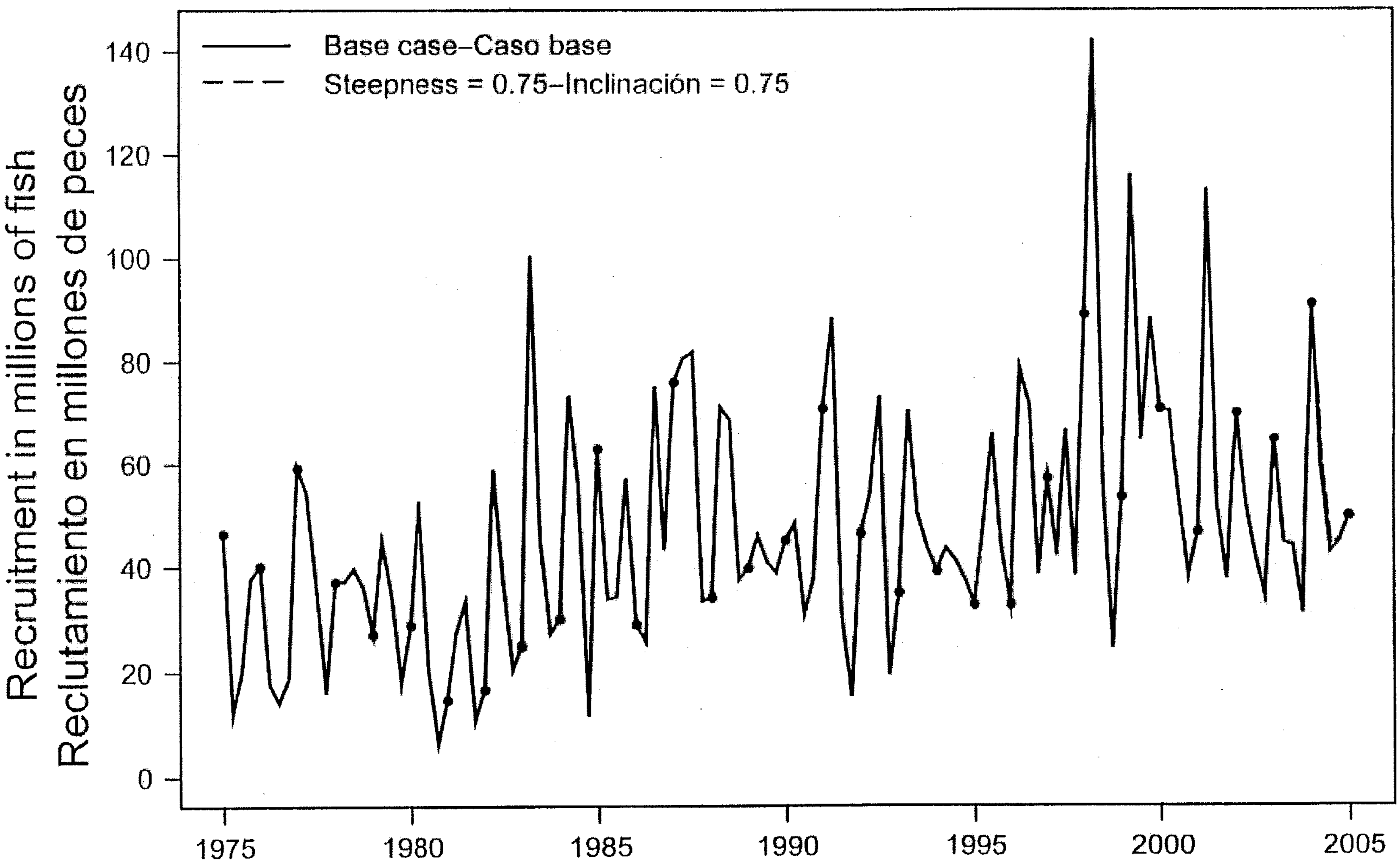


FIGURE A.2. Comparison of estimates of recruitment of yellowfin tuna from the analysis without a stock-recruitment relationship (base case) and with a stock-recruitment relationship (steepness = 0.75).

FIGURA A.2. Comparación de las estimaciones de reclutamiento de atún aleta amarilla del análisis sin relación población-reclutamiento (caso base) y con relación población-reclutamiento (inclinación = 0,75)

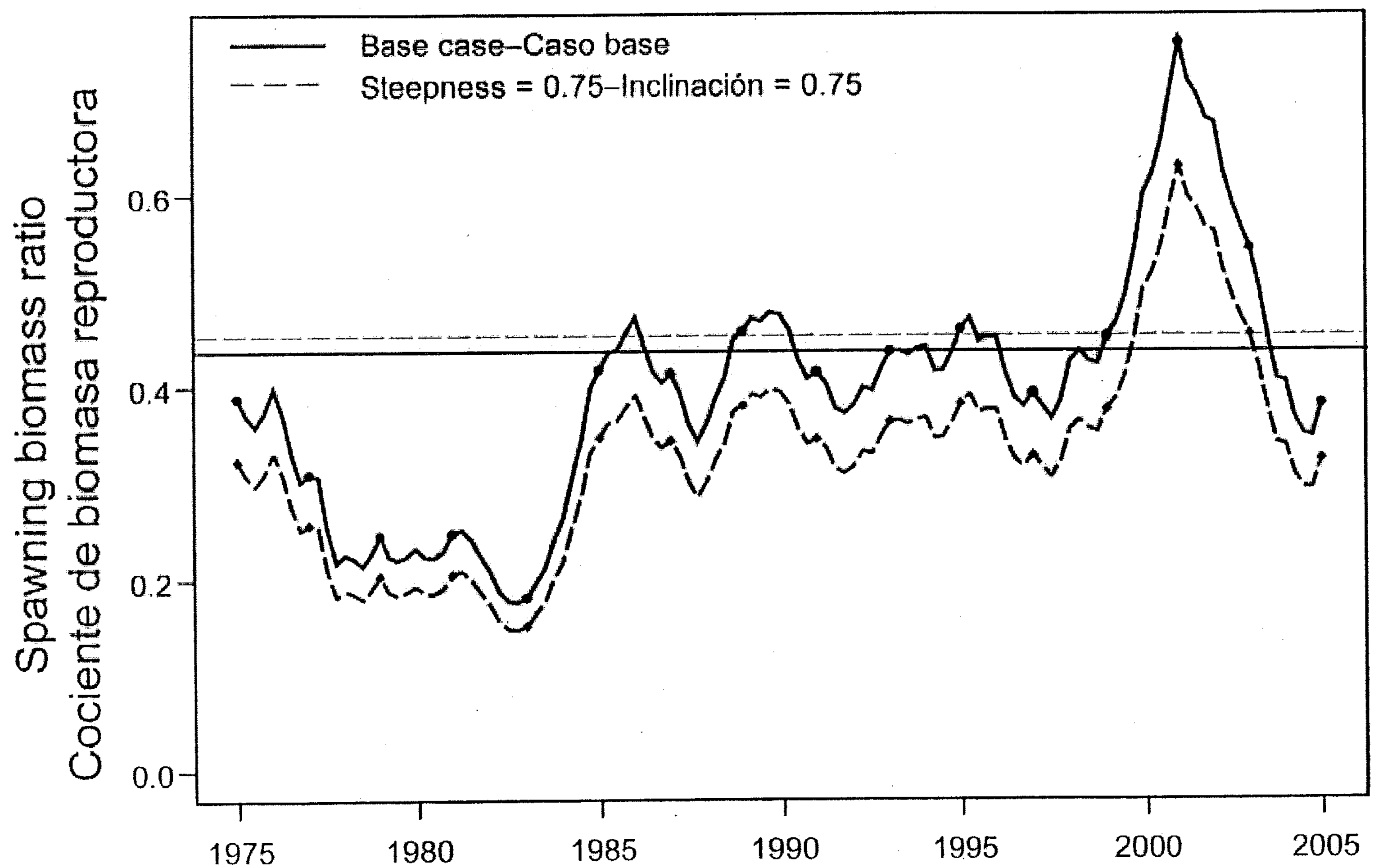


FIGURE A.3. Comparison of estimates of the spawning biomass ratio (SBR) of yellowfin tuna from the analysis without a stock-recruitment relationship (base case) and with a stock-recruitment relationship (steepness = 0.75). The horizontal lines represent the SBRs associated with AMSY for the two scenarios.

FIGURA A.3. Comparación de las estimaciones del cociente de biomasa reproductora (SBR) de atún aleta amarilla del análisis sin (caso base) y con relación población-reclutamiento (inclinación = 0,75). Las líneas horizontales representan el SBR asociado con el RMSP para los dos escenarios.

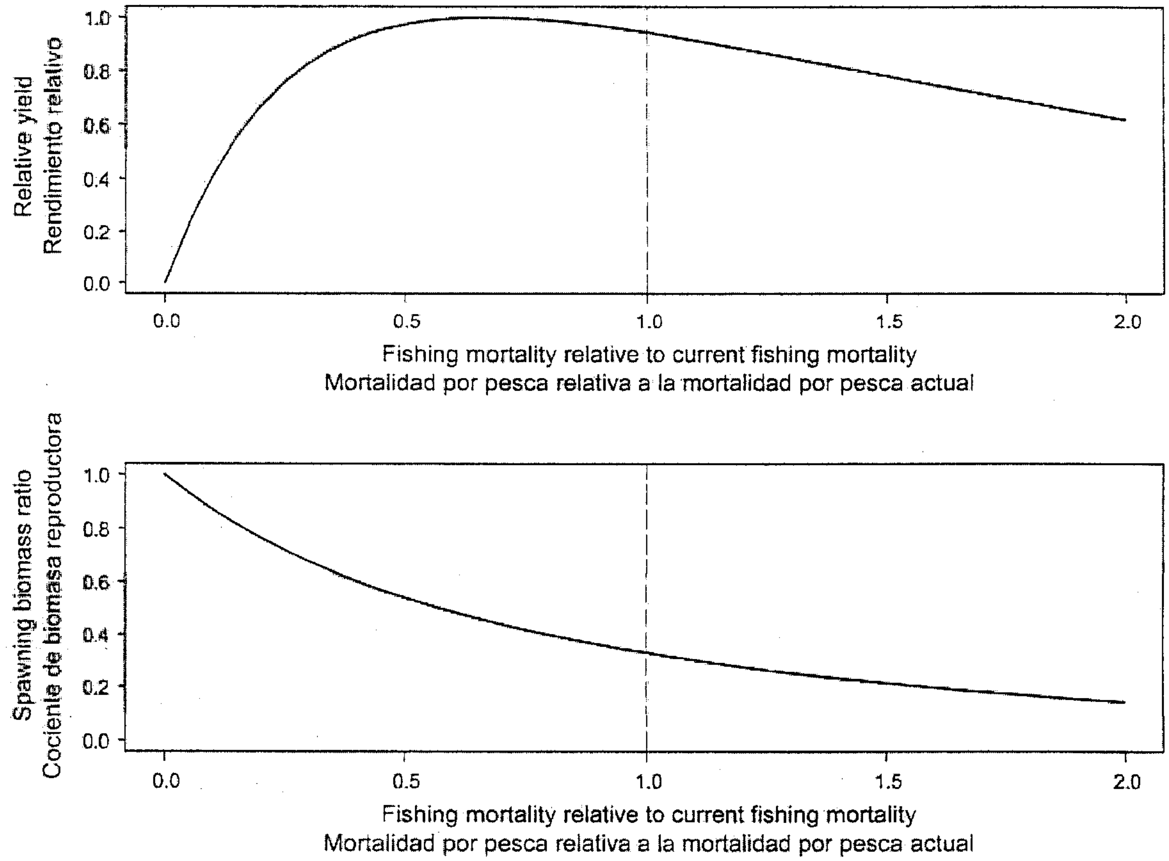


FIGURE A.4. Relative yield (upper panel) and the associated spawning biomass ratio (lower panel) of yellowfin tuna when the stock assessment model has a stock-recruitment relationship (steepness = 0.75).
FIGURA A4. Rendimiento relativo (recuadro superior) y el cociente de biomasa reproductora asociado (recuadro inferior) de atún aleta amarilla cuando el modelo de evaluación de la población incluye una relación población-reclutamiento (inclinación = 0.75).

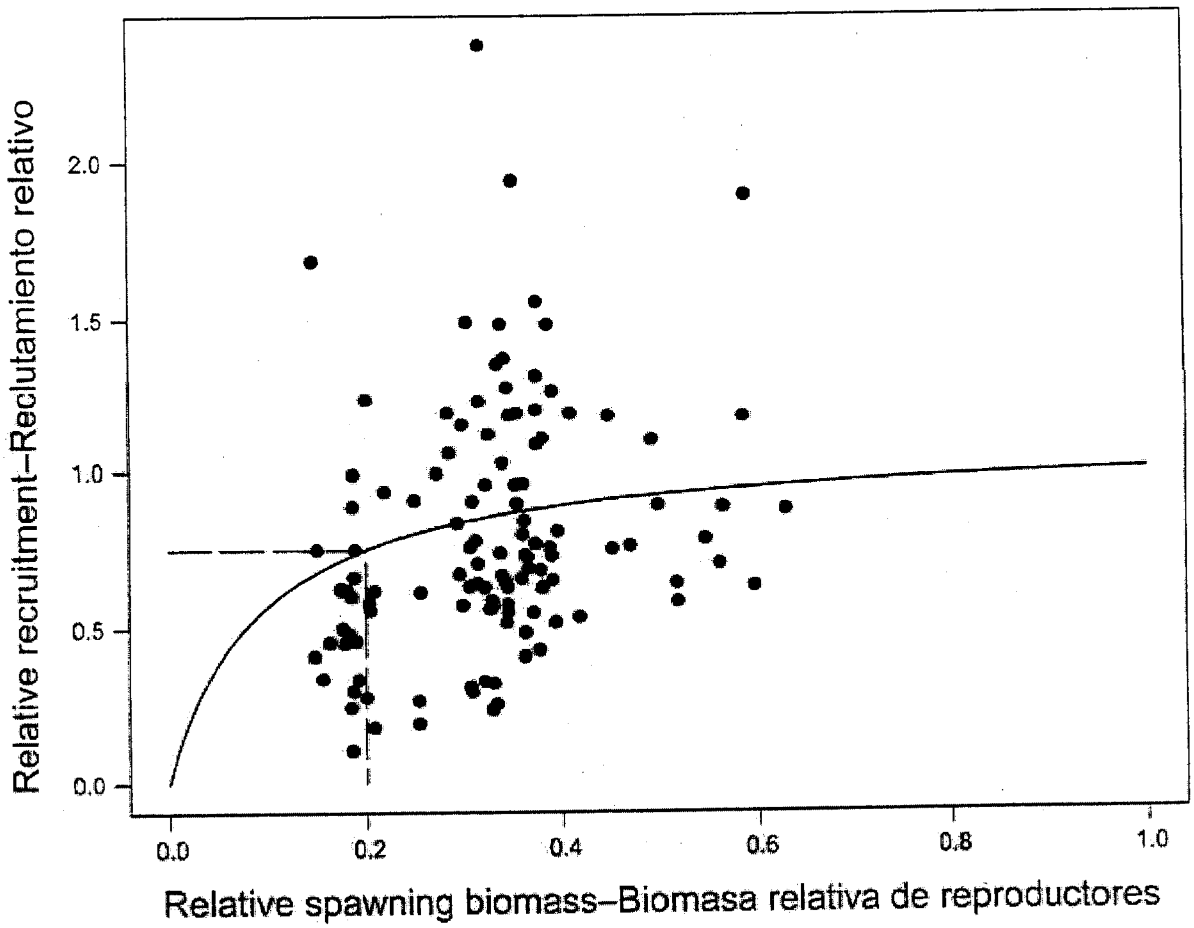


FIGURE A.5. Recruitment plotted against spawning biomass of yellowfin tuna when the analysis has a stock-recruitment relationship (steepness = 0.75).
FIGURA A.5. Reclutamiento graficado contra biomasa reproductora de atún aleta amarilla cuando el análisis incluye una relación población-reclutamiento (inclinación = 0,75).

APPENDIX B: ADDITIONAL RESULTS FROM THE BASE CASE ASSESSMENT

This appendix contains additional results from the base case assessment of yellowfin tuna in the EPO. These results are annual summaries of the age-specific estimates of abundance and total fishing mortality rates. This appendix was prepared in response to requests received during the second meeting of the Scientific Working Group.

ANEXO B: RESULTADOS ADICIONALES DE LA EVALUACION DEL CASO BASE

Este anexo contiene resultados adicionales de la evaluación de caso base del atún aleta amarilla en el OPO: resúmenes anuales de las estimaciones por edad de la abundancia y las tasas de mortalidad por pesca total. Fue preparado en respuesta a solicitudes expresadas durante la segunda reunión del Grupo de Trabajo Científico.

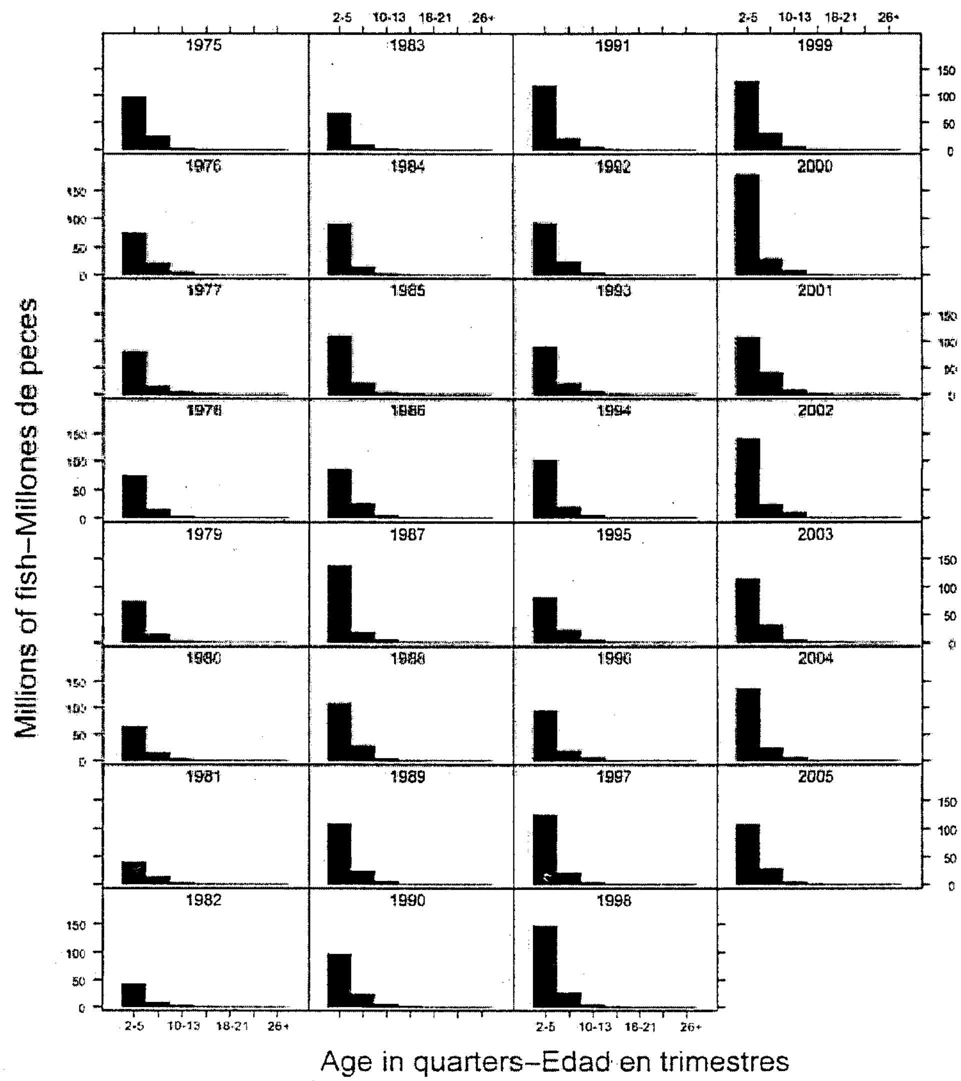


FIGURE B.1. Estimated numbers of yellowfin tuna present in the EPO on January 1 of each year.
FIGURA B.1. Número estimado de atunes aleta amarilla presentes en el OPO el 1 de enero de cada año.

TABLE B.1. Average annual fishing mortality rates for yellowfin tuna in the EPO.
TABLA B.1. Tasas de mortalidad por pesca anual media para el atún aleta amarilla en el OPO.

Year	Age in quarters—Edad en trimestres						
Año	2-5	6-9	10-13	14-17	18-21	22-25	26+
1975	0.0537	0.6136	1.1050	1.6660	0.2719	0.3536	0.5231
1976	0.0684	0.5879	1.1348	1.3179	0.6077	0.9451	1.5771
1977	0.0624	0.6679	1.0846	1.3398	0.7305	1.0263	1.6900
1978	0.1950	0.7952	1.1041	1.5989	0.4898	0.6702	0.9857
1979	0.1756	0.8907	1.2469	2.3370	0.6370	1.0077	1.7134
1980	0.1346	0.7534	1.3010	2.2882	0.4998	0.7515	1.2675
1981	0.2231	0.7658	1.2120	1.8981	0.7127	1.2420	2.1453
1982	0.1477	0.6834	1.1296	1.6538	0.5774	0.7854	1.2186
1983	0.1203	0.4271	0.8201	0.8484	0.4275	0.6176	0.8097
1984	0.0943	0.4388	0.7814	0.7735	0.3703	0.5164	0.7840
1985	0.0509	0.5408	0.9088	0.8342	0.3218	0.4206	0.6005
1986	0.0849	0.5521	1.1790	1.2534	0.2991	0.3798	0.5102
1987	0.0785	0.6481	1.1948	1.0207	0.3091	0.3966	0.5337
1988	0.1389	0.6653	1.2448	1.6935	0.3846	0.5069	0.7321
1989	0.1065	0.6458	1.0365	1.5412	0.4696	0.6910	1.1149
1990	0.0819	0.5782	1.2255	1.6433	0.4742	0.6348	0.8969
1991	0.0653	0.5485	1.1470	1.2327	0.4585	0.6286	0.9289
1992	0.0897	0.5416	1.1324	1.2384	0.3116	0.3818	0.5306
1993	0.1273	0.5413	0.8775	1.1083	0.3346	0.4218	0.5445
1994	0.0923	0.5189	0.9802	1.4580	0.5214	0.7562	1.1870
1995	0.0773	0.4555	0.8817	1.1689	0.3846	0.5845	0.9749
1996	0.1228	0.6130	1.0062	1.0459	0.2551	0.3251	0.4768
1997	0.1134	0.6921	1.2503	1.6889	0.6119	0.9656	1.4433
1998	0.0931	0.6324	1.1016	1.4582	0.3968	0.5603	0.8490
1999	0.1310	0.5683	1.1229	1.4075	0.2207	0.3072	0.4506
2000	0.0913	0.4312	0.7321	1.0154	0.4611	0.6496	1.1011
2001	0.1150	0.5267	1.0421	1.2529	0.5024	0.7743	1.3767
2002	0.0949	0.6014	1.0757	1.2234	0.4488	0.7654	1.3882
2003	0.0926	0.7456	1.5647	2.0204	0.8411	1.0856	1.6799
2004	0.0679	0.6192	1.5780	2.8401	1.4532	2.1868	3.3235

APPENDIX C: DIAGNOSTICS
ANEXO C: DIAGNÓSTICOS

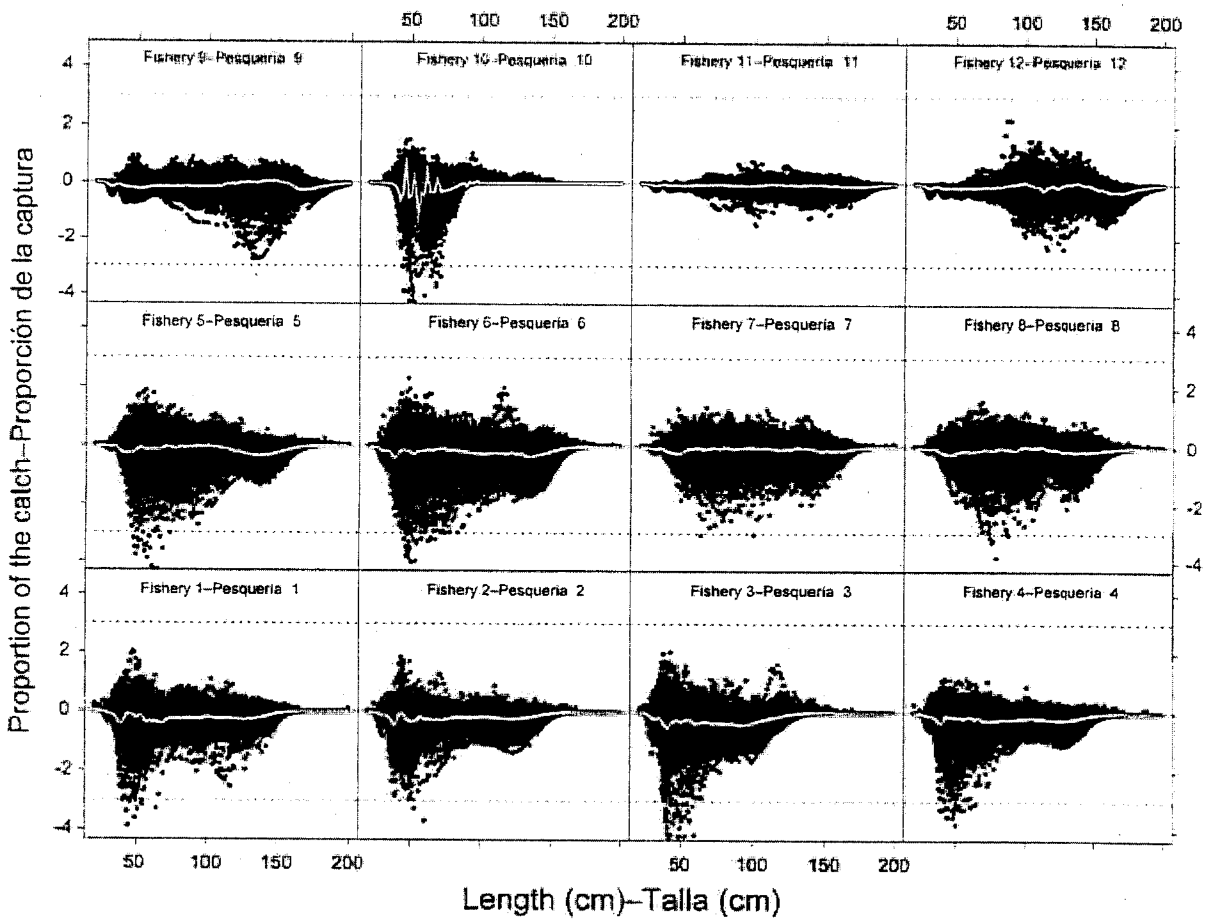


FIGURE C.1. Standardized residuals for the length-frequency data of yellowfin tuna by length. The dotted horizontal lines represent three standard deviations on either side of the mean.
FIGURA C.1. Residuales estandarizados para los datos de frecuencia de talla de atún aleta amarilla, por talla. Las líneas horizontales con puntos representan tres desviaciones estándar en cualquier lado del medio.

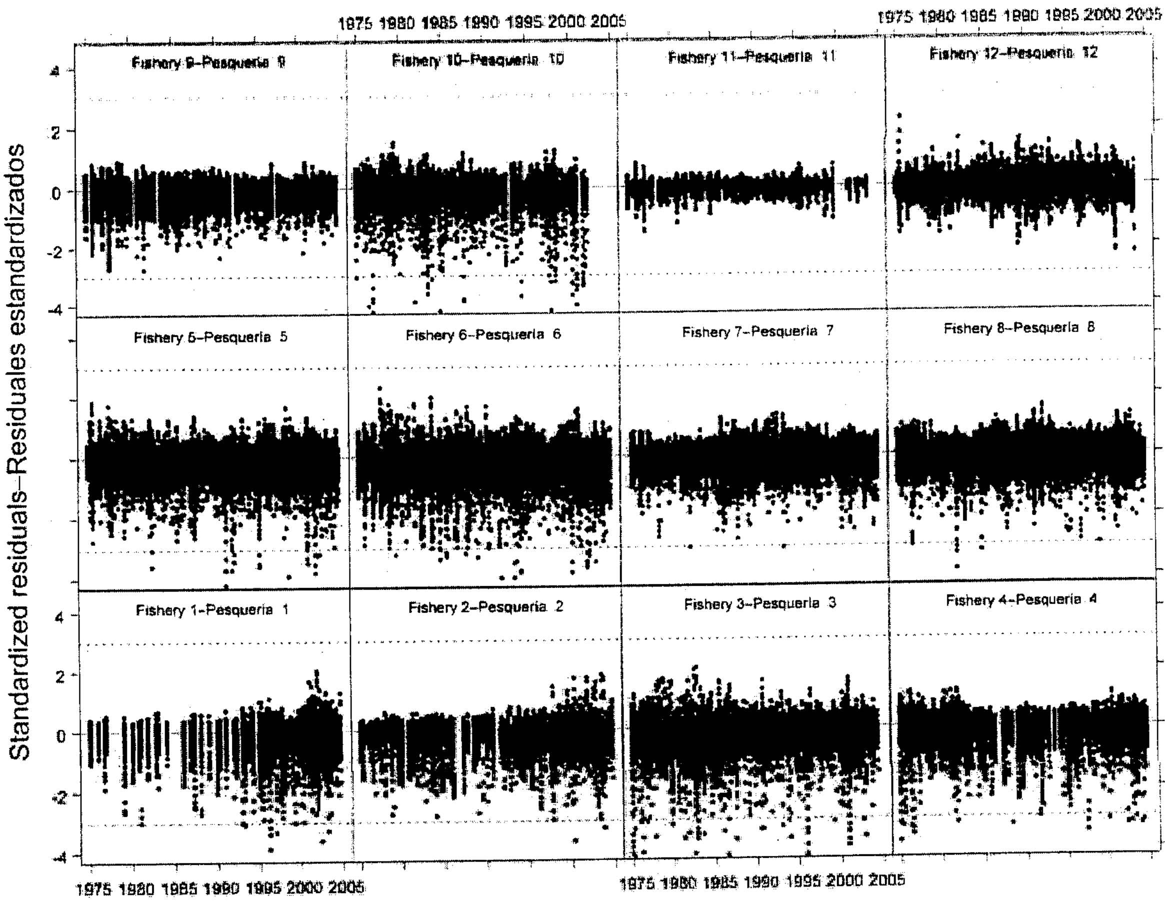


FIGURE C.2. Standardized residuals for the length-frequency data of yellowfin tuna by quarter. The dotted horizontal lines represent three standard deviations on either side of the mean.

FIGURA C.2. Residuales estandarizados para los datos de frecuencia de talla de atún aleta amarilla, por trimestre. Las líneas horizontales con puntos representan tres desviaciones estándar en cualquier lado del medio.

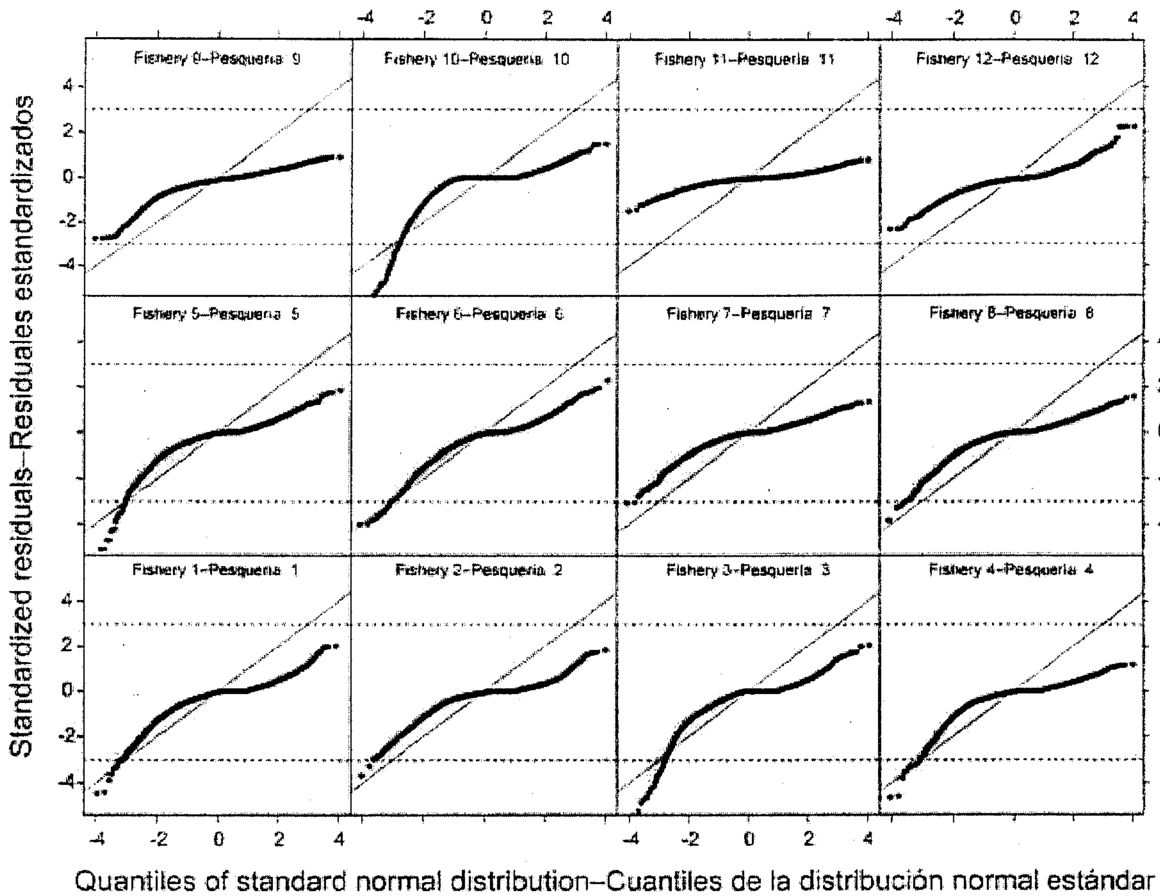


FIGURE C.3. Q-Qnorm plots for the length-frequency data for yellowfin tuna. The diagonal lines indicate the expectations for the residuals following normal distributions. The dotted horizontal lines represent three standard deviations on either side of the mean.

FIGURA C.3. Gráficas de Q-Qnorm para los datos de frecuencia de talla para atún aleta amarilla. Las líneas diagonales indican las expectativas de los residuales siguiendo distribuciones normales. Las líneas horizontales con puntos representan tres desviaciones estándar en cualquier lado del medio.

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HIGHLY MIGRATORY SPECIES MANAGEMENT TEAM REPORT ON CHANGES TO ROUTINE MANAGEMENT MEASURES

Following the submission of the Highly Migratory Species Management Team's (HMSMT) report for the Council briefing book, the Team received another suggested alternative from Chuck Janisse, Federation of Independent Seafood Harvesters (see attached email). Specifically, with regard to the proposed changes to the drift gillnet fishery regulations Mr. Janisse is requesting that the following alternative be included in the suite of alternatives approved for public review:

4. Require all drift gillnet vessels fishing north of 45° N. latitude have an at-sea federal observer onboard the vessel.

   Discussion: While the bycatch data from the Washington/Oregon drift gillnet experimental fishery was not previously used, it suggests that there may be encounters with leatherback sea turtles and/or marine mammals in the area north of 45° N. latitude; therefore, collecting additional data to determine whether a closure is needed may be warranted. However, as noted under Alternative 1, the one Oregon vessel that has fished this area is "unobservable"; therefore there is no way to monitor its bycatch. By requiring an at-sea observer to be onboard the vessel in order to fish in this area, observable vessels could continue to fish in this area, and NMFS could collect data on bycatch and protected species interactions, which could be used to support actions in the future. Additional discussions would be needed with the NMFS SWR Observer Program in regards to available funding and other administrative and logistical considerations for meeting a 100% observer requirement per this alternative.

   NMFS is currently testing an electronic monitoring system for drift gillnet vessels. The Council could expand the definition of the observer requirement for this alternative to include electronic monitoring. This would offer the possibility that vessels which cannot accommodate a federal at-sea observer could fish in this area.

<u>HMSMT Recommendation:</u>

1. Consider adding Alternative 4 to the suite of alternatives for public review that address the Drift Gillnet Turtle Closure Northern Boundary issue and decide whether to include electronic monitoring as meeting the observer requirement under this alternative.

Attachment: Email from Chuck Janisse, Federation of Independent Seafood Harvesters

Subject: Proposed DGN Regulation Alternatives
From: "Chuck Janisse"
Date: Sun, 3 Sep 2006 21:18:35 -0400
To: "Kit Dahl" , "Craig Heberer" , "Dale Squires" , "Elizabeth Petras" , "Jean McCrae" , "Michele Culver" , "Stephen Stohs" , "Steve Wertz" , "Suzanne Kohin"
CC: "Wayne Heikkila" , "Kit Dahl" , "Mark Helvey"

Highly Migratory Teamsters--

Regarding the proposed set of alternatives noted in the HMSMT Report, and corresponding meeting summary, relating to a change in the northern boundary of the leatherback turtle closed area, I submit the following comments for your consideration:

As stated in the meeting summary, "The genesis for this proposal is the discontinuity between the Washington closure and the seasonal closure farther south" (and not an enforcement issue as originally stated).

Follwing this rationale, if eliminating area closure discontinuity is the operative goal, and closing the area north of 45 fixes such discontinuity, it would then be logical to close the area south of 45 in order to fix that discontinuity. Close the DGN fishery and there will be no more discontinuity.

Concerning the staus quo alternative, the concern expressed in the HMSMT Report is that since the only Oregon permitted vessel that has fished the area is unobservable, there is no way to monitor its bycatch of protected species, especially leatherback sea turtles. This stated concern implies that a regulation requiring observers on all vessels that fish this area would provide data to reveal whether or not protective measures are needed. However, none of the presented alternatives take such an approach. Rather, it's assumed, absent current data, that closing the area north of 45 is necessary to guard against the possible depletion of protected resources by a single unobservable vessel. Not only is closure rationale weak in the extreme, it smacks of a punative action toward this particular vessel.

Concerning the alternative proposing to extend the leatherback closure boundary from 45 north to the Oregon/Washington border during the August 15-November 15 period, discussion in the HMSMT Report suggests that because observer data from the 1986-88 experimental thresher shark fishery was not considered in the 2000 BiOp that this ESA based time/area closure should be augmented six years after the fact, based on 18 year-old observer data that does not account for the difference in bycatch that may have resulted by the implemenation of Take Reduction Plan regulations, as well as HMS FMP regulations that prohibit DGN fishing within the 1,000 fathom curve off Oregon.

Further, observer data (32 sets) for the 1986 and 1987 experimental DGN thresher shark fishery, reported protected resource takes totaling 3 marine mammals(1 Pacific white-sided dolphin, 1 Harbor porpoise, and 1 Northern sea lion), all takes occuring in early July. Observer data (68 sets)for the 1988 experimental DGN thresher shark fishery reported protected resource takes totaling 28 marine mammals (8 Pacific white-sided dolphin, 6 Harbor porpoise, 4 Dall's porpoise, 4 Risso's dolphin, 2 Northern right whale dolphin, 1 unidentified large whale, and 3 Harbor seal), and 13 leatherback sea turtles. Of the 13 leatherbacks, 10 of them (6 of which were caught in one set) were caught north of the Oregon/Washington border, and the remaining 3 were caught before August 10th. None of the leatherback takes occured in time/area closure being proposed in this alternative. There is a rational basis problem for a time/area closure based on observer data that is unrelated to the regulation being proposed.

Concerning the alternative prohibiting the use of DGN north of 45 year-round, although the HMSMT Report notes that this alternative was analyzed in the HMS FMP, I can find no such analysis. A mere description of the proposed closure (Alternative 7) is all that Chapters 8 or 9 contain. There is no data or other compelling rationale to support such this restriction.

Please understand that my comments are offered in the spirit and support of rational HMS management decision-making. I'm concerned that, based on the information contained in the HMSMT Report, the Council does not have the best available information, nor range of alternatives for this proposed action upon which to rationally select a prefered alternative.

--Chuck Janisse

ENFORCEMENT CONSULTANTS REPORT ON CHANGES TO ROUTINE MEASURES ALTERNATIVES

The Enforcement Consultants (EC) have the following comments regarding the Highly Migratory Species Management Team Report dated September 2006:

- The numbers of foreign vessels entering U.S. waters has increased. The National Oceanic and Atmospheric Administration currently has two open cases under investigation where Mexican flagged vessels are allegedly reported to be fishing in U.S. waters. The California charter boat group has reported increases in the number of Mexican vessels observed entering and fishing in U.S. waters.

- Preventing foreign vessels from taking U.S. resources, and in this case valuable highly migratory species (HMS), will be enhanced with the ability to identify U.S. vs. foreign vessels from the air under Options 3 & 4 (from U.S. Coast Guard over-flights for example). This will allow at-sea enforcement to target suspect vessel incursions that lack visible markings. Without the markings only helicopters can effectively be used. With marking C-130s can be used and more flights over a larger area can be accomplished.

- The EC understands that this currently is only a southern California issue but the requirements would apply coastwide under the options provided. The Council may want to discuss limiting the rule to some area in southern California. Currently Oregon and Washington have a very small HMS charter vessel fleet and no real need to over fly this fleet has been identified.

The EC prefers Option 3, requirement for weather deck markings for all HMS charter boat vessels.

PFMC
09/12/06

Alliance for Responsible Recreational Fishing

August 26, 2006

Mr. Wayne Heikkila, Chairman
Highly Migratory Species Advisory Subpanel
Pacific Fisheries Management Council
PO Box 992723
Redding, CA 96099

Mr. Craig Heberer
Highly Migratory Species Management Team
Pacific Fisheries Management Council
501 W Ocean Blvd, Ste 4200
Long Beach, CA 90802-4213

RE: RECREATIONAL TAKE OF SPAWNING FEMALE THRESHER SHARK

Dear Mr. Heikkila and Mr. Heberer:

The Alliance for Responsible Recreational Fishing is a group of conservation-minded commercial and sport fishermen and women formed to promote, as the name suggests, responsible recreational fishing in California's ocean waters. We write you today to express our concern regarding the above subject matter.

We have noticed an increasing trend in Southern California ocean recreational fishing to target large female thresher shark (*Alopius vulpinus*) when they come near to shore in the spring to pup. Obviously, these large females are carrying young of the year, representing the future of the thresher shark population off the West Coast. Both the scientific and popular literature are filled with articles about how sharks reproduce slowly, females carrying only a few pups each year, and pup survivorship also an issue. In the current dialogue on marine protected areas (marine reserves), Dr. Mark Hixon of Oregon State University has repeatedly made the case that "big old fat females" of fish are far more important that the smaller female fish, due to the strong positive relationship between fish body size and number of young produced. Thus, this growing fishery is targeting the most important part of the reproducing stock of thresher shark off California.

This fishery takes place from San Diego to Newport Beach during the months of April through June. On any given weekend, there may be anywhere from a few dozen up to several hundred recreational fishing boats in this area, targeting thresher sharks. When word circulates that the sharks are inshore, boat numbers swell into the hundreds.

Our concerns stem from several facts regarding this recreational fishery, as follows:

- Currently the legal bag limit for thresher shark is 2 per day per angler. This implies that during the peak of this spawning aggregation fishery, and conservatively assuming 2 anglers per boat, up to 1,200 or so thresher shark may be taken ***per day***, many of which will be large females carrying young of the year. Four sharks per boat is a very conservative estimate, since charter recreational fishing boats are commonly known as "six-packs," licensed to carry six anglers per trip. While catch-and-release is practiced by a small proportion of the recreational fishery, it is also known that a certain proportion of mortalities result from catching and fighting these sharks for minutes to hours.

Further, because sharks may be released, any given boat may catch far more than two per person per day, or four per boat per day. The problem here is that, due to the gear used (see below), sharks may be tail hooked, dragged backwards and therefore drown during this process. So mortalities of large pregnant female thresher sharks may be quite a bit larger than one might think, and very little data is available to judge the merits of this recreational fishery activity.

- Some recreational fishing lobbying groups are currently supporting a change in the bag limit to one large pregnant female thresher shark per day. Unfortunately, this will not resolve the issues we are concerned about, due to the continued catch-and-release of as many large pregnant female thresher shark as a boat wishes to catch, with its associated mortalities from snagged sharks and/or the trauma of the fight to subdue the shark. Further, this fishery is rapidly growing recreationally, and more and more anglers will be entering the fishery, making moot a halving of the daily bag limit.

We respectfully request that, in order to achieve responsible recreational fishing goals for thresher shark, a gear change be required: the use of multi-hook baits and lures should be prohibited, and replaced with a regulation requiring single hook lures only. With this change the chance that a large pregnant female thresher shark will be snagged and dragged backward and drowned to death will be significantly reduced.

While there may be a minority of recreational thresher shark anglers that use circle hooks, minimizing the possibility of snagging and tail dragging pregnant female thresher sharks, it is well known, and passed from angler to angler, tackle shop to tackle shop, and around the docks, what type of terminal tackle gives the angler the highest probability of a hookup. Currently, this terminal tackle consists of a large (6-12") "hoochie-"type lure which may have multiple hooks in it, followed by a baitfish, like a mackerel or sardine, connected to the back of the hoochie with its own double albacore barbed hook or treble hook in the baitfish, followed by a trailing double or treble hook. This array of hooks has a high probability of snagging a thresher shark in other places besides the mouth, with the result being a snagged shark being dragged backwards through the water, known to kill sharks by "drowning" them (oxygen starvation).

It bears mention here that the 2003 Pew Oceans Commission Report "Ecological Effects of Fishing" authored by Drs. Paul Dayton and Simon Thrush specifically calls out the ill-advised practice of fishing on spawning aggregations, thus:

> Species that aggregate to spawn are often targeted by fishers who know where and when the aggregations occur (Ames, 1998; Dayton et al., 2000). Not only are individuals removed from populations, but also entire aggregations can be eliminated. A spawning aggregation, once eliminated, may never recover.

So it is well known, with specific examples from throughout the world, that recreational fishing in spawning areas of fishes may have severe negative impacts on fish stocks. At the very least, our recommendations should be implemented to minimize the damage being done to the future of the thresher shark stocks off the West Coast, for the future of recreational and commercial anglers and the seafood consuming public who have enjoyed fresh, local thresher shark in local markets for decades.

Thank you for considering our request that your advisory body take up at your September, 2006 meeting, the issue of a conservation-minded gear regulation change to minimize incidental harm to the future of the thresher shark stock on the West Coast represented by this burgeoning recreational thresher shark fishery in Southern California.

Sincerely,

Dr Fred Hepp

Dr. Fred Hepp, Conservation Manager

c: Dr. Don McIsaac, PFMC ED
Mr. Zeke Grader, PCFFA

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September 5, 2006

Mr. Donald K. Hansen
Chairman
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, Oregon 97220-1384

Dear Chairman Hansen:

I am writing on behalf on the Sea Turtle Restoration Project (STRP), a nonprofit organization representing over 5000 members, regarding the proposal before the Pacific Fishery Management Council (PFMC) to change the northern boundary of the leatherback turtle closure. We would like to express our support of the alternative that would prohibit the use of drift gillnet gear north of 45^0 latitude year round.

The Pacific leatherback sea turtle nesting population remains critically endangered and has plummeted from over 90,000 in 1980 to fewer than 5,000 in 2002, a decrease of 95%. Scientists warn that unless the mortality from drift gillnet and longline fishing is reduced the leatherback may go extinct in the next 5-30 years. The vulnerability of the leatherback's survival was highlighted in a recent report by the United Nations that declared the Malaysian population effectively extinct. All other Pacific leatherback populations continue to remain well below abundance levels and in an overall state of decline.

Leatherback sea turtles are known to be present along the Oregon coast, migrating across the Pacific to this important foraging area. We support any conservation measures that would increase protection for this critically endangered species and other marine life including endangered whales, seals, sea lions, sea birds and dolphins from further decline due to impacts of drift gillnet fishing, which has a long history of byctach problems.

The closure of waters north of 45^0 latitude to drift gillnet fishing provides the opportunity to put in place critical protection measures for the leatherback sea turtle and other threatened and endangered marine animals whilst having little impact on the drift gillnet fishing industry. As stated in the discussion by the Highly Migratory Species Management Team at their June meeting although up to ten Developmental Fishery permits can be issued each year for drift gillnet fishing in Oregon only one was issued in 2004 and no fishing occurred in 2005. Together with this, only a small number of drift gillnet vessels from California have fished in Oregon waters. Therefore economic impacts of this closure would appear to be minimal, whilst providing an important and extremely effective conservation measure.

In addition such a closure would be in accordance with the Endangered Species Act (ESA) which requires that federal departments use methods and procedures necessary to bring an threatened or endangered species back to a point at which it no longer requires protection under the ESA. By implementing a closure of waters north of 45^0 latitude to drift gillnet fishing the PFMC will be taking an important step in helping such a recovery of the leatherback sea turtle.

Recently the Council has been focused on rolling back effective protection measures in place for the leatherback sea turtle. They recommended at their March 2006 meeting the issuing of an Exempted Fishing Permit that would allow drift gillnet fishing back into the Pacific Leatherback Conservation Area and are currently considering such a permit that would allow longline fishing back along the US West Coast. At a time when the leatherback is facing such threats, it is encouraging to see the Council considering a proposal that would *increase* protections for this critically endangered species.

The Sea Turtle Restoration Project strongly encourages the PFMC to implement the alternative to prohibit the use of drift gillnet gear north of latitude 45^0 year round. We appreciate that turtle conservation issues are international in scope, and we encourage the Council to coordinate with the Western Pacific Fishery Management Council and international bodies to improve turtle protections across the Pacific. We would like to work with NOAA Fisheries and the Council in finding comprehensive solutions to overcome the serious threats to sea turtles in both U.S. and international waters. We believe implementing and increasing such protections for sea turtles along the U.S. Pacific coast is an essential element of this process.

We appreciate the opportunity to comment. If you have any questions about this important matter, please contact me at (415) 488-0370, ext. 106.

Sincerely

Karen Steele
Campaign Coordinator

Advocates for Wild, Healthy Oceans

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September 5, 2006

Mr. Donald K. Hansen, Chairman
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, Oregon 97220-1384

RE: Highly Migratory Species – Changes to Routine Management Measures – Drift Gillnet Fishery Regulations (Agenda E.1)

Dear Chairman Hansen:

As you are well aware, the current Pacific Leatherback Conservation Area time/area closure has been tremendously effective at minimizing take of endangered sea turtles since its implementation. Currently, the Council is considering the need to adjust the northern boundary to the leatherback closure. We commend the HMS Management Team for presenting the Council with a suite of management alternatives that embody a precautionary approach to management and enhance protections for this critically endangered species.

In less than three generations, leatherback sea turtle populations have suffered precipitous declines. Some populations are hovering on the brink of extinction due to high levels of incidental and intentional take throughout the Pacific region, with overall nesting population reductions in excess of 90-percent. Fisheries mortality has been especially problematic for leatherbacks. In 2000, NMFS for the first time found that operation of the drift-gillnet (DGN) fishery was likely to jeopardize the continued existence of leatherback sea turtles, stating that, “any additional impacts to the western Pacific leatherback stocks are likely to maintain or exacerbate the decline in these populations,” and that such effects “would be expected to appreciably reduce the likelihood of both the survival and recovery of the Pacific Ocean population of the leatherback sea turtle.” 2000 Biological Opinion at 94. In order to meet it’s obligation under the Endangered Species Act to ensure that the fishery would not cause jeopardy to the species, NMFS instituted a seasonal closure to the DGN fishery in the waters off California and Oregon Coasts. 66 Fed. Reg. 44549. Since 2000, areas north of Point Conception to 45° North latitude off the central Oregon coast, and out beyond the Exclusive Economic Zone (EEZ) to 129° West longitude, have been closed to DGN fishing from August 15th through November 15th each year to protect leatherback sea turtles which seasonally inhabit these waters.

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Recent satellite telemetry and aerial survey research on leatherback turtles in this region affirm that these waters provide important foraging grounds for animals originating from rookeries in the western Pacific. Moreover, observer data shows that there have been no recorded takes of leatherback sea turtles during the past three years, indicating that the DGN closures have been largely effective. Still, leatherbacks remain critically endangered and highly vulnerable to non-selective fishing practices and other human disturbances. While the effects of extending the boundary of the leatherback closure northward to the Oregon/Washington border or prohibiting the use of drift gillnet gear north of 45° North latitude year round are unknown, greater precaution and protection is warranted given the level of scientific uncertainty and the precarious state of leatherback populations. The final management decision should be governed by the most current biological information and incorporate a level of precaution to account for any uncertainty.

While the leatherback closure was designed to minimize interactions between the DGN fishery and sea turtles, it also plays an important role in protecting marine mammals, sharks, seabirds, and other target and non-target fish species. Adjusting the boundaries to increase the size of the leatherback closure or restrict indiscriminate drift-gillnet fishing altogether will provide incidental benefits to other protected, endangered and otherwise at-risk species. We also recognize that ease of enforcement plays a large role in determining the effectiveness of conservation measures, therefore we encourage the Council and NMFS to select an alternative that is precautionary, reflects the best available science and facilitates monitoring and enforcement efforts.

We appreciate your time and consideration of our comments and are willing to work with the Council and NMFS to promote more effective sea turtle conservation along the Pacific coast. If you have any questions, please do not hesitate to contact us.

Sincerely,

Wallace J. Nichols, PhD
Senior Research Scientist

Meghan Jeans
Pacific Fish Conservation Manager

Jim Martin
West Coast Regional Director
The Recreational Fishing Alliance
P.O. Box 2420
Fort Bragg, CA 95437

Monday, September 11, 2006
PFMC SEPTEMBER 2006
Item: E.1.b - Public Comment

To: Don Hansen, Chair
Pacific Fisheries Management Council
Re: Albacore Bag limits in the recreational fishery

Dear Chairman Hansen,

The RFA recognizes the need for The US West Coast recreational anglers to consider a bag limit on albacore. As a member of ITTC the US is bound to comply with measures adopted by the commission. It appears that albacore is heading in an overfished status by large-scale foreign fleets and US fishermen will have to make sacrifices based on this situation. It is the RFA's opinion that it would be prudent for our sector to set up reasonable bag limits prior to NOAA Fisheries forcing more unreasonable limits before obligations and compliance to the International Treaty demand we do.

While largely symbolic in nature, recreational bag limits serve to conserve resources and limit waste. Many of our members are asking why this is necessary without taking similar measures on foreign fleets. They have a point, since the recreational take of albacore is de minimus.

The RFA has had recent experience with a similar situation on the east coast with yellowfin tuna. Sport fishing advocates resisted bag limits, only to find themselves stuck with a three fish bag limit and no legal recourse. The NMFS used MRFFS data to estimate historical catches and reduced from there. The average bag was three fish. Similarly, actual catches of albacore are very low on the West Coast.

To avoid a similar outcome the Council must take timely action on this decision. The RFA recognizes regional differences in the fishery. We support the Department's proposed bag limit of 25 fish across the board on the west coast. North of Point Arena, the weather makes our trips few and far between. Canning albacore in mason jars remains a regional tradition on the north coast. We also want to maintain consistency with Oregon's regulations. We support a coast wide bag limit of 25, from Mexico to Canada.

We defer to the Sportfishing Association of California, the Golden Gate Fishermen's Association and the charter industry on the issue of having a 5-fish bag limit on CPFVs, but few of our members are interested in that low a bag for the private boater fleet.

Most of our members who are private boaters limit their take because of fuel costs, a desire to properly process the albacore we catch, and on heartfelt conservation principles. The RFA is concerned that if the bag limit is set too low, future restrictions could destroy the recreational fishery for albacore.

The simplest way to expedite this action under MSA would be for the PFMC to adopt a 25 fish bag limit in federal waters under its jurisdiction. If the states wish to adopt more stringent measures in various regions, they can do so.

Respectfully,

Jim Martin

Jim Martin
The Recreational Fishing Alliance

Coastside Position:

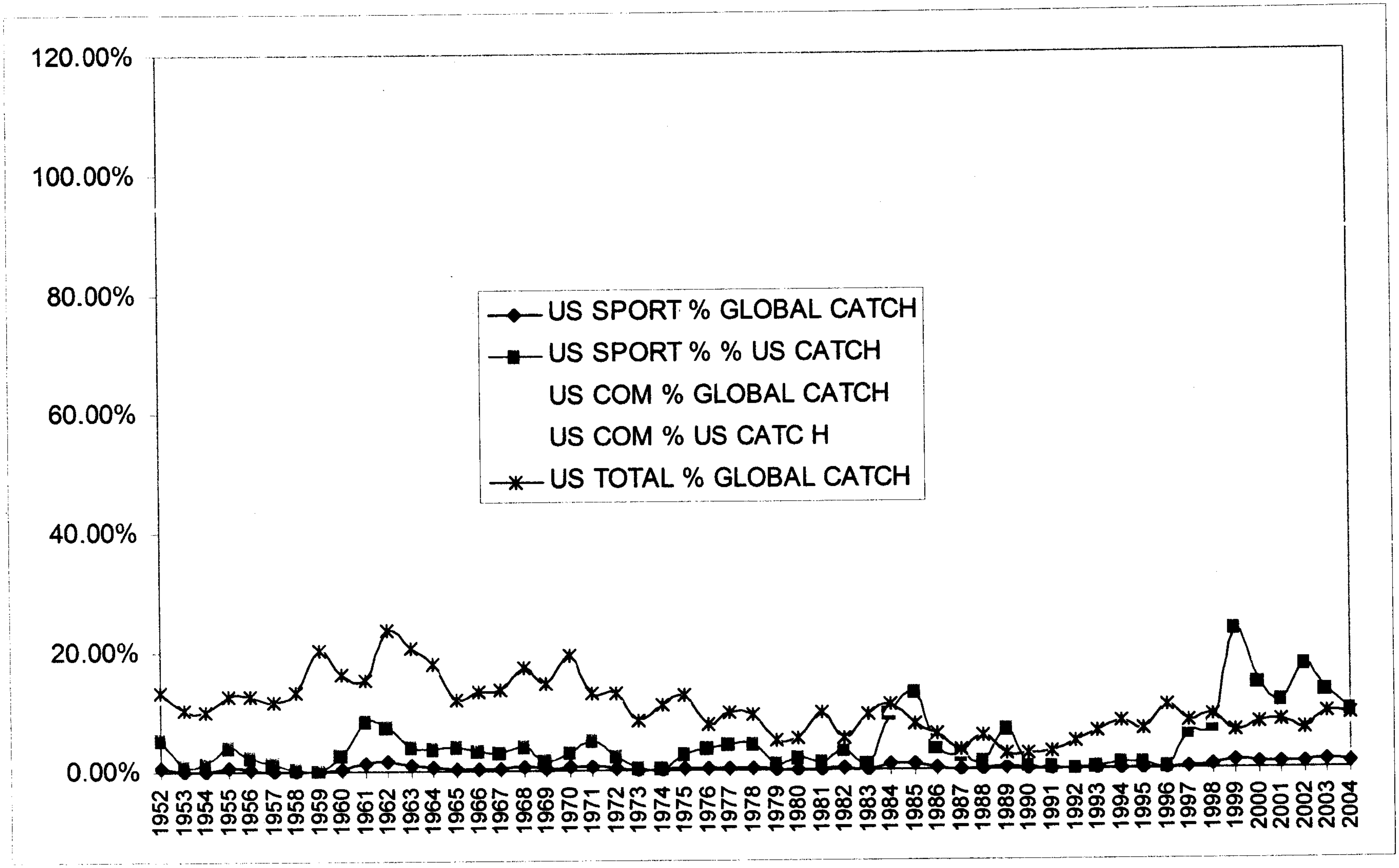
Recreational Tuna Limits In California

Dan Wolford, Science Director
Coastside Fishing Club

Sept. 2006

Agenda Item E.1.e
Supplemental Public Comment 2

U.S. Albacore in Perspective



Data from 1952 to present. (PFMC, 2006, http://www.pcouncil.org/bb/2006/0606/age3b_supp_hmsmt.pdf)

U.S. Recreational Albacore Take is Insignificant

- U.S recreational Albacore landings account for, on average, 0.45% of all landings
- U.S. recreational Albacore landings account for, on average, 4.46% of all U.S. Albacore landed
- California accounts for 43.4% of recreational landed Albacore, with southern California accouting for 28.9% and Northern California accounting for 14.5%.
- Oregon accounts for 30.3% of Albacore landed in the U.S.
- Washington accounts for 26.3% of Albacore landed in the U.S.

Data from 1952 to present. (PFMC, 2006, http://www.pcouncil.org/bb/2006/0606/age3b_supp_hmsmt.pdf)

CA Recreational Tuna

- Represents an insignificant portion of the total international take of tuna
- Is a major element of CA recreational fishing
- Is not the same in Northern/Central and Southern CA

Northern/Central CA

Weather limits fishing opportunity

Travel distance limits fishing opportunity

Typically ONLY Albacore

Year to year variability in availability

Southern CA

Weather encourages consistent fishing opportunities

Travel distance encourages fishing opportunity

Typically SEVERAL tuna species available

Consistently available year to year

North/Central – Southern CA Example Opportunities

- In Half Moon Bay
  - Only three opportunities for private boaters to target Albacore in 2005
    - Weather and distance
  - This year
    - Private boaters have had 9-10 opportunities for Albacore
    - One HMB CPFV made 2 trips for 4 Albacore
    - Another HMB CPFV made 1 trip for 4 Albacore
- From SF
  - In 2005 one CPFV made 1 trip for zero Albacore
  - In 2006 that CPFV made 1 trip for 4 Albacore
    - traveled 80 miles (one way) to get there
- By Contrast, this year in July ALONE, one San Diego CPFV made 22 trips, scoring
  - 186 Dorado
  - 1593 Yellowtail
  - 105 Yellowfin tuna
  - 103 Bluefin tuna
  - 106 Albacore
  - 100 Bonito

Coastside Members will Support Reasonable Albacore Limits

- Membership poll returned nearly 1000 valid responses
- 23% were opposed to any recreational limits on recreational Albacore
- 77% willing to accept some kind of recreational limits on Albacore
  - Of these, the majority favor different limits between North/Central CA and Southern CA (54 to 45 %)

Why Recreational Limits at All?

- Recreational take is insignificant
  - Imposing a limit is the first step down a slippery slope to unnecessarily restricting this recreational fishery
    - Because tuna is valued in both fresh and canned forms, the occasional large daily take is fully utilized
      - We need to take advantage of the limited opportunities
  - Imposing a limit is an important symbolic step
    - We recognize that implementing a recreational Albacore trip limit could be viewed as a step in support of the Inter-American Tropical Tuna Commission's Albacore resolution and the U.S. commitment to not increase its current effort level on Albacore.

CA Recreational Albacore Limits

- Coastside can accept and support the imposition of recreational Albacore limits
  - Either a limit of 25 per day throughout CA or
    - 10 Albacore per day south of Pt. Conception
    - 25 Albacore per day north of Pt. Conception

- Because of the differences in the Albacore fishing opportunities between Northern/Central and Southern CA, it is important to maintain the limit at 25 per day in the North/Central region.

NATIONAL MARINE FISHERIES SERVICE
SOUTHWEST REGION
HIGHLY MIGRATORY SPECIES
ACTIVITY REPORT

Closure - U.S. Longline Fishery for Bigeye Tuna

On July 6, 2006, NMFS closed the U.S. longline fishery for bigeye tuna in the Inter-American Tropical Tuna Commission (IATTC) Convention Area for the remainder of 2006. This closure was necessary because catch levels for bigeye tuna in the Convention Area reached the 150 metric ton limit for 2006 [Federal Register: July 6, 2006 (Volume 71, Number 129)] as agreed upon in the 2004 – 2006 Tuna Conservation Resolution.

US-Canada Albacore Treaty Vessel List

NMFS published a Federal Register Notice [Federal Register: August 18, 2006 (Volume 71, Number 160)] that clarifies NMFS' original intention that the vessel owners intending to fish for albacore in Canadian waters notify NMFS each year to be placed on the "vessel list" that remains valid for a single calendar year. The vessel list then reverts to zero vessels on December 31 of each year. Revising the way the list is created and updating the list every year is intended to facilitate the United States' obligation to annually provide Canada a current list of U.S. vessels that are likely to fish albacore off the coast of Canada. NMFS is undertaking rulemaking to clarify the requirements in 50 CFR 300.172.

Drift Gillnet EFP

The timeline for finalizing the documentation for the DGN EFP will be approximately mid-September. NMFS Protected Resources Division (PRD) staff are in the final stages of completing the Section 7 Biological Opinion and NMFS PRD staff anticipate completing the required MMPA 105(a)(5)(e) permits for marine mammals around mid-September. Once all the necessary documentation has been completed, NMFS will make a final decision on whether to approve or disapprove the EFP application.

New HMS Listserve

NMFS SWR announced the availability of a new Highly Migratory Species (HMS) listserve called West Coast HMS Listserve. Subscriber to the listserve will receive NMFS generated notices via email that announce issues important to fishermen who fish highly migratory species in the Pacific Ocean. This listserve is open to the public, but is not intended to be used for discussion purposes, rather for public announcements. To join please send an email request to Join-NMFS.WestCoastFisheries-HMS@noaa.gov.

Inter-American Tropical Tuna Commission's 74th Annual Meeting

The Inter-American Tropical Tuna Commission (IATTC) held its 74th annual meeting, June 26-30, 2006, in Busan, Korea. Subsidiary meetings conducted included the Joint Working Group on

Fishing by Non-Parties, the Permanent Working Group on Compliance, and the Working Group on Finance. (Current IATTC resolutions may be found on the Commission's website at: www.iattc.org.) Dr. Robin Allen, IATTC Executive Secretariat, announced his retirement effective September 1, 2007.

Resolutions Adopted at the June 2006 IATTC Meeting:

- Tuna Conservation Measures for 2007 - extension of program past the current 2006 recommendations. This measure mimics the current Resolution for Tuna Conservation Measures with the change of annual longline catch of bigeye tuna in the Eastern Pacific Ocean during 2007 not to exceed 500 metric tons or their national 2001 catch level, whichever is higher. This change provides the increased flexibility that the U.S. sought for managing the U.S. longline fleet.

- Consolidated Resolution on Bycatch – extends the requirements of the current Resolution until January 2008. The Resolution requires full retention of juvenile tunas and non-target species of fish, and provides for a review of compliance on the full retention measure (by flag state or entity) to take place in the Permanent Working Group on Compliance in 2007.

- Transshipments – a Resolution on the regulation of transshipments on the high seas was adopted, similar to measures adopted in ICCAT and IOTC. A cornerstone of this Resolution is the establishment of an observer program from vessels receiving transshipments of tuna and tuna like species. This Resolution limits transshipment on the high seas. This Resolution does not apply to troll vessels, pole-and-line vessels, or vessels engaged in the transshipment of fresh fish at sea.

Other Recommendations and Accomplishments

- A list of cooperating parties was adopted. Cooperating parties must request to be listed as a cooperating party annually. For 2006, the cooperating parties are Belize, Canada, China, Cook Islands, the European Union, Honduras, and Chinese Taipei (Taiwan).

- Next meeting dates – 18-29 June 2007. Place has not been determined. However, Panama and Mexico were put forward as possible venues.

NOTE:

- 2005 Resolution regarding Northern Albacore Tuna – this Resolution was not brought forward for further discussion, clarification, or additions. This Resolution requires that the total level of fishing effort for North Pacific albacore tuna in the Eastern Pacific Ocean not be increased beyond current levels.