NATIONAL MARINE FISHERIES SERVICE REPORT

National Marine Fisheries Service (NMFS) Southwest Region will briefly report on recent developments relevant to highly migratory species fisheries and issues of interest to the Council.

Council Task:

Discussion.

Reference Materials:

1. Agenda Item J.1.a, Attachment 1: NMFS Highly Migratory Species Report.

Agenda Order:

a. Southwest Region Activity Report — Mark Helvey
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. Council Discussion

PFMC
03/18/08

Agenda Item J.1.a
Attachment 1
April 2008

National Marine Fisheries Service Southwest Region Report
Highly Migratory Species

Swordfish-Leatherback Sea Turtle Utilization of Temperate Habitat (SLUTH) Workshop Announcement: The NMFS Southwest Region and Southwest Fisheries Science Center are sponsoring a workshop slated for May 28-29, 2008, on the campus of Scripps Institute of Oceanography in La Jolla. The goal of this workshop is to bring together scientists, fisheries managers, and knowledgeable swordfish fishermen to discuss key life history traits and the ecological and oceanographic parameters influencing the distribution and abundance of swordfish and leatherback sea turtles in the California Current. Workshop objectives include highlighting areas of distributional and habitat overlap, where further research and monitoring efforts would assist in developing methods to reduce leatherback bycatch in swordfish longline and driftnet fisheries.

Thresher Shark Fishing Seminar Announcement: The NMFS Southwest Region Sustainable Fisheries Division and the Pfleger Institute of Environmental Research are sponsoring a three-part informational seminar series scheduled for April 10 (Bahia Corinthian Yacht Club, 1601 Bayside Dr. Newport, CA 92625), April 15 (Oceanside Yacht Club, 1950 Harbor Drive N. Oceanside, CA 92054), and April 23 (Southwestern Yacht Club, 2702 Qualtrough St. San Diego, CA 92109). Seating is limited to the first 100 people at all seminars. The primary goal of the seminars is to bring together fishermen, scientists, and resource managers to discuss current research findings, innovative fishing tactics to increase post-release survival, and measures to promote a sustainable recreational thresher shark fishery. A flier announcing meeting venues will be distributed at the April Council meeting and is available on the NMFS SWR (http://swr.nmfs.noaa.gov/), and PIER websites (www.pier.org).

High Seas Shallow-Set Longline Alternatives: The NMFS Southwest Region has agreed to prepare the necessary NEPA documentation evaluating the shallow-set longline alternatives adopted for public review by the Council at their March 2008 meeting. The alternatives are briefly described in the meeting decision summary (http://www.pcouncil.org/decisions/currentdec.html) and will be explained more fully in the next Council newsletter. NMFS is preparing a statement of work which will be used to solicit bids from qualified contractors to carry out specific elements of this task.

Agenda Item J.1.b
REVISED Supplemental HMSAS Report
April 2008

HIGHLY MIGRATORY SPECIES ADVISORY SUBPANEL REPORT ON THE NMFS REPORT

MOU Regarding Regional Fishery Management Organizations

The Highly Migratory Species Advisory Subpanel (HMSAS) is concerned with the lack of review of the *Memorandum of Understanding Regarding Regional Fishery Management Council Participation in International Regional Fishery Management Organizations Governing Pacific Ocean Highly Migratory Species* (MOU). The last draft that we are aware of is dated April 2007. We have heard that emails have circulated concerning the MOU, but we have not received an update on the MOU that will be very influential in our fisheries representation in the international management organizations. One of many concerns in the 2007 document is the proposed representation on the Western and Central Pacific Fisheries Commission Advisory Committee. In our view, having five representatives from the Pacific Fisheries Management Council (Council) and ten representatives from the regions and fisheries of the Western Pacific Council will not be equitable and balanced to the interest of the Council.

Bluefin Tuna Transshipment

The HMSAS recommends that the Council submit comments to the National Marine Fisheries Service (NMFS) regarding Pacific bluefin tuna trans-shipment permits. Currently, NMFS is accepting public comment on bluefin tuna transshipment permits to the five Mexican vessels that wish to receive, within the Pacific waters of the U.S. Exclusive Economic Zone (EEZ), live Pacific bluefin tuna from U.S. purse seiners for the purpose of transporting the tuna to an open water grow-out facility located in Baja California, Mexico. This type of permit has been applied for and issued by NMFS for many years; the HMSAS is concerned about access to total catch data for bluefin caught in U.S. waters and transshipped to Mexico. NMFS should explain how catch information will be communicated to the Pacific Council.

PFMC
4/11/08

Agenda Item J.2
Situation Summary
April 2008

RECOMMENDATIONS TO THE U.S. SECTION OF THE INTER-AMERICAN TROPICAL TUNA COMMISSION (IATTC)

The Inter-American Tropical Tuna Commission (IATTC) is the regional fishery management organization responsible for coordinating international management of highly migratory species stocks in the Eastern Pacific Ocean (EPO). Both the Pacific-wide bigeye tuna stock and the separate eastern and western Pacific yellowfin tuna stocks continue to be subject to overfishing and may be approaching or have reached an overfished condition. They have also been declared subject to overfishing by the Secretary of Commerce.

The International Scientific Committee for Tuna and Tuna-like Species (ISC) completed a stock assessment for striped marlin in 2007. This assessment was based on the assumption that striped marlin is a single stock in the North Pacific. It concluded that the stock is substantially depleted from historic levels, 6 percent of 1952 levels if a stock recruitment relationship (h=0.75) is assumed versus 16 percent of 1952 levels if recruitment is hypothesized to be driven by environmental conditions with recruitment variability around a mean level. Based on this information, the ISC Plenary recommended that "the fishing mortality rate of striped marlin (which can be converted into effort or catch in management) should be reduced from the current level (2003 or before), taking into consideration various factors associated with this species and its fishery. Until appropriate measures in this regard are taken, the fishing mortality rate should not be increased," (see Attachment 1). The IATTC has also reported on the status of striped marlin in the EPO, based on the hypothesis that it is a separate stock, and reached a different conclusion. They conclude that "the stock of striped marlin in the EPO is probably in good condition, at or above the average maximum sustained yield (AMSY) level." They also conclude that catches during 2001–05 are well below estimated AMSY.

According to IATTC catch data, Japan accounted for the largest proportion of striped marlin catch in the EPO, 2000–06, at 48 percent. The U.S. accounted for 0.37 percent of catch during this period. The IATTC data show that all reported Japanese and U.S. catches were made by longline gear. The 2007 Highly Migratory Species (HMS) stock assessment and fishery evaluation (SAFE) reports west coast landings of marlin (unspecified) from U.S. waters by the California commercial passenger fishing vessel fleet during this period at between 2 and 4 mt annually (or about 0.03 percent of all IATTC reported landings during the period). No catches by the private boat recreational fleet are reported for this period. The SAFE does not report commercial landings of marlin.

In 2007 the IATTC was unable to adopt a new resolution containing conservation measures for yellowfin and bigeye tunas to replace Resolution C-06-02, which expired at the end of 2007. They have held three extraordinary meetings, the last March 5–7, 2008, in addition to their 2007 annual meeting in an unsuccessful effort to reach agreement on conservation measures for these stocks. Attachment 3 is a revised version of the IATTC Secretariat (scientific staff) proposal for conservation measures provided for the March 2008 IATTC meeting. This proposal states that proportional reductions in fishing mortality of 20 percent for yellowfin and 30 percent for bigeye are needed to meet conservation goals. The Secretariat proposal includes a 74-day purse seine fishery closure, a purse seine closed area (a box bounded by 94° and 110° W longitude and 3°N to 5° S latitude) from September 12 to December 31, and national catch limits for bigeye caught by longline gear. The analysis indicates that these measures would be sufficient to achieve the needed fishing mortality reductions.

The ISC also completed a stock assessment for North Pacific albacore tuna in 2007 (see attachment 1). It indicated that spawning stock biomass is at historically high levels but that current fishing mortality is high relative to most reference points. The current F would gradually reduce spawning stock biomass to the long term average by the mid 2010s. The ISC report also suggests the need for internationally recognized stock status reference points to facilitate the conservation and management of this stock. Both the IATTC and Western and Central Pacific Fisheries Commission (WCPFC) adopted resolutions calling on nations to not increase fishing mortality on this stock.

The IATTC holds its annual meeting June 16–27, 2008, in Panama. The General Advisory Committee (GAC) to the U.S. Section will hold a 1-day meeting on June 2, 2008, in La Jolla, California, to solicit recommendations to the U.S. Commissioners on the U.S. position at the IATTC meeting. The Council has the opportunity now to formulate its own recommendations on conservation and management measures for EPO HMS stocks, which can be communicated to Rod McInnis, National Marine Fisheries Service Southwest Regional Administrator, who is a U.S. Commissioner, and the IATTC GAC for their consideration.

Council Action:

Develop Recommendations for the Conservation and Management of EPO HMS Stocks for Consideration by the U.S. Section to the IATTC.

Reference Materials:

Agenda Item J.2.a, Attachment 1: Report of the Seventh Meeting of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean. October 30, 2007 (Excerpts; complete document on web and CD-ROM).
Agenda Item J.2.a, Attachment 2: Inter-American Tropical Tuna Commission Fishery Status Report Number 5. 2008 (Excerpts; complete document on web and CD-ROM).
Agenda Item J.2a, Attachment 3: Document IATTC-77-04 Rev; Proposal for Conservation of Yellowfin and Bigeye Tuna in the Eastern Pacific Ocean.

Agenda Order:

a. Agenda Item Overview — Kit Dahl
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. **Council Action**: Develop Recommendations for the Conservation and Management of Eastern Pacific Ocean HMS Stocks for Consideration by the U.S. Section to the IATTC

PFMC
03/19/08

Agenda Item J.2.a
Attachment 1
April 2008

REPORT OF THE SEVENTH MEETING OF THE INTERNATIONAL SCIENTIFIC COMMITTEE FOR TUNA AND TUNA-LIKE SPECIES IN THE NORTH PACIFIC OCEAN

PLENARY SESSION
(Revised October 30, 2007)

25-30 July 2007
Busan, Korea

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Busan, Korea
Plenary Session, July 25-30, 2007

Highlights of the ISC7 Plenary Meeting

The ISC7 Plenary, held in Busan, Korea from 25-30 July 2007, was attended by delegations from Canada, Chinese Taipei, Japan, Korea, Mexico and the United States. The Plenary reached consensus on several important issues including stock status and conservation advice, as well as governance and data management procedures. Based on assessments carried out during the past year, recommendations regarding the reduction of fishing mortality rates for albacore and striped marlin were adopted. Plans for undertaking a Pacific bluefin tuna assessment in the next year were approved. Governance and operational procedures were updated and amended in the form of an Operations Manual which was approved by the members. Through discussion, data management procedures underwent continued development and improvement. The next Plenary will be held in July 2008 in either Japan or Chinese Taipei.

1 INTRODUCTION AND OPENING OF THE MEETING

1.1 Introduction

The ISC was established in 1995 through an intergovernmental agreement between the governments of Japan and the United States of America. Since its establishment and first meeting in 1996, the ISC has undergone a number of changes to its charter and name (from the Interim Scientific Committee to the International Scientific Committee) and has adopted guidelines for its operations. The two main goals of the ISC are to 1) to enhance scientific research and cooperation for conservation and rational utilization of the species of tuna and tuna-like fishes which inhabit the North Pacific Ocean during a part or all of their life cycle; and 2) to establish the scientific groundwork, if at some point in the future, it is decided to create a multilateral regime for the conservation and rational utilization of these species in this region. The Committee is made up of voting Members from coastal states and fishing entities of the region and coastal states and fishing entities with vessels fishing for highly migratory species in the region, and non-voting members from relevant intergovernmental fishery and marine science organizations, recognized by all voting Members.

The ISC provides scientific advice on the stocks and fisheries of tuna and tuna-like species in the North Pacific to the Member governments and regional fishery management organizations. The most recently available data for which complete statistics have been tabulated by ISC Members and reported for their fisheries operating in the North Pacific is 2005. The total landed amount was 643,568 metric tons (t) of the major species (albacore – *Thunnus alalunga*, bigeye tuna – *T. obesus*, Pacific bluefin tuna – *T. orientalis*, yellowfin tuna – *T. albacares*, skipjack tuna – *Katsuwonus pelamis*, swordfish – *Xiphias gladius*, striped marlin – *Tetrapterus audax*, and blue marlin- *Makaira nigricans*). This represents an increase in catch of just over 15% in comparison to 2004 data. In 2005 there were slight increases in Pacific bluefin and yellowfin tuna catches and swordfish catches, but the main contributor to the higher catches in 2005 was the increase in skipjack tuna catches from 243,128 t in 2004 to 328,146 t in the following year.

1.2 Opening of the Meeting

The Seventh Plenary meeting of the ISC was convened at 0900 on 25 July 2007 by the Chairman, G. Sakagawa. A role call confirmed the presence of delegates from Canada, Chinese Taipei, Japan, Korea, Mexico and the United States (U.S.) (*Annex 1*). Absent members were China, the Inter-American Tropical Tuna Commission (IATTC), the Secretariat for the Pacific Community (SPC), North Pacific Marine Science Organization (PICES) and the Food and Agriculture Organization (FAO). A Western and Central Pacific Fisheries Commission (WCPFC) representative attended as an Observer.

Deok-Bae Park, President of Korea's National Fisheries Research and Development Institute (NFRDI) officially welcomed the participants to Busan. He noted that this year marks the 50th anniversary of Korea's distant water fisheries, including the tuna longline fishery, and encouraged scientists in their important work toward providing conservation advice for the valuable tuna species that inhabit the North Pacific.

After some brief logistical announcements, the agenda for the meeting was tabled (*Annex 2*). S. Clarke was assigned lead rapporteur duties. Assistance was provided by J. Brodziak and K. Uosaki for Agenda Item 7 and G. DiNardo and Y. Takeuchi for Agenda Item 9.

2 ADOPTION OF AGENDA

One addition to the agenda involving a presentation by H. Honda regarding research on recruitment of Pacific bluefin tuna and opportunities for collaboration was proposed. The Chairman suggested this presentation could be scheduled between Agenda Items 8 and 9. With this change the agenda was adopted.

3 DELEGATION REPORTS ON FISHERY MONITORING, DATA COLLECTION AND RESEARCH

3.1 Canada

M. Stocker presented a summary of catch, effort, and catch per unit of effort (CPUE) data for the Canadian North Pacific albacore tuna fishery in 2006 (*ISC/07/PLENARY/04*). The Canadian fishery for albacore in the North Pacific is a troll fishery using tuna jigs. All Canadian vessels must carry logbooks while fishing for highly migratory species in any waters. Detailed analysis of a combination of sales slips, logbooks, phone-in and transhipment records are undertaken to report fisheries statistics for the Canadian albacore fishery.

In 2006, 171 Canadian vessels operated in the North Pacific Ocean and caught 5,819 t of albacore in 6,239 vessel days (v-d) of fishing for a CPUE of 0.93 t/v-d. Estimates for 2006 are considered preliminary. Both catch and CPUE have followed an increasing trend over the period 1995-2004 and then dropped in 2005. The catch and CPUE increased from 2005 to 2006. Almost all of the 2006 catch was taken within 200 miles of the North American coast. Access by Canadian albacore vessels to waters in the US Exclusive Economic Zone (EEZ) is governed by a US-Canada albacore treaty.

In terms of research activities, a project to document the existing relational database for the Canadian Pacific albacore catch and effort data has been completed. A technical report has been published and is available at http://www.dfo-mpo.gc.ca/Library/327827.pdf. The report describes the design of the entire database (including trip log, sales slip and hail components) based on a Venn diagram concept, and includes a figure that documents the structure of the relationships between these components.

<u>Discussion</u>

A question was raised regarding the reason for the continued increasing trend in CPUE in the albacore troll fishery. M. Stocker replied that this could be explained by the fact that the most skilled fishermen remain active in the industry. This creates a situation where the catch rate is increasing while the total catch and effort are decreasing.

3.2 Chinese-Taipei

Shyh-Jiun Wang presented the report for Chinese Taipei (*ISC/07/PLENARY/05*). There are two major Chinese Taipei tuna fisheries operating in the North Pacific. Distant water longliners (DWLL) >100 GRT usually operate in the high seas or under license in foreign EEZs. Offshore longliners (OSLL) are smaller than 100 GRT and generally operate in the waters of Chinese Taipei.

The number of DWLL vessels operating in the Pacific Ocean in 2005 was 133, but reduced to 117 in 2006. Catches of albacore in the North Pacific were estimated at about

4,000 t per year in 2004-2006, whereas Pacific bluefin tuna catches have been < 1 t per year since 2000. Catches of swordfish were <100 t before 2000, increased to more than 1,000 t in 2001 to 2003 due to increasing fishing efforts for bigeye tuna, but then declined to <1,000 t in 2004 to 2006. Most Chinese Taipei DWLL vessels operate in the North Pacific from September to the following March, then shift to the South Pacific to target southern albacore from April through August.

The OSLL vessels generally target bigeye tuna and yellowfin tuna with considerable swordfish and marlin bycatch. OSLL catch of albacore is 100-900 t since 2000. Catches of Pacific bluefin tuna peaked at 3,000 t in 1999 and reduced to a level of 1,500-2,000 t after 2000. The catch of swordfish was 1,813 t in 2005 and estimated at 2,587 t for 2006. These catch estimates do not include landings in frozen form. From logbooks collected between 2002 and 2005, it was observed that fishing activities have been primarily located in the area of 110 to 150°E and 10-30°N, i.e. in waters southeast of Chinese Taipei and northeast of the Philippines.

Size frequency data on major tuna and tuna-like species caught by DWLL and OSLL fisheries in the North Pacific region are available from 2004-2006. For DWLL fisheries, the catch size data is recorded in logbooks. For OSLL fisheries, the data were collected from port sampling in domestic tuna fishing ports under a sampling program begun in 1997. Port sampling was carried out in Pago Pago (American Samoa), Suva and Levuka (Fiji) in 2005 and American Samoa in 2006. An observer program was launched in 2001 and included 2 North Pacific trips in 2004-2005 and 3 North Pacific trips in 2006. VMS has been mandatory for all DWLLs operating in the Pacific since June 2004. VMS data are used to verify logbook data. National Taiwan University (NTU) has conducted stock assessments for swordfish and sailfish, and is currently undertaking a stock assessment of blue marlin. Biological studies are in progress on black and striped marlin and a billfish tagging program has been undertaken.

Discussion

Chinese Taipei delegates were asked about their efforts to improve data coverage and quality. R.F. Wu responded that in the past Category I catch data had relied on agent and trade slips only but that now logbooks and VMS records are being used to cross-check these data. Finer scale Category II data will be similarly cross-checked but the data for 2006 are still considered preliminary.

Clarification was requested as to the coverage of the catches reported in Table 1 of the Chinese Taipei national report and specifically whether catches landed in frozen form and foreign landings were included. R.F. Wu responded that frozen catch from OSLLs is difficult to classify by fishing ground since it may have come from the Indian Ocean. Chinese Taipei officials hope to be able to better deal with this issue in the future. Nevertheless, Chinese Taipei delegates consider that DWLL catches are not affected by this issue, and OSLL catches are not drastically affected because the frozen catch in the North Pacific is not very large.

A question was raised regarding the plans to increase North Pacific observer coverage in the future. This issue is still under discussion by Chinese Taipei authorities but efforts to increase the observer coverage will continue.

In response to a request for more details on the billfish tagging program, C.L. Sun replied that this research was conducted by the National Taiwan University in conjunction with the Fisheries Research Institute and Fisheries Agency. However, now that it is becoming an important research program, it will be taken over by the Fisheries Research Institute. Results have been good thus far and there are plans to add black and striped marlin to the program. Opportunities for collaboration are available.

The Plenary Chairman reminded the delegates that the report falls short of the ISC requirements because it implies that there are only two fisheries for tuna and tuna-like species. In reality, other coastal gears are being deployed and should be covered in a more comprehensive report. Complete information on billfishes taken by all fleets is also required. The Chairman noted that this comment was also raised last year.

Clarification of the coverage rate for the DWLL catch records was requested. R.F. Wu replied that the coverage rate is >80%. Chinese Taipei delegates were then asked to explain how it had been possible to incorporate the requirement to measure fish into their logbook regulations. R.F. Wu replied that it was a requirement to measure the first 30 fish caught each day regardless of species. Tunas are measured from snout to fork; billfish are measured from lower jaw to fork. As mentioned in the presentation, there is some port sampling and though this began only 3 years ago it has already been expanded to Mauritius and Trinidad-Tobago, and will be further expanded with the hiring of 17 new government employees with college degree assigned to domestic port sampling. It was pointed out, however, that under the current system there is no way to validate the fishermen's measurements with those of independent observers and this should be considered as an essential element of the port sampling in the future. Another suggestion was made to weight the length frequency data in Figure 3 by catch since this might reflect a different distribution than that shown by the un-raised length frequencies in Figure 3.

3.3 Korea

S.D. Hwang presented the national report for Korea (*ISC/07/PLENARY/11*). From 1995-2006 the annual total catch of fishes captured by the Korean distant-water longline fleet in the North Pacific ranged between 11,403 and 27,212 t (average 17,818 t). In 2006, the annual catch increased compared to recent years to 19,711 t compared with recent years. Major species caught by longlines in the North Pacific were bigeye tuna (11,152 t, 57%) and yellowfin tuna (5,079 t, 26%) in 2006. The catch of Pacific bluefin tuna was negligible.

Most Pacific bluefin tuna produced by Korea were by-catch in the domestic purse seine fishery targeting mackerels. The annual catch of Pacific bluefin tuna by 33 purse seiners and 4 trawlers fluctuated in 2001-2006 between 591 and 1,005 t. In 2006, the monthly catch was highest in the months of April (248 t, 30%) and August (285 t, 34%). In

Korean coastal areas, most Pacific bluefin tuna are small individuals of 26-100 cm fork length (FL). The 40-50 cm FL size class dominated in 2006 whereas the 50-60 cm FL class dominated in 2004 and 2005. Catches of Pacific bluefin tuna were mainly taken in the southern coastal waters of Korea near Jeju and Tsushima Islands. The distribution of Pacific bluefin tuna catch appears to depend on the distribution of the fishery fleet's target species and the degree of biological interaction among Pacific bluefin tuna, mackerels and squids.

NFRDI initiated an international fisheries observer program for distant-water fisheries in 2002. In 2006, nine observers were deployed on Korean fishing vessels. To reduce numbers of seabird and sea turtle by-catch in the tuna longline fishery, guidebooks and posters summarizing information on these species were distributed to fishing boats including tuna longliners.

Discussion

Several technical questions were raised regarding the data presented. In response Korean delegates replied that:

- data for "white marlin" is actually data for "black marlin";
- due to delays in compiling data 1-3 years are required to finalize the catch figures;
- the mackerel species being targeted by purse seines are the same species as those targeted in Japan;
- the observed relationships between Pacific bluefin tuna abundance and oceanographic conditions were based on surface water temperature data;
- there are no size data available for billfishes even though the flying squid gill net fishery may have caught billfishes as bycatch;
- the original information underlying Table 1 is collected in both number and weight; and
- Korean purse seiners use general purpose purse seine nets for targeting small pelagic fishes which have not been modified to target Pacific bluefin tuna.

Several data requests were raised including provisions of catch-by-size for Pacific bluefin tuna caught by the Korean purse seine fishery, and data similar to those in Table 1 but for billfish so that average weights can be calculated. To the latter request, D.H. An replied that since the Korean longline fishery is targeting yellowfin tuna and bigeye tuna they may not have data for billfishes.

A final question pertained to why Figure 2 shows a considerable change in fork length (FL) of Pacific bluefin tuna from 2000-2006 and whether this could indicate a change in fishing grounds. After discussion by the group it was concluded a change in fishing grounds was unlikely. Instead, the increase in sample size from <500 to nearly 5,000 was probably responsible for the change. S.D. Hwang noted that it is probably unrealistic to expect that the entire size range of Pacific bluefin tuna could be sampled from a fishery in which this species is not a target species.

3.4 Japan

The national report for Japan was presented by H. Yamada (*ISC/07/PLENARY/09*). Japanese tuna catches are collected by three major fisheries, i.e. longline, purse seine, pole-and-line, as well as other miscellaneous fisheries like troll, drift net and set net fisheries. Total landings of tunas, swordfish and billfishes in the Pacific Ocean were 543,000 t in 2005.

Total catch of longline vessels smaller than 20 GRT has continuously increased since the 1980s, and was 30,000 t in 2005. The effort of this fishery was relatively stable in the 1980s, but increased after that. The total catch and effort of longline vessels larger than 20 GRT was stable until 1990, but both catch and effort have shown decreasing trends since then. The total catch was 45,000 t in the North Pacific in 2005. Bigeye tuna has been the dominant species in the landings.

Total catch of the purse seine fishery in the waters north of 20ºN was variable during the documented period, ranging from 23,000 t to 102,000 t, and was 80,000 t in 2005. Skipjack tuna (skipjack) dominates in purse seine catch, followed by Pacific bluefin tuna and yellowfin tuna. The effort of this fishery was highest in the mid 1980s (> 4,000 sets) but has been about 2,500-3,000 sets in recent years.

Total catch of the offshore and distant water pole-and-line fishery in the waters north of 20ºN was variable ranging from 90,000 t to 199,000 t, and was 120,000 t in 2005. Skipjack and albacore dominate the pole-and-line catch. The effort of this fishery decreased during the 1980s due to a decrease in the number of vessels, but it has been relatively stable since the early 1990s.

The annual catches of Pacific bluefin tuna have been stable at an average of 13,000 t since 2000, except for a high catch of 21,000 t in 2005. Purse seines have the largest catches of Pacific bluefin tuna with a catch of 7,100 t in 2006. The catch of albacore by longline was 17,000 t in 2006. This catch is similar to the catch in 2005 which is the lowest level in the last decade. This is due to substantial reductions in the number of large longline vessels due to economic circumstances. Swordfish catch by offshore and distant water longliners in 2005 (5,714 t) in the North Pacific showed a 9% increase from that in 2004.

Research cruises for bigeye tuna and blue marlin tagging, research on early life history of tunas, and testing of bycatch mitigation measures in longline fisheries were conducted by the National Research Institute of Far Seas Fisheries. Tagging studies using conventional tags, archival tags and pop-up archival tags are carried out for many kinds of tunas and tuna-like species. Studies of biological parameters for skipjack and Pacific bluefin tuna were also conducted.

Discussion

In response to a question, K. Uosaki noted that preliminary results from the 2007 albacore pole and line fishery showed that the catch was more than 20,000 t, therefore an increase over the catch values from the past 2 years. However, the skipjack fishery is performing poorly this year.

Various technical questions relating to data and research were also raised. Clarification was requested regarding the size difference between bigeye tuna caught in temperate versus tropical areas. N. Miyabe confirmed that modal size (100 cm versus 120 cm FL) and average weight (30 kg versus 50 kg) were lower in temperate waters compared to tropical waters but he considered this might be due to a seasonal difference rather than location alone. Further details on the testing of mitigation measures were requested to be released so they can inform potential actions by WCPFC. These details are provided in the report of the Bycatch WG. A request was also raised for provision of data on the number of active vessels rather than just the registered number of vessels. This could indicate whether or not a smaller number of vessels are using a greater number of hooks. N. Miyabe considered that this issue was complex due to vessels moving from area to area and thus there was a potential for double-counting. VMS will be in place soon and may help to address this issue. However, since the scientific standard unit is number of hooks, the absence of data on the number of vessels should not impede assessments. When asked whether previous work on age 0 skipjack was continuing, it was confirmed that additional sampling was conducted west of the Marianas and south of the Federated States of Micronesia last year and analysis is underway.

A request was made to coordinate on future tagging studies with WCPFC. Because of its limited research budget, Japan welcomes such collaboration and has coordinated with SPC in the past. It was suggested that this issue can be discussed at the WCPFC Scientific Committee Meeting next month.

3.5 Mexico

M. Dreyfus presented the Mexican national report (*ISC/07/PLENARY/10*). The tuna fishery of Mexico developed to its present size in the 1970s when Mexico implemented its 200 mile EEZ. Catch is dominated by yellowfin tuna, and to a lesser extent skipjack. Since the beginning of Pacific bluefin tuna farming on the west coast of the Baja California peninsula, this species is also a target. The fleet is mainly composed of purse seine vessels with concessions to catch all tuna species. Pacific bluefin tuna farming is undertaken by Mexican as well as foreign investment companies, but Pacific bluefin tuna for farming must be caught by the tuna fleet. Although the number of farms is stable, there have been record catches in 2004 and 2006. Therefore these fluctuations are related to environmental conditions.

All vessels above 363 tons of carrying capacity have observers on board (from both IATTC and Mexican observer programs). In the case of the national program, sampling is routinely performed on board for yellowfin tuna and since 2005 also for Pacific bluefin tuna. The number of vessels and the capacity of the fleet are stable.

In the case of the swordfish fishery, there are less than 30 vessels operating off the west coast of the Baja California peninsula using gillnets as well as longlines. They are allowed to operate only outside a zone of 50 miles from the coast within which billfishes are reserved for the sport fishing fleet. Billfishes are more important for sport fishing activity, mainly located in the states of Baja California Sur and Sinaloa. Increases in sport fishing effort have been observed particularly in Cabo San Lucas. The catch and release rate in sport fisheries is estimated to be 75%.

Discussion

In the discussion it was confirmed that since all billfishes are reserved for the sport fishery within a zone of 50 nmi from the coast, the research programs conducted by the INP through monitoring the fishery are the main source of scientific information on these species, as long as they are the target species. All available catch, size and weight data have been reported to the swordfish and marlin WGs. Catches of Pacific bluefin tuna in 2006 were the highest on record and it appears 2007 will show a mid-range catch. However, since yellowfin tuna is also relatively scarce this year, there may be re-direction of effort to other species such as Pacific bluefin tuna as happens in years in which tropical tuna catches are low. Nevertheless, Pacific bluefin tuna fishing grounds are located to the north of the yellowfin tuna fishing grounds, therefore this deters some of the vessels which are searching for yellowfin tuna from shifting to the Pacific bluefin tuna fishing grounds. The area west of Baja California appears to be a productive area for both Pacific bluefin tuna and sardines and there is a predator-prey connection. Although 80% of the Pacific bluefin tuna catch is sent to the farms, M. Dreyfus confirmed that the rise in catches was not due to an expansion of the industry but instead due to an increase in availability of the resource. Those interested in more information about the Pacific bluefin tuna pen-rearing industry were referred to the report of the Pacific bluefin tuna WG.

3.6 United States of America

W. Fox presented the United States (U.S.) national report on behalf of A. Coan who could not attend the meeting (*ISC/07/PLENARY/06*). Various U.S. fisheries harvest tuna and tuna-like species in the North Pacific. Large-scale purse seine, albacore troll, and longline fisheries operate both in coastal waters and on the high seas. Small-scale gill net, harpoon, and pole-and-line fisheries and commercial and recreational troll and handline fisheries usually operate in coastal waters. Overall, the range of U.S. fisheries in the Pacific is extensive, from coastal waters of North America to Guam and the Commonwealth of the Northern Mariana Islands (CNMI) in the western Pacific, and from the equatorial region to the upper reaches of the North Pacific Transition Zone.

In U.S. Pacific fisheries for tunas and billfishes, fishery monitoring responsibilities are shared by the National Marine Fisheries Service (NMFS) and by partner fisheries agencies in the states of California, Oregon, Washington, Hawaii, and territories of American Samoa, Guam, and the CNMI. On the federal side, monitoring is conducted by the Southwest Regional Office (SWRO) and the Southwest Fisheries Science Center (SWFSC) in California and the Pacific Islands Regional Office (PIRO) and the Pacific Islands Fisheries Science Center (PIFSC) in Hawaii.

U.S. government research on tunas and tuna-like species of the North Pacific Ocean is shared between the SWFSC and PIFSC. Studies are largely carried out from laboratories in La Jolla, California for the SWFSC and in Honolulu, Hawaii for the PIFSC, and in collaboration with scientists of other government or university institutions, both in the U.S. and abroad. Both Centers have studies devoted to stock assessment, biological and oceanographic research, and fishery management issues, but each Center concentrates on different species and fisheries in order to minimize duplication.

Discussion

Further clarification on a proposed Pacific bluefin tuna tagging project was provided. The plan is for NMFS to hire the vessel and use the sales proceeds from non-tagged fish to offset the cost of the hire. The tagging will be conducted in conjunction with a Mexican farming operation but will take place in U.S. waters. The program is designed to take place at the end of the Pacific bluefin tuna season with the intended result that the tagged individuals will remain at liberty for some time (i.e. perhaps until the start of the next fishing season). Whether this occurs will depend on the degree to which tagged individuals move, but there is believed to be little effort on Pacific bluefin tuna in U.S. waters. This program differs from NMFS collaboration with the TOPP program because TOPP mostly deploys archival tags.

A question was raised as to why the U.S. purse seine fleet is catching a larger percentage of bigeye tuna than other purse seine fleets, e.g. most purse seiners, including Korea vessels very similar to U.S. vessels catch 6-7% bigeye tuna whereas the U.S. purse seiners catch around 10% bigeye tuna. Potential differences such as more setting on fish aggregating devices (FADs) or floating objects by the U.S. fleet, or use of helicopters by the U.S. fleet were discussed. However, it was concluded that the market value/prices, yield, species composition and abundance, and changes in fishing grounds, could also play a large part in determining catch rates. Furthermore, a species composition of >10% bigeye tuna is not unusual. In any case the U.S. purse seine fleet is shrinking and may soon reach an economic tipping point where fuel prices outweigh returns. Many of the vessels which have already left the fleet have been sold and moved into other fishing grounds such as the eastern Pacific.

There was also a discussion concerning the targeting strategy of the Hawaii longline fishery and why it appears to have shifted from albacore to bigeye tuna. It was clarified that the Hawaii longline fishery has always mainly targeted bigeye tuna but that a small portion of the fleet targeted swordfish and a subset of these targeted albacore. However, due to recent effort restrictions on swordfish effort, there is almost no albacore targeting occurring now. The hypothesis that the Hawaii longline fleet has shifted from albacore to bigeye tuna because of decline in albacore stocks is also not supported by the constancy of catch per unit effort in the U.S. albacore troll fishery.

4 REPORT OF CHAIRMAN

The Chairman reported that the Committee made progress in advancing research required to meet the objectives of the Committee. Since the Sixth Plenary Meeting in 2006, the ISC held eight working group workshops, completed two full stock assessments (albacore and striped marlin), developed work plans for completing full assessments for Pacific bluefin tuna and swordfish by 2010, concluded an agreement with the WCPFC for providing scientific advice to the Northern Committee of the WCPFC, prepared a penultimate draft of the ISC Procedures Manual, and completed a long list of action items identified by the Sixth Plenary.

Despite this significant progress, further gains are needed and at a more rapid pace than to date. Members were reminded that through cooperation, collaboration and increased investment of resources, this challenge can be effectively addressed. Cooperation, such as collection and exchange of complete and timely fishery statistics is required. Collaboration, such as full support of working group activities including participation in workshops is essential. Investment of resources, such as dedicated national budgets for projects listed as research gaps in working group reports needs to be made. Priority activities for the next two years should include supporting tasks required to complete full stock assessments for Pacific bluefin tuna and North Pacific swordfish; updated stock assessments for albacore and striped marlin; providing the resources and developing the infrastructure for a fully capable ISC data and information management system; upgrading the website to meet expanding needs; and increasing the scientific capacity of the members to address growing ISC stock assessment needs.

The Chairman thanked the members for supporting ISC activities during the past year, and looked forward to continued support in the coming year. He also thanked the working group Chairmen and active members of the working groups for their contributions to the progress made by the Committee during the year, especially in expanding the scientific knowledge on the biology, fisheries and stock condition of highly migratory species in the North Pacific Ocean.

5 INTERACTION WITH REGIONAL ORGANIZATIONS

5.1 Activities relating to WCPFC

S.K. Soh introduced the issue of the relationship between the ISC, the Northern Committee (NC) and the WCPFC’s Scientific Committee (SC) with regard to northern stocks. According to the Memorandum of Understanding (MOU) between the ISC and the WCPFC, the ISC will provide scientific information and advice on the northern stocks to the WCPFC, the NC and the SC. Under the current agenda, both the NC and the SC will consider northern stocks at each of their regular sessions. In order to promote efficiency and cost-effectiveness of the WCPFC’s work, the WCPFC Secretariat has prepared a discussion paper suggesting a review of the roles and responsibilities between the ISC, the NC and the SC in respect to the northern stocks (*WCPFC-SC3/GN WP-4*). This paper outlines 3 options as follows:

Option 1: The SC and NC will receive the same information on the northern stocks (currently swordfish, Pacific bluefin tuna and albacore but the issue of including striped marlin is under discussion), and other stocks as requested, by the NC from the ISC Plenary. This is the current situation. If the SC has opinions they may voice them to the NC and the NC will ask the ISC for clarification. The SC or the NC may request an independent assessment of the advice provided, if considered necessary.

Option 2: The NC provides management advice to the WCPFC regarding species in the list of 'northern stocks' based on the ISC's advice. The SC would only cover those species not formally identified in the list of 'northern stocks'.

Option 3: The SC reviews the details of the ISC work and reports it to the NC and the WCPFC for management decisions. This will duplicate the work of the ISC at the SC meeting.

It was acknowledged by S.K. Soh that Option 3 is not practical. The ISC was invited to provide any views on the proposed agenda item at the upcoming SC meeting in August 2007.

<u>Discussion</u>

All agreed that given the lack of staff capacity and research budgets in this field that duplication and redundancy should be avoided as a matter of priority. It was noted that the MOU between the ISC and the WCPFC which lays out procedures very similar to those in Option 1 was practical and could provide useful guidance. However, concerns were expressed regarding the process by which the SC would review the work of the ISC under Option 1, particularly given the extensive nature of the documentation produced by the ISC WGs, and the resource and timing implications for WCPFC should they decide to call for an independent review of the assessment(s). A related concern was voiced regarding the three-channel provision of ISC advice under Option 1 and its potential to create confusion or stalemate.

As an alternative, a fourth option was suggested in which the SC would nominate a representative to participate in the ISC WG assessments throughout the process. When the assessment is complete and provided to the SC, the representative would then be called upon to endorse the results to the SC or call for further review. It was acknowledged that this fourth option would create resource demands for the WCPFC but these demands are relatively minor compared to the demands triggered by a call for full-scale re-assessment. It was also pointed out that the WCPFC is routinely invited to participate in the ISC WG assessments which are scheduled to avoid other major RFMO activities. It may be necessary to formalize procedures through which the WCPFC is invited to participant under the fourth option, in order to specifically create the role of a "qualified representative".

The discussion concluded with consensus that the issue is complex and a decision should not be rushed. Several options under consideration, as well as potentially other options which have not yet been developed, appear to be viable. It was agreed that the best solution would need to promote efficiency, continue the sound science embodied in the ISC WG assessments, protect the interests of all members, and maintain productive relationships between all interacting RFMO bodies.

5.2 Activities relating to PICES

The Plenary Chairman called to the attention of the group that the PICES 16th annual meeting will be held in Victoria, Canada on Oct 26th to Nov 5th. PICES has invited the ISC to send a representative to speak about potential collaborative research and the ISC needs to respond to this invitation. No honorarium or travel funding can be made available but if members are interested in attending PICES as the ISC representative they should notify the Chairman. In a related note, members were also urged to consider attending the WCPFC SC meeting in Honolulu to be held 13-24 August.

6 REPORTS OF WORKING GROUPS

6.1 Albacore

M. Stocker presented a summary of the ISC Albacore Working Group (ALBWG) activities since the 6th ISC Plenary. The total catch of North Pacific albacore for all nations combined peaked at a record high of about 125,000 t in 1976, then declined to a low of about 37,000 t in 1991. In the early 1990s, catches increased again, peaking in 1999 at 125,000 t, and averaged about 88,000 t since the early 2000. The 2005 catch of about 62,000 t was the lowest observed since the early 1990s. During the past five years, fisheries based in Japan accounted for 66% of the total harvest, followed by fisheries in the United States (16%), Chinese Taipei (8%) and Canada (7%). Other countries targeting the North Pacific stock contributed 3% to the catch and included Korea, Mexico, Tonga, Belize, Cook Islands, and Ecuador. While various fishing gears have been employed over the years to harvest albacore in the North Pacific, the main gears used over the last five years were longline (36%), pole-and-line (37%), and troll (22%). Other gears used since the mid-1990s included purse seine, gill net, and recreational fishing gears, which in combination accounted for roughly 5% of the total catch of albacore from the North Pacific.

A Stock Assessment Task Group workshop was convened at the Pacific Biological Station in Nanaimo, B.C. July 13-17, 2006 for the purpose of data preparation for the full ISC ALBWG stock assessment workshop. The report of the Stock Assessment Task Group workshop is included in *Annex 5*.

The ALBWG stock assessment workshop was held at the National Research Institute of Far Seas Fisheries (NRIFSF) in Shimizu, Shizuoka, Japan from November 28 to December 5, 2006. A total of 16 participants from Canada, Japan, and the U.S. attended the workshop; regrettably there were no participants from Mexico, Chinese Taipei, IATTC and SPC. The charge for the workshop was to complete a full assessment of the North Pacific albacore stock with data from 1966 to 2005, and to develop scientific advice on biological reference points for consideration of management action and for recommending action. In addition to conducting a full assessment, the workshop reviewed recent fisheries, reviewed biological studies, considered alternative stock assessment models, made research recommendations, updated the work plan for 2007, and discussed administrative matters. The workshop report is included in *Annex 5*.

The time and place for the next ALBWG workshop is planned for early 2008 in La Jolla, California, U.S. The objectives of the workshop will be to: (1) update the catch (Table 1) to 2007; (2) conduct a thorough evaluation of the abundance indices; and (3) conduct further assessment modeling work using the Stock Synthesis-II (SS-II) model, with the goal of presenting sometime in 2008 a baseline model that can be used to develop WG-related consensus concerning the status of the albacore population in the North Pacific Ocean. Further efforts will be needed to ensure input data (time series) are the best available, and model assumptions and related parameterization issues are appropriate. It is expected that this work will be completed sometime in mid-2008 and presented at the ISC ALBWG workshop to be held in conjunction with the 8th meeting of the ISC Plenary in 2008. The next full assessment for North Pacific albacore will be carried out in 2009.

Discussion

A question was raised regarding the data available for incorporating estimates of Illegal, Unregulated and Unreported (IUU) fishing into the stock assessment models. A particular problem could be that if the number of active vessels is unknown, the number of vessels potentially engaged in IUU would be nearly impossible to estimate. M. Stocker agreed that these are important issues to consider and noted that the WG had yet to tackle them fully.

The Plenary Chairman then asked for a review of the ALBWG's progress against the action items that had been agreed last year. The main actions items pertained to commitments to review and rescue data from the early 1950s through the mid 1970s. M. Stocker replied that data starting in 1966 had been rescued and used in the assessment, thus extending the historical extent of the assessment backward from 1975 by 9 years. However, it was explained that problems had been encountered when attempting to rescue data from 1952-1966 since these data were mostly limited to annual catch values and were not useful for the kind of fine-scale assessment models being run by the ALBWG. In addition, much of these early data have problems with species identification. Therefore, in this case there is a trade-off between the length of the data series and its quality. Members were referred to the ALBWG report for detailed discussions of these issues. While members agreed there may be ways to work around these data deficiencies and still extend the historical extent of the model, it was also deemed important to continue efforts to rescue these data.

6.2 Pacific bluefin tuna

Y. Takeuchi, Chairman of the last two workshops of the Pacific Bluefin Tuna Working Group (PBFWG), summarized the efforts since the last Plenary meeting including a summary of the two PBFWG workshops held during this period. Catch of Pacific bluefin tuna fluctuated from a low of 8,500 t in 1990 to a peak catch of 38,000 t in 1956. Recent five-year (2002-2006) average catch is about 22,000 t, nearly the same as the historical average. Japanese catch continues to consist of about half or more of total Pacific bluefin tuna catch. In addition, the U.S. fishery caught substantial amounts of Pacific bluefin tuna until the 1980s. Mexico and Chinese Taipei have increased their catches in recent years although they remain relatively smaller than those of Japan. In response to a request from the Plenary in 2006, the current catch database held by the PBFWG was expanded to include the catch of New Zealand longline vessels operating in their EEZ. At the two intercessional workshops since the last Plenary, the WG have made significant progress in addressing both data gaps and model uncertainties. This work involved:

- Age and growth study from otoliths by scientists from Japan and Chinese Taipei;
- Comprehensive review of historical size data;
- Estimation of historical quarterly catches for the stock assessment model;
- Review of historical Japanese longline CPUE;
- Review of Pacific bluefin tuna catch in the pre-assessment period;
- Review of alternative stock assessment models (i.e. SS-II).

The PBFWG developed a schedule of intercessional workshops to complete a full stock assessment by the next ISC Plenary meeting. A workshop dedicated to data preparation and model development will be held from 11-18 December 2007 in Shimizu. That will be followed by a stock assessment workshop from May 28-June 4 2008. Key stock assessment scientists will meet one week before (21-27 May 2008) the assessment. This will ensure that preparations are in order for the assessment.

Discussion

Once again the discussion focused on progress of this WG with regard to previously agreed action items. Y. Takeuchi clarified that progress had been made with regard to obtaining relevant data from non-member countries including receipt of data from New Zealand and communication with the SPC regarding additional data. The Plenary Chairman acknowledged that originally there had been a desire to fast track the Pacific bluefin tuna stock assessment but that ultimately it was decided that more time was necessary to assemble the correct data. For this reason, the stock assessment is scheduled for completion in May-June 2008.

The IATTC requested that the assessment be held earlier to allow its staff to avoid workload conflicts in May and to allow IATTC to present the findings to peer review before its annual meeting in June. While members were sympathetic to IATTC's scheduling issues and appreciated IATTC's sincere interest in participating in the assessment, there was general agreement to support the Pacific bluefin tuna WG in its desire to adhere to the original schedule. The Plenary Chairman will contact R. Allen of the IATTC and inform him of the decision.

6.3 Marlin and Swordfish

G. DiNardo, Chairman of the Marlin, summarized the efforts of the Marlin (MARWG) and Swordfish (SWOWG) working groups since the last Plenary including a summary of the three joint MARWG-SWOWG workshops held during this period. Workshop goals included the review and update of fishery statistics, agreements on stock structure scenarios, estimation and agreement on standardized CPUE time series, and completion of a striped marlin stock assessment. In addition, the WGs discussed the need and timing for a World Swordfish Meeting which was identified as an action item for the SWOWG at the 2006 Plenary.

Significant progress was made to facilitate the goals, including the updating of Category I, II, and III data and standardization of CPUE time series. A request for Category I, II, and III data for all billfish caught by member countries in the North Pacific was approved by the WGs, and these data were submitted to the WG Chairmen. While significant improvements in catch statistics have occurred, most notably for the fisheries of Mexico and Chinese Taipei, further improvements from other member countries is still needed. A striped marlin stock assessment was completed and conservation advice proffered.

Administrative matters were presented including a proposal to merge the MARWG and SWOWG into a single Billfish WG (BILLWG). The rationale for this proposal was outlined to Plenary members, and a decision on the proposal was requested. Elections for WG Chairmen were also conducted and it was agreed that if the ISC Plenary supports the establishment of the BILLWG, then one chairman should be elected. Nominations were taken and a vote conducted, with Chinese Taipei, Mexico, Japan, and the USA all voting for the election of G. DiNardo as Chairman of the BILLWG. A proposed assessment schedule was presented which included the completion of a North Pacific swordfish stock assessment in July 2009 and a Pacific-wide blue marlin stock assessment in July 2010. It was pointed out that a collaborative approach will be required to complete the blue marlin assessment and efforts are currently underway to establish the necessary collaborations. The WG's recommendation for dealing with the requirement of a World Swordfish Meeting in 2008 was presented, and concurrence from the Plenary sought. Proposed dates and venues for upcoming intercessional workshops were presented and they include January 15-23, 2008, possibly in Hawaii, USA, and June 2008 in Hokkaido, Japan.

Problems impinging on the ability of the WG to complete it's goals were presented, including the lack of (1) sufficient data in the ISC database and (2) continued participation at WG workshops by member countries. Possible solutions to the problems were presented and guidance from the Plenary sought. Finally, it was pointed out that many of the WG's goals were achieved and that their successful completion is linked directly to the commitment and dedication of scientists from the member countries and organizations.

Discussion

The Plenary Chairman commended the MARWG and SWOWG for their excellent progress. Members agreed with the recommendation and rational of the WG to combine the MARWG and SWOWG into a single BILLWG. It also endorsed the election of G. DiNardo as the Chairman of this BILLWG.

Through discussion it was clarified that a special session on swordfish is being proposed for the World Fisheries Congress (WFC) in Yokohama in October 2008. Plans for a multi-day World Swordfish Symposium would be postponed until after the swordfish stock assessment workshops in May-June 2008. The WFC session would focus on resolving issues of stock structure for the Pacific. Members expressed support for the proposal to hold the special session at the WFC.

The possibility of accelerating the schedule of the planned assessment was discussed. However, the statistics currently in the ISC database are so incomplete that considerable time will be required to assemble the necessary data. It is therefore practically impossible to have a swordfish assessment ready for the July 2008 Plenary, although there will be stock condition determination conducted in Japan in June 2008 that will be reported to the July 2008 Plenary.

Related issues of capacity building through participation in WG workshops and data sharing to allow members to use WG data to test their own models were raised. It was clarified that members are strongly encouraged to participate in assessment WGs from the very beginning of the process to not only contribute data but to build capacity within their own staff. One of the early tasks of the WG will be to select the best model or models for the assessment and full participation in such exercises is encouraged. After model(s) have been selected, there is no prohibition on running other models for comparison but this should be done within the context of the WG workshops with the data being actively used in that workshop.

The final discussion point involved evaluating progress against the previously agreed Action Items. With reference to document *ISC/07/PLENARY/01*, the SWOWG accomplished all three of its action items and the Plenary Chairman considered that the MARWG had also undertaken all of the required actions.

6.4 Bycatch

G. DiNardo substituted for C. Boggs in presenting the report of the Bycatch Working Group (BCWG). The BCWG held an intercessional workshop from May 2-5, 2007 in Honolulu, Hawaii attended by scientists from Chinese Taipei, IATTC, Japan, Mexico, and the U.S. Members reviewed the WG Terms of Reference developed at the previous workshop and agreed that the WG would focus on highly migratory species (HMS) and their fisheries, specifically on fisheries interactions with sea turtles, seabirds, and sharks. In particular, the review of bycatch stock status would be a recurring group activity, but the group would not actually conduct assessments due to lack of expertise. Since the group provided a broad summary of bycatch stock status last year, it focused on new topics in 2007. One objective was to review bycatch estimates for HMS fisheries, but most attendees only had data on sea turtles or seabirds. Substantial data on shark catches may be forthcoming from several members, but an issue is whether or not these represent bycatch or targeted catch.

Methods for producing bycatch estimates were reviewed, beginning with the need for observer programs. The value of systematic observer sampling for producing unbiased estimates of fleet-wide bycatch was emphasized, as was the need to understand different operational styles that can greatly influence bycatch rates. Past attempts to produce global and Pacific estimates of longline sea turtle bycatch were reviewed and deemed unreliable. The extent of observer coverage was summarized, and with one exception (U.S.), past coverage was considered too low to provide useful bycatch data. However observer programs are being initiated or expanded by several members.

The WG requests guidance from the ISC Plenary as to whether the WG should examine only those fisheries targeting HMS in the North Pacific or should it also examine other fisheries which may interact with the same bycatch species of concern to the WG. The participants discussed this issue but could not reach consensus. Most participants believed that the WG's role is to examine just those fisheries which target HMS.

A detailed work plan was developed based on objectives agreed last year. For some elements it was not possible to identify parties to conduct the work, but most projects are underway. Salient activities include: the submission to the ISC of fisheries and bycatch statistics needed to initiate estimation of bycatch by fishery sectors; continuation of experiments on sea turtle, seabird and shark bycatch reduction; and analysis of trends in sea turtle abundance and trends in fisheries effort to look for any relationships between the two. Bycatch reduction research underway was reviewed. Although current and proposed conservation and management measures of various RFMOs were presented, there was resistance to proposing or discussing technical specifications or best practices for such measures.

Discussion

It was noted in the discussion that the BCWG will meet in May 2008 and then again in conjunction with the Plenary next year (July 2008). Members discussed the suggestion that the activities of the BCWG with respect to seabird and sea turtle bycatch mitigation measures are duplicative of other efforts underway by the IATTC and the WCPFC. Given the Terms of Reference of the BCWG, if the emphasis is shifted away from seabirds and sea turtles, this would lead to a greater focus on shark issues. While it was noted that the Plenary Chairman and the Chairman of the BCWG agree that the current seabird and sea turtle focus is redundant with other organizations, and that there is currently a vacuum concerning shark research in the Pacific, reservations were expressed about disengaging from seabird and sea turtle issues. Reasons cited included a loss of ISC expertise in handling these issues on a North Pacific-wide basis and ability to shape the debate with academic and non-governmental organizations who promote these issues; and the need to wait until further management measures (e.g. the IATTC has sea turtle measures (only) and the WCPFC has seabird measures (only)) are adopted before changing course. On the other hand, all members acknowledged the need to focus ISC efforts toward activities where a concrete contribution can be made, rather than simply reviewing information that is also being presented in other forums. Members reached consensus on a recommendation the BCWG review where it can best focus its work given its limited resources and the areas already being covered by other organizations. The WG's Terms of Reference will not be changed but it is expected that a shift in emphasis away from seabird and sea turtle issues, and toward shark issues, is likely to result.

The group also discussed a request from the WG to clarify whether it should be addressing only impacts from HMS fisheries, or all fisheries which impact the species in the WG's Terms of Reference. It was noted that it is quite difficult to obtain data for HMS fisheries and would likely be even harder to obtain data for non-HMS fisheries in the North Pacific. Several members stated that broadening the scope to non-HMS fisheries would exceed the mandate of the ISC. All members agreed that a holistic approach to evaluating impacts to bycatch species was necessary and that this requires taking into account not only HMS fishery impacts but also non-HMS fishery impacts, pollution, habitat impacts, etc. However, WG efforts should be focused on HMS fisheries since that is the primary area of ISC expertise. While beyond the remit of the ISC, a suggestion was noted that an international focus group for sea turtle issues in the North Pacific, i.e. one that meets regularly to coordinate new research/information and assess population status, is missing and could be established by interested nations.

7 STOCK STATUS AND CONSERVATION ADVICE

7.1 Albacore

M. Stocker presented an overview of the ALBWG stock assessment workshop (*Annex 5*). A total of 16 participants from Canada, Japan, and the United States, attended the Workshop. A total of 19 working documents were tabled. The 2006 stock assessment was conducted with the VPA-2BOX model.

A single catch-at-age matrix (1966-2005) applicable to all (inclusive) fisheries was developed by simply summing the completed catch-at-age matrices from the 'eastern' and 'western' North Pacific Ocean. The combined catch-at-age matrix served as the foundation for stock assessments based on the VPA-2BOX model analysis.

Seventeen abundance (CPUE) indices were used in the 2006 albacore assessment:

- U.S./Canada Troll (ages 2,3,4,5)
- U.S. Longline (age-aggregated 6-9+)
- Japan Pole-and-Line (ages 2,3,4,5)

- Japan Longline (age 3,4,5,6,7,8,9+)
- Chinese Taipei (age-aggregated)

The VPA team conducted VPA-2BOX model analysis (15) for this year's workshop using 'primary' sources of input data. Model Scenario D1 was selected by the WG to assess current stock status and project future stock conditions.

Spawning stock biomass (*SSB*, in tons) time series (1966-2006) for north Pacific albacore generated from Model D1 (based on 'May 1' estimates) show fluctuations around the modeled time series average of 100,000 t. The 2006 stock assessment indicated that *SSB* increased from 2002 (73,500 t) to 2006 (153,300 t) and is projected to increase to 165,800 t in 2007. The increase is attributable to strong year classes in 2001 and 2003. The estimated spawning stock size in 2006 of 153,300 t is approximately 53% above the overall time series average (1966-2005). Projections (2007-2020), using an average productivity of 27.75 million fish and F equal to 0.75, indicate that the SSB will reach equilibrium by 2015 at 92,600 t (90% CI=62,700-129,300).

The WG reviewed two documents relative to Biological Reference Points (BRPs): 1) computational methods; and 2) simulation and probability analysis. Computation of BRPs was limited to examination of current F levels relative to a suite of candidate F-level BRPs. Equilibrium yield-per-recruit analysis(*Y/R)* and spawning stock biomass-per-recruit (*SB/R)* calculations were conducted using similar vital rates (growth, maturity, and natural mortality) as used in Model D1 calculations. The population projections and associated uncertainty were used to construct probability profiles for *SSB*. Each profile presents the probability that the spawning stock biomass will fall below a specified threshold level during one or more years of the projection period.

In conclusion the WG noted the following:

- Retrospective analysis shows a noticeable trend of over-estimating current stock size; and conversely underestimating current fishing mortality rate;
- The population is being fished at roughly *F*17% (i.e., $F_{2002\text{-}2004}$ = 0.75); similar to the 2004 assessment;
- F_{cur} (0.75) is high relative to commonly used F reference points;
- The ALBWG expressed concern about the considerable decline in total albacore catch since 2002;
- The $F_{SSB\text{-}MIN}$ analysis indicates that at the 95% probability of success all of the threshold Fs would require reductions from F_{cur};
- Therefore, the ALBWG strongly recommends that all countries support precautionary-based fishing practices.

Discussion

Details of the 2006 albacore assessment were discussed:

- While it might appear contradictory that some fisheries show increasing CPUEs while others show decreasing CPUEs, this may be due to high catch rates for smaller fish in good years resulting in a fishing down of these year classes, leaving fewer fish left for fisheries targeting larger fish. It is thus consistent with population dynamics theory.
- The reason for a consistently overestimated spawning stock biomass/exploitable biomass in the most recent year (shown in retrospective analysis) is difficult to pinpoint. It might be possible that with the proposed use of the SS-II model in the future this problem can be avoided.
- As indicated by the broad confidence intervals in the projections of spawning stock biomass, there seems to be considerable uncertainty, particularly with respect to predicting future recruitment.
- It was pointed out that although several related scenarios were modelled, the assessment does not present a future projection with a constant catch scenario. It was suggested that in conjunction with future assessments, a suite of constant catch projections may be useful for managers.
- The WG decided the best approach was to model recruitment using an average for 1966-1998 with random variation. This is in contrast to the previous approach in which alternative low and high recruitment regimes were assumed. However, it was suggested that for future assessments it would be useful to examine alternative recruitment parameter forms. It was acknowledged that when recruitment varies a great deal and constant catch projection are made, it may be necessary to assume a relatively low catch in order to avoid population depletion within the projection model.
- An alternative suggestion to address uncertainties in recruitment was to have the Plenary invite further involvement of fisheries oceanographers in the WGs and thereby get better information on whether periodicity is present or regime shifts have occurred. However, any potential autocorrelation in recruitment was not considered to be a major issue for the scenarios run in the current assessment.
- Despite the discussion of uncertainties and the differing interpretations of the results, there was consensus that the assessment represented the scientists' best attempt at evaluating stock status. Future improvements to both data and models are necessary and anticipated.

A procedural question was raised about whether *Annex 5* requires an individual endorsement from the Plenary. The Chairman clarified that it was standard practice to endorse the annexes in conjunction with the adoption of the Plenary report.

In summary, members agreed that stock assessment results indicated that 2006 estimate of spawning stock biomass (SSB) is the second highest in history (roughly, 153,000 t). This high level of SSB is reflective of strong year classes in 1999, 2001 and 2003. On the other hand, it is also indicated that the current fishing mortality rate (F=0.75) is high relative to commonly used reference points. Projected levels of SSB are forecasted to decline from a high level of 166,000 t in 2007 to the equilibrium level of roughly 92,000 t by 2015, if the population is fished at the current F of 0.75, which is near the long-term average (1966-2005).

Conservation Advice

After discussion of the 2006 ALBWG's assessment report and comments raised by Plenary members, the ISC offers the following scientific advice:

Previous scientific advice, based on the 2004 stock assessment, recommended that current fishing mortality rate (F) should not be increased. It was noted that management objectives for the IATTC and WCPFC are based on maintaining population levels which produce maximum sustainable yield. Due to updating, and improvements and refinements in data and models used in the 2006 stock assessment, it is now recognized that F_{cur} (0.75) is high relative to most of the F reference points (see Table 5a in *Annex 5*). On the other hand, the same analysis indicates that the current estimate of the SSB is the second highest in history but that keeping the current F would gradually reduce the SSB to the long-term average by the mid 2010s. Therefore, the recommendation of not increasing F from current level (F_{cur}(2002-2004)=0.75) is still valid. However, with the projection based on the continued current high F, the fishing mortality rate will have to be reduced. The degree to which, when and how reductions should occur will depend on which reference points are selected and the desired probability and practicability of success of attaining these reference points in a timeframe to be agreed. The ISC requires additional guidance on these issues from the management authorities in a timely manner to work further on these issues.

7.2 Pacific Bluefin Tuna

Y. Takeuchi introduced the outlook for the stock in relation to the 2001 year class which was estimated to be exceptionally strong (*Annex 10*). The conclusion was as follows:

> *"WG planned to review recent trends in stock abundance at this workshop in addition to reviewing the strength of the 2001 year class. While the two topics are interrelated, the more general review of recent trends could not be undertaken using the data available to the WG at this workshop. A thorough review of recent trends will be undertaken in conjunction with the next stock assessment.*
>
> *Nonetheless, the WG noted that the last Pacific bluefin tuna stock assessment (Jan 2006) estimated an exceptionally strong 2001 year class. Based largely on the estimated size of this year class, the stock projections indicated that the current level of SSB (Spawning Stock Biomass) could be maintained at the current F level. Based on this assessment, the ISC6 Plenary recommended that F should not be increased from the current level.*
>
> *The WG agreed that preliminary analysis of the Japanese catch and size-frequency data that has become available since the last assessment (2005-2007) indicates that the 2001 year-class was not as strong as previously thought, but may have indeed been larger than the average year class.*

More importantly, however, the survivorship of this year class in 2007 is unclear and cannot be well estimated until the next stock assessment (2008). While the last well-estimated strong year-class (1994) appeared clearly in the JLL size frequency data in 2000 (i.e. at age 6), the 2001 year-class did not appear in the 2007 JLL fishery. Consequently, the conclusion of the last stock assessment regarding the likelihood that the 2001 year-class would maintain the bluefin SSB level now appears to have been optimistic in light of the new data that have become available since the last assessment. "

Discussion

In the discussion that followed the presentation, it was noted that no complete stock assessment has been performed since the last Plenary meeting. However, a stock assessment is scheduled for completion in the coming year. In clarifying the status of the Pacific bluefin tuna stock, Y. Takeuchi explained that it is supported by several strong year classes including the 1994 year class, the strongest in the time series. In the past, other strong year classes have had a major positive impact on the stock.

Conservation Advice

After discussion of the 2006 PBFWG's assessment report and consideration of comments raised by Plenary members, the ISC offers the following conservation advice:

It was concluded that the advice provided by the ISC Plenary in 2006 still holds. That is:

> ***"Noting the uncertainty in the assessments, the ISC Plenary agreed with the WG recommendation that bluefin tuna fishing mortality[*] not be increased above recent levels as a precautionary measure. "***

7.3 Swordfish

G. DiNardo informed the Plenary that the next North Pacific swordfish stock assessment is scheduled to be completed in 2009. Thus, no stock status and conservation advice was provided at this time.

Discussion

G. DiNardo explained that there was no assessment to present at this Plenary but that a plan to produce an assessment had been tabled under Agenda Item 6 (see Section 6.3). He clarified that no conservation advice has yet been provided to the Plenary.

[*] "fishing mortality" refers to a rate which can be converted into effort or catch in management

7.4 Striped Marlin

K. Piner and J. Brodziak presented a brief overview of a stock assessment of North Pacific striped marlin completed by the MARWG in March 2007 (*Annex 8*). This is an update of the previous assessment presented at last year's Plenary meeting. A total of 29 different fisheries, defined by region, country and gear were used in the assessment. Nine fisheries, all of them longline fisheries from the western or central Pacific, provided reasonable measures of abundance. One series was available from the Eastern Pacific but it was shorter and noisier. Size data were available from 13 fisheries from 1970 onward. A decline in catch since the 1960s was observed. CPUE indices were constructed by combining across gears and countries by area for fives areas in the Pacific. The main CPUE series showed a decline; coastal longlines from Japan and Hawaii showed similar trends. Most of the striped marlin catch comes from the northwest Pacific.

Catch, CPUE and length composition data from the sources described above were included in a SS-II model of the population dynamics. Due to uncertainty in the controlling factor of recruitment, two parallel hypotheses were forwarded as separate assessment models. In the first, recruitment was determined by a maternal effect described by a Beverton and Holt Spawner-Recruit curve with the steepness parameter set to h=0.7. In the second hypothesis, recruitment was driven by environmental conditions with recruitment variability around a mean level.

Both hypotheses indicated a stock depleted from historical levels, but assuming a maternal effect resulted in a more depleted stock (6% of 1952 levels for maternal effect versus 16% of 1952 levels for environmental effect). Additional forms of uncertainty were identified by the WG including the true nature of the stock delineation, constant catchability of the CPUE series (i.e. targeting and standardization issues), life-history parameters and the true level of catch in the North Pacific. It would be possible to model eastern and western sides of the Pacific in two separate models but the lack of data available for the eastern Pacific constrains this option. The basic data supporting biological parameters will be improved. Further CPUE standardization research will also continue.

Fishery selectivity estimates from the stock-recruitment and environmentally-driven recruitment models were used as alternative scenarios for calculating biological reference points. The reference points for the alternative scenarios were similar and as a result, reference points were robust to model selection uncertainty. The WG discussed the relative benefits of maintaining various levels of striped marlin spawning potential as a biological reference point and concluded that it would be useful to consider the 20% and 40% values of maximum spawning potential as candidate reference points.

The WG also considered the F_{Max} value as a potential reference point for striped marlin but observed that using this reference would diminish spawning potential ratio values to less than 1% of the maximum spawning potential. This, combined with the fact that the F_{Max} values for Model 1 and Model 2 were over 5-fold larger than the striped marlin natural mortality rate, indicated that using F_{Max} as a target or limit reference point was not appropriate for striped marlin given the model results. The WG also considered the current fishing mortality rate for striped marlin as a potential reference. In this case, the current fishing mortality rate was the average fishing mortality rate during 2001-2003, i.e. under Model 1, F_{Cur}=0.72 and under Model 2, F_{Cur}=0.64 per year.

The WG projected the management implications of applying the F_{Cur}, $F_{20\%}$ and $F_{40\%}$ reference points to the striped marlin stock during 2004-2009. Relative benefits were measured in terms of increasing spawning biomass and maintaining yield under the stock-recruitment and environmentally-driven recruitment models. This comparison emphasized the intrinsic trade-off between the biological conservation and fishery yield benefits of the alternative reference points. Overall, the relative merit of the F_{Cur} and $F_{20\%}$ reference points depends on whether the striped marlin stock can be sustainably fished at the current low spawning potential ratio of roughly 9%.

The WG concluded that there was a clear decline in striped marlin abundance since the 1970s. However the actual magnitude of decline may be under- or over-estimated given the noted uncertainties in assessment data and model structure (see *Annex 9*, Section 6.3). Additionally:

- The WG concluded that the stock-recruitment steepness parameter appeared to be the most important axis of uncertainty for evaluating stock status of striped marlin.
- The WG expressed concern that almost all of the CPUE data in the assessment, especially in the most recent years was from the western Pacific. The relatively short time series of CPUE values from the eastern Pacific was a limiting factor for assessing biomass trends in this region. To address the concern that the western Pacific data could be unduly influencing stock assessment results, it was suggested that a split area assessment could be conducted.
- The WG noted that there was limited empirical information on striped marlin life history characteristics across the species range in the North Pacific. This suggests that spatial variation in striped marlin growth may not be adequately approximated in the assessment model.
- The WG noted that the total enumeration of striped marlin catch, including discards and unreported landings, was a source of concern.
- The WG suggested that there should be further investigation of the use of aggregated fishery length frequency data for stock assessment.

The WG discussed how to characterize the status of the striped marlin stock in a way that reflected its concerns about the health of the population but also the uncertainty of the data used in the stock assessment. It was noted that declines in catch and declines in catch per unit effort from several different fisheries support the conclusion that the marlin population has declined, but the precise extent of the decline is uncertain.

The WG discussed what the objectives and responsibilities of the WG were with respect to providing management guidance. It was noted that the WG will need to know the management objectives to provide specific guidance. It was decided that a range of reference points would be presented, along with impacts to the stock and yield if that reference point were to be adopted. The WG recommended that projections be provided to the Plenary to clarify the impacts.

<u>Discussion</u>

Several technical points regarding the assessment were clarified through Plenary discussion as follows:

- It was pointed out that in some of the model projections; the yield from the current value of F is greater than simulations of a reduced value of F. This was attributed to arbitrarily selected starting values which do not actually affect the model fit. Although it was decided that such scenarios are not erroneous they were felt to be misleading and perhaps require better explanation.
- Since the model projections were only recently completed and circulated to the WG, there was not sufficient time to study the results thoroughly.
- Clarification was sought regarding the equilibrium yield and biomass as obtained from model projections when a stock-recruitment relationship was not assumed (Model 2). It was noted that the recent average yield of striped marlin could be sustainable, however, this may require an increase in F, since the average equilibrium yield at the annual current F (F=0.6) is about 500 t below the recent yield.
- Questions were raised regarding the WG's ability to account for different targeting strategies when standardizing the CPUE indices.
- Concerns were expressed that constraints on recruitment estimates prior to 1965 might introduce an underestimation bias to recruitment estimates in recent years.
- It was suggested that some reference points be chosen and a Kobe chart (i.e. two different reference points on two axes with the stock's position in each year plotted) produced. However, concerns were expressed that there is not sufficient clarity on which reference points to select.
- One suggestion was made to formulate a reference point based on maintaining the stock's spawning potential at 20-40%.
- Another area of uncertainty in the assessment is unaccounted for catch. This could occur due to under-reporting, lack of data for a fishery, mis-reporting by species, etc. While this is a concern, it is unlikely to be remedied in the near future.
- There was a lengthy discussion on different views regarding the interpretation of the assessment results. One interpretation is that the assessment results convey a clear message that the stock has declined precipitously and should be conserved through an immediate reduction in F. Another interpretation is that the uncertainties in the assessment are considerable and prevent full understanding of the state of the stock. Only by removing these uncertainties can the stock status be clarified.

Three procedural issues were raised. The first, regarding the access to data of participating scientists, was dealt with under Section 7.1. Another issue resulted in calls for clarification of the role of the Plenary in reviewing the WG's assessments and of the role of the WGs in formulating conservation advice. The final issue was a suggestion for a traffic light system (i.e. red, yellow and green colors), such as that used by the recent RFMO meeting in Kobe, to focus managers on the categories of interest in an easily understandable way.

Conservation Advice

After discussion of the 2007 MARWGs' report and comments raised by Plenary members, the ISC offers the following conservation advice:

While further guidance from the management authority is necessary, including guidance on reference points and the desirable degree of reduction, the fishing mortality rate of striped marlin (which can be converted into effort or catch in management) should be reduced from the current level (2003 or before), taking into consideration various factors associated with this species and its fishery. Until appropriate measures in this regard are taken, the fishing mortality rate should not be increased.

7.5 Bycatch

A report on bycatch was presented by G. DiNardo on behalf of C. Boggs, the Chairman of the BCWG. Guidance from the Plenary had been sought regarding which species and issues to address and with regard to taking a holistic approach to bycatch species impacts. Useful guidance was received on both topics. G. DiNardo informed the Plenary that no assessments were completed since the last Plenary meeting; therefore no conservation advice was offered.

8 REVIEW OF STOCK STATUS OF SECONDARY STOCKS

8.1 Eastern Pacific – Yellowfin and Bigeye Tunas

M. Dreyfus presented an overview of IATTC stock assessments for yellowfin and bigeye tunas (*ISC/07/PLENARY/INFO/03* and *ISC/07/PLENARY/INFO/04*). The fishery is predominantly a purse seine fishery (with sets on dolphins, free-swimming schools and floating objects), with longlines being the next most common gear type. In the case of the purse seine fishery, fleet capacity in cubic meters has recently reached a peak of over 200,000 cubic meters. For longlines, the number of hooks reached a peak in 2003 and has diminished since then. The catch composition is usually led by yellowfin tuna with skipjack in second place, but for 2005 and 2006, catches of the latter have surpassed catches of yellowfin tuna which are at their lowest level in more than two decades. Catches of bigeye, albacore and Pacific bluefin tuna comprise a smaller proportion of the fishery. Size composition of the catch varies depending on gear type. Longlines target adult tuna whereas the purse seine fishery also captures smaller tunas particularly when setting on floating objects. The average weight of tuna in the purse seine fishery has been decreasing over time and averaged 7.8 kg in 2006.

For yellowfin tuna, based on the assessment model (A-SCALA), the spawning biomass ratio is below the level corresponding to average maximum sustainable yield (AMSY), thus the stock is overfished. Effort levels are above the ones that would support AMSY. There were record catches in the early 2000s and recruitment was very high, but more recently recruitment has been similar to the long-term average. Recent catches are below AMSY and are now 44% of previous values. If a stock recruitment relationship is assumed, the results are more pessimistic. The fishing mortality rate has generally been below that required to support AMSY except in recent years.

Bigeye tuna catches have been predominantly from longline fisheries until 1994 when a FAD fishery in the southern part of the eastern Pacific at 10^{o}N and 20^{o}S latitude was developed. At the present time catches are higher in the surface fishery that focuses on juvenile bigeye tuna. The mean weight of bigeye tunas in the surface fishery in 2006 is 5.3 kg. Based on the assessment model (SS-II), the recent fishing mortality rate is about 20% greater than the corresponding AMSY. As a consequence, if fishing effort is not reduced, total biomass and spawning biomass will eventually decline. The current status and future projections are more pessimistic in terms of stock status if a stock recruitment relation is considered. Diagrams of stock size and fishing mortality rate relative to AMSY reference points show that overall the reference points have not been exceeded until recent years, but the two most recent estimates indicate the stock is overfished and overfishing is occurring.

Discussion

The group discussed what might be the reasons for recent, high skipjack catches in the coastal waters off Ecuador and Peru. It is possible that this phenomenon is due to an inverse relationship between yellowfin and skipjack which has previously seemed to be associated with El Niño events. It could be that the current large fleet size is causing the shift to be even more noticeable in this El Niño cycle. It is also possible that the low catch of yellowfin tuna in recent years is El Niño-related. In particular, following El Niño there is usually very good recruitment of small yellowfin tuna. This appears to have been taken into consideration in formulating IATTC's management recommendations. Another contributing factor could be that the segment of the purse seine fleet targeting floating objects has increased, and since fish size is smallest for floating object sets, this could lead to lower catches overall. It was noted that IATTC has just appointed a new Director of Investigations, Dr. Guillermo Compeán Jiménez, and it is hoped that Dr. Compeán will be able to participate in the ISC Plenary next year.

8.2 Western and Central Pacific – Yellowfin and Bigeye Tuna

Dr. S.K. Soh of the WCPFC presented the results of the assessments of western and central Pacific yellowfin and bigeye tuna that were presented at the WCPFC Scientific Committee meeting last August. MULTIFAN-CL was used to fit to catch, size and tagging data. The principal index came from longline CPUE (GLM standardized) and estimated parameters were selectivity, catchability, movement, recruitment, growth, and stock-recruitment relationship (SRR) steepness using fixed parameters of natural mortality-at-age, length-weight, and maturity-at-age. The total catch of yellowfin and bigeye tuna in the WCPO is about 400,000 t and 100,000 t, respectively. Data sources for the stock assessment were catch in number and weight, standardized and nominal effort, length and weight frequency, tag releases and recoveries, and other auxiliary information used to formulate priors, e.g. estimates of tag reporting rates.

In all analyses, recruitment of yellowfin increased from about 1970 and remained stable over the last two decades, whereas recruitment of bigeye increased from about 1980 and has been at high levels since the early 1990s. Both yellowfin and bigeye biomass declined to about half of its initial level by 1970 and has been fairly stable since then, except for a recent decline of biomass for yellowfin tuna. Biomass is currently 51% of unexploited levels for yellowfin and 30% for bigeye tuna. Kobe charts of both yellowfin and bigeye tuna show that their current biomass is not in an overfished state, but there is a high probability that overfishing is occurring.

Discussion

During the discussion, members remarked upon the usefulness of the Kobe charts of stock size and fishing mortality rate relative to reference points as used by both IATTC and WCPFC, and encouraged their use within ISC. It was remarked that although the stock assessments to be presented at next month's WCPFC Scientific Committee are not yet publicly available, the outlook for tuna stocks is improved in comparison to past assessments. G. DiNardo informed the group that the WCPFC yellowfin tuna assessment had been sent out for independent peer review and that comments received had been fed back to the SPC and considered in formulating this year's assessment. The same process is occurring for the WCPFC bigeye tuna assessment and comments are expected back in November. It was noted that due to a desire by the SPC to focus in detail on the yellowfin tuna assessment, a full assessment of bigeye tuna will occur next year.

9 REVIEW OF STATISTICS AND DATA BASE ISSUES

9.1 Report of the STATWG

The STATWG workshop was held prior to the Plenary on 22-24 July (*Annex 11*). All members except China, FAO, SPC and PICES were represented. One of the main tasks of the workshop was to review what data have been received and where gaps remain. Canada, Korea, Chinese Taipei, and the U.S. have submitted data for Categories I-III. Japan has submitted data for Categories I and II only, while Mexico has only submitted Category I data. No data have been received from China. Only Japan, Chinese Taipei and the U.S. have provided metadata.

One of the major issues for the STATWG is that data are passed by member's data correspondents to the WGs, bypassing the Database Administrator. In such cases, it is difficult for the Database Administrator to know when a submission has been made and what data are contained in the submission. A further difficulty is that WGs sometimes adjust data and do not feed the results of such adjustments back to the Database

Administrator. These and other issues have led, at times, to large discrepancies between WG and STATWG databases. It was concluded by the STATWG that the WG catch tables currently represent best available data for assessments and that these data should be used as the basis for the catch tables.

The STATWG discussed modifications to the ISC website, including a policy for loading working documents on the website and archiving information from the WGs. A future work plan was formulated which identifies several high priority action items for the group. These actions include preparing a timetable for the implementation of new functionality within the system including data quality control, enhancement of the website, storage of archival data from the WGs, and better procedures for WG and STATWG interaction. N. Miyabe stated that the appointment of a full-time database manager is essential to the success of the ISC database.

9.2 Database Administration

The status of the database was reviewed by H. Yamada. A data submission protocol was created at the STATWG workshop in 2002, and modified in the last workshop in 2006, at which point the modified protocol was distributed to the ISC members. Despite this, some submissions have contained missing and/or incorrect codes or missing columns which caused the rejection of some data when uploading into the main ISC database. In other cases, catch quantity units were rounded to the nearest metric ton rather than the required rounding to the nearest 0.1 t. In this case, if metadata are available it may be possible to correct this, but otherwise the true unit is unknown and the data cannot be rectified. H. Yamada encouraged all data correspondents to pay close attention to data submission procedures when providing data.

Discussion

In order to reduce duplication of effort between the WGs and the Database Administrator it was agreed that the flow of data should be from the data correspondents to the WGs and from the WGs to the Database Administrator. This would avoid current problems arising from WG modification of data. With regard to WG data, the primary function of the ISC main database would be to back-up and maintain the data from the WGs, including WG-prepared metadata. In addition, the Database Administrator would serve a coordinating function when a single gear type is catching a variety of species. There was consensus that better coordination between the WGs and the Database Administrator is required, and a periodic submission timetable for WGs to provide data to the Database Administrator was suggested.

In terms of overall responsibilities, the STATWG would have two main duties:

- Oversee production (i.e. compiling, checking and loading) of Category I data for comprehensive catch tables for highly migratory species (this would include not only the tunas but billfishes and bycatch species) in the North Pacific;

- Oversee the archiving of WG data, catch data, catch distribution maps for major species and metadata.

The current confidentiality policy in the ISC Rules of Procedures should be used as a guide.

This led to a discussion of what data should be held by the ISC main database. In this regard, it was noted that the WGs already have Category II and III data but at a finer scale, if required, for stock assessment purposes. These data are not available to the public. On the other hand, similar data of this type are being summarized and made available to interested individuals by other RFMOs.

It was decided that the remit of the Database Administrator will be changed to specify that he/she should receive data from the WGs through explicit procedures; store WG data and catch distribution maps, and produce Category I tables for tuna and tuna-like species of interest to the ISC. The ISC Rules of Procedures will be re-examined and modified as necessary to refine the role of the Database Administrator and the STATWG. New draft procedures will be trialed as a means of accelerating progress on data management systems.

N. Miyabe was asked to clarify the STATWG's position with regard to data exchange with the WCPFC. He referred to statements in the STATWG report which highlight the need to avoid redundancy, the importance of sharing public domain data, and the strong expertise of ISC members in understanding tuna and tuna-like species resources and fisheries in the North Pacific. The ISC welcomes the participation of WCPFC scientists in ISC stock assessment working group workshops.

A suggestion was made to develop a standard performance report for each member to show at a glance which data have and have not been submitted. It was believed this could serve as a useful prompt, and should be produced periodically.

Concerns regarding the slow pace of development of the ISC database system were expressed. Japan delegates were asked whether resourcing for the database work was sufficient. N. Miyabe replied that the Japanese government is providing a reasonable amount of funding for the task for which Japan has assumed responsibility. However, staffing will likely continue to be by contract sources owing to administrative constraints preventing the hiring of permanent staff. The current staff person is on contract through March 2008. While understanding was expressed for the administrative constraints, it was suggested that staff turnover with contractors could lead to inefficiencies and delays and thus a long-term, or permanent position would be preferred. In response to a question, N. Miyabe replied that outside assistance in the form of seconded staff, or similar, from members would certainly be helpful.

9.3 Data Rescue

The Plenary Chairman made a brief statement on data rescue issues. As discussed in the STATWG, Plenary was reminded that the first priority was to compile data from 1971 to the present, then work backward decade-by-decade until the 1950s. Since according to the Chairman of the STATWG, N. Miyabe, there are many data missing from the database, it is important to set data rescue goals and continuously work toward those goals.

9.4 Public Domain Data

H. Yamada made a brief presentation on public domain data. Category I data were confirmed to be public domain data. Differences in archived data between the WG databases and the ISC main database were identified. Noted discrepancies between the Category I data held in the main database and by the WGs were attributed to changes to data in the WGs which are not reported to the Database Administrator, different compilation methodologies, and data sets missing from one database or the other. An example, drawn from Pacific bluefin tuna catches, was used to illustrate the issue (*Annex 11*).

Catch tables were presented (*Tables 1* through *3*) for albacore, swordfish and striped marlin, respectively. As noted above, all of these data are derived from WG data rather than from the ISC main database and may be different from catches reported by members to other forums where "official statistics" are required. The catch table for bluefin tuna, as compiled by the Pacific bluefin tuna WG, is contained in *Annex 6*.

Discussion

Chairmen of the working groups clarified that the data shown in their WG catch tables represent data used in the most recent stock assessments or as of the most recent workshops. In some cases new data may have been received or modifications made to existing data since the last assessment, and those changes may be reflected in the catch tables. There was consensus that the table captions should clearly state that the data were provided by the species WG and could differ from the "officially submitted" statistics. The importance of adding a reference to each table to indicate the date of last update was also agreed.

The Plenary Chariman pointed out that in order to prepare Category I catch tables the STATWG will need more than WG data, e.g. data on yellowfin, bigeye, and skipjack tunas and bycatch will be required. It was explained that for catch distribution maps, the WGs should already be preparing these; therefore the WGs will submit them to the Database Administrator. A question was raised with regard to the WCPFC data exchange issue and further clarification was provided.

10 REVIEW OF SCHEDULE OF MEETINGS

10.1 Time and Place of ISC8

Provisional dates for ISC8 are 23-28 July 2008. Related working group workshops in conjunction with ISC8 will be held beginning 16 July 2008. Japan and the United States traditionally take turns hosting the meeting, and next year it is Japan's turn. Delegates from Japan announced that Japan would be pleased to host ISC8 but given the offer made earlier by the Chinese Taipei delegation to host ISC8, it would be better to defer the decision until after such time when the two members can discuss and settle the matter bilaterally. Chinese Taipei officials stated that they remain interested in holding the meeting but are open to further discussions with Japanese colleagues. The U.S. delegation indicated that should Japanese colleagues exercise their responsibility to host ISC8, the U.S. would be flexible and agreeable to allowing Chinese Taipei colleagues to host ISC9. The Plenary Chairman will be informed of the outcome of the consultation among concerned parties and members will be informed of the selected venue.

10.2 Working Group Intercessional Workshops

A tentative schedule of ISC workshops and other highly migratory species' RFMO meetings has been compiled for 2007-2009 (*Table 4*). Only one conflict emerged in the scheduling of ISC intercessional workshops, i.e. timing of the ISC swordfish and ISC Pacific bluefin tuna assessment workshops, but this was resolved by the Chairmen. Members are encouraged to participate as fully as possible in the WG workshops. The Plenary Chairman will distribute the schedule to other RFMOs so that they will be aware of ISC meetings and workshops.

11 ADMINISTRATIVE MATTERS

11.1 Operational Procedures Manual

The Plenary Chairman introduced a draft Operations Manual (*ISC/07/PLENARY/03*) as an important source of information about the ISC and how it operates. If the Plenary approves the document it will be a living document which will be updated as necessary to reflect evolving operational practice. A log of changes will be maintained.

Members discussed whether any additional amendments might be necessary to the tabled draft. The Chairman suggested that given the call for data on all billfishes to be submitted, the Chairman of the Billfish WG should update the species codes to include all relevant billfish species monitored by the ISC.

The Chairman called to members' attention the change in membership categories to include voting and non-voting members. The non-voting members are comprised of the U.N. Food and Agriculture Organization (FAO), the Inter-American Tropical Tuna Commission (IATTC), the North Pacific Marine Science Organization (PICES), and the Secretariat for the Pacific Community (SPC). It was clarified that there is also Observer and Invited Expert status which would allow non-members to attend meetings and workshops. The difference between the two is that the Invited Expert is nominated by a member, whereas an Observer may be self-nominated. Both must be approved by members.

In this context, the situation with respect to the WCPFC Scientific Committee was discussed. It was explained that this situation is specified in the MOU between the WCPFC and the ISC. Specifically, provisions are already specified by which a representative of the WCPFC is invited to observe the ISC Plenary meeting and WG workshops, and the Chairman, or designee, of the ISC is invited to observe the annual meetings of the WCPFC, the Northern Committee and the Scientific Committee. The possibility of a WCPFC representative becoming a non-voting member was discussed and it was resolved that it would be up to the WCPFC, only in the form of the Scientific Committee, to apply for non-voting member status. It was confirmed that under Observer status, there are no restrictions on the degree of participation by a WCPFC representative other than the restriction on voting (which would apply in the case of non-voting member as well) but it should be of a degree similar to that allowed by the WCPFC for the ISC observer.

With respect to the original ISC Guidelines which require simultaneous Japanese language translation of the Plenary session, the Chairman informed members that under the new wording of the Guidelines, this is now optional.

The U.S. delegation raised the idea of providing a glossary of standard terms within the ISC Operations Manual. This was advocated as means of maintaining agreement among the ISC members on the usage of common terminology.

11.2 Organization Structure

The Plenary Chairman tabled a document showing the ISC Organizational Structure (*ISC/07/PLENARY/08*). The following items were discussed
:

- The Mexican delegation leader will be M.A. Cisneros Mata;
- The Korean delegation leader and representative to all WGs is S.D. Hwang;
- Chinese Taipei will confirm all delegation names by September 2007;
- The IATTC representative to the albacore WG is Alexandre Aires-da-Silva;
- The swordfish and marlin WGs will be merged as agreed into a billfish WG;
- The names of data correspondents and email addresses for all names will be added.

A final diagram will be distributed to the head of each delegation and to each WG Chairman.

11.3 Election of Vice-Chairman

Given the resignation of J.R. Koh as Vice-Chairman of the ISC due to a change in job duties, the Chairman explained it is necessary to conduct a special election for Vice-Chairman to serve out the one remaining year of Dr. Koh's term. After rounds of balloting, in which each of the six members present cast one vote, H. Honda was elected as ISC Vice-Chairman. H. Honda thanked the members for their support and stressed the importance of cooperation among members, attention to the needs of industry and consumers, and the necessity of focusing on applied fishery science.

11.4 Website Design

After calling members' attention to the commitments to upgrade the ISC website (see *Annex 11* and Section 9 of this report), the Plenary Chairman asked H. Yamada to explain what plans are currently in place to progress with the necessary enhancements. H. Yamada replied that he was planning to add a box for Chairman's comments on the webpage and will begin searching for a new server (operated by a private company) that can accommodate and host the new requirements for the website. The U.S. delegation offered to assist by providing the services of web design contractor who has recently completed upgrades to the National Marine Fisheries Service Southwest Fisheries Science Center's website. The Japan delegation thanked the U.S. for their kind offer, but stated that the work on a new design and server has already been started by Japan. After receiving guidance on the conceptual design of the website, Japanese colleagues would first like to attempt construction of the website themselves but they would call upon the U.S. if any difficulties are encountered. A decision was made to continue as suggested by the Japan delegation but with the requirement that periodic updates on progress, including structural design, flow, functionality, and content be provided to the heads of delegations and WG Chairmen in order to ensure full participation and adequate consultation.

11.5 Preparations for meetings

The Plenary Chairman remarked that he would provide a list of requirements and organizational tools, such as meeting room configurations, distribution lists and logistics guidance, to whichever member will be hosting the next Plenary meeting as guidelines for hosting and organizing the ISC8 meeting.

11.6 Other matters

The use of Kobe charts to indicate whether stocks are overfished or whether overfishing is occurring was revisited. It was agreed that WGs should attempt to use such diagrams as much as is practical. If it is not clear which reference points should be used, multiple diagrams with various reference points should be prepared. The ALBWG agreed to trial use of these diagrams in their next assessment and will begin work in the interim, using the 2006 assessment results, to develop prototype diagrams.

H. Honda presented an outline of two major research programs for the sustainable use of tuna resources around Japan being undertaken by Japan's National Research Institute of Far Seas Fisheries. Both programs are being conducted over the period 2007-2009 with funding from the Japan Fisheries Research Agency. Outcomes of the studies will be applied to developing indicators or models for predicting recruitment strength in early life history stages for larvae and/or juveniles of Pacific bluefin tuna. The results will also be used to analyze long term fluctuations in natural stocks of tuna resources, especially Pacific bluefin tuna. The first of the two programs consists of basic research, using field surveys and modelling, on the recruitment strategy of Pacific bluefin tuna around Japan. The second program is an analytical study of long term fluctuations in tuna stocks around Japan, especially Pacific bluefin tuna, using historical data sets.

Discussion

The Mexico delegation remarked that they are developing a similar project on tuna recruitment which will use different methodology but complement Japan's work. Chinese Taipei officials complimented Japan on the project and stated their hopes of contributing to the study. The Chairman thanked H. Honda for his interesting presentation and expressed appreciation for the financial support of such studies by Japan.

12 ADOPTION OF REPORT

A draft Report of the Seventh Meeting of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean was prepared based on input and comment from all participants, and circulated to all members for review. The report was reviewed in its entirety, section by section, within the Plenary meeting and additional comments were incorporated. The report, including all of its annexes, was then adopted as a final document which will be distributed to all members within one week.

13 CLOSE OF MEETING

M. Dreyfus complimented the Plenary Chairman on his skillful and effective management of the meeting, and expressed his appreciation to the rapporteurs and meeting organizers. N. Miyabe, on behalf of the Japanese delegation, also thanked the Chairman for a useful meeting. The Plenary Chairman recognized the WG Chairs and the new ISC Vice-Chair, H. Honda, for their important work, and encouraged them to continue to try to resolve technical issues within their WGs. He thanked the Japan and U.S. delegations for their strong support of the ISC, noting that without interest from members it will be difficult to accomplish the goals of the ISC. Finally, he expressed his and the participants gratitude to the National Fisheries Research and Development Institute of Korea for hosting the meeting. D.Y. Moon responded on behalf of the Korea delegation with congratulations on a successful outcome. The meeting adjourned at 14:20 on July 31, 2007.

Table 1. North Pacific albacore catches (in metric tons) by fishery, 1952-2006. Blank indicates no effort. **--** indicates data not available. 0 indicates less than 1 metric ton. Provisional estimates in ( ). Data are from the Albacore Working Group catch tables as of 28 July 2007 and may differ from official statistics.

Year	**Canada**		**Japan**						**Korea**		**Mexico**
	Troll	Purse Seine	Gill Net	Long Line	Pole & Line	Purse Seine	Troll	Unsp. Gear	Gill Net	Long Line	Purse Seine
1952	71			26,687	41,787	154		237			
1953	5			27,777	32,921	38		132			
1954				20,958	28,069	23		38			
1955				16,277	24,236	8		136			
1956	17			14,341	42,810			57			
1957	8			21,053	49,500	83		151			
1958	74			18,432	22,175	8		124			
1959	212			15,802	14,252			67			
1960	5	136		17,369	25,156			76			
1961	4			17,437	18,639	7		268			0
1962	1			15,764	8,729	53		191			0
1963	5			13,464	26,420	59		218			0
1964	3			15,458	23,858	128		319			0
1965	15			13,701	41,491	11		121			0
1966	44			25,050	22,830	111		585			0
1967	161			28,869	30,481	89		520			
1968	1,028			23,961	16,597	267		1,109			
1969	1,365			18,006	31,912	521		935			0
1970	390			16,283	24,263	317		456			0
1971	1,746			11,524	52,957	902		308			0
1972	3,921		1	13,043	60,569	277		623			100
1973	1,400		39	16,795	68,767	1,353		495			0
1974	1,331		224	13,409	73,564	161		879			1
1975	111		166	10,318	52,152	159		228		2,463	1
1976	278		1,070	15,825	85,336	1,109		272		859	36
1977	53		688	15,696	31,934	669		355		792	0
1978	23		4,029	13,023	59,877	1,115		2,078		228	1
1979	521		2,856	14,215	44,662	125		1,126	0	259	1
1980	212		2,986	14,689	46,742	329		1,179	6	597	31
1981	200		10,348	17,922	27,426	252		663	16	459	8
1982	104		12,511	16,767	29,614	561		440	113	387	7
1983	225		6,852	15,097	21,098	350		118	233	454	33
1984	50		8,988	15,060	26,013	3,380		511	516	136	113
1985	56		11,204	14,351	20,714	1,533		305	576	291	49
1986	30		7,813	12,928	16,096	1,542		626	726	241	3
1987	104		6,698	14,702	19,082	1,205		155	817	549	7
1988	155		9,074	14,731	6,216	1,208		134	1,016	409	15
1989	140		7,437	13,104	8,629	2,521		393	1,023	150	2
1990	302		6,064	15,789	8,532	1,995		249	1,016	6	2
1991	139		3,401	17,046	7,103	2,652		392	852	3	2
1992	363		2,721	19,049	13,888	4,104		1,527	271	15	10
1993	494		287	29,966	12,797	2,889		867		32	11
1994	1,998		263	29,600	26,389	2,026		799		45	6
1995	1,763		282	29,075	20,981	1,177	856	81		440	5
1996	3,316		116	32,493	20,272	581	815	117		333	21
1997	2,168		359	38,951	32,238	1,068	1,585	123		319	53
1998	4,177		206	35,812	22,926	1,554	1,190	88		288	8
1999	2,734		289	33,364	50,369	6,872	891	127		107	23
2000	4,531		67	30,046	21,549	2,408	645	171		414	79
2001	5,248		117	28,819	29,430	974	416	96		82	22
2002	5,379		332	23,644	48,454	3,303	787	135		(113)	28
2003	6,861	0	126	20,954	36,114	627	922	106	(0)	(144)	28
2004	7,856	0	61	17,547	32,255	7,200	772	65	(0)	(68)	(104)
2005	4,829		154	21,020	16,133	850	665	316	(0)	(520)	(0)
2006	(5,819)		(154)	(21,020)	(16,133)	(850)	(665)	(316)	(0)	(520)	(109)

[1] Data are from the 1st ISC Albacore Working Group, November 28 - December 5, 2006 except as noted below.
Recent updates -- Childers added Hawaii troll/handline for US (7/3/2007), -- Uosaki updated figures in 2005 and 2006 for Japan (7/23/2007); Chinese Taipei updates for 2005 and 2006 received 28 July 2007.

Table 1. (cont.) North Pacific albacore catches (in metric tons) by fishery, 1952-2006. Blank indicates no effort. **--** indicates data not available. 0 indicates less than 1 metric ton. Provisional estimates in ( ). Data are from the Albacore Working Group catch tables as of 28 July 2007 and may differ from official statistics.

Year	Chinese Taipei		United States								Other		Grand Total
	Gill Net	Long Line[2]	Pole& Line	Gill Net	Long Line	Purse Seine	Sport	Troll	Troll/ Handline	Unsp. Gear	Long Line[3]	Troll	
1952					46		1,373	23,843					**94,198**
1953					23		171	15,740					**76,807**
1954					13		147	12,246					**61,494**
1955					9		577	13,264					**54,507**
1956					6		482	18,751					**76,464**
1957					4		304	21,165					**92,268**
1958					7		48	14,855					**55,723**
1959					5		0	20,990		0			**51,328**
1960					4		557	20,100		0			**63,403**
1961			2,837		5		1,355	12,055		1			**52,608**
1962			1,085		7		1,681	19,752		1			**47,264**
1963			2,432		7		1,161	25,140		0			**68,906**
1964			3,411		4		824	18,388		0			**62,393**
1965			417		3		731	16,542		0			**73,032**
1966			1,600		8		588	15,333		1			**66,150**
1967		330	4,113		12		707	17,814		0			**83,096**
1968		216	4,906		11		951	20,434		0			**69,480**
1969		65	2,996		14		358	18,827		0			**74,999**
1970		34	4,416		9		822	21,032		0			**68,022**
1971		20	2,071		11		1,175	20,526		0			**91,240**
1972		187	3,750		8		637	23,600		0			**106,717**
1973		--	2,236		14		84	15,653		0			**106,836**
1974		486	4,777		9		94	20,178		0			**115,113**
1975		1,240	3,243		33		640	18,932		10			**89,696**
1976		686	2,700		23		713	15,905		4			**124,816**
1977		572	1,497		37		537	9,969		0			**62,799**
1978		6	950		54		810	16,613		15			**98,822**
1979		81	303		--		74	6,781		0			**71,004**
1980	--	249	382		--		168	7,556		0			**75,126**
1981	--	143	748		25		195	12,637		0			**71,042**
1982	--	38	425		105		257	6,609		21			**67,960**
1983	--	8	607		6		87	9,359		0			**54,527**
1984	--	--	1,030		2	3,728	1,427	9,304		0			**70,258**
1985	--	--	1,498	2	0	26	1,176	6,415	7	0			**58,203**
1986	--	--	432	3		47	196	4,708	5	0			**45,396**
1987	2,514	--	158	5	150	1	74	2,766	6	0			**48,994**
1988	7,389	--	598	15	307	17	64	4,212	9	10			**45,579**
1989	8,350	40	54	4	248	1	160	1,860	36	23			**44,176**
1990	16,701	4	115	29	177	71	24	2,603	15	4			**53,698**
1991	3,398	12	0	17	312	0	6	1,845	72	71			**37,324**
1992	7,866	--	0	0	334	0	2	4,572	54	72			**54,847**
1993		5	0	0	438		25	6,254	71	0			**54,136**
1994		83	0	38	544		106	10,978	90	213		158	**73,336**
1995		4,280	80	52	882		102	8,045	177	1		137	**68,416**
1996		7,596	24	83	1,185	11	88	16,938	188	0	1,735	505	**86,417**
1997		9,119	73	60	1,653	2	1,018	14,252	133	1	2,824	404	**106,402**
1998		8,617	79	80	1,120	33	1,208	14,410	88	2	5,871	286	**98,042**
1999		8,186	60	149	1,542	48	3,621	10,060	331	1	6,307	261	**125,342**
2000		8,842	69	55	940	4	1,798	9,645	120	3	3,654	490	**85,529**
2001		8,684	139	94	1,295	51	1,635	11,210	194	0	1,471	127	**90,105**
2002		7,965	381	30	525	4	2,357	10,387	235		700	(127)	**(104,887)**
2003		7,166	59	16	524	44	2,214	14,102	85	0	(2,400)	(127)	**(92,620)**
2004		4,988	126	12	360	1	1,506	13,346	160	0	(2,400)	(127)	**(88,955)**
2005		4,472	66	20	(304)		(1,719)	8,413	170	0	(2,400)	(127)	**(64,183)**
2006		4,317	(22)	(3)	(274)		(291)	(12,590)	(86)	(0)	(2,400)	(127)	**(67,704)**

[2] Catches for 2000-2004 contain estimates of offshore longline catches from vessels landing at domestic ports

[3] Other longline catches from vessels flying flags of convenience being called back to Chinese Taipei. Catches may be duplicated in the Chinese Taipei longline series (November 2005).

Table 2. Swordfish catches (in metric tons) by fishery, 1952-2006. Blank indicates no effort. - indicates data not available. 0 indicates less than 1 metric ton. Provisional estimates in ( ). Data are from the Swordfish Working Group catch tables as of 1 February 2007 and may differ from official statistics.

Year	Japan								Chinese Taipei[5]			
	Distant/ Offshore Longline[2]	Coastal Longline	Harpoon[3]	Drift Net	Other Bait Fishing	Trap Net	Other[4]	Total	Distant Water Longline	Offshore Long line	Other	Total
1952	8,890	152	0	2,569	6	68	6	11,691	-	-		-
1953	10,796	77	0	1,407	20	21	87	12,408	-	-		-
1954	12,563	96	0	813	104	18	17	13,611	-	-		-
1955	13,064	29	0	821	119	37	41	14,111	-	-		-
1956	14,596	10	0	775	66	31	7	15,485	-	-		-
1957	14,268	37	0	858	59	18	11	15,251	-	-		-
1958	18,525	42	0	1,069	46	31	21	19,734	-	-		-
1959	17,236	66	0	891	34	31	10	18,268	-	-		-
1960	20,058	51	1	1,191	23	67	7	21,400	-	-		-
1961	19,715	51	2	1,335	19	15	11	21,147	-	-		-
1962	10,607	78	0	1,371	26	15	18	12,115	-	-		-
1963	10,322	98	0	747	43	17	16	11,243	-	-		-
1964	7,669	91	4	1,006	42	17	28	8,858	-	343	18	361
1965	8,742	119	0	1,908	26	14	182	10,991	-	358	10	368
1966	9,866	113	0	1,728	41	11	4	11,764	-	331	27	358
1967	10,883	184	0	891	33	12	5	12,008	-	646	35	681
1968	9,810	236	0	1,539	41	14	9	11,649	-	763	12	775
1969	9,416	296	0	1,557	42	11	5	11,327	0	843	7	850
1970	7,324	427	0	1,748	36	9	1	9,545	-	904	5	909
1971	7,037	350	1	473	17	37	0	7,915	-	992	3	995
1972	6,796	531	55	282	20	1	1	7,686	-	862	11	873
1973	7,123	414	720	121	27	23	2	8,430	-	860	119	979
1974	5,983	654	1,304	190	27	16	1	8,175	1	880	136	1,017
1975	7,031	620	2,672	205	58	18	2	10,606	29	899	153	1,081
1976	8,054	750	3,488	313	170	14	1	12,790	23	613	194	830
1977	8,383	880	2,344	201	71	7	1	11,887	36	542	141	719
1978	8,001	1,031	2,475	130	110	22	1	11,770	-	546	12	558
1979	8,602	1,038	983	161	45	15	1	10,845	7	661	33	701
1980	6,005	849	1,746	398	30	15	1	9,045	10	603	76	689
1981	7,039	727	1,848	129	59	10	0	9,812	2	656	25	683
1982	6,064	874	1,257	195	58	7	0	8,546	1	855	49	905
1983	7,692	999	1,033	166	30	9	2	9,931	0	783	166	949
1984	7,177	1,177	1,053	117	98	13	0	9,635	-	733	264	997
1985	9,335	999	1,133	191	69	10	0	11,737	-	566	259	825
1986	8,721	1,037	1,264	123	47	9	0	11,201	-	456	211	667
1987	9,495	860	1,051	87	45	11	0	11,549	3	1,328	190	1,521
1988	8,574	678	1,234	173	19	8	0	10,686	-	777	263	1,040
1989	6,690	752	1,596	362	21	10	0	9,431	50	1,491	38	1,579
1990	5,833	690	1,074	128	13	4	0	7,742	143	1,309	154	1,606
1991	4,809	807	498	153	20	5	0	6,292	40	1,390	180	1,610
1992	7,234	1,181	887	381	16	6	0	9,705	21	1,473	243	1,737
1993	8,298	1,394	292	309	43	4	1	10,341	54	1,174	310	1,538
1994	7,366	1,357	421	308	37	4	0	9,493	-	1,155	219	1,374
1995	6,422	1,387	561	440	17	7	0	8,834	50	1,135	225	1,410
1996	6,916	1,067	428	633	9	4	0	9,057	9	701	31	741
1997	7,002	1,214	365	396	11	5	0	8,993	15	1,358	61	1,434
1998	6,233	1,190	471	535	9	2	0	8,441	20	1,178	41	1,239
1999	5,557	1,049	724	461	2	5	0	7,798	70	1,385	61	1,516
2000	6,180	1,121	808	539	7	5	1	8,661	325	1,531	86	1,942
2001	6,932	908	732	255	5	15	0	8,848	1,039	1,691	91	2,821
2002	6,230	965	1,164	222	8	11	0	8,600	1,633	1,557	27	3,217
2003	5,352	1,039	1,198	167	10	4	0	7,770	1,084	2,196	11	3,291
2004	(6,165)	1,454	1,339	33	33	23	1	(9,048)	884	1,828	16	2,728
2005	(6,972)							(6,972)	437	1,813	26	2,276
2006												

1 Catch data are currently unavailable for Korea, Philippines, and some other countries catching swordfish in the N. Pacific.
2 Catches by gear for 1952-1970 were estimated roughly using FAO statistics and other data. Catches for 1971-2002 are more reliably estimated.
3 Contains trolling and harpoon but majority of catch obtained by harpoon.
4 For 1952-1970 "Other" refers to catches by other baitfishing methods, trap nets, and various unspecified gears.
5 Offshore longline category includes some catches from harpoon and other fisheries but does not include catches unloaded in foreign ports

Table 2.(cont.) Swordfish catches (in metric tons) by fishery, 1952-2006. Blank indicates no effort. **-** indicates data not available. 0 indicates less than 1 metric ton. Provisional estimates in ( ). Data are from the Swordfish Working Group catch tables as of 1 February 2007 and may differ from official statistics.

Year	Korea	Mexico	United States[2]						Grand Total
			Hawaii	California					
	Longline	All Gears	Longline	Longline	Gill Net	Harpoon	Unknown	Total	
1952	-	-	-	-	-	-	-	-	11,691
1953	-	-	-	-	-	-	-	-	12,408
1954	-	-	-	-	-	-	-	-	13,611
1955	-	-	-	-	-	-	-	-	14,111
1956	-	-	-	-	-	-	-	-	15,485
1957	-	-	-	-	-	-	-	-	15,251
1958	-	-	-	-	-	-	-	-	19,734
1959	-	-	-	-	-	-	-	-	18,268
1960	-	-	-	-	-	-	-	-	21,400
1961	-	-	-	-	-	-	-	-	21,147
1962	-	-	-	-	-	-	-	-	12,115
1963	-	-	-	-	-	-	-	-	11,243
1964	-	-	-	-	-	-	-	-	9,219
1965	-	-	-	-	-	-	-	-	11,359
1966	-	-	-	-	-	-	-	-	12,122
1967	-	-	-	-	-	-	-	-	12,689
1968	-	-	-	-	-	-	-	-	12,424
1969	-	-	-	-	-	-	-	-	12,177
1970	-	-	5	-	-	612	10	627	11,081
1971	-	-	1	-	-	99	3	103	9,013
1972	-	2	0	-	-	171	4	175	8,736
1973	-	4	0	-	-	399	4	403	9,816
1974	-	6	0	-	-	406	22	428	9,626
1975	-	-	0	-	-	557	13	570	12,257
1976	-	-	0	-	-	42	13	55	13,675
1977	-	-	17	-	-	318	19	354	12,960
1978	-	-	9	-	-	1,699	13	1,721	14,049
1979	-	7	7	-	-	329	57	393	11,946
1980	-	380	5	-	160	566	62	793	10,907
1981	-	1,575	3	1	461	267	20	752	12,822
1982	-	1,365	5	2	911	156	43	1,117	11,933
1983	-	120	5	1	1,321	58	378	1,763	12,763
1984	-	47	3	14	2,101	96	678	2,892	13,571
1985	-	18	2	46	2,368	211	792	3,419	15,999
1986	-	422	2	4	1,594	236	696	2,532	14,822
1987	-	550	24	4	1,287	211	300	1,826	15,446
1988	-	613	24	19	1,092	180	344	1,659	13,998
1989	-	690	218	29	1,050	54	224	1,575	13,275
1990	-	2,650	2,436	18	1,028	50	137	3,669	15,667
1991	-	861	4,508	39	836	16	137	5,536	14,299
1992	-	1,160	5,700	95	1,332	74	44	7,245	19,847
1993	-	812	5,909	165	1,400	169	36	7,679	20,370
1994	-	581	3,176	740	799	153	8	4,876	16,324
1995	-	437	2,713	279	755	96	31	3,874	14,555
1996	12	439	2,502	347	752	81	10	3,692	13,941
1997	246	2,365	2,881	664	707	84	3	4,339	17,377
1998	123	3,603	3,263	422	924	48	13	4,670	18,076
1999	104	1,136	3,100	1,333	606	81	2	5,122	15,676
2000	161	2,216	2,949	1,908	646	90	9	5,602	18,582
2001	349	780	220	1,763	375	52	5	2,415	15,213
2002	350	465	204	1,320	302	90	3	1,919	14,551
2003	311	671	147	1,812	216	107	0	2,282	14,325
2004	(350)	270.1	(213)	(898)	182	89	(37)	(1,419)	(14,883)
2005	(407)	234.5	(1360)	-	219	73	(0)	(1,652)	(13,506)
2006		347.2							(347)

1 Catch data are currently unavailable for Korea, Philippines, and some other countries catching swordfish in the N. Pacific.
2 Estimated round weight of retained catch. Does not include discards.

Table 3. Striped marlin catches (in metric tons) by fishery, 1952-2005. Blank indicates no effort. - indicates data not available. 0 indicates less than 1 metric ton. Provisional estimates in ( ). Data are from the Marlin Working Group catch tables as of 1 February 2007 and may differ from official statistics.

Year	Japan							Chinese Taipei[1]				
	Distant Water Longline	Off Shore Longline	Other Longline	Small Mesh Gillnet	Large Mesh Gillnet	Other[2]	Total	Distant Water Longline	Highseas Drift Gillnet	Off Shore Longline	Other	Total
1952	2,901		722	0	0	1,564	5,187					-
1953	2,138		47	0	0	954	3,139					-
1954	3,068		52	0	0	1,088	4,208					-
1955	3,082		28	0	0	1,038	4,149					-
1956	3,729		59	0	0	1,996	5,785					-
1957	3,189		119	0	0	2,459	5,766					-
1958	4,106		277	0	3	2,914	7,301					-
1959	4,152		156	0	2	3,191	7,501					-
1960	3,862		101	0	4	1,937	5,905					-
1961	4,420		169	0	2	1,797	6,388					-
1962	5,739		110	0	8	1,912	7,770					-
1963	6,135		62	0	17	1,910	8,124					-
1964	14,304		42	0	2	2,344	16,691			560	199	759
1965	11,602		19	0	1	2,796	14,418			392	175	567
1966	8,419		112	0	2	1,573	10,106			356	157	513
1967	11,698		127	0	3	1,551	13,379	2		385	204	591
1968	15,913		230	0	3	1,040	17,186	1		332	208	541
1969	8,544	600	3	0	3	2,630	11,780	2		571	192	765
1970	12,996	690	181	0	3	1,029	14,899	0		495	189	684
1971	10,965	667	259	0	10	2,016	13,917	0		449	135	584
1972	7,006	837	145	0	243	990	9,221	9		380	126	515
1973	6,299	632	118	0	3,265	630	10,944	1		568	139	708
1974	6,625	327	49	0	3,112	775	10,888	24		650	118	792
1975	5,193	286	38	0	6,534	685	12,736	64		732	96	892
1976	4,996	244	34	0	3,561	571	9,406	32		347	140	519
1977	2,722	256	15	0	4,424	547	7,964	17		524	219	760
1978	2,464	243	27	0	5,593	418	8,745	0		618	78	696
1979	4,898	366	21	0	2,532	526	8,343	26		432	122	580
1980	5,871	607	5	0	3,467	537	10,488	61		223	132	416
1981	3,957	259	12	0	3,866	538	8,632	17		491	95	603
1982	5,211	270	13	0	2,351	655	8,500	7		397	138	542
1983	3,575	320	10	22	1,845	792	6,564	0		555	214	769
1984	3,335	386	9	76	2,257	719	6,782	0		965	339	1,304
1985	3,698	711	24	40	2,323	732	7,528	0		513	181	694
1986	5,178	901	33	48	3,536	571	10,267	0		179	148	327
1987	5,439	1,187	6	32	1,856	513	9,033	31		383	151	565
1988	5,768	752	7	54	2,157	668	9,406	7		457	169	633
1989	4,582	1,081	13	102	1,562	537	7,877	8		184	157	349
1990	2,298	1,125	3	19	1,926	545	5,916	2		137	256	395
1991	2,677	1,197	3	27	1,302	506	5,712	36		254	286	576
1992	2,757	1,247	10	35	1,169	302	5,520	1		219	197	417
1993	3,286	1,723	1	0	828	443	6,281	5		221	142	368
1994	2,911	1,284	1	0	1,443	383	6,022	1		137	196	334
1995	3,494	1,840	3	0	970	278	6,585	27		83	82	192
1996	1,951	1,836	4	0	703	152	4,646	26		162	47	235
1997	2,120	1,400	3	0	813	163	4,499	59		290	47	396
1998	1,784	1,975	2	0	1,092	304	5,157	90		205	50	345
1999	1,608	1,551	4	0	1,126	183	4,472	66		128	42	236
2000	1,152	1,109	8	0	1,062	297	3,628	153		161	55	369
2001	985	1,326	11	0	1,077	237	3,636	121		129	51	301
2002	764	795	5	0	1,264	291	3,119	251		226	29	506
2003	1,008	826	3	0	1,064	203	3,104	241		91	43	375
2004	(761)	(964)	(2)	(0)	(1,339)	(90)	(3,066)	261		95	24	380
2005	(803)						(803)	176		76	32	284

1 Estimated from catch in number of fish

2 Contains bait fishing, net fishing, trapnet, trolling, harpoon, etc.

Table 3.(cont). Striped marlin catches (in metric tons) by fishery, 1952-2005. Blank indicates no effort. - indicates data not available. 0 indicates less than 1 metric ton. Provisional estimates in ( ). Data are from the Marlin Working Group catch tables as of 1 February 2007 and may differ from official statistics.

Year	Costa Rica[1]	Korea			Mexico			United States					Grand Total
	Sport	Long Line	Highseas Drift Gillnet	Total	Long Line	Sport[1]	Total	Long Line	Troll	Hand Line	Sport[1]	Total	
1952		-		0			0				23	23	5,210
1953		-		0			0				5	5	3,144
1954		-		0			0				16	16	4,224
1955		-		0			0				5	5	4,154
1956		-		0			0				34	34	5,819
1957		-		0			0				42	42	5,808
1958		-		0			0				59	59	7,360
1959		-		0			0				65	65	7,566
1960		-		0			0				30	30	5,935
1961		-		0			0				24	24	6,412
1962		-		0			0				5	5	7,775
1963		-		0			0				68	68	8,192
1964		-		0			0				58	58	17,508
1965		-		0			0				23	23	15,008
1966		-		0			0				36	36	10,655
1967		-		0			0				49	49	14,018
1968		-		0			0				51	51	17,778
1969		-		0			0				30	30	12,575
1970		-		0			0				18	18	15,601
1971		-		0			0				17	17	14,518
1972		-		0			0				21	21	9,757
1973		-		0			0				9	9	11,660
1974		-		0			0				55	55	11,735
1975		-		0			0				27	27	13,655
1976		-		0			0				31	31	9,956
1977		-		0			0				41	41	8,766
1978		-		0			0				37	37	9,478
1979		-		0			0				36	36	8,960
1980		-		0			0				33	33	10,937
1981		-		0			0				60	60	9,295
1982		-		0			0				41	41	9,083
1983		-		0			0				39	39	7,373
1984		-		0			0				36	36	8,122
1985		-		0			0				42	42	8,263
1986		-		0	-		0				19	19	10,614
1987		-		0	-		0	272	30	1	28	331	9,928
1988		-		0	-		0	504	54	1	30	589	10,628
1989		-		0	-		0	612	24	0	52	688	8,914
1990		-		0	-	181	181	538	27	0	23	588	7,079
1991	106	-		0	-	75	75	663	40	0	12	715	7,184
1992	281	-		0	-	142	142	459	38	1	25	523	6,884
1993	438	-		0	-	159	159	471	68	1	11	551	7,796
1994	521	-		0	-	179	179	326	34	0	17	377	7,433
1995	153	-		0	-	190	190	543	52	0	14	609	7,729
1996	122	348		348	-	237	237	418	54	1	20	493	6,081
1997	138	828		828	-	193	193	352	38	1	21	412	6,466
1998	144	519		519	-	345	345	378	26	0	23	427	6,937
1999	166	352		352	-	266	266	364	28	1	12	405	5,897
2000	97	436		436	-	312	312	200	14	1	10	225	5,067
2001	151	206		206	-	237	237	351	42	2		395	4,926
2002	76	153		153	-	305	305	226	29	0		255	4,414
2003	79	172		172	-	322	322	538	28	0		566	4,618
2004	(19)	(75)		(75)	-	-	0	(384)	(56)	(2)		(442)	(3,768)
2005	-	(115)		(115)	-	-	0	(377)	-	-		(377)	(1,465)

[1] Estimated from catch in number of fish

Table 4. Schedule of ISC and Other Tuna and Tuna-like Species Regional Fisheries Management Organization Meetings, 2007-2009.

		09-07	10-07	11-07	12-07	01-08	02-08	03-08	04-08	05-08	06-08	07-08	08-08	09-08	10-08	11-08	12-08	01-09	02-09	03-09	04-09
ISC	**ALB WG**						MD/RP (28-), La Jolla	MD/RP (1-6), La Jolla				UP (16- 17)					MD				
	PBF WG				DP/MD (11-18), Shimizu					DP/MD (21-27) FA (28-30)	FA (1-4)							MD RP			
	BILL WG					SWO DP/MD (15-23)					SWO SC (3-10), Japan				SWO MD (25-1) SYM (20-24)					SWO FA	
	BC WG									Shark DP		RE (16-17)					Shark SC	Shark SC			
	STAT WG											RE (18-21)									
	Plenary											(23-28)									
Other	**ICCAT**	Spp. Groups (24-28)	SCRS (1-5)						Tuna Assess		BET Assess			Spp. Groups (29- 3)	SCRS (6-10)	Comm (12-18)					
	IATTC									Stock Assess. (12-16)	Comm (22-27)				Work shop (14-17)						
	WPFC	NC (11-13)			Comm (3-7)								SC (10-22)	NC (9-11)			Comm (1-5)				
	IOTC			SC (5-9)						Comm (11-16)						SC (3-7)					
	Others									Tuna Conf. (19-22)					WFC (20-24)						

Key: MD = Model development and analyses; DP = Data preparation and review; RP = Biological reference points; SC = Stock condition advice; FA = Complete stock assessment with new model, data or information; UP = Updated stock assessment with additional data and minor corrections to existing data; RE = Review of activities, plans and progress; SYM = Symposium Comm. = Commission, NC = Northern Committee, SC = Science Committee

7th Meeting of the

INTERNATIONAL SCIENTIFIC COMMITTEE FOR TUNA AND TUNA-LIKE SPECIES IN THE NORTH PACIFIC OCEAN

Busan National University
Sangnam International House
Geumjeong-gu
Busan 609-735, Korea

July 25-30, 2007

Agenda

1. Opening
2. Adoption of Agenda
3. Delegation Reports on Research and Fishery Monitoring
4. Report of Chairman
5. Reports of Working Groups
6. Stock Status and Conservation Advice
7. Review of Stock Status of Secondary Stocks
8. Review of Statistics and Data Base Issues
9. Relationship between ISC and Regional Organizations
10. Review of Meeting Schedule
11. Administrative Matters
12. Adoption of Report
13. Close of Meeting

REPORT OF THE SEVENTH MEETING OF THE INTERNATIONAL SCIENTIFIC COMMITTEE FOR TUNA AND TUNA-LIKE SPECIES IN THE NORTH PACIFIC OCEAN

Plenary Session, July 25-30, 2007
Busan, Korea

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REPORT OF THE SEVENTH MEETING OF THE INTERNATIONAL SCIENTIFIC COMMITTEE FOR TUNA AND TUNA-LIKE SPECIES IN THE NORTH PACIFIC OCEAN

Plenary Session, July 25-30, 2007
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LIST OF MEETING DOCUMENTS

Plenary Documents

ISC/07/PLENARY/01	ISC Action Plan for 2006-2007 (*ISC*)
ISC/07/PLENARY/02	IATTC-75-06: The Fishery for Tunas and Billfishes in the Eastern Pacific Ocean in 2006 (*IATTC*)
ISC/07/PLENARY/03	Operations Manual for the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (*ISC*)
ISC/07/PLENARY/04	The 2006 Canadian North Pacific Albacore Troll Fishery (*Max Stocker, Fisheries and Oceans Canada*)
ISC/07/PLENARY/05	Recent Status of Chinese-Taipei Tuna Fisheries in the North Pacific Region for 2005 (*Fisheries Agency, Council of Agriculture, Chinese-Taipei*)
ISC/07/PLENARY/06	U.S. Fisheries and Research on Tuna and Tuna-like Species in the North Pacific Ocean (*NOAA Fisheries SWFSC and PIFSC*)
ISC/07/PLENARY/07	Schedule of ISC and Other Highly Migratory Species Regional Fisheries Management Organization Meetings, 2007-09 (*ISC*)
ISC/07/PLENARY/08	ISC Organizational Chart (June 2007) (*ISC*)
ISC/07/PLENARY/09	National Report of Japan *(Harumi Yamada and Koji Uosaki, National Research Institute of Far Seas Fisheries)*
ISC/07/PLENARY/10	Mexican Progress Report to the ISC (*INP*)

ISC/07/PLENARY/11	National Report of Korea *(S.D. Hwang, D.N. Kim, K.H. Choi, D.H. An, and D.Y. Moon, National Fisheries Research and Development Institute)*

<u>Informational Documents</u>

ISC/07/PLENARY/INFO/01	Stock Assessment of Yellowfin Tuna in the Western and Central Pacific Ocean, Including an Analysis of Management Options (WCPFC-SC2-2006/SA WP-1) (*WCPFC*)
ISC/07/PLENARY/INFO/02	Stock Assessment of Bigeye Tuna in the Western and Central Pacific Ocean, Including an Analysis of Management Options (WCPFC-SC2-2006/SA WP-2) (*WCPFC*)
ISC/07/PLENARY/INFO/03	Status of Yellowfin Tuna in the Eastern Pacific Ocean (*IATTC*)
ISC/07/PLENARY/INFO/04	Status of Bigeye Tuna in the Eastern Pacific Ocean (*IATTC*)
ISC/07/PLENARY/INFO/05	The Relationship between the International Scientific Committee, the Northern Committee and the Scientific Committee in Respect to the Northern Stocks (WCPFC-SC3/GN WP-4) (*WCPFC*)

LIST OF ANNEXES

Agenda Item J.2.a
Attachment 2
April 2008

INTER-AMERICAN TROPICAL TUNA COMMISSION
COMISIÓN INTERAMERICANA DEL ATÚN TROPICAL

Fishery Status Report-Informe de la Situación de la Pesquería No. 5

TUNAS AND BILLFISHES IN THE EASTERN PACIFIC OCEAN IN 2006
LOS ATUNES Y PECES PICUDOS EN EL OCEANO PACÍFICO ORIENTAL EN 2006

La Jolla, California
2008

COVER PHOTOGRAPH BY WAYNE PERRYMAN
FOTOGRAFÍA EN LA PORTADA POR WAYNE PERRYMAN

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FISHERY STATUS REPORT 5

TUNAS AND BILLFISHES IN THE EASTERN PACIFIC OCEAN IN 2006

INTRODUCTION

This report provides a summary of the fishery for tunas in the eastern Pacific Ocean (EPO), assessments of the major stocks of tunas and billfishes that are exploited in the fishery, and an evaluation of the pelagic ecosystem in the EPO.

The report is based on data available to the IATTC staff in May 2007. The sections on bluefin and albacore tunas (E, F), and the three sections on billfishes (G, H, I) are essentially the same as the corresponding sections of IATTC Fishery Status Report 4, published in 2006, except for updates of the figures.

All weights of catches and discards are in metric tons (t). In the tables, 0 means no effort or catch <0.5 t; - means no data collected; * means data missing or not available. The following abbreviations are used:

Species:

ALB	Albacore tuna (*Thunnus alalunga*)
BET	Bigeye tuna (*Thunnus obesus*)
BIL	Unidentified istiophorid billfishes
BKJ	Black skipjack (*Euthynnus lineatus*)
BLM	Black marlin (*Makaira indica*)
BUM	Blue marlin (*Makaira nigricans*)
BZX	Bonito (*Sarda* spp.)
CAR	Chondrichthyes, cartilaginous fishes nei[1]
CGX	Carangids (Carangidae)
DOX	Dorado (*Coryphaena* spp.)
MLS	Striped marlin (*Tetrapturus audax*)
MZZ	Osteichthyes, marine fishes nei
PBF	Pacific bluefin tuna (*Thunnus orientalis*)
SFA	Indo-Pacific sailfish (*Istiophorus platypterus)*
SKJ	Skipjack tuna (*Katsuwonus pelamis*)
SKX	Unidentified elasmobranchs
SSP	Shortbill spearfish (*Tetrapturus angustirostris*)
SWO	Swordfish (*Xiphias gladius*)
TUN	Unidentified tunas
YFT	Yellowfin tuna (*Thunnus albacares*)

[1] not elsewhere included

Set types:

DEL	Dolphin
NOA	Unassociated school
OBJ	Floating object
	FLT: Flotsam
	FAD: Fish-aggregating device

Fishing gears:

FPN	Trap
GN	Gillnet
HAR	Harpoon
LL	Longline
LP	Pole and line
LTL	Troll
LX	Hook and line
OTR	Other[2]
NK	Unknown
PS	Purse seine
RG	Recreational
TX	Trawl

Ocean areas:

EPO	Eastern Pacific Ocean
WCPO	Western and Central Pacific Ocean

Stock assessment:

AMSY	Average maximum sustainable yield
B	Biomass
C	Catch
CPUE	Catch per unit of effort
F	Coefficient of fishing mortality
S	Index of spawning biomass
SBR	Spawning biomass ratio
SSB	Spawning stock biomass

Flags:

BLZ	Belize
BOL	Bolivia
CAN	Canada
CHL	Chile
CHN	China
COK	Cook Islands
COL	Colombia
CRI	Costa Rica
ECU	Ecuador
ESP	Spain
GTM	Guatemala
HND	Honduras
JPN	Japan
KOR	Republic of Korea
MEX	Mexico
NIC	Nicaragua
PAN	Panama
PER	Peru
PYF	French Polynesia
SLV	El Salvador
TWN	Chinese Taipei
UNK	Unknown
USA	United States of America
VEN	Venezuela
VUT	Vanuatu

[2] used to group known gear types

INFORME DE LA SITUACIÓN DE LA PESQUERÍA 5

LOS ATUNES Y PECES PICUDOS EN EL OCÉANO PACÍFICO ORIENTAL EN 2006

INTRODUCCIÓN

El presente informe contiene un resumen de la pesquería de atunes en el Océano Pacífico oriental (OPO), evaluaciones de las poblaciones principales de atunes y peces picudos que son explotadas en la pesquería, y una evaluación del ecosistema pelágico en el OPO.

El informe se basa en datos disponibles al personal de la CIAT en mayo de 2007. Las secciones sobre los atunes aleta azul y albacora (E, F), y las tres secciones sobre peces picudos (G, H, I), son esencialmente iguales a las secciones correspondientes del Informe de la Situación de la Pesquería 4, publicado en 2006, salvo actualizaciones de las figuras.

Se expresa el peso de capturas y descartes en toneladas métricas (t). En las tablas, 0 en una casilla significa ningún esfuerzo o una captura de menos de 0,5 t; - significa que no se tomaron datos, y * significa datos faltantes o no disponibles. Se usan las abreviaturas siguientes:

Especie:

ALB	Atún albacora (*Thunnus alalunga*)
BET	Atún patudo (*Thunnus obesus*)
BIL	Peces picudos istioflóridos no identicados
BKJ	Atún barrilete negro (*Euthynnus lineatus*)
BLM	Marlín negro(*Makaira indica*)
BUM	Marlín azul (*Makaira nigricans*)
BZX	Bonito (*Sarda* spp.)
CAR	Chondrichthyes, peces cartilaginosus nep[1]
CGX	Carangidos (Carangidae)
DOX	Dorado (*Coryphaena* spp.)
MLS	Marlín rayado (*Tetrapturus audax*)
MZZ	Osteichthyes, peces marinos nep
PBF	Atún aleta azul del Pacífico (*Thunnus orientalis*)
SFA	Pez vela del Indo-Pacifico (*Istiophorus platypterus)*
SKJ	Atún barrilete (*Katsuwonus pelamis*)
SSP	Marlín trompa corta (*Tetrapturus angustirostris*)
SWO	Pez espada (*Xiphias gladius*)
TUN	Atunes no identificados
YFT	Atún alta amarilla (*Thunnus albacares*)

[1] no especificado en otra partida

Tipos de lance:

DEL	Delfín
NOA	No asociados
OBJ	Objeto flotante
	FLT: Natural
	FAD: Planteado

Artes de pesca:

FPN	Almadraba
GN	Red de transmalla
HAR	Arpón
LL	Palangre
LP	Caña
LTL	Curricán
LX	Linea y anzuelo
OTR	Otras[2]
NK	Desconocido
PS	Red de cerco
RG	Deportivo
TX	Red de arrastre

Áreas oceánicas:

EPO	Océano Pacifico oriental
WCPO	Océano Pacifico occidental y central

Evaluación de poblaciones:

B	Biomasa
C	Captura
CPUE	Captura por unidad de esfuerzo
F	Coeficiente de mortalidad por pesca
RMSP	Rendimiento máximo sostenible promedio
S	Índice de biomasa reproductora
SBR	Cociente de biomasa reproductora
SSB	Biomasa de lapoblación reproductora

Banderas:

BLZ	Belice
BOL	Bolivia
CAN	Canadá
CHL	Chile
CHN	China
COK	Islas Cook
COL	Colombia
CRI	Costa Rica
ECU	Ecuador
ESP	España
GTM	Guatemala
HND	Honduras
JPN	Japón
KOR	Repúblia de Corea
MEX	México
NIC	Nicaragua
PAN	Panamá
PER	Perú
PYF	Polinesia Francesa
SLV	El Salvador
TWN	Taipei Chino
UNK	Desconocido
USA	Estados Unidos de América
VEN	Venezuela
VUT	Vanuatu

[2] usado para agrupar artes conocidas

A. THE FISHERY FOR TUNAS AND BILLFISHES IN THE EASTERN PACIFIC OCEAN

This section summarizes the fisheries for species covered by the IATTC Convention (tunas and other fish caught by tuna-fishing vessels) in the eastern Pacific Ocean (EPO). The most important of these are the scombrids (Family Scombridae), which include tunas, bonitos, seerfishes, and mackerels. The principal species of tunas caught are yellowfin, skipjack, bigeye, and albacore, with lesser catches of Pacific bluefin, black skipjack, and frigate and bullet tunas; other scombrids, such as bonitos and wahoo, are also caught.
This report also covers other species caught by tuna-fishing vessels in the EPO: billfishes (swordfish, marlins, shortbill spearfish, and sailfish) carangids (yellowtail, rainbow runner, and jack mackerel), dorado, elasmobranchs (sharks, rays, and skates), and other fishes.

Most of the catches are made by the purse-seine and longline fleets; the pole-and-line fleet and various artisanal and recreational fisheries account for a small percentage of the total catches.

Detailed data are available for the purse-seine and pole-and-line fisheries; the data for the longline, artisanal, and recreational fisheries are incomplete.

The IATTC Regional Vessel Register contains details of vessels authorized to fish for tunas in the EPO. The IATTC has detailed records of most of the purse-seine and pole-and-line vessels that fish for yellowfin, skipjack, bigeye, and/or Pacific bluefin tuna in the EPO. The Register is incomplete for small vessels. It contains records for large (overall length >24 m) longline vessels of some nations that fish in the EPO and in other areas.

The data in this report are derived from various sources, including vessel logbooks, observer data, unloading records provided by canners and other processors, export and import records, estimates derived from the species and size composition sampling program, reports from governments and other entities, and published reports.

1. CATCHES AND LANDINGS OF TUNAS, BILLFISHES, AND ASSOCIATED SPECIES

Estimating the total catch of a species of fish is difficult, for various reasons. Some fish are discarded at sea, and the data for some gear types are often incomplete. Data for fish discarded at sea by purse-seine vessels with carrying capacities greater than 363 metric tons (t) have been collected by observers since 1993, which allows for better estimation of the total amounts of fish caught by the purse-seine fleet. Estimates of the total amount of the catch that is landed (hereafter referred to as the retained catch) are based principally on data from unloadings. Beginning with Fishery Status Report 3, which reports on the fishery in 2004, the unloading data for purse-seine and pole-and-line vessels have been adjusted, based on the species composition estimates for yellowfin, skipjack, and bigeye tunas. The current species composition sampling program, described in Section 1.3.1, began in 2000, so the catch data for 2000-2006 are adjusted, based on estimates obtained for each year, by flag. The catch data for the previous years were adjusted by applying the average ratio by species from the 2000-2006 estimates, by flag, and summing over all flags. This has tended to increase the estimated catches of bigeye and decrease those of yellowfin and/or skipjack. These adjustments are all preliminary, and may be improved in the future. All of the purse-seine and pole-and-line data for 2006 are preliminary.

Data on the retained catches of most of the larger longline vessels are obtained from the governments of the nations that fish for tunas in the EPO. Longline vessels, particularly the larger ones, direct their effort primarily at bigeye, yellowfin, albacore, or swordfish. Data from smaller longliners, artisanal vessels, and other vessels that fish for tunas, billfishes, dorado, and sharks in the EPO were gathered either directly from the governments, from logbooks, or from reports published by the governments. Data for the western and central Pacific Ocean (WCPO) were provided by the Ocean Fisheries Programme of the Secretariat of the Pacific Community (SPC). All data for longlines and other gears for 2005 and 2006 are preliminary.

The data from all of the above sources are compiled in a database by the IATTC staff and summarized in this report. In recent years, the IATTC staff has increased its effort toward compiling data on the catches of tunas, billfishes, and other species caught by other gear types, such as trollers, harpooners, gillnetters, and recreational vessels. The estimated total catches from all sources mentioned above of yellowfin, skipjack, and bigeye in the entire Pacific Ocean are shown in Table A-1, and are discussed further in the sections below.

Estimates of the annual retained and discarded catches of tunas and other species taken by tuna-fishing vessels in the EPO during 1976-2006 are shown in Table A-2. The catches of tunas and bonitos by all gears during 2002-2006, by gear and flag, are shown in Tables A-3a-e, and the purse-seine and pole-and-line catches and the recreational landings of tunas and bonitos during 2005-2006 are summarized by flag in Tables A-4a-b. There were no restrictions on fishing for tunas in the EPO during 1988-1997, but the catches of most species have been affected by restrictions on fishing during some or all of the last six months of 1998-2006. Furthermore, regulations placed on purse-seine vessels directing their effort at tunas associated with dolphins have affected the way these vessels operate, especially since the late 1980s, as discussed in Section 3.

The catches have also been affected by climate perturbations, such as the major El Niño events that occurred during 1982-1983 and 1997-1998. These events made the fish less vulnerable to capture by purse seiners due to the greater depth of the thermocline, but had no apparent effect on the longline catches. Yellowfin recruitment tends to be greater after an El Niño event. The effects of El Niño events and other environmental conditions on the fisheries of the EPO are discussed further in Section J.5, **PHYSICAL ENVIRONMENT**.

1.1. Catches by species

1.1.1. Yellowfin tuna

The annual catches of yellowfin during 1977-2006 are shown in Table A-1 and Figure B-1. Overall, the catches in both the EPO and WCPO have increased during this period. In the EPO, the El Niño event of 1982-1983 led to a reduction in the catches in those years, whereas the catches in the WCPO were apparently not affected. Although the El Niño episode of 1997-1998 was greater in scope, it did not have the same effect on the yellowfin catches in the EPO. The catch of yellowfin in the EPO, in 2002, 443 thousand t, was the greatest on record, but in 2004 and 2005 it decreased substantially, and the catch during 2006, 175 thousand t, was the lowest since 1984. In the WCPO, the catches of yellowfin reached 353 thousand t in 1990, peaked at 462 thousand t in 1998, and remained high through 2003; they fell to 367 thousand t in 2004, and in 2005 increased to 426 thousand t.

The annual retained catches of yellowfin in the EPO by purse-seine and pole-and-line vessels during

1977-2006 are shown in Table A-2a. The average annual retained catch during 1991-2005 was 276 thousand t (range: 212 to 413 thousand t). The preliminary estimate of the retained catch in 2006, 167 thousand t, was 38% less than in 2005, and 39% less than the average for 1991-2005. The average amount of yellowfin discarded at sea during 1993-2005 was about 2% of the total purse-seine catch (retained catch plus discards) of yellowfin (range: 1 to 3%) (Table A-2a).

The annual retained catches of yellowfin in the EPO by longliners during 1977-2006 are shown in Table A-2a. During 1991-2005 they remained relatively stable, averaging about 21 thousand t (range: 10 to 31 thousand t), or about 7% of the total retained catches of yellowfin. Yellowfin are also caught by recreational vessels, as incidental catch in gillnets, and by artisanal fisheries. Estimates of these catches are shown in Table A-2a, under "Other gears" (OTR); during 1991-2005 they averaged about 2 thousand t.

Further information on yellowfin tuna is presented in Section B of this report.

1.1.2. Skipjack tuna

The annual catches of skipjack during 1977-2006 are shown in Table A-1 and Figure C-1. Most of the skipjack catch in the Pacific is taken in the WCPO. The greatest reported catch in the WCPO, about 1.5 million t, occurred in 2005, while the greatest total catch in the EPO, 322 thousand t, occurred in 2006.

The annual retained catches of skipjack in the EPO by purse-seine and pole-and-line vessels during 1977-2006 are shown in Table A-2a. During 1991-2005 the annual retained catch averaged 157 thousand t (range 64 to 275 thousand t). The preliminary estimate of the retained catch in 2006, 309 thousand t, is 97% greater than the average for 1991-2005, and 12% greater than the previous record-high retained catch of 2003. The average amount of skipjack discarded at sea during 1993-2005 was about 11% of the total catch of skipjack (range: 7 to 19%) (Table A-2a).

Small amounts of skipjack are caught with longlines and other gears (Table A-2a).

Further information on skipjack tuna is presented in Section C of this report.

1.1.3. Bigeye tuna

The annual catches of bigeye during 1977-2006 are shown in Table A-1 and Figure D-1. Overall, the catches in both the EPO and WCPO have increased, but with considerable fluctuation. The catches in the EPO reached 105 thousand t in 1986, and have fluctuated between about 74 and 147 thousand t since then, with the greatest catch in 2000. In the WCPO the catches of bigeye increased to more than 77 thousand t during the late 1970s, decreased during the 1980s, and then increased, with lesser fluctuations, until 1999, when the catches reached more than 116 thousand t. Catches of bigeye in the WCPO increased significantly in 2004 and 2005, to 145 and 158 thousand t, respectively.

Prior to 1994, the average annual retained catch of bigeye taken by purse-seine vessels in the EPO was about 8 thousand t (range 1 to 22 thousand t) (Table A-2a). Following the development of fish-aggregating devices (FADs), placed in the water by fishermen to aggregate tunas, the annual retained catches of bigeye increased from 35 thousand t in 1994 to between 44 and 94 thousand t during 1995-2000. A preliminary estimate of the retained catch in the EPO in 2006 is 71 thousand t. The average amount of bigeye discarded at sea during 1993-2005 was about 5% of the purse-seine catch of the species (range: 2 to 9%). Small amounts of bigeye have been caught in some years by pole-and-line vessels, as shown in Table A-2a.

During 1977-1993, prior to the increased use of FADs and the resulting greater catches of bigeye by purse-seine vessels, the longline catches of bigeye in the EPO ranged from 46 to 104 thousand t (average: 74 thousand t) about 88%, on average, of the retained catches of this species from the EPO. During 1994-2005 the annual retained catches of bigeye by the longline fisheries ranged from about 36 to 74 thousand t (average: 54 thousand t), an average of 46% of the total catch of bigeye in the EPO (Table A-2a). The preliminary estimate of the longline catch in the EPO in 2006 is 30 thousand t (Table A-2a).

Small amounts of bigeye are caught by other gears, as shown in Table A-2a.

Further information on bigeye tuna is presented in Section D of this report.

1.1.4. Bluefin tuna

The catches of Pacific bluefin in the entire Pacific Ocean, by flag and gear, are shown in Table A-5 and Figure E-1. The data, which were obtained from the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC), are reported by fishing nation or entity, regardless of the area of the Pacific Ocean in which the fish were caught.

The catches of Pacific bluefin in the EPO during 1977-2006, by gear, are shown in Table A-2. During 1991-2005 the annual retained catch of bluefin from the EPO by purse-seine and pole-and-line vessels averaged 3 thousand t (range 400 t to 9 thousand t). The preliminary estimate of the retained catch of bluefin in 2006, 10 thousand t, is 7 thousand t greater than the average for 1991-2005. Small amounts of bluefin are discarded at sea by purse-seine vessels (Table A-2a).

Further information on Pacific bluefin tuna is presented in Section E of this report.

1.1.5. Albacore tuna

The catches of albacore in the entire Pacific Ocean, by gear and area (north and south of the equator) are shown in Table A-6 and in Figures F-1a-b. The catches of albacore in the EPO, by gear, are shown in Table A-2a. A significant portion of the albacore catch is taken by troll gear, included under "Other gears" (OTR) in Table A-2a. The catch data were obtained from IATTC data for the EPO and from data compiled by the SPC for the WCPO.

Further information on albacore tuna is presented in Section F of this report.

1.1.6. Other tunas and tuna-like species

While yellowfin, skipjack, and bigeye tunas comprise the most significant portion of the retained catches of the purse-seine and pole-and-line fleets in the EPO, other tunas and tuna-like species, such as black skipjack, bonito, wahoo, and frigate and bullet tunas, contribute to the overall harvest in this area. The estimated annual retained and discarded catches of these species during 1977-2006 are presented in Table A-2a. The catches reported in the unidentified tunas category (TUN) in Table A-2a contain some catches reported by species (frigate or bullet tunas, wahoo) along with the unidentified tunas. The total retained catch of these other species by these fisheries was about 6 thousand t in 2006, which is greater than the 1991-2005 annual average retained catch of about 2 thousand t (range: 500 t to 9 thousand t).

Black skipjack are also caught by other gears in the EPO, mostly by coastal artisanal fisheries. Bonitos are also caught by artisanal fisheries, and have been reported as catch by longline vessels in some years.

1.1.7. Billfishes

Catch data for billfishes (swordfish, blue marlin, black marlin, striped marlin, shortbill spearfish, and sailfish) are shown in Table A-2b and in Figures G-1, H-1, and I-1.

Swordfish are caught in the EPO with large-scale and artisanal longline gear, gillnets, harpoons, and occasionally with recreational gear. The average annual longline catch of swordfish during 1991-2005 was 13 thousand t, but during 2001-2005 was about 17 thousand t. It is not clear whether this is due to increased abundance of swordfish or increased effort directed toward that species.

Other billfishes are caught with large-scale and artisanal longline gear and recreational gear. The average annual longline catches of blue marlin and striped marlin during 1991-2005 were about 5 thousand and 3 thousand t, respectively. Smaller amounts of other billfishes are taken by longline.

Unfortunately, little information is available on the recreational catches of billfishes, but they are believed to be substantially less than the commercial catches for all species.

Small amounts of billfishes are caught by purse seiners, but these are considered to be discarded, although some may be landed but not reported. These data are also included in Table A-2b.

Further information on swordfish, blue marlin, and striped marlin is presented in Sections G-I of this report.

1.1.8. Other species

Data on the catches and discards of carangids (yellowtail, rainbow runner, and jack mackerel), dorado, elasmobranchs (sharks, rays, and skates), and other fishes caught in the EPO are shown in Table A-2c.

Dorado are unloaded mainly in ports in South and Central America. Although the catches are greater than 10 thousand t in some years, the gear types used are often not reported.

1.2. Distributions of the catches of tunas

1.2.1. Purse-seine catches

The average annual distributions of the purse-seine catches of yellowfin, skipjack, and bigeye, by set type, in the EPO during 1996-2005, are shown in Figures A-1a, A-2a, and A-3a, and preliminary estimates for 2006 are shown in Figures A-1b, A-2b, and A-3b. The catches of yellowfin were low in the Northern areas off Mexico and Central America in 2006, as had been the case in 2004 and 2005. The yellowfin catches off South America were also lower than the 1996-2005 average. The skipjack catches in 2006 were significantly greater than those of 1996-2005. Significant catches of skipjack were made throughout the year from about 5°N to 15°S. As had been the case in 2004, and 2005, the catches of skipjack in the inshore areas off Mexico were greater, possibly due to changes in fishing strategy due to poor yellowfin fishing. Bigeye are not often caught north of about 7°N. The catches of bigeye have decreased in the Inshore areas off South America for several years. With the development of the fishery for tunas associated with FADs, the relative importance of the inshore areas has decreased, while that of the offshore areas has increased. Most of the bigeye catches are taken on FADs between 5°N and 5°S.

1.2.2. Longline catches

Data on the spatial and temporal distributions of the catches in the EPO by the distant-water longline fleets of China, Chinese Taipei, French Polynesia, Japan, the Republic of Korea, Spain, the United States, and Vanuatu are maintained in databases of the IATTC. Bigeye and yellowfin tunas make up the majority of the catches by most of these vessels. The distributions of the catches of bigeye and yellowfin tunas in the Pacific Ocean by the Japanese longline fleet during 2000-2004 are shown in Figure A-4. Data for the Japanese longline fishery in the EPO during 1956-1997 is available in IATTC Bulletins describing that fishery.

1.3. Size compositions of the catches of tunas

1.3.1. Purse-seine, pole-and-line, and recreational fisheries

Length-frequency samples are the basic source of data used for estimating the size and age compositions of the various species of fish in the landings. This information is necessary to obtain age-structured estimates of the populations for various purposes, including the integrated modeling that the staff has employed during the last several years. The results of such studies have been described in several IATTC Bulletins, in its Annual Reports for 1954-2002, and in its Stock Assessment Reports.

Length-frequency samples of yellowfin, skipjack, bigeye, Pacific bluefin, and, occasionally, black skipjack from the catches of purse-seine, pole-and-line, and recreational vessels in the EPO are collected by IATTC personnel at ports of landing in Ecuador, Mexico, Panama, the USA, and Venezuela. The catches of yellowfin and skipjack were first sampled in 1954, bluefin in 1973, and bigeye in 1975. Sampling has continued to the present.

The methods for sampling the catches of tunas are described in the IATTC Annual Report for 2000 and in IATTC Stock Assessment Reports 2 and 4. Briefly, the fish in a well of a purse-seine or pole-and-line vessel are selected for sampling only if all the fish in the well were caught during the same calendar month, in the same type of set (floating-object, unassociated school, or dolphin), and in the same sampling area. These data are then categorized by fishery (Figure A-5), based on the staff's most recent stock assessments.

Data for fish caught during the 2001-2006 period are presented in this report. Two sets of length-frequency histograms are presented for each species, except bluefin and black skipjack; the first shows the data by stratum (gear type, set type, and area) for 2006, and the second shows the combined data for each year of the 2001–2006 period. For bluefin, the histograms show the 2001-2006 catches by commercial and recreational gear combined. For black skipjack, the histograms show the 2001-2006 catches by commercial gear. Only a small amount of catch was taken by pole-and-line vessels in 2006, and no samples were obtained from these vessels.

For stock assessments of yellowfin, nine purse-seine fisheries (four associated with floating objects, three associated with dolphins, and two unassociated) and one pole-and-line fishery are defined (Figure A-5). The last fishery includes all 13 sampling areas. Of the 1,053 wells sampled, 739 contained yellowfin. The estimated size compositions of the fish caught during 2006 are shown in Figure A-6a. The majority of the yellowfin catch was taken in sets associated with dolphins and in unassociated sets Most of the larger yellowfin (>100 cm) were caught during the third and fourth quarters in the Northern and Inshore dolphin fisheries, and during the first quarter in the Southern dolphin fishery. Larger fish were also caught in the Southern unassociated fishery, mostly during the fourth quarter. A small amount of large yellowfin was taken in the Southern floating-object fishery during the third quarter. A mode of smaller yellowfin (50 cm) was evident in all the floating-object fisheries during the year, and in the unassociated fishery in the South during the first and second quarters. Small amounts of yellowfin were caught in the floating-object fisheries throughout the year. The catches by pole-and-line vessels were negligible.

The estimated size compositions of the yellowfin caught by all fisheries combined during 2001-2006 are shown in Figure A-6b. The average weights of the yellowfin caught in 2006 were considerably less than those of the previous five years.

For stock assessments of skipjack, seven purse-seine fisheries (four associated with floating objects, two unassociated, one associated with dolphins) and one pole-and-line fishery are defined (Figure A-5). The last two fisheries include all 13 sampling areas. Of the 1,053 wells sampled, 877 contained skipjack. The estimated size compositions of the fish caught during 2006 are shown in Figure A-7a. Large amounts of skipjack in the 40- to 50-cm size range were caught in all of the floating-object fisheries and in the Southern unassociated fishery during the first, second, and third quarters of 2006. Larger skipjack in the 60- to 70-cm size range were caught primarily during the third and fourth quarters in the North and Equatorial floating-object fisheries and in the Southern unassociated fishery. Lesser amounts of the larger skipjack were taken in the floating-object fishery during the first and second quarters and in the dolphin fishery throughout the year. Negligible amounts of skipjack were caught by pole-and-line vessels.

The estimated size compositions of the skipjack caught by all fisheries combined during 2001-2006 are shown in Figure A-7b. The average weights of skipjack are considerably less than those of the previous five years.

For stock assessments of bigeye, six purse-seine fisheries (four associated with floating objects, one unassociated, one associated with dolphins) and one pole-and-line fishery are defined (Figure A-5). The last three fisheries include all 13 sampling areas. Of the 1,053 wells sampled, 338 contained bigeye. The estimated size compositions of the fish caught during 2006 are shown in Figure A-8a. In 2000 the majority of the catch was taken in floating-object sets in the Equatorial area, whereas from 2001 to 2003 the majority of the bigeye catch was taken in sets on floating objects in the Southern area. In 2006, as in 2004 and 2005, nearly equal amounts of bigeye were taken in the Northern, Equatorial, and Southern floating-object fisheries. Small amounts of bigeye were caught in unassociated sets, in floating-object sets in the Inshore area, and in sets on schools associated with dolphins. There were no recorded catches of bigeye by pole-and-line vessels.

The estimated size compositions of the bigeye caught by all fisheries combined during 2001-2006 are shown in Figure A-8b. The average weight of the fish was greatest in 2000, when the greatest catch of bigeye was taken. From 2002 to 2005 the average weights of bigeye were fairly constant, but in 2006 it was considerably less. The smaller bigeye (40-60 cm) were caught in floating-object sets throughout the year, while most of the larger fish (>80 cm) were caught in floating-object sets during the first, second, and fourth quarters in the Equatorial area, and during most of the year in the Southern area.

Pacific bluefin are caught by purse-seine and recreational gear off California and Baja California from about 23°N to 35°N, with most of the catch being taken during May through October. During 2006 bluefin were caught between 26°N and 31°N from March through August. The majority of the catches of bluefin by both commercial and recreational vessels were taken during June, July, and August. In the past,the sizes of the fish in the commercial and recreational catches have been reported separately. In 2004, 2005, and 2006, however, small sample sizes make it infeasible to estimate the size compositions separately. Therefore, the sizes of the fish in the commercial and recreational catches of bluefin were combined for each year of the 2001-2006 period. The estimated size compositions are shown in Figure A-9.

Black skipjack are caught incidentally by fishermen who direct their effort toward yellowfin, skipjack, and bigeye tuna. The demand for this species is low, so most of the catch is discarded at sea, but small amounts, mixed with the more desirable species, are sometimes retained. Fourteen samples of black skipjack were taken in 2006; the estimated size compositions are shown in Figure A-10.

1.3.2. Longline fishery

The estimated size compositions of the catches of yellowfin and bigeye by the Japanese longline fishery in the EPO during 2000-2004 are shown in Figures A-11 and A-12. The average weights of both yellowfin and bigeye taken by that fishery have remained about the same throughout its existence. Information on the size compositions of fish caught by the Japanese longline fishery in the EPO during 1958-1997 is available in IATTC Bulletins describing that fishery.

1.4. Catches of tunas and bonitos, by flag and gear

The annual retained catches of tunas and bonitos in the EPO during 2002-2006, by flag and gear, are shown in Tables A-3a-e. These tables include all of the known catches of tunas and bonitos compiled from records gathered from governments, fish-processing companies, logbooks, and import-export records. Similar information on tunas and bonitos prior to 2001, and historic data for tunas, billfishes, sharks, carangids, dorado, and miscellaneous fishes are available on the IATTC web site. The purse-seine, pole-and-line, and recreational catches of tunas and bonitos in 2005 and 2006, by flag, are summarized in Tables A-4a-b (top panels).

1.5. Landings of tunas and bonitos by purse-seine and pole-and-line vessels

The landings are fish unloaded from fishing vessels during a calendar year, regardless of the year of catch. The country of landing is that in which the fish were unloaded or, in the case of transshipments, the country that received the transshipped fish. Preliminary landings data for 2005 and 2006 (Tables A-4a-b, lower panels) indicate that, of the 569 thousand t of tunas and bonitos landed in 2006, 59% was landed in Ecuador and 18% in Mexico. Other countries with significant landings of tunas and bonitos caught in the EPO included Colombia and Venezuela (5% each). It is important to note that, when final information is available, the landings currently assigned to various countries may change due to exports from storage facilities to processors in other nations.

1.6. Purse-seine catches per cubic meter of well volume

The total retained catch per cubic meter of well volume (C/m^3) for the purse-seine vessels that fish for tunas in the EPO are presented in Table A-7 for the EPO, by vessel size group and species, for 2001-2006. To provide more detail in this index, the vessels are assigned to eight size groups. Yellowfin, skipjack, and bigeye contribute the most to the C/m^3 for the larger vessels, while other species of tuna, such as black skipjack, make up an important part of the C/m^3 of the smaller vessels in many years.

2. EFFORT

2.1. Purse seine

Estimates of the numbers of purse-seine sets of each type (associated with dolphins, associated with floating objects, and unassociated) in the EPO during the 1989-2006 period, and the retained catches of these sets, are shown in Table A-8 and in Figure 1. The estimates for vessels ≤363 t carrying capacity were calculated from logbook data in the IATTC statistical data base, and those for vessels >363 t carrying capacity were calculated from the observer data bases of the IATTC, Colombia, Ecuador, the European Union, Mexico, Nicaragua, Panama, the United States, and Venezuela. The greatest numbers of sets associated with floating objects and unassociated sets were made from the mid-1970s to the early 1980s. Despite opposition to fishing for tunas associated with dolphins and the refusal of U.S. canners to accept tunas caught during trips during which sets were made on dolphin-associated fish, the numbers of sets associated with dolphins decreased only moderately during the mid-1990s, and in 2003 were the greatest recorded.

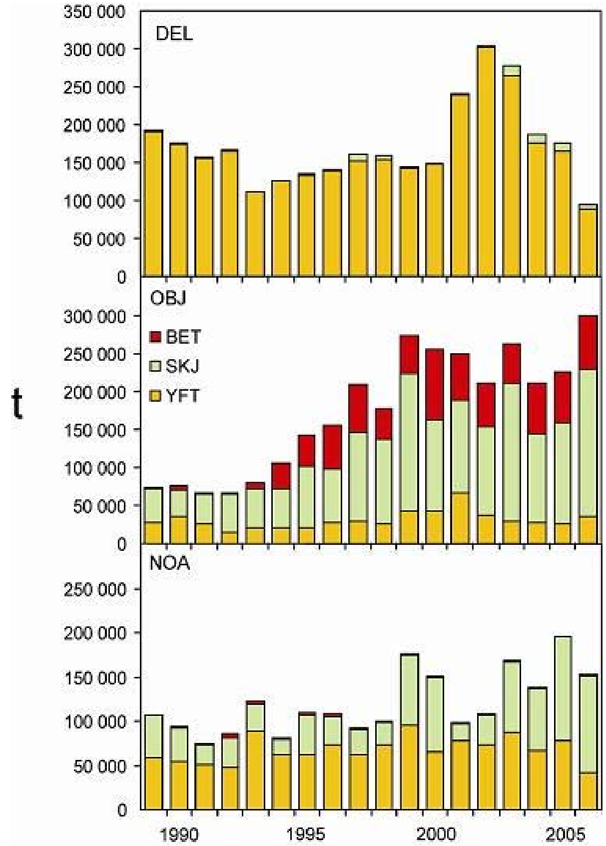

FIGURE 1. Purse-seine catches of tunas, by species and set type, 1989-2006.

There are two types of floating objects, flotsam and FADs. The occurrence of the former is unplanned from the point of view of the fishermen, whereas the latter are constructed by fishermen specifically for the purpose of attracting fish. FADs have been widely used for about 12 years, and their relative importance has increased during this period, while that of flotsam has decreased, as shown by the data in Table A-9.

2.2. Longline

The reported nominal fishing effort (in thousands of hooks) by longline vessels in the EPO, and their catches of the predominant tuna species, are shown in Table A-10.

3. THE FLEETS

3.1 The purse-seine and pole-and-line fleets

The IATTC staff maintains detailed records of gear, flag, and fish-carrying capacity for most of the vessels that fish with purse-seine or pole-and-line gear for yellowfin, skipjack, bigeye, and/or Pacific bluefin tuna in the EPO. The fleet described here includes purse-seine and pole-and-line vessels that have fished all or part of the year in the EPO for any of these four species.

Historically the owner's or builder's estimates of carrying capacities of individual vessels, in tons of fish, were used until landing records indicated that revision of these estimates was required.

Since 2000, the IATTC has used well volume, in cubic meters (m^3), instead of weight, in metric tons (t), to measure the carrying capacities of the vessels. Since a well can be loaded with different densities of fish, measuring carrying capacity in weight is subjective, as a load of fish packed into a well at a higher density weighs more than a load of fish packed at a lower density. Using volume as a measure of capacity eliminates this problem.

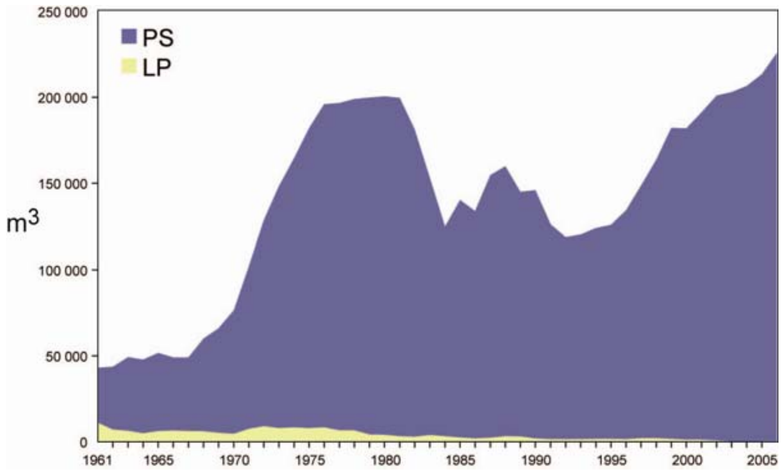

FIGURE 2. Carrying capacity, in cubic meters of well volume, of the purse-seine and pole-and-line fleets in the EPO, 1961-2006.

The IATTC staff began collecting capacity data by volume in 1999, but has not yet obtained this information for all vessels. For vessels for which reliable information on well volume is not available, the estimated capacity in metric tons was converted to cubic meters.

Until about 1960 fishing for tunas in the EPO was dominated by pole-and-line vessels operating in coastal regions and in the vicinity of offshore islands and banks. During the late 1950s and early 1960s most of the larger pole-and-line vessels were converted to purse seiners, and by 1961 the EPO fishery was dominated by these vessels. From 1961 to 2006 the number of pole-and-line vessels decreased from 93 to 4, and their total well volume from about 11 thousand to about 500 m^3. During the same period the number of purse-seine vessels increased from 125 to 225, and their total well volume from about 32 thousand to about 225 thousand m^3, an average of about 1,000 m^3 per vessel. An earlier peak in numbers and total well volume of purse seiners occurred from the mid-1970s to the early 1980s, when the number of vessels reached 282 and the total well volume about 195 thousand m^3, an average of about 691 m^3 per vessel (Table A-11; Figure 2).

The catch rates in the EPO were low during 1978-1981, due to concentration of fishing effort on small fish, and the situation was exacerbated by a major El Niño event, which began in mid-1982 and persisted until late 1983 and made the fish less vulnerable to capture. The total well volume of purse-seine and pole-and-line vessels then declined as vessels were deactivated or left the EPO to fish in other areas, primarily the western Pacific Ocean, and in 1984 it reached its lowest level since 1971, about 125 thousand m^3. In early 1990 the U.S. tuna-canning industry adopted a policy of not purchasing tunas caught during trips during which sets on tunas associated with dolphins were made. This caused many U.S.-flag vessels to leave the EPO, with a consequent reduction in the fleet to about 119 thousand m^3 in 1992. With increases in participation of vessels of other nations in the fishery, the total well volume has increased steadily since 1992, and in 2006 was 226 thousand m^3.

The 2005 and preliminary 2006 data for numbers and total well volumes of purse-seine and pole-and-line vessels that fished for tunas in the EPO are shown in Tables A-12a-b. The fleet was dominated by vessels operating under the Mexican and Ecuadorian flags during 2006. The Ecuadorian fleet had about 26% and the Mexican fleet had about 25% of the total well volume during 2006, Panama about 15%, Venezuela about 14%, Colombia about 6%, Nicaragua and El Salvador about 4% each, and

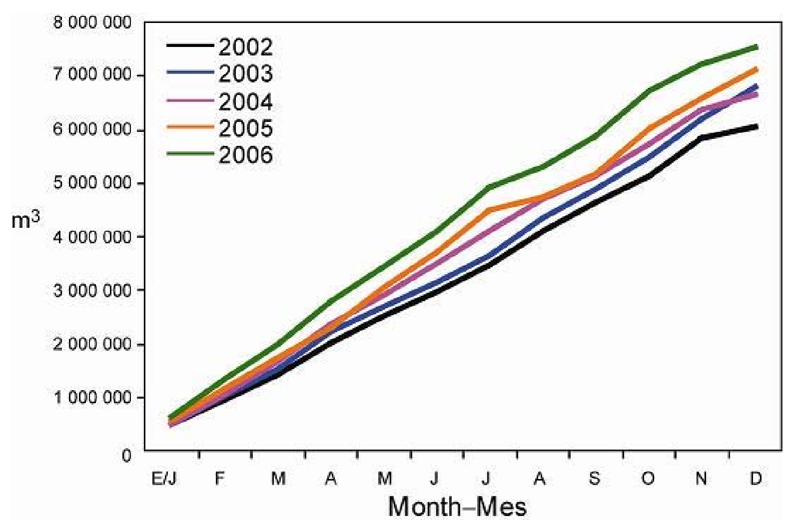

FIGURE 3. Cumulative capacity of the purse-seine and pole-and-line fleet at sea, by month, 2002-2006.

Spain about 3%.

The cumulative capacity at sea during 2006 is compared to those of the previous four years in Figure 3.

The monthly average, minimum, and maximum total well volumes at sea (VAS), in thousands of cubic meters, of purse-seine and pole-and-line vessels that fished for tunas in the EPO during 1996-2005, and the 2006 values, are shown in Table A-13. The monthly values are averages of the VAS estimated at weekly intervals by the IATTC staff. The fishery was regulated during some or all of the last four months of 1998-2006, so the VAS values for September-December 2006 are not comparable to the average VAS values for those months of 1996-2005. The average VAS values for 1996-2005 and 2006 were 109 thousand m^3 (60% of total capacity) and 146 thousand m^3 (64% of total capacity), respectively.

3.2. Other fleets of the EPO

Information on other types of vessels that fish for tunas in the EPO is available on the IATTC's Regional Vessel Register, on the IATTC web site. The Register is incomplete for small vessels. In some cases, particularly for large longline vessels, the Register contains information for vessels authorized to fish not only in the EPO, but also in other oceans, and which may not have fished in the EPO during 2006, or ever.

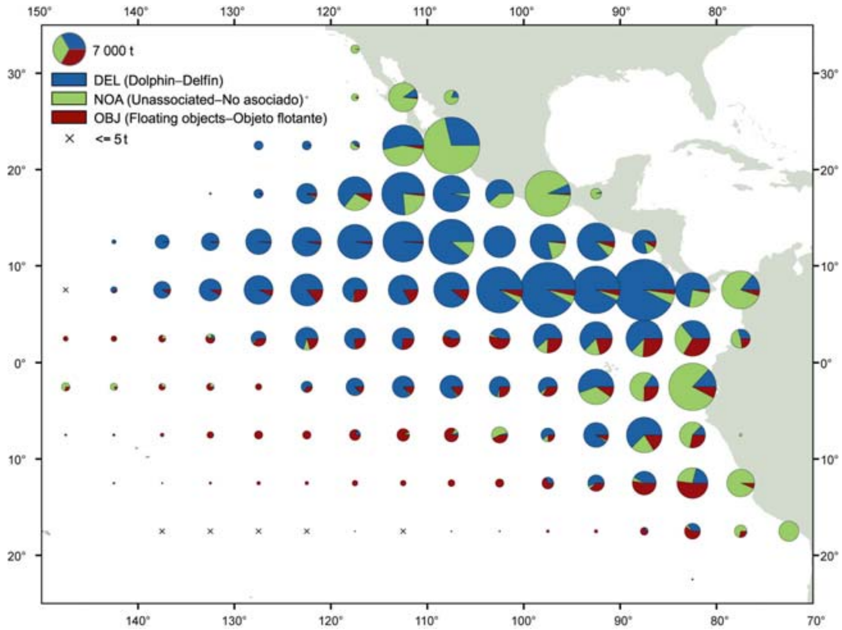

FIGURE A-1a. Average annual distributions of the purse-seine catches of yellowfin, by set type, 1996-2005. The sizes of the circles are proportional to the amounts of yellowfin caught in those 5° by 5° areas.
FIGURA A-1a. Distribución media anual de las capturas cerqueras de aleta amarilla, por tipo de lance, 1996-2005. El tamaño de cada círculo es proporcional a la cantidad de aleta amarilla capturado en la cuadrícula de 5° x 5° correspondiente.

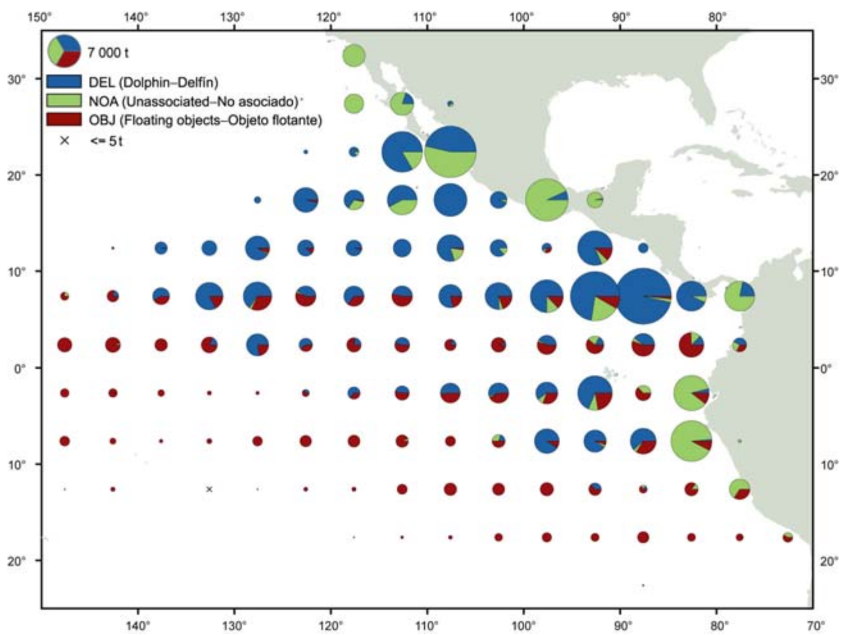

FIGURE A-1b. Annual distributions of the purse-seine catches of yellowfin, by set type, 2006. The sizes of the circles are proportional to the amounts of yellowfin caught in those 5° by 5° areas.
FIGURA A-1b. Distribución anual de las capturas cerqueras de aleta amarilla, por tipo de lance, 2006. El tamaño de cada círculo es proporcional a la cantidad de aleta amarilla capturado en la cuadrícula de 5° x 5° correspondiente.

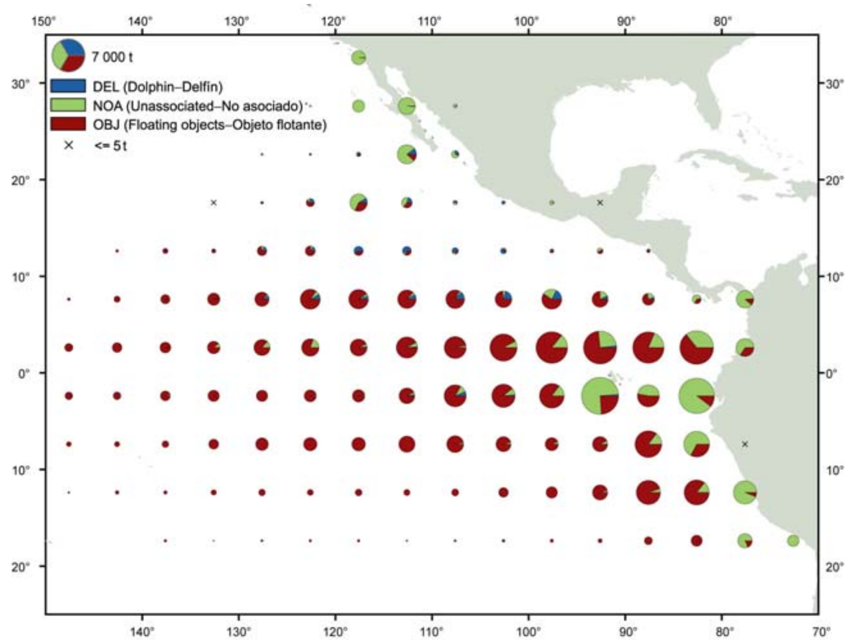

FIGURE A-2a. Average annual distributions of the purse-seine catches of skipjack, by set type, 1996-2005. The sizes of the circles are proportional to the amounts of skipjack caught in those 5° by 5° areas.
FIGURA A-2a. Distribución media anual de las capturas cerqueras de barrilete, por tipo de lance, 1996-2005. El tamaño de cada círculo es proporcional a la cantidad de barrilete capturado en la cuadrícula de 5° x 5° correspondiente.

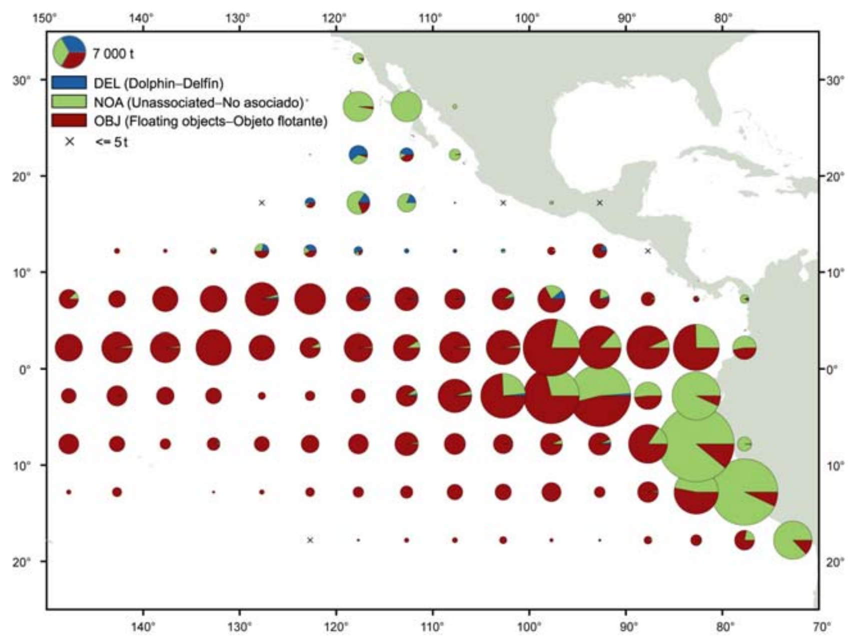

FIGURE A-2b. Annual distributions of the purse-seine catches of skipjack, by set type, 2006. The sizes of the circles are proportional to the amounts of skipjack caught in those 5° by 5° areas.
FIGURA A-2b. Distribución anual de las capturas cerqueras de barrilete, por tipo de lance, 2006. El tamaño de cada círculo es proporcional a la cantidad de barrilete capturado en la cuadrícula de 5° x 5° correspondiente.

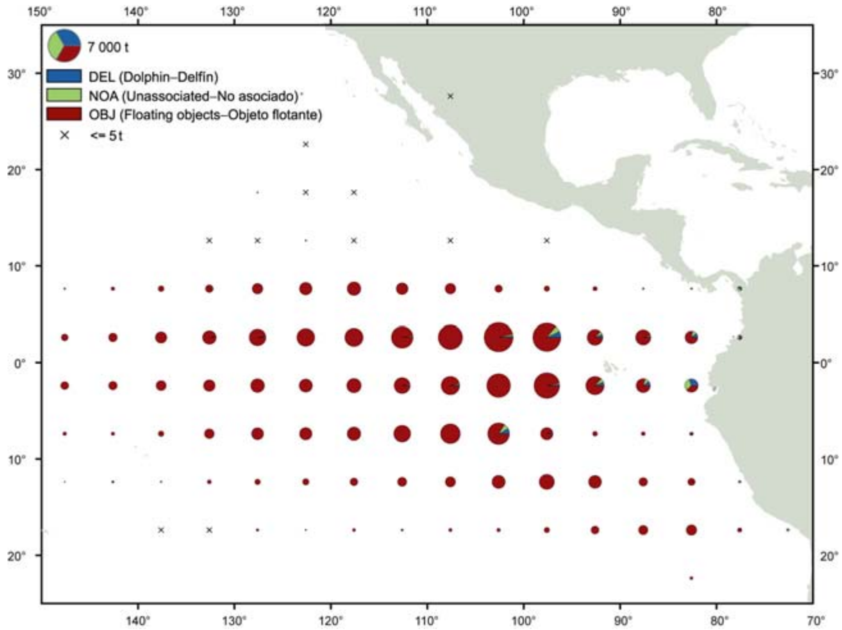

FIGURE A-3a. Average annual distributions of the purse-seine catches of bigeye, by set type, 1996-2005. The sizes of the circles are proportional to the amounts of bigeye caught in those 5° by 5° areas.
FIGURA A-3a. Distribución media anual de las capturas cerqueras de patudo, por tipo de lance, 1996-2005. El tamaño de cada círculo es proporcional a la cantidad de patudo capturado en la cuadrícula de 5° x 5° correspondiente.

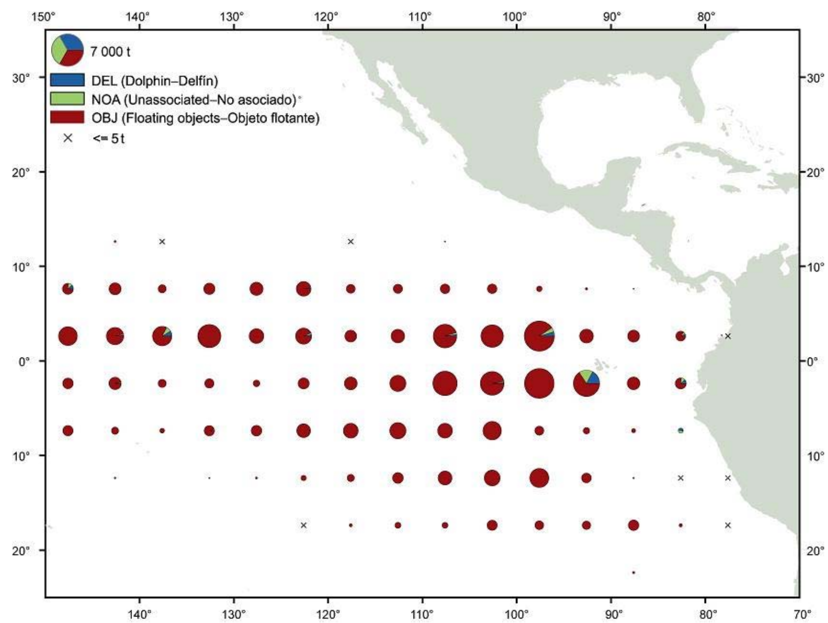

FIGURE A-3b. Annual distributions of the purse-seine catches of bigeye, by set type, 2006. The sizes of the circles are proportional to the amounts of bigeye caught in those 5° by 5° areas.
FIGURA A-3b. Distribución anual de las capturas cerqueras de patudo, por tipo de lance, 2006. El tamaño de cada círculo es proporcional a la cantidad de patudo capturado en la cuadrícula de 5° x 5° correspondiente.

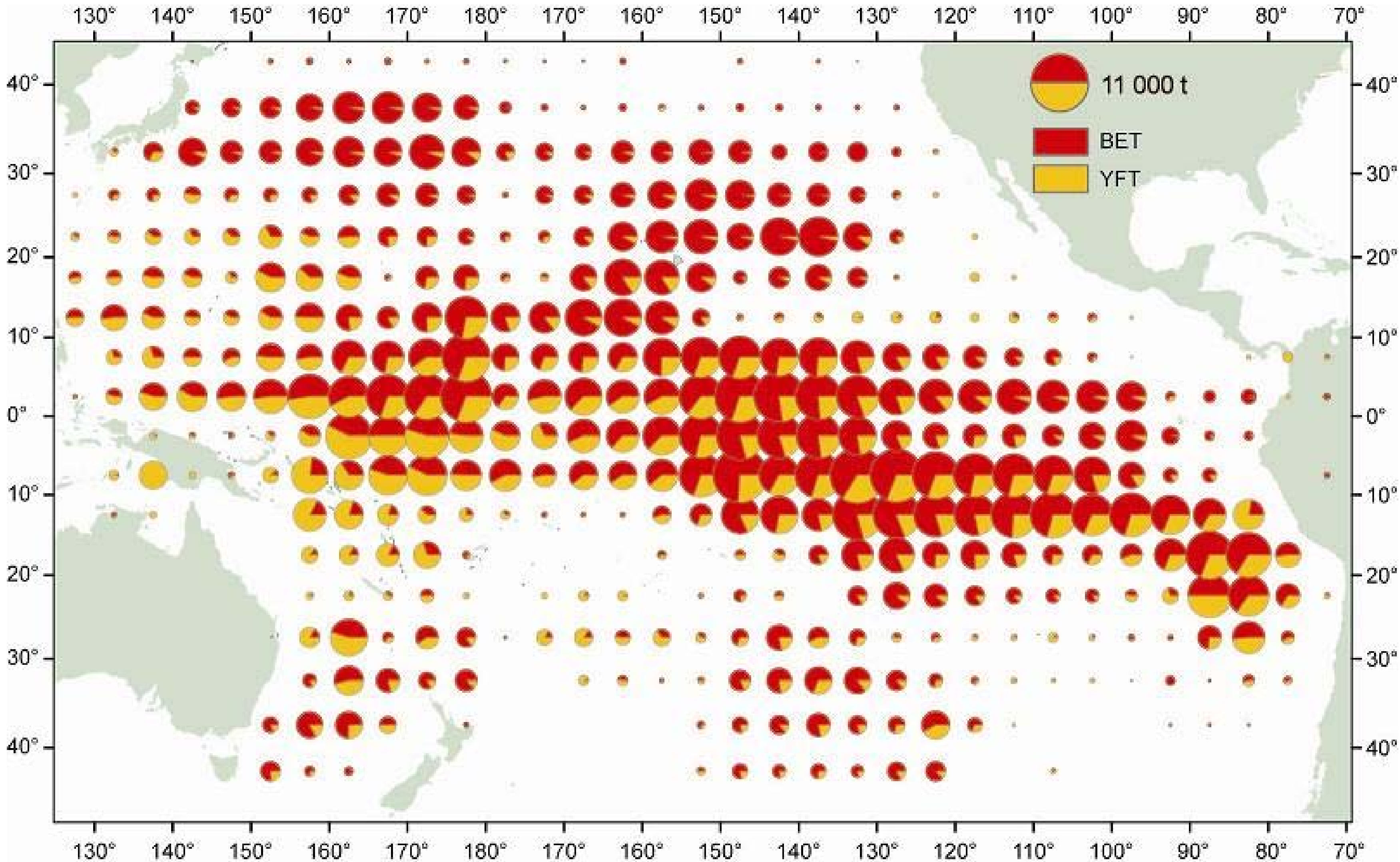

FIGURE A-4. Distributions of the catches of bigeye and yellowfin tunas in the Pacific Ocean, in metric tons, by longline vessels, 2000-2004. The sizes of the circles are proportional to the amounts of bigeye and yellowfin caught in those 5° by 5° areas.

FIGURA A-4. Distribución de las capturas de atunes patudo y aleta amarilla en el Océano Pacifico, en toneladas métricas, por buques palangreros, 2000-2004. El tamaño de cada círculo es proporcional a la cantidad de patudo y aleta amarilla capturado en la cuadrícula de 5° x 5° correspondiente.

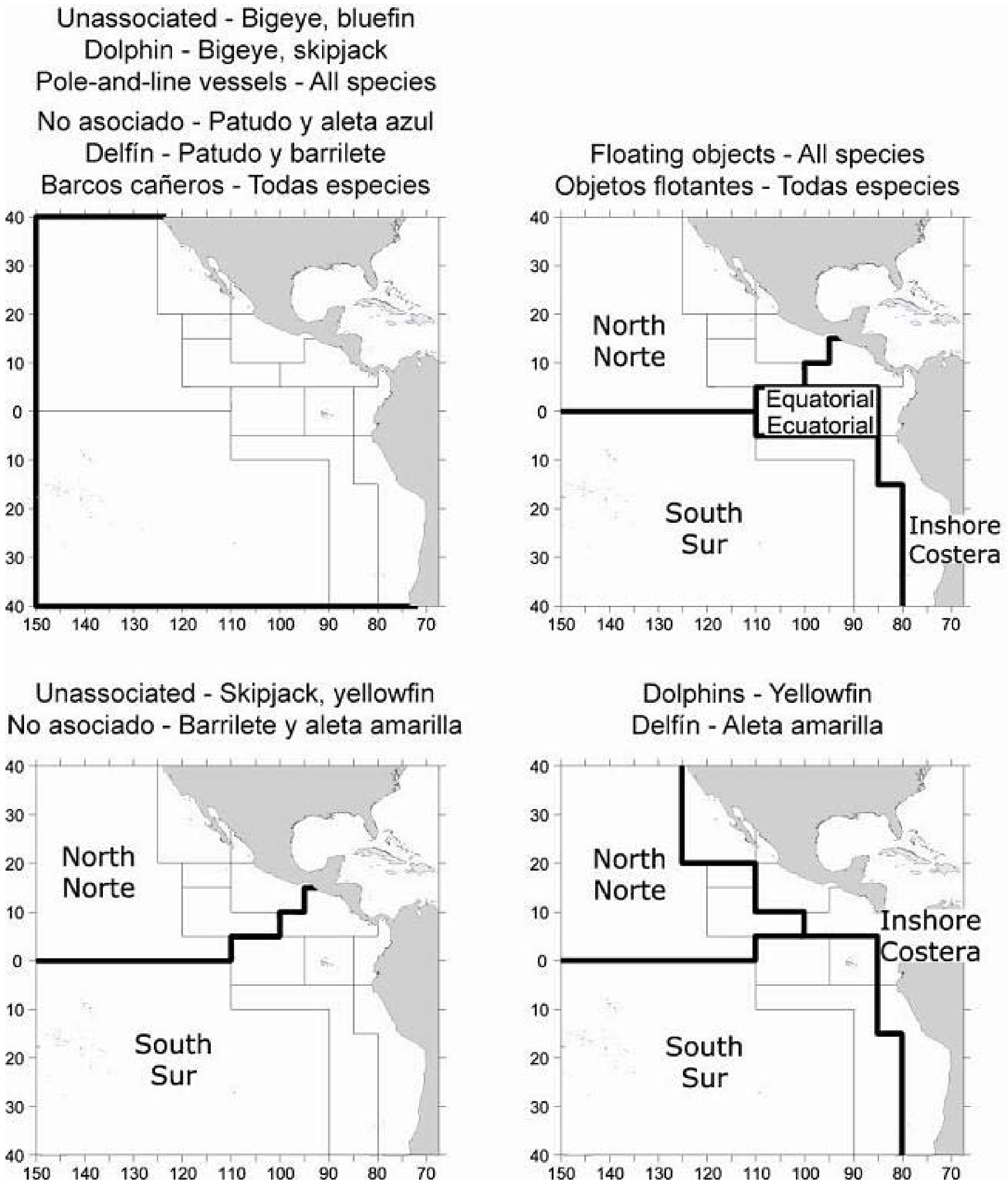

FIGURE A-5. The fisheries defined by the IATTC staff for stock assessment of yellowfin, skipjack, and bigeye in the EPO. The thin lines indicate the boundaries of the 13 length-frequency sampling areas, and the bold lines the boundaries of the fisheries.

FIGURA A-5. Las pesquerías definidas por el personal de la CIAT para la evaluación de las poblaciones de atún aleta amarilla, barrilete, y patudo en el OPO. Las líneas delgadas indican los límites de las 13 zonas de muestreo de frecuencia de tallas, y las líneas gruesas los límites de las pesquerías.

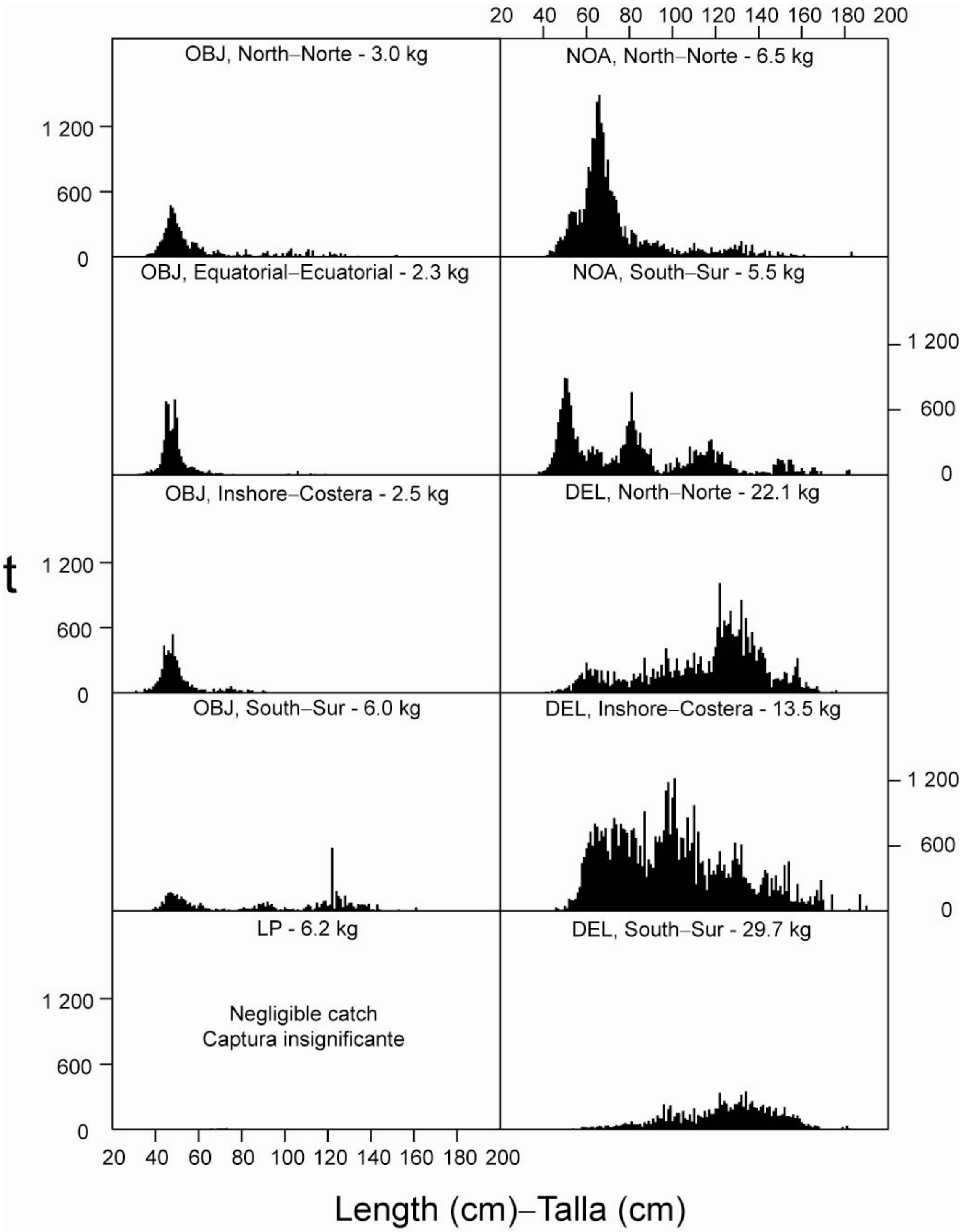

FIGURE A-6a. Estimated size compositions of the yellowfin caught in the EPO during 2006 for each fishery designated in Figure A-5. The average weights of the fish in the samples are given at the tops of the panels.

FIGURA A-6a. Composición por tallas estimada del aleta amarilla capturado en el OPO durante 2006 en cada pesquería ilustrada en la Figura A-5. En cada recuadro se detalla el peso promedio de los peces en las muestras.

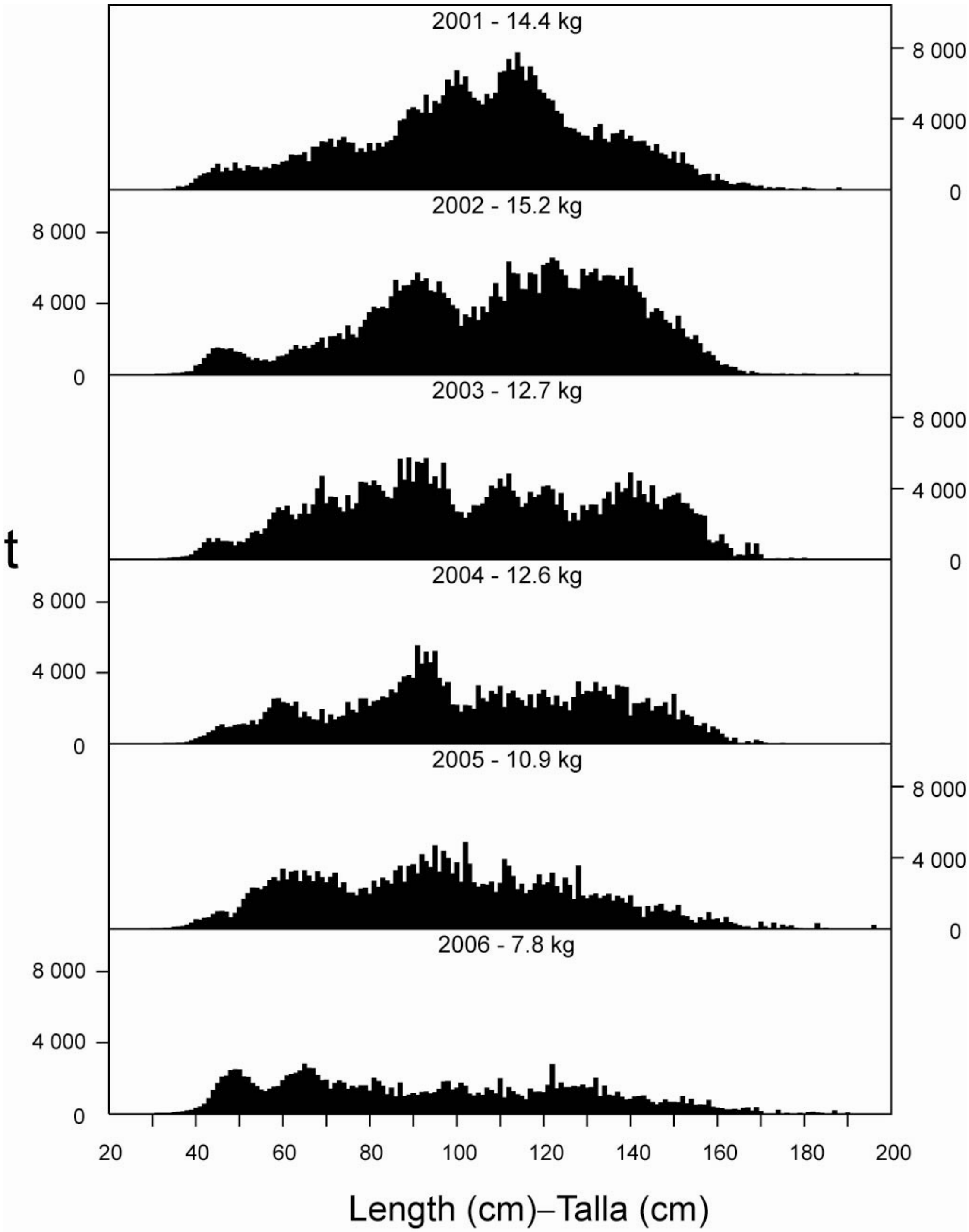

FIGURE A-6b. Estimated size compositions of the yellowfin caught by purse-seine and pole-and-line vessels in the EPO during 2001-2006. The average weights of the fish in the samples are given at the tops of the panels.

FIGURA A-6b. Composición por tallas estimada del aleta amarilla capturado por buques cerqueros y cañeros en el OPO durante 2001-2006. En cada recuadro se detalla el peso promedio de los peces en las muestras.

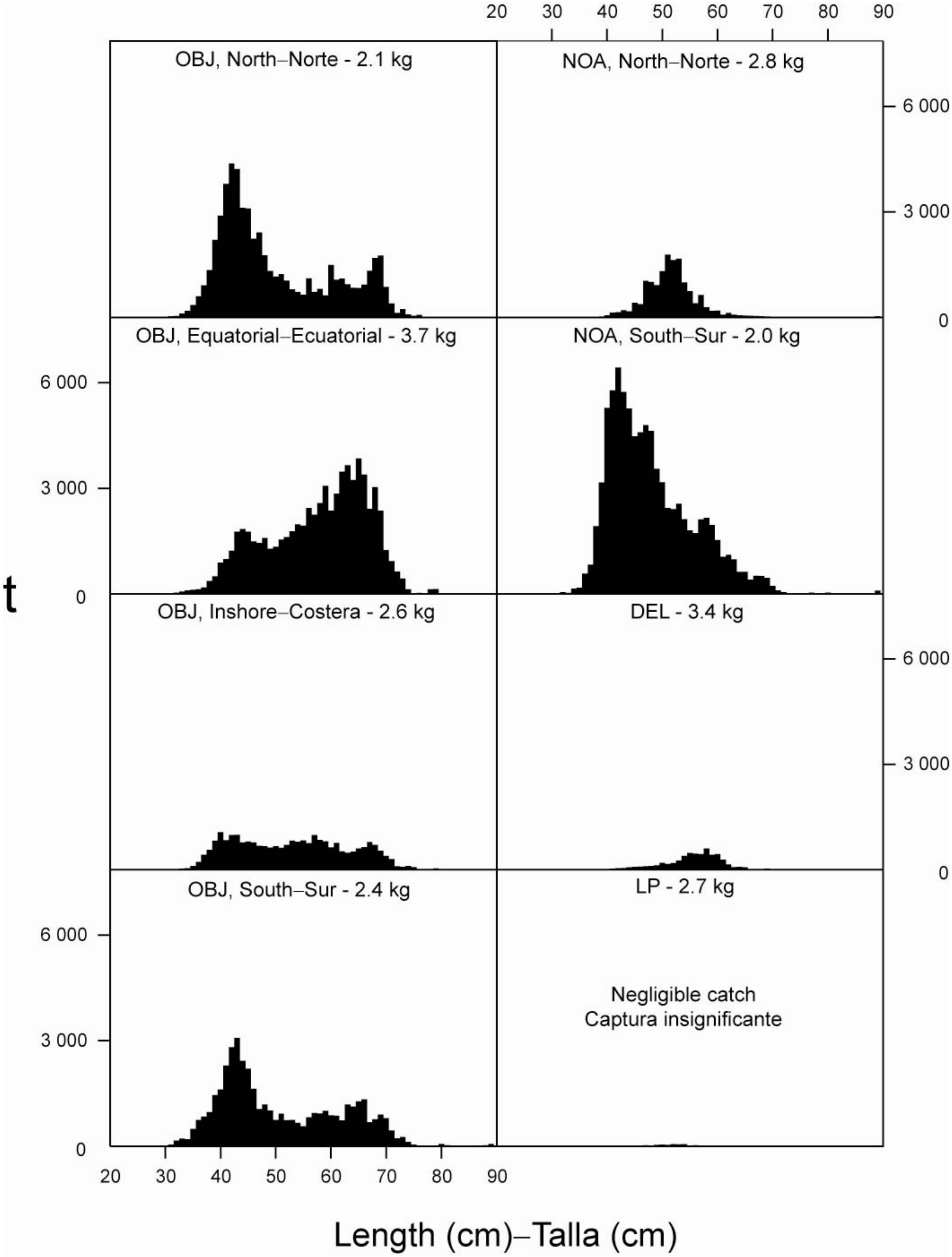

FIGURE A-7a. Estimated size compositions of the skipjack caught in the EPO during 2006 for each fishery designated in Figure A-5. The average weights of the fish in the samples are given at the tops of the panels.

FIGURA A-7a. Composición por tallas estimada del barrilete capturado en el OPO durante 2006 en cada pesquería ilustrada en la Figura A-5. En cada recuadro se detalla el peso promedio de los peces en las muestras.

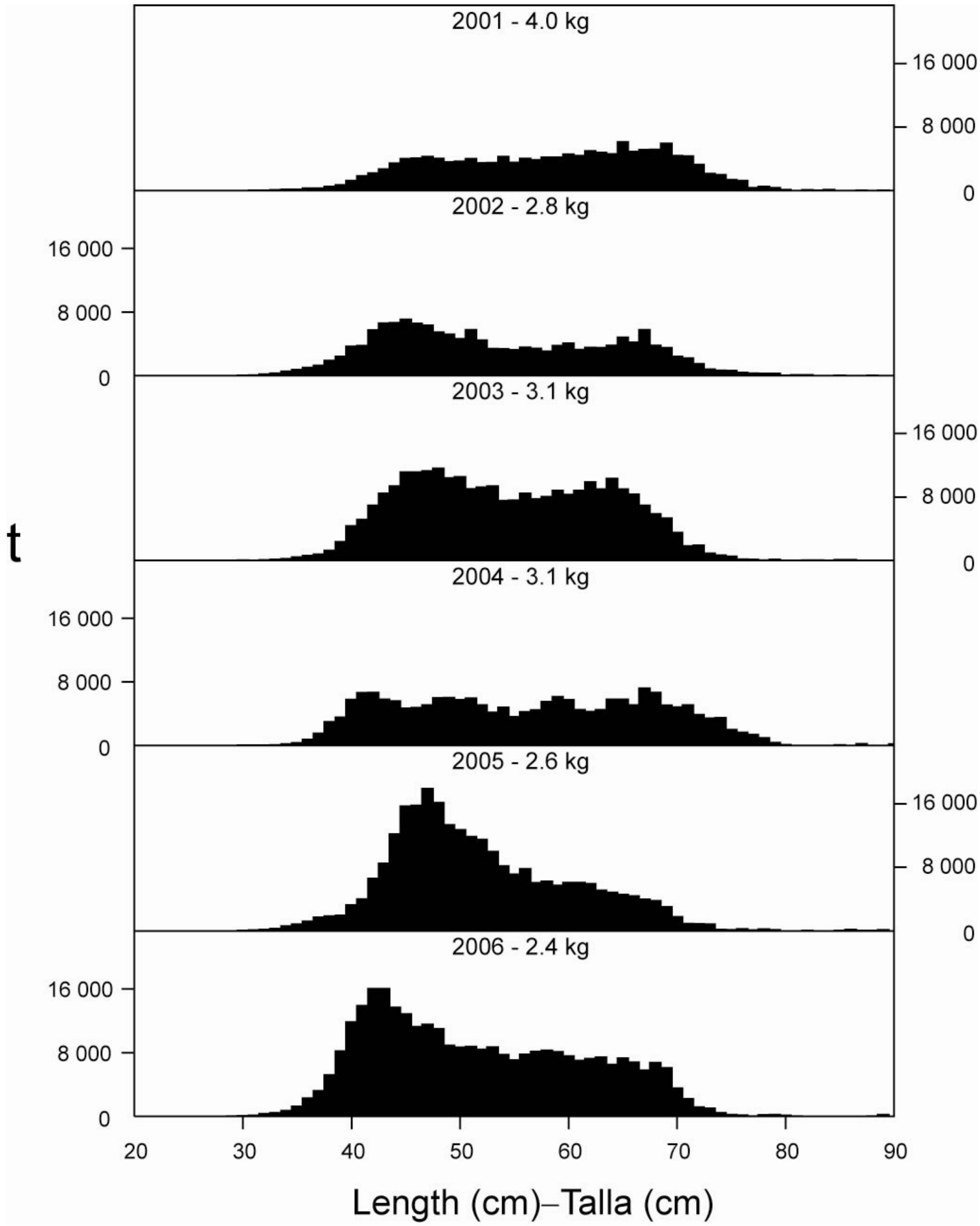

FIGURE A-7b. Estimated size compositions of the skipjack caught by purse-seine and pole-and-line vessels in the EPO during 2001-2006. The average weights of the fish in the samples are given at the tops of the panels.

FIGURA A-7b. Composición por tallas estimada del barrilete capturado por buques cerqueros y cañeros en el OPO durante 2001-2006. En cada recuadro se detalla el peso promedio de los peces en las muestras.

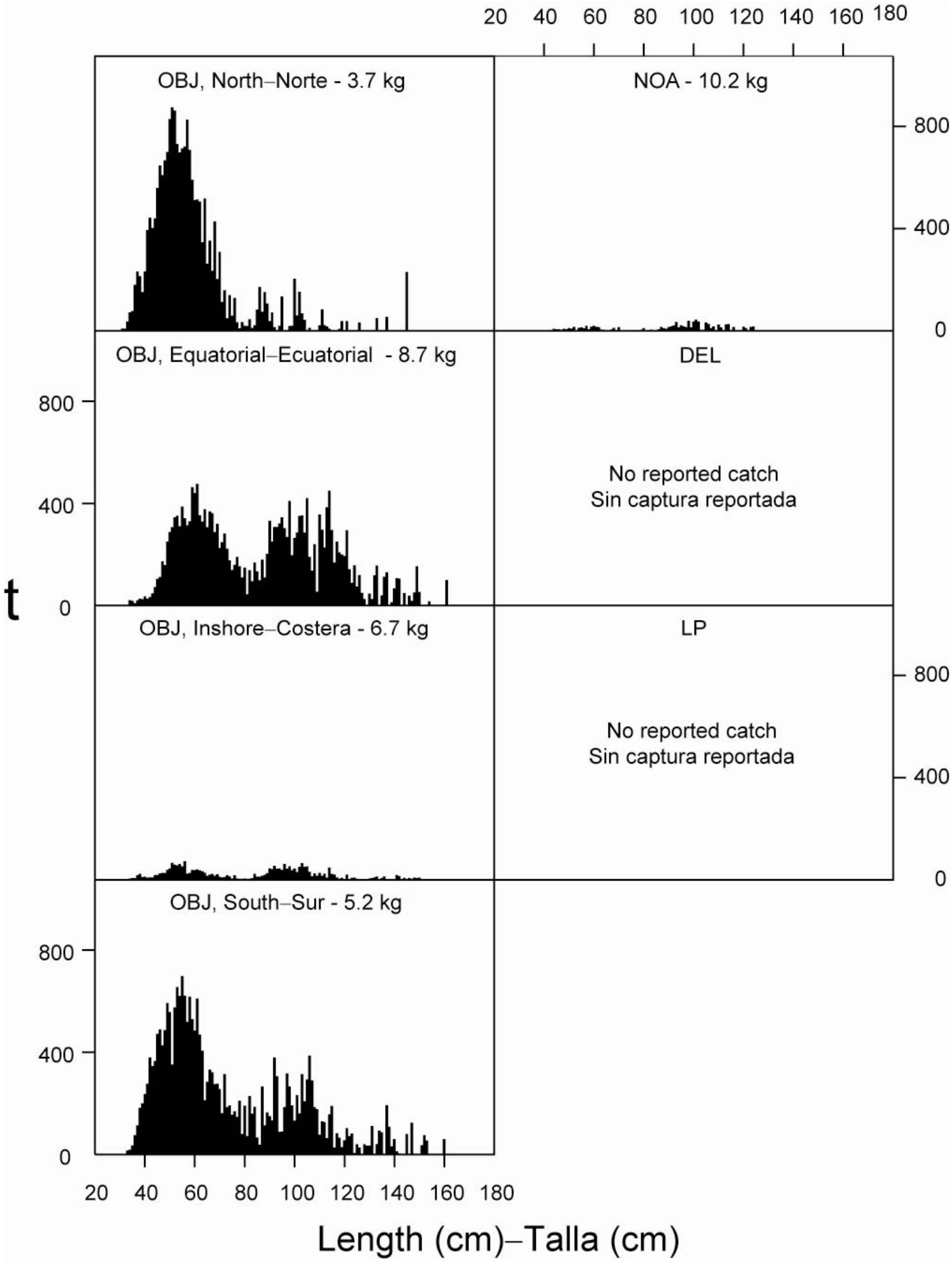

FIGURE A-8a. Estimated size compositions of the bigeye caught in the EPO during 2006 for each fishery designated in Figure A-5. The average weights of the fish in the samples are given at the tops of the panels.

FIGURA A-8a. Composición por tallas estimada del patudo capturado e en el OPO durante 2006 en cada pesquería ilustrada en la Figura A-5. En cada recuadro se detalla el peso promedio de los peces en las muestras.

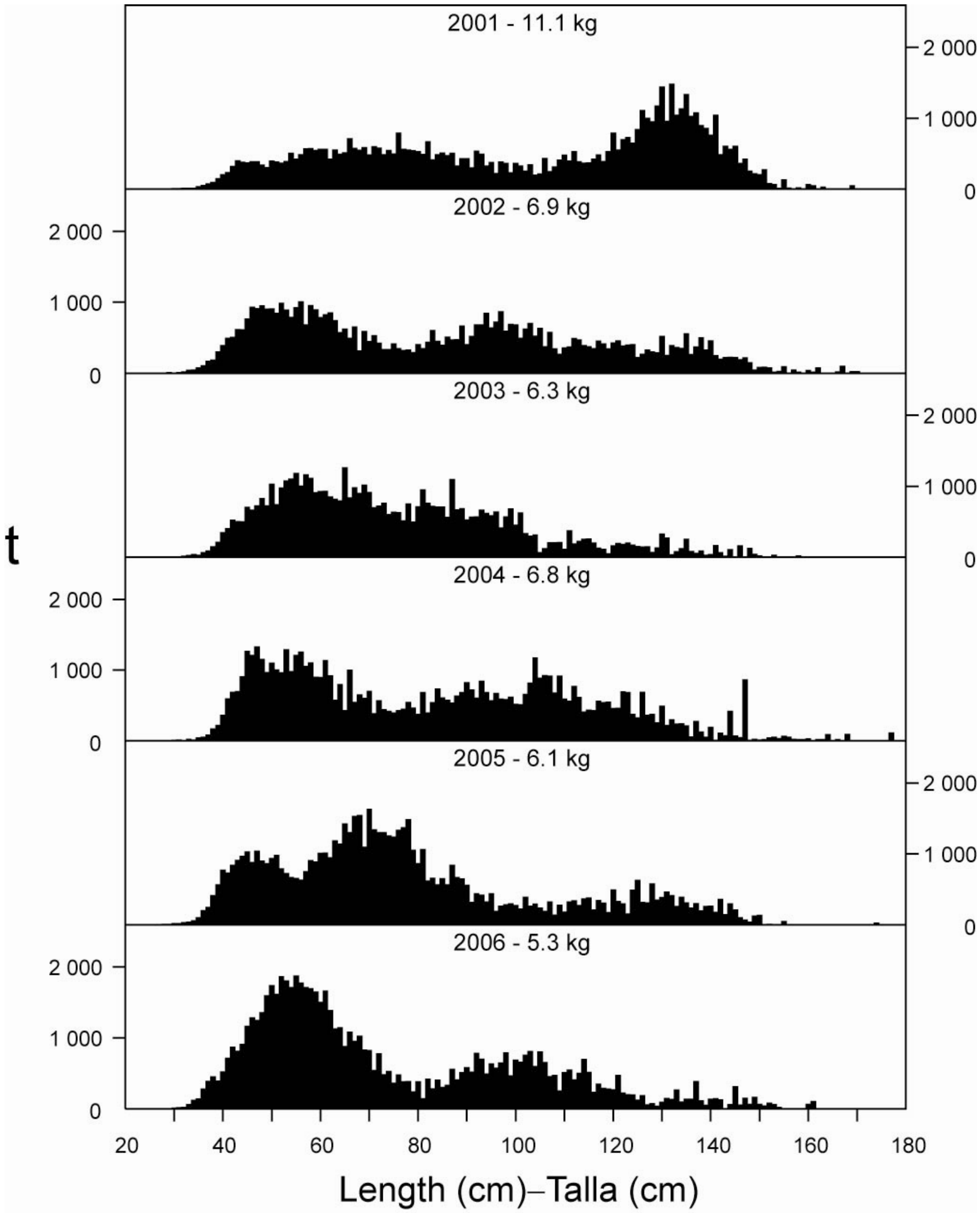

FIGURE A-8b. Estimated size compositions of the bigeye caught by purse-seine vessels in the EPO during 2001-2006. The average weights of the fish in the samples are given at the tops of the panels.

FIGURA A-8b. Composición por tallas estimada del patudo capturado por buques cerqueros en el OPO durante 2001-2006. En cada recuadro se detalla el peso promedio de los peces en las muestras.

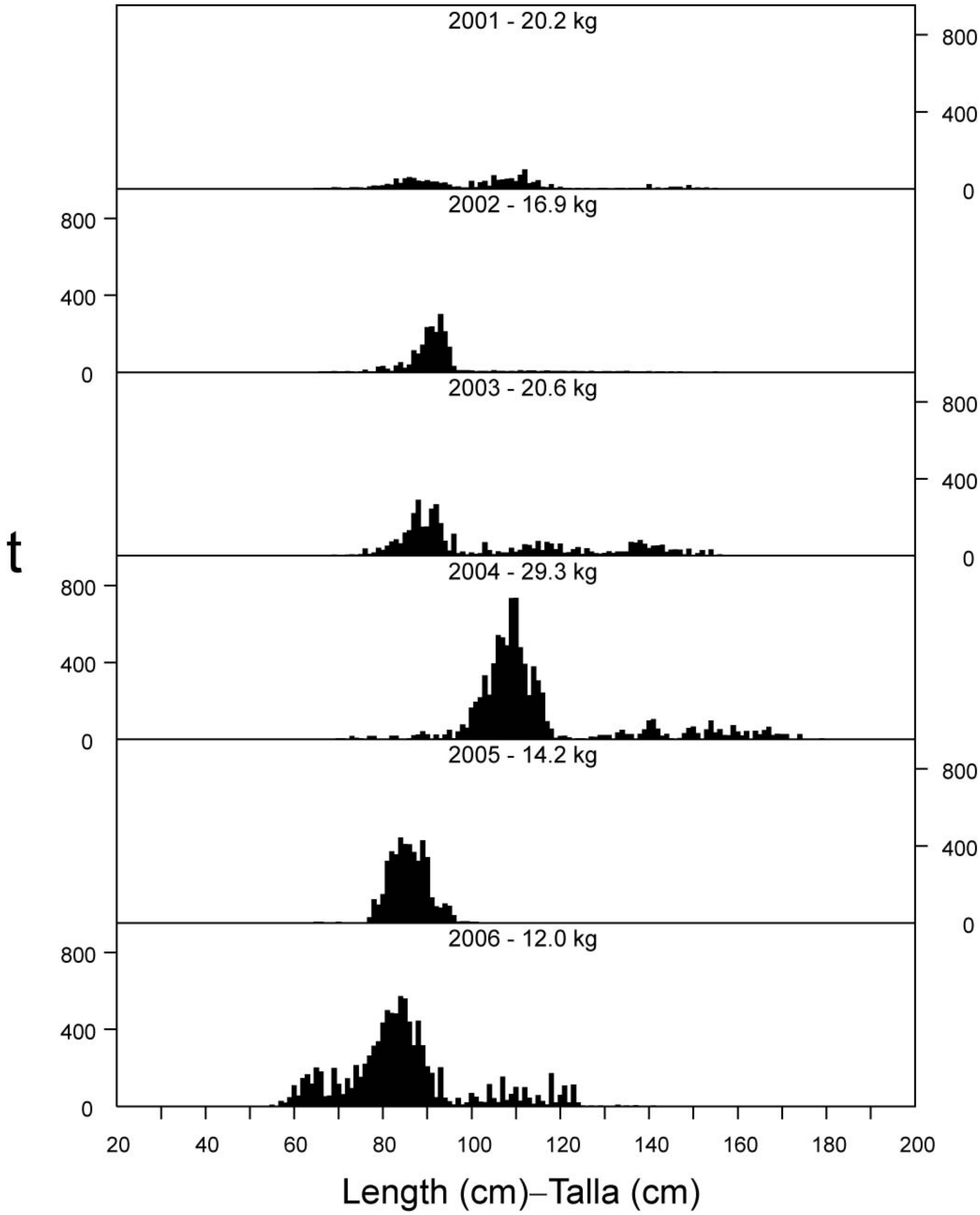

FIGURE A-9. Estimated catches of Pacific bluefin by purse-seine and recreational gear in the EPO during 2001-2006. The values at the tops of the panels are the average weights.

FIGURA A-9. Captura estimada de aleta azul del Pacífico con arte de cerco y deportiva en el OPO durante 2001-2006. El valor en cada recuadro representa el peso promedio.

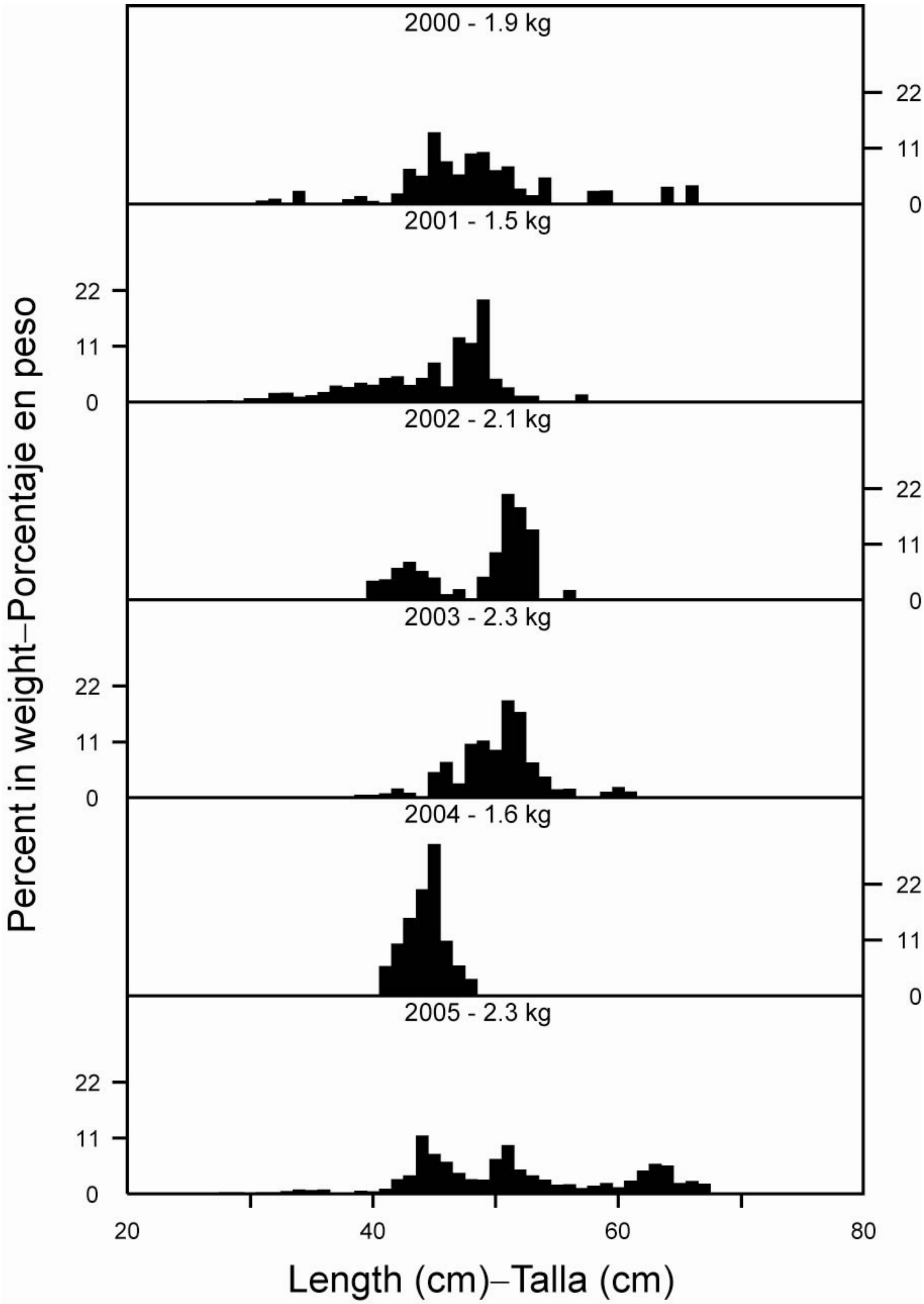

FIGURE A-10. Estimated size compositions of the catches of black skipjack by purse-seine vessels in the EPO during 2001-2006. The values at the tops of the panels are the average weights.

FIGURA A-10. Composición por tallas estimada del barrilete negro capturado por buques cerqueros en el OPO durante 2001-2006. El valor en cada recuadro representa el peso promedio.

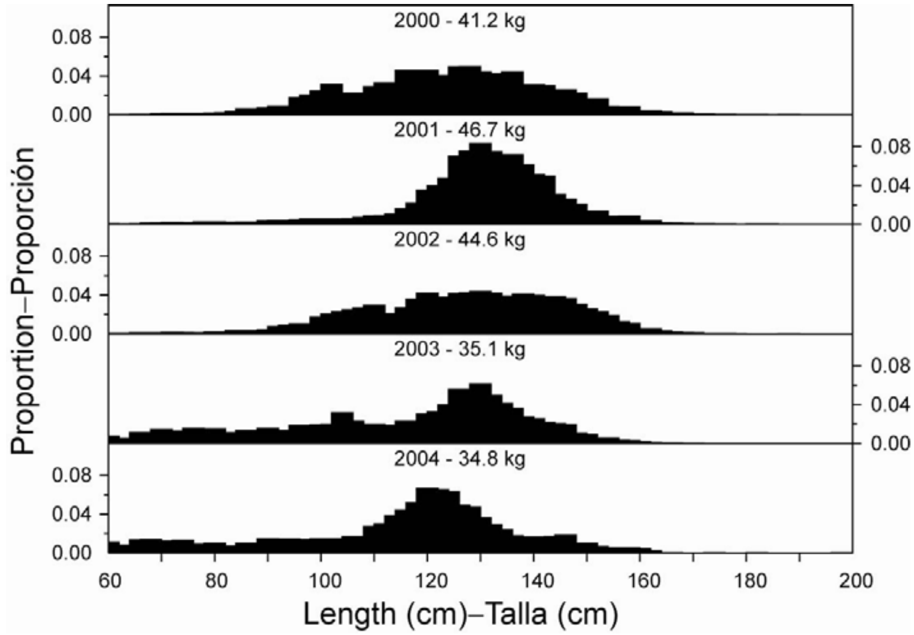

FIGURE A-11. Estimated size compositions of the catches of yellowfin tuna by the Japanese longline fishery in the EPO, 2000-2004.
FIGURA A-11. Composición por tallas estimada de las capturas de atún aleta amarilla por la pesquería palangrera japonesa en el OPO, 2000-2004.

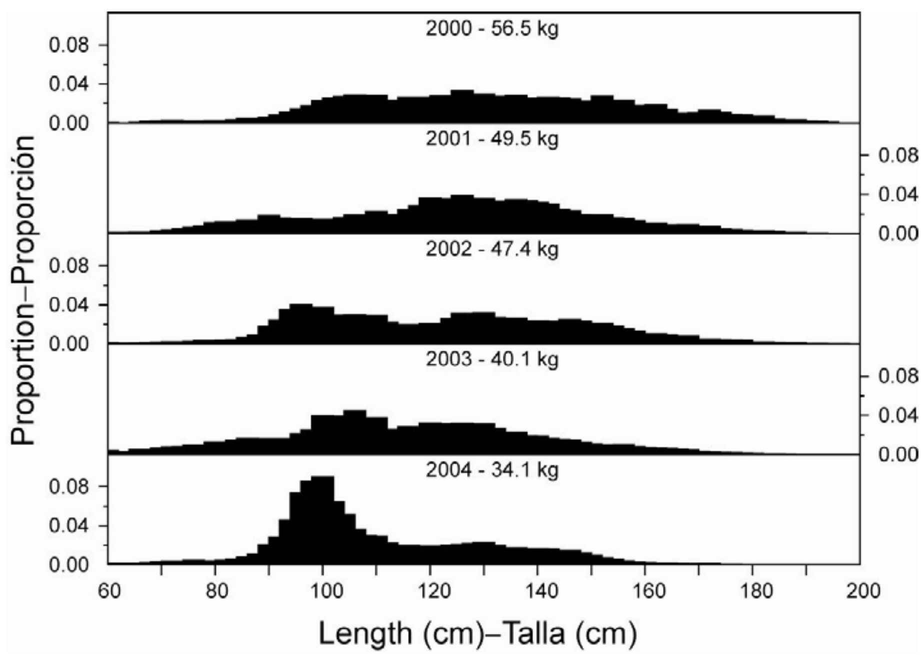

FIGURE A-12. Estimated size compositions of the catches of bigeye tuna by the Japanese longline fishery in the EPO, 2000-2004.
FIGURA A-12. Composición por tallas estimada de las capturas de atún patudo por la pesquería palangrera japonesa en el OPO, 2000-2004.

TABLE A-1. Annual catches of yellowfin, skipjack, and bigeye, by all types of gear combined, in the Pacific Ocean, 1977-2006. The EPO totals for 1993-2006 include discards from purse-seine vessels with carrying capacities greater than 363 t.

TABLA A-1. Capturas anuales de aleta amarilla, barrilete, y patudo, por todas las artes combinadas, en el Océano Pacífico, 1977-2006. Los totales del OPO de 1993-2006 incluyen los descartes de buques cerqueros de más de 363 t de capacidad de acarreo.

	YFT			**SKJ**			**BET**			**Total**		
	EPO	**WCPO**	**Total**	**EPO**	**WCPO**	**Total**	**EPO**	**WCPO**	**Total**	**EPO**	**WCPO**	**Total**
1977	199,380	181,538	380,918	94,108	397,147	491,255	85,249	76,788	162,037	378,737	655,473	1,034,210
1978	173,996	174,073	348,069	179,676	441,128	620,804	89,198	59,094	148,292	442,870	674,295	1,117,165
1979	187,137	194,442	381,579	141,504	405,327	546,831	67,533	66,372	133,905	396,174	666,141	1,062,315
1980	158,850	213,139	371,989	138,108	450,956	589,064	86,403	65,133	151,536	383,361	729,228	1,112,589
1981	178,514	225,922	404,436	126,001	430,522	556,523	68,339	53,346	121,685	372,854	709,790	1,082,644
1982	127,537	221,010	348,547	104,670	478,477	583,147	60,346	59,301	119,647	292,553	758,788	1,051,341
1983	100,013	256,532	356,545	62,150	669,602	731,752	64,755	59,896	124,651	226,918	986,030	1,212,948
1984	149,478	252,772	402,250	63,613	741,714	805,327	55,273	64,108	119,381	268,364	1,058,594	1,326,958
1985	226,036	259,164	485,200	52,000	595,086	647,086	72,404	68,706	141,110	350,440	922,956	1,273,396
1986	286,149	250,661	536,810	67,748	739,301	807,049	105,120	63,777	168,897	459,017	1,053,739	1,512,756
1987	286,359	303,346	589,705	66,464	675,053	741,517	101,314	79,269	180,583	454,137	1,057,668	1,511,805
1988	296,635	263,032	559,667	92,125	830,456	922,581	74,304	68,447	142,751	463,064	1,161,935	1,624,999
1989	299,739	313,793	613,532	98,930	808,902	907,832	72,993	77,237	150,230	471,662	1,199,932	1,671,594
1990	302,284	353,492	655,776	77,117	871,732	948,849	104,807	90,419	195,226	484,208	1,315,643	1,799,851
1991	266,091	394,712	660,803	65,895	1,097,899	1,163,794	109,116	73,768	182,884	441,102	1,566,379	2,007,481
1992	253,714	416,160	669,874	87,354	999,355	1,086,709	91,999	92,120	184,119	433,067	1,507,635	1,940,702
1993	256,675	386,142	642,817	100,521	904,841	1,005,362	82,834	79,885	162,719	440,030	1,370,868	1,810,898
1994	248,248	393,250	641,498	84,641	1,007,759	1,092,400	109,326	90,585	199,911	442,215	1,491,594	1,933,809
1995	244,601	372,482	617,083	150,670	1,042,219	1,192,889	108,209	82,932	191,141	503,479	1,497,633	2,001,112
1996	266,463	308,210	574,673	132,929	1,019,503	1,152,432	114,703	83,813	198,516	514,095	1,411,526	1,925,621
1997	278,264	429,336	707,600	188,530	966,501	1,155,031	122,348	109,403	231,751	589,142	1,505,240	2,094,382
1998	280,140	462,253	742,393	165,673	1,294,761	1,460,434	93,946	108,380	202,326	539,759	1,865,394	2,405,153
1999	304,939	412,789	717,728	292,070	1,150,572	1,442,642	93,300	116,830	210,130	690,309	1,680,191	2,370,500
2000	289,057	423,743	712,800	232,241	1,220,789	1,453,030	147,250	109,231	256,481	668,548	1,753,763	2,422,311
2001	423,767	425,102	848,869	159,160	1,121,695	1,280,855	131,475	105,943	237,418	714,402	1,652,740	2,367,142
2002	443,177	409,752	852,929	167,288	1,294,380	1,461,668	132,810	121,530	254,340	743,275	1,825,662	2,568,937
2003	413,612	449,450	863,062	301,882	1,288,418	1,590,300	116,474	107,332	223,806	831,968	1,845,200	2,677,168
2004	294,437	366,956	661,393	218,589	1,384,131	1,602,720	112,489	145,239	257,728	625,514	1,896,326	2,521,840
2005	288,019	425,692	713,711	284,329	1,451,906	1,736,235	114,151	157,534	271,685	686,498	2,035,132	2,721,630
2006	174,780	*	174,780	322,004	*	322,004	103,322	*	103,322	600,106	*	600,106

TABLE A-2a. Estimated retained catches (Ret.), by gear type, and estimated discards (Dis.), by purse-seine vessels with carrying capacities greater than 363 t only, of tunas and bonitos, in metric tons, in the EPO, 1977-2006 The purse-seine and pole-and-line data for yellowfin, skipjack, and bigeye tunas have been adjusted to the species composition estimate and are preliminary. The data for 2005-2006 are preliminary.
TABLA A-2a. Estimaciones de las capturas retenidas (Ret.), por arte de pesca, y de los descartes (Dis.), por buques cerqueros de más de 363 t de capacidad de acarreo únicamente, de atunes y bonitos, en toneladas métricas, en el OPO, 1977-2006. Los datos de los atunes aleta amarilla, barrilete, y patudo de las pesquerías cerquera y cañera fueron ajustados a la estimación de composición por especie, y son preliminares. Los datos de 2005-2006 son preliminares.

	Yellowfin—Aleta amarilla						Skipjack—Barrilete						Bigeye—Patudo					
	PS		LP	LL	OTR	Total	PS		LP	LL	OTR	Total	PS		LP	LL	OTR	Total
	Ret.	Dis.					Ret.	Dis.					Ret.	Dis.				
1977	184,922	-	1,841	12,355	262	199,380	84,603	-	7,522	112	1,871	94,108	11,161	-	2	74,086	0	85,249
1978	158,801	-	3,888	10,188	1,119	173,996	172,294	-	6,047	61	1,274	179,676	18,539	-	-	70,659	0	89,198
1979	170,650	-	4,789	11,473	225	187,137	133,695	-	6,346	33	1,430	141,504	12,097	-	-	55,435	1	67,533
1980	143,042	-	1,481	13,477	850	158,850	130,912	-	5,225	26	1,945	138,108	21,938	-	-	64,335	130	86,403
1981	168,234	-	1,477	7,999	804	178,514	119,165	-	5,906	20	910	126,001	14,921	-	-	53,416	2	68,339
1982	114,755	-	1,538	10,961	283	127,537	100,499	-	3,760	28	383	104,670	6,939	-	42	53,365	0	60,346
1983	83,929	-	4,007	10,895	1,182	100,013	56,851	-	4,387	28	884	62,150	4,575	-	39	60,043	98	64,755
1984	135,785	-	2,991	10,345	357	149,478	59,859	-	2,884	32	838	63,613	8,861	-	2	46,394	16	55,273
1985	211,459	-	1,070	13,198	309	226,036	50,829	-	946	44	181	52,000	6,056	-	2	66,325	21	72,404
1986	260,512	-	2,537	22,808	292	286,149	65,634	-	1,921	58	135	67,748	2,686	-	-	102,425	9	105,120
1987	262,008	-	5,107	18,911	333	286,359	64,019	-	2,233	37	175	66,464	1,177	-	-	100,121	16	101,314
1988	277,293	-	3,723	14,660	959	296,635	87,113	-	4,325	26	661	92,125	1,535	-	5	72,758	6	74,304
1989	277,996	-	4,145	17,032	566	299,739	94,934	-	2,940	28	1,028	98,930	2,030	-	-	70,963	0	72,993
1990	263,253	-	2,676	34,633	1,722	302,284	74,369	-	823	41	1,884	77,117	5,921	-	-	98,871	15	104,807
1991	231,257	-	2,856	30,730	1,248	266,091	62,228	-	1,717	33	1,917	65,895	4,870	-	31	104,194	21	109,116
1992	228,121	-	3,789	18,527	3,277	253,714	84,283	-	1,957	24	1,090	87,354	7,179	-	-	84,799	21	91,999
1993	219,492	4,722	4,951	23,809	3,701	256,675	83,830	10,588	3,772	61	2,270	100,521	9,657	645	-	72,473	59	82,834
1994	208,408	4,691	3,625	29,545	1,979	248,248	70,126	10,472	3,240	73	730	84,641	34,899	2,261	-	71,359	807	109,326
1995	215,434	5,275	1,268	20,054	2,570	244,601	127,047	16,378	5,253	77	1,915	150,670	45,321	3,251	-	58,256	1,381	108,209
1996	238,607	6,314	3,762	16,425	1,355	266,463	103,973	24,837	2,555	52	1,512	132,929	61,311	5,689	-	46,957	746	114,703
1997	244,878	5,516	4,418	21,448	2,004	278,264	153,456	31,558	3,260	135	121	188,530	64,272	5,482	-	52,571	23	122,348
1998	253,959	4,718	5,085	14,212	2,166	280,140	140,631	22,856	1,684	294	208	165,673	44,129	2,853	-	46,347	617	93,946
1999	281,920	6,638	1,783	10,651	3,947	304,939	261,565	26,851	2,044	201	1,409	292,070	51,158	5,176	-	36,425	541	93,300
2000	255,025	6,796	2,431	22,772	2,034	289,057	205,459	26,415	231	68	67	232,241	93,753	5,649	0	47,579	269	147,250
2001	382,229	7,808	3,916	28,475	1,339	423,767	143,784	13,233	448	1,215	479	159,160	61,408	1,294	0	68,726	47	131,475
2002	412,407	4,019	950	24,002	1,799	443,177	153,398	12,625	616	261	388	167,288	57,437	937	0	74,405	31	132,810
2003	381,147	5,338	470	23,763	2,894	413,612	274,490	23,302	638	635	2,817	301,882	54,509	2,260	0	59,666	39	116,474
2004	269,463	2,967	1,884	16,970	3,153	294,437	198,678	17,555	528	712	1,116	218,589	67,337	1,588	0	43,354	210	112,489
2005	268,585	3,180	1,844	10,442	3,968	288,019	261,599	19,425	1,278	241	1,786	284,329	68,699	1,972	0	43,433	47	114,151
2006	166,739	1,494	693	3,976	1,878	174,780	308,148	13,155	429	184	89	322,004	71,195	1,848	0	30,271	8	103,322

TABLE A-2a. (continued)
TABLA A-2a. (continuación)

	Pacific bluefin—Aleta azul del Pacífico						Albacore—Albacora						Black skipjack—Barrilete negro					
	PS		LP	LL	OTR	Total	PS		LP	LL	OTR	Total	PS		LP	LL	OTR	Total
	Ret.	Dis.					Ret.	Dis.					Ret.	Dis.				
1977	5,449	-	10	11	34	5,504	15	-	1,960	10,578	11,471	24,024	1,445	-	11	-	1	1,457
1978	5,389	-	4	9	8	5,410	156	-	1,577	11,939	17,436	31,108	2,165	-	3	-	-	2,168
1979	6,102	-	5	6	19	6,132	148	-	179	5,583	5,043	10,953	1,334	-	30	-	-	1,364
1980	2,909	-	-	0	31	2,940	194	-	407	5,319	5,649	11,569	3,653	-	30	-	-	3,683
1981	1,085	-	-	4	9	1,098	99	-	608	7,275	12,301	20,283	1,907	-	3	-	-	1,910
1982	3,145	-	-	7	12	3,164	355	-	198	8,407	3,562	12,522	1,337	-	-	-	-	1,337
1983	835	-	-	2	34	871	7	-	449	7,433	7,840	15,729	1,222	-	0	-	13	1,235
1984	840	-	0	3	65	908	3,910	-	1,441	6,712	9,794	21,857	662	-	-	-	3	665
1985	3,996	-	-	1	111	4,108	42	-	877	7,268	6,654	14,841	288	-	0	-	7	295
1986	5,040	-	-	1	66	5,107	47	-	86	6,450	4,701	11,284	568	-	-	-	18	586
1987	980	-	-	3	54	1,037	1	-	320	9,994	2,662	12,977	570	-	-	-	1	571
1988	1,380	-	-	2	49	1,431	17	-	271	9,934	5,549	15,771	957	-	-	-	311	1,268
1989	1,102	-	5	4	124	1,235	1	-	21	6,784	2,695	9,501	802	-	0	-	-	802
1990	1,430	-	61	12	90	1,593	39	-	170	6,536	4,105	10,850	784	-	-	-	4	788
1991	420	-	-	5	94	519	-	-	834	7,893	2,754	11,481	422	-	-	-	25	447
1992	1,928	-	-	21	116	2,065	-	-	255	17,080	5,740	23,075	104	-	-	-	3	107
1993	579	0	-	11	329	919	-	0	1	11,194	4,410	15,605	103	4,116	-	-	31	4,250
1994	969	0	-	12	121	1,102	-	0	85	10,390	10,143	20,618	188	834	-	-	40	1,062
1995	629	0	-	25	264	918	-	0	465	6,185	7,425	14,075	203	1,448	-	-	0	1,651
1996	8,223	0	-	19	80	8,322	11	0	72	7,631	8,398	16,112	706	2,304	-	-	12	3,022
1997	2,608	3	2	14	256	2,883	1	0	59	9,678	7,542	17,280	100	2,512	-	-	11	2,623
1998	1,772	0	0	94	504	2,370	42	0	81	12,635	13,155	25,913	488	1,876	39	-	0	2,403
1999	2,553	54	5.0	152	552	3,316	47	0.0	227	11,633	14,557	26,464	170	3,424	-	-	0	3,594
2000	3,712	0	61	46	374	4,193	71	0	86	9,663	13,455	23,275	294	1,877	-	-	0	2,170
2001	891	3	1	148	390	1,433	3	0	157	19,410	13,766	33,337	2,258	1,253	-	-	0	3,511
2002	1,708	6	3	70	358	2,146	31	0	381	15,289	14,453	30,155	1,459	2,207	8	-	-	3,674
2003	3,233	0	3	87	409	3,733	34	0	59	24,901	20,544	45,537	433	1,606	6	13	117	2,175
2004	8,880	19	0	15	59	8,974	105	0	126	18,444	22,159	40,834	883	351	-	27	862	2,123
2005	4,743	15	0	0	84	4,843	2	0	66	9,069	15,671	24,808	1,472	1,909	-	-	22	3,403
2006	9,795		0	-	96	9,891	109		-	6,390	6,402	12,901	2,000	-	-	-	-	2,000

TABLE A-2a. (continued)
TABLA A-2a. (continuación)

	Bonitos						Unidentified tunas—Atunes no identificados						Total scombrids—Total de escómbridos					
	PS		LP	LL	OTR	Total	PS		LP	LL	OTR	Total	PS		LP	LL	OTR	Total
	Ret.	Dis.					Ret.	Dis.					Ret.	Dis.				
1977	10,983	-	292	-	2,875	14,150	21	-	-	-	5,782	5,803	298,599	-	11,638	97,142	22,296	429,675
1978	4,801	-	35	-	2,419	7,255	188	-	-	-	6,677	6,865	362,333	-	11,554	92,856	28,933	495,676
1979	1,801	-	3	-	2,658	4,462	558	-	-	-	3,016	3,574	326,385	-	11,352	72,530	12,392	422,659
1980	6,089	-	36	-	2,727	8,852	442	-	-	-	836	1,278	309,179	-	7,179	83,157	12,168	411,683
1981	5,690	-	27	-	4,609	10,326	214	-	3	-	1,109	1,326	311,315	-	8,024	68,714	19,744	407,797
1982	2,122	-	-	-	6,776	8,898	52	-	-	-	382	434	229,204	-	5,538	72,768	11,398	318,908
1983	3,827	-	2	-	7,291	11,120	82	-	-	-	4,711	4,793	151,328	-	8,884	78,401	22,053	260,666
1984	3,514	-	-	-	7,291	10,805	7	-	-	-	2,524	2,531	213,438	-	7,318	63,486	20,888	305,130
1985	3,599	-	5	-	7,869	11,473	18	-	-	-	678	696	276,287	-	2,900	86,836	15,830	381,853
1986	232	-	258	-	1,889	2,379	177	-	4	-	986	1,167	334,896	-	4,806	131,742	8,096	479,540
1987	3,195	-	121	-	1,782	5,098	479	-	-	-	2,043	2,522	332,429	-	7,781	129,066	7,066	476,342
1988	8,811	-	739	-	947	10,497	258	-	-	-	2,939	3,197	377,364	-	9,063	97,380	11,421	495,228
1989	11,278	-	818	-	465	12,561	469	-	0	-	621	1,090	388,612	-	7,929	94,811	5,499	496,851
1990	13,641	-	215	-	371	14,227	373	-	0	3	692	1,068	359,810	-	3,945	140,093	8,883	512,734
1991	1,207	-	82	-	242	1,531	4	-	-	29	192	225	300,408	-	5,520	142,855	6,493	455,305
1992	977	-	-	-	318	1,295	120	-	-	27	1,071	1,218	322,712	-	6,001	120,453	11,636	460,827
1993	599	12	1	-	436	1,048	12	2,172	-	12	4,082	6,278	314,272	22,254	8,725	107,550	15,318	468,129
1994	8,331	147	362	-	185	9,025	9	969	-	1	464	1,442	322,930	19,373	7,312	111,380	14,480	475,464
1995	7,929	55	81	-	54	8,119	12	1,006	-	1	1,004	2,023	396,575	27,412	7,067	84,598	14,613	530,265
1996	647	1	7	-	16	671	36	1,300	-	1	1,038	2,375	413,514	40,444	6,396	71,085	13,157	544,596
1997	1,097	4	8	-	34	1,143	75	3,879	-	8	1,437	5,399	466,487	48,954	7,747	83,854	11,428	618,470
1998	1,330	4	7	-	588	1,929	15	1,633	-	26	18,158	19,832	442,366	33,940	6,896	73,608	35,396	592,207
1999	1,719	0	-	24	369	2,112	29	3,266	-	2,115	4,279	9,689	599,161	45,410	4,059	61,201	25,654	735,485
2000	636	0	0	75	56	767	190	1,795	-	1,994	1,468	5,447	559,139	42,532	2,809	82,197	17,723	704,402
2001	17	0	0	34	19	71	206	1,861	-	2,453	56	4,575	590,797	25,453	4,523	120,461	16,095	757,329
2002	0	0	0	42	1	43	576	2,709	-	3,278	1,422	7,985	627,017	22,503	1,958	117,348	18,452	787,279
2003	0	0	1	0	25	26	81	1,629	-	373	750	2,832	713,927	34,135	1,177	109,438	27,595	886,271
2004	15	47	1	8	3	73	259	1,426	-	504	258	2,447	545,620	23,982	2,539	80,034	27,820	679,996
2005	313	18	0	0	11	342	190	2,371	-	518	427	3,506	605,604	29,463	3,187	63,703	22,016	723,973
2006	3,477		12	0	0	3,488	99	2,507	-	5	192	2,803	561,562	20,876	1,133	40,826	8,665	633,062

TABLE A-2b. Estimated retained catches, by gear type, and estimated discards, by purse-seine vessels with carrying capacities greater than 363 t only, of billfishes, in metric tons, in the EPO, 1977-2006. Data for 2005-2006 are preliminary. PS dis. = discards by purse-seine vessels.
TABLA A-2b. Estimaciones de las capturas retenidas, por arte de pesca, y de los descartes, por buques cerqueros de más de 363 t de capacidad de acarreo únicamente, de peces picudos, en toneladas métricas, en el OPO, 1977-2006. Los datos de 2005-2006 son preliminares. PS dis. = descartes por buques cerqueros.

	Swordfish—Pez espada				Blue marlin—Marlín azul				Black marlin—Marlín negro				Striped marlin—Marlín rayado			
	PS dis.	LL	OTR	Total	PS dis.	LL	OTR	Total	PS dis.	LL	OTR	Total	PS dis.	LL	OTR	Total
1977	-	4,298	788	5,086	-	3,016	-	3,016	-	621	-	621	-	3,145	0	3,145
1978	-	4,103	2,205	6,308	-	3,570	-	3,570	-	417	-	417	-	2,495	0	2,495
1979	-	2,658	614	3,272	-	4,528	-	4,528	-	332	-	332	-	4,137	0	4,137
1980	-	3,746	1,107	4,853	-	4,016	-	4,016	-	335	-	335	-	4,827	0	4,827
1981	-	3,070	1,134	4,204	-	4,476	-	4,476	-	247	-	247	-	4,876	0	4,876
1982	-	2,604	1,551	4,155	-	4,745	-	4,745	-	213	-	213	-	4,711	0	4,711
1983	-	3,341	2,338	5,679	-	4,459	-	4,459	-	240	-	240	-	4,472	0	4,472
1984	-	2,752	3,336	6,088	-	5,197	-	5,197	-	248	-	248	-	2,662	0	2,662
1985	-	1,885	3,768	5,653	-	3,588	-	3,588	-	180	-	180	-	1,599	0	1,599
1986	-	3,286	3,294	6,580	-	5,278	-	5,278	-	297	-	297	-	3,540	0	3,540
1987	-	4,676	3,740	8,416	-	7,282	-	7,282	-	358	-	358	-	7,647	0	7,647
1988	-	4,916	5,642	10,558	-	5,662	-	5,662	-	288	-	288	-	5,283	0	5,283
1989	-	5,202	6,072	11,274	-	5,392	-	5,392	-	193	-	193	-	3,473	0	3,473
1990	-	5,807	5,066	10,873	-	5,540	-	5,540	-	223	-	223	-	3,260	0	3,260
1991	17	10,564	4,414	14,995	69	6,462	257	6,788	58	246	-	304	76	2,805	188	3,069
1992	4	9,793	4,294	14,091	52	6,426	201	6,679	95	228	-	323	69	2,907	147	3,123
1993	5	6,167	4,434	10,606	103	6,279	292	6,674	92	217	-	309	71	3,332	243	3,646
1994	3	4,963	3,849	8,815	97	8,609	418	9,124	72	256	-	328	36	3,126	270	3,432
1995	4	4,466	3,003	7,473	99	6,944	344	7,387	76	158	-	234	24	2,943	306	3,273
1996	1	6,756	2,801	9,558	85	3,396	200	3,681	79	99	-	178	25	2,981	237	3,243
1997	4	9,508	2,853	12,365	150	5,468	340	5,958	101	153	-	254	28	4,201	272	4,501
1998	3	9,381	3,665	13,049	153	4,477	580	5,210	102	168	-	270	21	3,277	281	3,579
1999	2	7,470	2,064	9,536	214	3,010	680	3,904	117	94	-	211	37	2,287	334	2,658
2000	2	8,523	2,789	11,315	152	3,028	606	3,786	95	105	-	200	20	1,698	191	1,909
2001	4	15,354	2,617	17,974	175	3,554	643	4,371	122	123	-	245	23	1,687	274	1,984
2002	1	16,960	2,757	19,718	235	2,818	662	3,716	125	78	-	203	79	1,946	214	2,238
2003	5	17,879	641	18,526	209	3,140	876	4,225	144	72	-	216	35	1,773	138	1,947
2004	2	15,197	488	15,687	168	3,353	416	3,937	74	38	-	112	23	1,311	234	1,568
2005	3	8,797	4,490	13,290	236	2,619	820	3,676	103	41	-	145	39	1.278	328	1,645
2006	4	1,647	222	1,873	241	751	156	1,149	121	5	-	126	49	527	92	668

TABLE A-2b. (continued)
TABLA A-2b. (continuación)

	Shortbill spearfish—Marlín trompa corta				Sailfish—Pez vela				Unidentified istiophorid billfishes—Picudos istiofóridos no identificados				Total billfishes—Total de peces picudos			
	PS dis.	**LL**	**OTR**	**Total**	**PS dis.**	**LL**	**OTR**	**Total**	**PS dis.**	**LL**	**OTR**	**Total**	**PS dis.**	**LL**	**OTR**	**Total**
1977	-	-	-	-	-	753	-	753	-	15	-	15	-	11,848	788	12,636
1978	-	-	-	-	-	878	-	878	-	3	-	3	-	11,466	2,205	13,671
1979	-	-	-	-	-	251	-	251	-	6	-	6	-	11,912	614	12,526
1980	-	-	-	-	-	244	-	244	-	0	-	0	-	13,168	1,107	14,275
1981	-	-	-	-	-	379	-	379	-	9	-	9	-	13,057	1,134	14,191
1982	-	-	-	-	-	1,084	-	1,084	-	3	-	3	-	13,360	1,551	14,911
1983	-	-	-	-	-	890	-	890	-	2	-	2	-	13,404	2,338	15,742
1984	-	-	-	-	-	345	-	345	-	-	-	-	-	11,204	3,336	14,540
1985	-	-	-	-	-	395	-	395	-	1	-	1	-	7,648	3,768	11,416
1986	-	5	-	5	-	583	-	583	-	1	-	1	-	12,990	3,294	16,284
1987	-	15	-	15	-	649	-	649	-	398	-	398	-	21,025	3,740	24,765
1988	-	13	-	13	-	649	-	649	-	368	-	368	-	17,179	5,642	22,821
1989	-	0	-	0	-	192	-	192	-	51	-	51	-	14,503	6,072	20,575
1990	-	-	-	-	-	6	-	6	-	125	-	125	-	14,961	5,066	20,027
1991	0	1	-	1	40	10	707	757	-	112	-	112	260	20,200	5,566	26,026
1992	1	1	-	2	41	741	610	1,392	-	1,123	-	1,123	262	21,219	5,252	26,733
1993	0	1	-	1	57	1,145	1,121	2,323	96	1,650	-	1,746	424	18,791	6,090	25,305
1994	0	144	-	144	38	878	804	1,720	23	1,028	-	1,051	270	19,004	5,341	24,615
1995	1	155	-	156	28	237	1,114	1,379	12	232	-	244	243	15,135	4,767	20,145
1996	1	126	-	127	22	197	541	760	19	308	1	328	231	13,863	3,780	17,874
1997	1	141	-	142	24	799	418	1,241	8	1,324	-	1,332	316	21,594	3,883	25,793
1998	0	200	-	200	58	394	988	1,440	13	575	52	640	350	18,472	5,566	24,388
1999	1	278	-	279	40	107	1,109	1,256	16	1,135	-	1,151	427	14,381	4,187	18,995
2000	1	285	-	285	55	138	1,239	1,433	7	880	136	1,023	332	14,657	4,961	19,950
2001	1	304	-	304	34	189	1,614	1,837	6	1,741	204	1,951	364	22,952	5,352	28,668
2002	1	273	-	274	39	393	1,416	1,848	10	2,467	14	2,491	490	24,935	5,063	30,487
2003	4	289	-	293	96	162	1,012	1,269	11	1,387	-	1,398	504	24,702	2,668	27,874
2004	1	200	-	200	36	156	1,261	1,453	9	1,384	-	1,394	313	21,640	2,399	24,352
2005	1	276	-	278	40	37	782	859	10	896	-	906	432	13,945	6,420	20,797
2006	1	2	-	3	51	26	593	670	12	476	-	488	480	3,434	1,063	4,977

TABLE A-2c. Estimated retained catches (Ret.), by gear type, and estimated discards (Dis.), by purse-seine vessels with a carrying capacity greater than 363 t only, of other species, in metric tons, in the EPO, 1977-2006. Data for 2005-2006 are preliminary.

TABLA A-2c. Estimaciones de las capturas retenidas (Ret.), por arte de pesca, y de los descartes (Dis.), por buques cerqueros de más de 363 t de capacidad de acarreo únicamente, de otras especies, en toneladas métricas, en el OPO, 1977-2006. Los datos de 2005-2006 son preliminares.

	Unidentified carangids—Carángidos no identificados						Dorado (*Coryphaena* spp.)						Unidentified elasmobranchs—Elasmobranquios no identificados						Unidentified fishes—Peces no identificados					
	PS		LP	LL	OTR	Total	PS		LP	LL	OTR	Total	PS		LP	LL	OTR	Total	PS		LP	LL	OTR	Total
	Ret.	Dis.					Ret.	Dis.					Ret.	Dis.					Ret.	Dis.				
1977	1,099	-	-	-	-	1,099	167	-	0	-	827	994	233	-	-	-	34	267	427	-	-	-	-	427
1978	238	-	1	-	-	239	87	-	-	-	738	825	145	-	-	-	390	535	148	-	-	-	-	148
1979	81	-	0	-	-	81	124	-	-	-	927	1,051	7	-	-	17	1,290	1,314	478	-	-	7	-	485
1980	224	-	2	-	-	226	124	-	0	-	1,001	1,125	16	-	-	7	858	881	301	-	-	-	-	301
1981	111	-	17	-	-	128	410	-	-	-	628	1,038	49	-	-	120	1,211	1,380	201	-	3	51	-	255
1982	122	-	-	-	-	122	274	-	-	-	980	1,254	22	-	30	215	864	1,131	284	-	-	59	-	343
1983	1,240	-	-	-	-	1,240	88	-	-	-	3,374	3,462	34	-	-	85	695	814	267	-	1	-	-	268
1984	414	-	-	-	-	414	103	-	-	-	202	305	47	-	-	6	1,039	1,092	415	-	-	-	3	418
1985	317	-	4	-	-	321	93	-	-	-	108	201	27	-	-	13	481	521	77	-	-	7	-	84
1986	188	-	19	-	-	207	632	-	-	-	1,828	2,460	29	-	-	1	1,979	2,009	94	-	-	0	-	94
1987	566	-	5	-	-	571	271	-	-	-	4,272	4,543	96	-	-	87	1,020	1,203	210	-	-	535	-	745
1988	825	-	1	-	-	826	69	-	-	-	1,560	1,629	1	-	-	23	1,041	1,065	141	-	-	360	-	501
1989	60	-	2	-	-	62	210	-	-	-	1,680	1,890	29	-	-	66	1,025	1,120	237	-	-	152	-	389
1990	234	-	0	-	1	235	63	-	-	-	1,491	1,554	0	-	-	280	1,095	1,375	240	-	-	260	13	513
1991	116	-	-	-	0	116	57	-	-	7	613	677	1	-	6	1,111	1,346	2,464	462	-	1	457	-	920
1992	116	-	-	-	0	116	69	-	-	37	708	814	-	-	-	2,293	1,190	3,483	445	-	-	182	-	627
1993	17	64	-	-	2	83	36	719	-	17	724	1,496	24	2,256	-	1,026	916	4,222	223	477	2	182	-	884
1994	7	40	-	-	16	63	279	1,237	-	46	3,459	5,021	113	2,353	-	1,234	1,314	5,015	10	354	-	251	-	615
1995	11	48	-	-	9	68	110	1,097	-	39	2,127	3,373	20	2,693	-	922	1,075	4,710	-	561	-	209	-	770
1996	55	217	-	-	57	329	119	1,332	-	43	183	1,677	3	2,453	-	1,121	2,151	5,728	5	354	-	455	-	814
1997	2	150	-	-	39	191	36	1,241	-	564	9,411	11,252	22	3,470	-	924	2,360	6,776	14	426	-	847	-	1,287
1998	57	178	-	-	4	239	15	836	-	39	11,656	12,546	6	3,228	-	2,008	4,484	9,726	65	983	-	1,338	-	2,386
1999	35	216	1	-	-	252	75	1,262	-	2,333	5,111	8,781		2,209	-	5,939	2,144	10,292	86	762	-	973	-	1,821
2000	57	121	-	4	4	186	109	1,547	-	3,537	1,041	6,233	3	1,691	-	8,621	406	10,720	1	287	-	1,487	0	1,775
2001	0	170	-	18	26	214	148	2,266	-	4,721	14,046	21,182	0	1,556	-	12,542	117	14,214	0	517	-	1,721	1	2,239
2002	0	135	-	15	20	171	45	1,849	-	3,974	11,969	17,837	0	683	-	11,043	3,751	15,476	0	517	-	1,895	0	2,412
2003	0	160	-	54	-	214	23	904	-	1,079	4,263	6,269	0	1,827	-	10,063	4,903	16,794	0	245	-	4,518	0	4,762
2004	0	161	-	-	-	161	99	1,005	-	1,649	6,965	9,718	0	1,455	9	9,014	2,190	12,668	14	684	-	515	0	1,213
2005	61	105	-	-	-	166	111	1,072	-	686	11,828	13,697	0	1,014	4	9,708	2,410	13,136	195	206	-	385	0	786
2006	133	474	-	-	-	607	132	1,295	-	227	13,583	15,237	0	1,306	-	4,186	881	6,373	494	396	-	0	0	890

TABLE A-3a. Estimates of the retained catches of tunas and bonitos, by flag, gear type, and species, in metric tons, in the EPO, 2002. The purse-seine and pole-and-line data for yellowfin, skipjack, and bigeye tunas have been adjusted to the species composition estimates and are preliminary.
TABLA A-3a. Estimaciones de las capturas retenidas de atunes y bonitos, por bandera, arte de pesca, y especie, en toneladas métricas, en el OPO, 2002. Los datos de los atunes aleta amarilla, barrilete, y patudo de las pesquerías cerquera y cañera fueron ajustados a la estimación de composición por especie, y son preliminares.

2002		YFT	SKJ	BET	PBF	ALB	BKJ	BZX	TUN	Total
BLZ	LL	1,447	0	1,459	67	438	0	0	0	3,411
CAN	LTL	0	0	0	0	4,753	0	0	0	4,753
CHL	NK	15	0	7	0	40	0	0	0	62
CHN	LL	1,457	0	7,614	0	1,327	0	0	0	10,398
COL	PS	29,725	2,613	300	0	0	0	0	284	32,922
CRI	NK	1,563	0	19	0	0	0	0	0	1,582
ECU	NK	0	0	5	0	0	0	0	0	5
	PS	30,930	80,806	26,934	0	0	877	0	84	139,631
ESP	LL								175	175
	PS	5,021	20,404	8,106	0	0	0	0	0	33,531
JPN	LL	8,513	66	34,193	2	2,627	0	0	0	45,401
KOR	LL	3,626	44	10,358	1	341	0	0	0	14,370
MEX	GN	1	0	0	0	0	0	0	0	1
	LL	4	0	0	1	0	0	0	0	5
	LP	950	616	0	1	0	8	0	0	1,575
	PS	153,172	6,312	2	1,708	28	358	0	0	161,581
PAN	LL	907	59	6	0	13	0	0	312	1,297
	PS	20,188	7,105	2,465	0	0	5	0	0	29,763
PER	NK	195	109	0	0	0	0	0	1,422	1,726
PYF	LL	278	27	388	0	2,545	0	0	0	3,238
SLV	PS	3,130	5,966	6,841	0	0	0	0	0	15,937
TWN	LL	7,360	64	17,253	0	7,096	0	0	0	31,773
USA	GN	1	0	0	7	0	0	1	0	9
	LL	5	1	132	0	0	0	0	1	139
	LP	0	0	0	2	381	0	0	0	383
	LTL	0	0	0	0	7,256	0	0	0	7,256
	PS	8,494	3,383	2,618	0	3	214	0	194	14,906
	RG	24	279	0	351	2,357	0	0	0	3,011
VEN	PS	121,919	2,631	0	0	0	0	0	0	124,550
VUT	LL	290	0	2,995	0	902	0	0	0	4,187
	PS	5,529	6,283	2,860	0	0	0	0	0	14,672
OTR[1]	LL[2]	115	0	7	0	47	0	42	2,790	3,002
	PS[3]	34,299	17,895	7,311	0	0	5	0	14	59,524

[1] This category is used to avoid revealing the operations of individual vessels or companies—Se usa esta categoría para no revelar información sobre las actividades de buques o empresas individuales.
[2] Includes Cook Islands, El Salvador, Guatemala, Honduras, and Nicaragua—Incluye El Salvador, Guatemala, Honduras, Islas Cook, y Nicaragua.
[3] Includes Belize, Bolivia, Guatemala, Honduras, Nicaragua, Peru, and Unknown—Incluye Belice, Bolivia, Guatemala, Honduras, Nicaragua, Perú, y Desconocido.

TABLE A-3b. Estimates of the retained catches of tunas and bonitos, by flag, gear type, and species, in metric tons, in the EPO, 2003. The purse-seine and pole-and-line data for yellowfin, skipjack, and bigeye tunas have been adjusted to the species composition estimates and are preliminary.
TABLA A-3b. Estimaciones de las capturas retenidas de atunes y bonitos, por bandera, arte de pesca, y especie, en toneladas métricas, en el OPO, 2003. Los datos de los atunes aleta amarilla, barrilete, y patudo de las pesquerías cerquera y cañera fueron ajustados a la estimación de composición por especie, y son preliminares.

2003		YFT	SKJ	BET	PBF	ALB	BKJ	BZX	TUN	Total
BLZ	LL	353	0	604	42	600	0	0	0	1,599
CAN	LTL	0	0	0	0	6,295	0	0	0	6,295
CHL	LL	0	0	0	0	0	13	0	0	13
	NK	73	0	14	0	1	0	24	0	112
CHN	LL	2,739	0	10,066	0	1,743	0	0	0	14,548
COL	PS	17,482	6,249	261	0	0	0	0	0	23,992
CRI	NK	1,418	0	18	0	0	0	0	0	1,436
ECU	LL	148	293	0	0	0	0	0	0	441
	NK	0	93	0	0	0	0	0	0	93
	PS	33,094	139,052	24,824	0	0	61	0	38	197,069
ESP	LL	0	0	58	0	0	0	0	186	244
	PS	3,760	28,606	7,983	0	0	0	0	0	40,349
JPN	LL	9,133	50	24,796	3	2,122	0	0	0	36,104
KOR	LL	4,911	25	10,272	0	343	0	0	0	15,551
MEX	LL	365	0	0	43	0	0	0	0	408
	LP	468	637	0	0	0	6	0	0	1,111
	PS	172,208	8,752	8	3,211	29	193	0	0	184,401
PAN	PS	25,042	13,473	4,674	0	0	3	0	10	43,202
PER	NK	806	2,575	0	0	0	117	0	750	4,248
PYF	LL	462	60	346	0	3,233	0	0	144	4,246
TWN	LL	3,477	172	12,016	0	12,663	0	0	0	28,328
USA	GN	0	9	6	14	16	0	1	0	46
	LL	5	1	232	0	24	0	0	4	266
	LP	2	1	0	3	59	0	1	0	66
	LTL	0	0	0	0	11,622	0	0	0	11,622
	PS	915	8,190	2,810	22	3	163	0	25	12,128
	RG	597	140	1	395	2,212	0	0	0	3,345
VEN	PS	95,137	7,913	439	0	0	0	0	0	103,489
VUT	LL	699	0	1,258	0	4,133	0	0	0	6,090
	PS	2,943	21,057	6,583	0	0	13	0	0	30,596
OTR[1]	LL[2]	1,472	33	18	0	438	0	0	39	2,000
	PS[3]	30,566	41,198	6,927	0	2	0	0	8	78,701

[1] This category is used to avoid revealing the operations of individual vessels or companies—Se usa esta categoría para no revelar información sobre las actividades de buques o empresas individuales.
[2] Includes Cook Islands, Honduras, Nicaragua, and Panama—Incluye Honduras, Islas Cook, Nicaragua, y Panamá.
[3] Includes Belize, Bolivia, El Salvador, Guatemala, Honduras, Peru, and Unknown—Incluye Belice, Bolivia, El Salvador, Guatemala, Honduras, Perú, y Desconocido.

TABLE A-3c Estimates of the retained catches of tunas and bonitos, by flag, gear type, and species, in metric tons, in the EPO, 2004. The purse-seine and pole-and-line data for yellowfin, skipjack, and bigeye tunas have been adjusted to the species composition estimates and are preliminary.

TABLA A-3c. Estimaciones de las capturas retenidas de atunes y bonitos, por bandera, arte de pesca, y especie, en toneladas métricas, en el OPO, 2004 Los datos de los atunes aleta amarilla, barrilete, y patudo de las pesquerías cerquera y cañera fueron ajustados a la estimación de composición por especie, y son preliminares.

2004		YFT	SKJ	BET	PBF	ALB	BKJ	BZX	TUN	Total
BLZ	LL	190	26	120	*	296	*	*	*	632
CAN	LTL	*	*	*	*	7,676	*	*	*	7,676
CHL	LL	86	*	9	*	8	27	8	*	138
CHN	LL	798	*	2,645	*	590	*	*	*	4,034
CRI	NK	1,701	*	21	*	*	*	*	*	1,722
ECU	LL	*	*	312	*	*	*	*	*	312
	NK	*	*	185	*	*	*	*	*	185
	PS	40,501	88,470	30,647	*	*	97	7	12	159,733
ESP	LL	*	*	5	*	*	*	*	318	323
HND	PS	1,058	3,634	1,858	*	*	*	*	1	6,551
JPN	LL	7,240	96	21,132	1	2,264	*	*	*	30,733
KOR	LL	2,997	31	10,729	*	783	*	*	*	14,540
MEX	LL	32	*	*	14	*	*	*	*	46
	LP	1,882	528	*	*	*	*	*	*	2,410
	PS	90,897	24,972	*	8,880	104	418	8	54	125,332
NIC	LL	43	*	*	*	*	*	*	*	43
PAN	LL	2,802	148	48	*	143	*	*	11	3,152
	PS	31,308	20,365	11,434	*	*	25	*	2	63,134
PER	NK	291	1,098	*	*	*	862	*	258	2,509
PYF	LL	767	56	405	*	1,802	*	*	143	3,173
TWN	LL	1,824	339	7,384	*	9,988	*	*	*	19,535
USA	GN	1	*	*	10	12	*	3	*	26
	LL	6	3	149	*	8	*	*	1	167
	LP	2	*	*	*	126	*	1	*	129
	LTL	1	*	*	*	12,718	*	*	*	12,719
	PS	2,529	5,117	3,746	*	1	296	*	178	11,867
	RG	1,159	18	4	49	1,506	*	*	*	2,736
VEN	PS	54,220	13,058	1,056	*	*	47	*	1	68,382
VUT	LL	171	*	407	*	2,554	*	*	*	3,132
	PS	1,625	8,387	5,174	*	*	*	*	*	15,186
OTR[1]	LL	15	13	9	*	8	*	*	31	76
	PS[2]	47,325	34,675	13,422	*	247	1	*	12	95,682

[1] This category is used to avoid revealing the operations of individual vessels or companies—Se usa esta categoría para no revelar información sobre las actividades de buques o empresas individuales.

[2] Includes Bolivia, Colombia, El Salvador, Guatemala, Nicarargua, Spain, and Unknown—Incluye Bolivia, Colombia, El Salvador, España, Guatemala, Nicaragua, y Desconocido.

TABLE A-3d. Estimates of the retained catches of tunas and bonitos, by flag, gear type, and species, in metric tons, in the EPO, 2005. The purse-seine and pole-and-line data for yellowfin, skipjack, and bigeye tunas have been adjusted to the species composition estimates and are preliminary.
TABLA A-3d. Estimaciones de las capturas retenidas de atunes y bonitos, por bandera, arte de pesca, y especie, en toneladas métricas, en el OPO, 2005. Los datos de los atunes aleta amarilla, barrilete, y patudo de las pesquerías cerquera y cañera fueron ajustados a la estimación de composición por especie, y son preliminares.

2005		YFT	SKJ	BET	PBF	ALB	BKJ	BZX	TUN	Total
BLZ	LL	164	16	112	*	46	*	*	*	338
CAN	LTL	*	*	*	*	4,799	*	*	*	4,799
CHL	NK	110	*	24	*	7	22	11	*	174
CHN	LL	682	*	2,104	*	895	*	*	*	3,681
CRI	NK	1,791	*	23	*	*	*	*	*	1,814
ECU	LL	*	*	39	*	*	*	*	*	39
	PS	40,214	137,102	30,568	*	*	141	40	28	208,093
ESP	LL	*	*	*	*	*	*	*	362	362
HND	PS	2,246	5,498	3,714	*	*	*	*	*	11,458
JPN	LL	4,303	50	21,137	0	2,805	*	*	*	28,295
KOR	LL	532	*	11,580	*	172	*	*	*	12,284
MEX	LP	1,844	1,278	*	*	*	*	*	*	3,121
	PS	111,543	31,601	*	4,542	*	1,193	273	92	149,245
NIC	LL	18	*	*	*	*	*	*	*	18
	PS	7,008	2,511	34	*	*	*	*	*	9,553
PAN	LL	1,782	94	30	*	91	*	*	*	1,997
	PS	30,311	28,534	13,370	*	*	8	*	8	72,231
PER	NK	458	365	*	*	*	*	*	427	1,250
	OTR	708	1,398	*	*	*	*	*	*	2,106
PYF	LL	530	14	398	*	1,572	*	*	146	2,661
SLV	PS	7,001	5,347	1,016	*	*	73	*	60	13,497
TWN	LL	2,422	66	6,441	*	3,300	*	*	*	12,229
USA	GN	2	*	*	5	20	*	*	*	27
	LL	7	1	536	*	9	*	*	9	562
	LP	*	*	*	*	66	*	*	*	66
	LTL	*	*	*	*	9,069	*	*	*	9,069
	RG	899	23	*	79	1,719	*	*	*	2,720
VEN	PS	42,180	14,254	120	*	*	41	*	2	56,597
VUT	LL	*	*	1,056	*	179	*	*	*	1,235
OTR[1]	LL	2	*	*	*	57	*	*	1	60
	PS[2]	28,082	36,752	19,877	201	2	16	*	*	84,930

[1] This category is used to avoid revealing the operations of individual vessels or companies—Se usa esta categoría para no revelar información sobre las actividades de buques o empresas individuales.
[2] Includes Colombia, Guatemala, Spain, United States, Vanuatu, and Unknown —Incluye Colombia, España, Estados Unidos, Guatemala, Vanuatú, y Desconocido.

TABLE A-3e. Estimates of the retained catches of tunas and bonitos, by flag, gear type, and species, in metric tons, in the EPO, 2006. The purse-seine and pole-and-line data for yellowfin, skipjack, and bigeye tunas have been adjusted to the species composition estimates and are preliminary.

TABLA A-3e. Estimaciones de las capturas retenidas de atunes y bonitos, por bandera, arte de pesca, y especie, en toneladas métricas, en el OPO, 2006. Los datos de los atunes aleta amarilla, barrilete, y patudo de las pesquerías cerquera y cañera fueron ajustados a la estimación de composición por especie, y son preliminares.

2006		YFT	SKJ	BET	PBF	ALB	BKJ	BZX	TUN	Total
BLZ	LL	105	13	75	*	8	*	*	*	201
CAN	LTL	*	*	*	*	5,139	*	*	*	5,139
CHN	LL	36	*	709	*	13	*	*	*	758
CRI	NK	642	*	8	*	*	*	*	*	650
ECU	PS	26,152	143,094	34,176	*	*	79	*	67	203,568
HND	PS	1,694	6,483	3,061	*	*	*	*	*	11,238
JPN	LL	*	*	13,618	*	278	*	*	*	13,896
KOR	LL	*	*	8,694	*	58	*	*	*	8,752
MEX	LP	693	429	*	*	*	*	12	*	1,133
	PS	67,859	19,118	*	9,795	109	1,897	3,229	31	102,038
NIC	PS	7,257	5,371	1,878	*	*	*	*	1	14,507
PAN	LL	2,164	114	37	*	110	*	*	*	2,425
	PS	23,673	46,742	10,645	*	*	8	*	*	81,068
PER	NK	595	73	*	*	*	*	*	192	860
TWN	LL	1,671	57*	6,412	*	4,235	*	*	*	12,375
USA	LL	*	*	78	*	*	*	*	*	78
	RG	641	16	*	96	376	*	*	*	1,129
VEN	PS	17,226	25,725	4,135	*	*	11	248	*	47,345
VUT	LL	*	*	648	*	1,688	*	*	*	2,336
OTR[1]	LL	*	*	*	*	207	*	*	3	210
	PS[2]	22,878	61,615	17,300	*	*	5	*	2	101,800

[1] This category is used to avoid revealing the operations of individual vessels or companies—Se usa esta categoría para no revelar información sobre las actividades de buques o empresas individuales.

[2] Includes Bolivia, Colombia, El Salvador, Guatemala, Spain, United States, and Vanuatu—Incluye Bolivia, Colombia, El Salvador, España, Estados Unidos, Guatemala, y Vanuatú.

TABLE A-4a. Preliminary estimates of the retained catches and landings, in metric tons, of tunas and bonitos caught by purse-seine, pole-and-line, and recreational vessels in 2005, by species and vessel flag (upper panel) and locations where processed (lower panel). The purse-seine and pole-and-line data for yellowfin, skipjack, and bigeye tunas have been adjusted to the species composition estimates and are preliminary.

TABLA A-4a. Estimaciones preliminares de las capturas retenidas y descargas de atunes y bonitos capturado por buques cerqueros, cañeros y deportivos en el OPO en 2005, por especie y bandera del buque (panel superior) y localidad donde fue procesado (panel inferior), en toneladas métricas. Los datos de los atunes aleta amarilla, barrilete, y patudo de las pesquerías cerquera y cañera fueron ajustados a las estimaciones de composición por especie, y son preliminares.

	YFT	SKJ	BET	PBF	ALB	BKJ	BZX	TUN	Total	%
	Retained catches–Capturas retenidas									
ECU	40,214	137,102	30,568	*	*	141	40	28	208,093	34.0
HND	2,246	5,498	3,714	*	*	*	*	*	11,458	1.9
MEX	113,387	32,879	*	4,542	*	1,193	273	92	152,366	24.9
NIC	7,008	2,511	34	*	*	*	*	*	9,553	1.6
PAN	30,311	28,534	13,370	*	*	8	*	8	72,231	11.8
SLV	7,001	5,347	1,016	*	*	73	*	60	13,497	2.2
VEN	42,180	14,254	120	*	*	41	*	2	56,597	9.3
OTR	28,981	36,775	19,877	280	1,787	16	*	*	87,716	14.3
Total	271,328	262,900	68,699	4,822	1,787	1,472	313	190	611,511	
	Landings–Descargas									
COL	35,968	14,317	3,817	*	*	*	*	2	54,104	8.9
CRI	14,931	5,380	668	*	*	*	*	*	20,979	3.5
ECU	66,038	188,021	57,331	*	*	165	40	37	311,632	51.5
MEX	109,700	32,074	292	4,513	*	1,193	273	92	148,137	24.5
VEN	16,503	3,633	*	*	*	*	*	*	20,136	3.3
OTR	26,139	17,447	3,704	388	1,787	114	*	60	49,639	8.2
Total	269,279	260,872	65,812	4,901	1,787	1,472	313	191	604,627	

[1] Includes Colombia, Guatemala, Spain, United States, Vanuatu, and Unknown. This category is used to avoid revealing the operations of individual vessels or companies.

[1] Incluye, Colombia, España, Guatemala, Estados Unidos, Vanuatú, y Desconocido. Se usa esta categoría para no revelar información sobre las actividades de buques o empresas individuales.

[2] Includes El Salvador, Guatamala, Peru, Spain, United States, and Unknown. This category is used to avoid revealing the operations of individual vessels or companies.

[2] Incluye El Salvador, España, Estados Unidos, Guatamala, Perú, y Desconocido. Se usa esta categoría para no revelar información sobre las actividades de buques o empresas individuales.

TABLE A-4b Preliminary estimates of the retained catches and landings, in metric tons, of tunas and bonitos caught by purse-seine, pole-and-line, and recreational vessels in the EPO in 2006, by species and vessel flag (upper panel) and locations where processed (lower panel). The purse-seine and pole-and-line data for yellowfin, skipjack, and bigeye tunas have been adjusted to the species composition estimates and are preliminary.

TABLA A-4b. Estimaciones preliminares de las capturas retenidas y descargas de atunes y bonitos capturado por buques cerqueros, cañeros y deportivos en el OPO en 2006, por especie y bandera del buque (panel superior) y localidad donde fue procesado (panel inferior), en toneladas métricas. Los datos de los atunes aleta amarilla, barrilete, y patudo de las pesquerías cerquera y cañera fueron ajustados a las estimaciones de composición por especie, y son preliminares.

	YFT	SKJ	BET	PBF	ALB	BKJ	BZX	TUN	Total	%
	Retained catches–Capturas retenidas									
ECU	26,152	143,094	34,176	*	*	79	*	67	203,568	36.1
HND	1,694	6,483	3,061	*	*	*	*	*	11,238	2.0
MEX	68,552	19,547	*	9,795	109	1,897	3,240	31	103,171	18.3
NIC	7,257	5,371	1,878	*	*	*	*	1	14,507	2.6
PAN	23,673	46,742	10,645	*	*	8	*	*	81,068	14.4
VEN	17,226	25,725	4,135	*	*	11	248	*	47,345	8.4
OTR	23,519	61,631	17,300	96	376	5	*	*	102,927	18.3
Total	168,073	308,593	71,195	9,891	485	2,000	3,488	99	563,824	
	Landings–Descargas									
COL	11,549	15,416	2,845	*	*	8	*	*	29,818	5.2
ECU	52,921	223,969	57,252	*	*	81	248	67	334,538	58.8
MEX	68,209	18,733	*	9,795	109	1,897	3,240	31	102,014	17.9
VEN	12,116	15,623	1,500	*	*	11	*	*	29,250	5.1
OTR	33,068	31,750	8,362	96	376	3	*	1	73,656	12.9
Total	177,863	305,491	69,959	9,891	485	2,000	3,488	99	569,276	

[1] Includes Bolivia, Colombia, El Salvador, Guatemala, Spain, United States, and Vanuatu. This category is used to avoid revealing the operations of individual vessels or companies.

[1] Incluye Bolivia, Colombia, El Salvador, España, Estados Unidos, Guatemala, y Vanuatú. Se usa esta categoría para no revelar información sobre las actividades de buques o empresas individuales.

[2] Includes Costa Rica,El Salvador, Guatemala, Peru, United States, and Unknown. This category is used to avoid revealing the operations of individual vessels or companies.

[2] Incluye Costa Rica, El Salvador, Estados Unidos, Guatemala, Perú, y Desconocido. Se usa esta categoría para no revelar información sobre las actividades de buques o empresas individuales.

TABLE A-5. Annual retained catches of Pacific bluefin tuna, by gear type and flag, in metric tons. The data for 2005 and 2006 are preliminary.
TABLA A-5. Capturas retenidas anuales de atún aleta azul del Pacífico, por arte de pesca y bandera, en toneladas métricas. Los datos de 2005 y 2006 son preliminares.

PBF	Western Pacific flags—Banderas del Pacífico occidental[1]										Eastern Pacific flags—Banderas del Pacífico oriental					Total
	JPN				KOR[1]		TWN			Sub-total	USA[2]		MEX		Sub-total	
	PS	LP	LL	OTR	PS	OTR	PS	LL	OTR		PS	OTR	PS	OTR		
1977	5,110	2,256	712	5,519	-	-	-	131	-	13,727	3,265	44	2,184	-	5,493	19,220
1978	10,427	1,154	1,049	9,486	-	-	-	66	-	22,183	4,663	12	546	-	5,221	27,404
1979	13,881	1,250	1,223	9,418	-	-	-	58	-	25,830	5,889	24	213	-	6,126	31,956
1980	11,327	1,392	1,170	5,945	-	-	-	114	-	19,948	2,327	31	582	-	2,940	22,888
1981	25,430	754	796	6,428	-	-	-	179	-	33,587	867	9	218	-	1,094	34,681
1982	19,234	1,777	880	4,161	31	-	-	207	11	26,302	2,639	12	506	-	3,157	29,459
1983	14,784	356	707	3,883	13	-	9	175	12	19,939	621	34	214	-	869	20,808
1984	4,433	587	360	4,797	4	-	5	477	-	10,664	673	65	167	-	905	11,569
1985	4,162	1,817	496	5,475	1	-	80	210	67	12,308	3,320	111	676	-	4,107	16,415
1986	7,412	1,086	249	4,944	344	-	16	70	81	14,202	4,851	66	189	-	5,106	19,308
1987	8,672	1,565	346	3,536	89	-	21	365	87	14,681	861	54	119	-	1,034	15,715
1988	3,601	907	241	2,436	32	-	197	108	431	7,953	923	49	448	1	1,421	9,374
1989	6,166	754	440	1,977	71	-	259	205	578	10,450	1,045	129	57	-	1,231	11,681
1990	2,959	536	396	2,359	132	-	149	189	454	7,174	1,380	151	50	-	1,581	8,755
1991	4,336	286	285	3,994	265	-	-	342	107	9,614	411	94	9	-	514	10,128
1992	4,255	166	573	3,102	288	-	73	464	76	8,998	1,928	117	0	-	2,045	11,043
1993	5,156	129	857	1,645	40	-	1	471	4	8,302	579	329	0	-	908	9,210
1994	7,345	162	1,138	4,887	50	-	-	559	-	14,141	906	120	63	2	1,091	15,232
1995	5,334	270	769	6,702	821	-	-	335	2	14,233	619	275	10	-	904	15,137
1996	5,540	94	978	4,628	102	-	-	956	-	12,299	4,523	87	3,700	-	8,310	20,609
1997	6,137	34	1,383	3,817	1054	-	-	1814	-	14,239	2,240	266	368	-	2,874	17,113
1998	2,715	85	1,260	3,663	188	-	-	1910	-	9,820	1,771	585	1	-	2,357	12,177
1999	11,619	35	1,155	4,411	256	-	-	3089	-	20,565	184	656	2,369	35	3,244	23,809
2000	8,193	102	1,005	5,763	794	-	-	2780	2	18,638	693	378	3,019	99	4,188	22,827
2001	3,139	180	1,004	4,947	995	10	-	1839	104	12,218	28	395	863	-	1,287	13,505
2002	4,171	99	889	4,023	674	1	-	1523	4	11,384	0	360	1,708	2	2,070	13,454
2003	945	44	1,230	3,246	1591	-	-	1863	21	8,940	22	412	3,211	43	3,688	12,628
2004	4,792	132	1,311	4,054	636	-	-	1714	-	12,639	0	59	8,880	14	8,953	21,592
2005	3,927	549	1,824	8,702	950	-	-	1368	-	17,319	201	84	4,542	*	4,827	22,147
2006	3,780	108	1,037	5,049	*	-	-	1148	-	11,123	*	96	9,795	*	9,891	21,013

[1] Source: International Scientific Committee, Report of the Fifth ISC Pacific Bluefin Tuna Working Group—Fuente: Comité Científico Internacional, Informe del Quinto Grupo de Trabajo sobre el Atún Aleta Azul del Pacífico.

TABLE A-6a. Annual retained catches of North Pacific albacore by region and gear, in metric tons, compiled from IATTC data (EPO) and SPC data (WCPO). The data for 2005 and 2006 are preliminary.

TABLA A-6a. Capturas retenidas anuales de atún albacora del Pacífico Norte por región, en toneladas métricas, compiladas de datos de la CIAT (OPO) y la SPC (WCPO). Los datos de 2005 y 2006 son preliminares.

ALB (N)	Eastern Pacific Ocean Océano Pacífico oriental						Western and central Pacific Ocean Océano Pacífico occidental y central					Total
	LL	LP	LTL	PS	OTR	Subtotal	LL	LP	LTL	OTR	Subtotal	
1977	811	1,960	9,968	15	543	13,298	16,347	34,822	54	2,336	53,558	66,856
1978	790	1,577	16,613	156	821	19,957	12,610	57,018	23	10,419	80,070	100,027
1979	1,394	179	4,955	148	74	6,750	13,163	45,635	2,347	6,970	68,115	74,865
1980	1,268	407	5,421	194	168	7,459	14,245	43,495	2,347	7,511	67,597	75,056
1981	2,040	608	12,039	99	227	15,013	16,517	26,375	798	21,597	65,287	80,300
1982	1,971	198	3,303	355	257	6,084	15,693	29,744	3,410	26,154	75,001	81,085
1983	1,572	449	7,751	7	87	9,866	14,416	20,155	1,833	14,337	50,741	60,607
1984	2,592	1,441	8,343	3,910	1,427	17,713	12,972	25,928	1,011	26,266	66,177	83,890
1985	1,312	877	5,308	42	1,176	8,715	13,252	21,967	1,163	24,878	61,260	69,975
1986	698	86	4,282	47	196	5,309	12,349	14,525	456	18,603	45,933	51,242
1987	1,114	320	2,300	1	171	3,906	14,171	19,103	570	18,242	52,086	55,992
1988	899	271	4,202	17	64	5,454	14,417	7,839	165	27,923	50,343	55,797
1989	957	21	1,852	1	160	2,991	12,921	11,241	148	26,789	51,099	54,090
1990	1,139	170	2,440	39	24	3,812	15,034	13,944	465	32,154	61,597	65,409
1991	1,514	834	1,783	-	6	4,137	15,984	5,729	201	15,052	36,966	41,103
1992	1,635	255	4,515	-	2	6,407	17,788	14,774	419	19,952	52,933	59,340
1993	1,772	1	4,331	-	25	6,129	28,777	12,844	2,417	3,132	47,170	53,299
1994	2,356	85	9,574	-	106	12,121	28,386	30,439	3,560	3,804	66,189	78,310
1995	1,381	465	7,306	-	102	9,254	31,496	22,619	3,452	1,981	59,548	68,802
1996	1,675	72	8,195	11	88	10,041	37,614	22,551	13,654	720	74,539	84,580
1997	1,365	59	6,057	1	1,018	8,500	46,528	35,056	12,617	2,056	96,257	104,757
1998	1,730	81	11,936	42	1,208	14,996	46,101	27,797	8,138	1,663	83,700	98,696
1999	2,701	227	10,831	47	3,621	17,427	43,360	54,817	3,022	7,476	108,675	126,102
2000	1,880	86	10,874	71	1,798	14,710	38,989	21,767	4,371	2,956	68,082	82,792
2001	1,822	157	11,597	3	1,635	15,215	34,468	29,254	5,141	1,472	70,334	85,549
2002	1,226	381	11,906	31	2,357	15,900	21,852	49,575	4,417	3,904	79,749	95,649
2003	1,125	59	17,786	34	2,228	21,232	28,662	34,648	4,100	1,465	68,876	90,107
2004	919	126	20,196	105	1,518	22,864	21,832	34,911	1,977	7,597	66,317	89,181
2005	2,595	66	13,744	2	1,739	18,146	22,625	34,971	5,397	873	63,866	82,012
2006	4,245	*	5,977	109	376	10,707	*	*	*	*	*	10,707

TABLE A-6b. Annual retained catches of South Pacific albacore by region, in metric tons, compiled from IATTC data (EPO) and SPC data (WCPO). The data for 2005 and 2006 are preliminary.

TABLA A-6b. Capturas retenidas anuales de atún albacora del Pacífico Sur por región, en toneladas métricas, compiladas de datos de la CIAT (OPO) y la SPC (WCPO). Los datos de 2005 y 2006 son preliminares.

ALB (S)	Eastern Pacific Ocean Océano Pacífico oriental				Western and central Pacific Ocean Océano Pacífico occidental y central					Total
	LL	LTL	OTR	Subtotal	LL	LP	LTL	OTR	Subtotal	
1977	9,767	-	960	10,727	28,247	100	621	-	28,968	39,695
1978	11,149	-	2	11,151	21,739	100	1,686	-	23,525	34,676
1979	4,189	-	14	4,203	21,968	100	814	-	22,882	27,085
1980	4,050	-	60	4,110	26,917	101	1,468	-	28,486	32,596
1981	5,235	-	35	5,270	27,458	-	2,085	-	29,543	34,813
1982	6,436	-	2	6,438	21,911	1	2,434	4	24,350	30,788
1983	5,862	-	2	5,864	18,447	-	744	37	19,228	25,092
1984	4,120	-	24	4,144	16,220	2	2,773	1,565	20,560	24,704
1985	5,955	-	170	6,125	21,183	-	3,253	1,767	26,203	32,328
1986	5,752	74	149	5,975	26,885	-	1,929	1,797	30,611	36,586
1987	8,880	188	3	9,071	13,089	9	1,946	927	15,971	25,042
1988	9,035	1,282	0	10,317	19,249	-	3,014	5,283	27,546	37,863
1989	5,828	593	90	6,510	12,396	-	7,777	21,878	42,052	48,562
1990	5,397	1,336	306	7,038	13,969	245	5,639	7,232	27,086	34,124
1991	6,380	795	170	7,345	17,005	14	7,010	1,319	25,348	32,693
1992	15,446	1,205	18	16,668	15,146	11	5,373	47	20,578	37,246
1993	9,423	35	19	9,476	20,807	74	4,261	51	25,194	34,670
1994	8,034	441	22	8,498	26,252	67	6,723	67	33,108	41,606
1995	4,804	2	15	4,821	24,576	139	7,706	89	32,510	37,331
1996	5,956	94	21	6,071	17,906	57	7,273	135	25,371	31,442
1997	8,313	466	-	8,779	18,821	21	4,213	133	23,188	31,967
1998	10,905	11	-	10,916	26,941	47	6,247	85	33,320	44,236
1999	8,932	98	7	9,036	23,021	138	3,293	67	26,520	35,556
2000	7,783	780	3	8,565	26,197	102	5,340	136	31,776	40,341
2001	17,589	528	5	18,122	31,095	37	4,523	194	35,849	53,971
2002	14,064	150	40	14,254	46,932	18	4,345	112	51,407	65,661
2003	23,776	529	1	24,306	31,937	12	4,767	137	36,853	61,159
2004	17,525	445	-	17,970	42,810	110	3,793	124	46,837	64,807
2005	6,475	181	7	6,663	47,886	109	3,400	130	51,525	58,188
2006	2,145	49	*	2,193	*	*	*	*	*	2,193

TABLE A-7. Catches per cubic meter of well volume for the purse-seine fleet in the EPO, by species and vessel capacity group. All = YFT, SKJ, BET, PBF, ALB, BKJ, BZX, and TUN (see Table A-2a).

TABLA A-7. Capturas por metro cúbico de volumen de bodega de la flota cerquera en el OPO, por especie y clase de arqueo del buque. All = YFT, SKJ, BET, PBF, ALB, BKJ, BZX, y TUN (ver Tabla A-2a).

	Species Especie	Well volume—Volumen de bodega (m^3)								
		<401	401-800	801-1100	1101-1300	1301-1500	1501-1800	1801-2100	>2100	Total
2001	YFT	2.3	1.4	1.4	3.0	2.0	2.6	0.8	0.6	2.0
	SKJ	1.2	1.0	0.9	0.2	0.6	0.4	1.3	1.2	0.7
	BET	0.0	0.3	0.3	0.1	0.3	0.1	0.6	0.5	0.2
	All	3.7	2.8	2.6	3.3	3.1	3.0	2.8	2.2	3.0
2002	YFT	1.7	1.6	1.1	3.3	2.6	2.3	0.7	0.5	2.0
	SKJ	1.3	1.3	0.9	0.3	0.7	0.2	1.3	1.4	0.8
	BET	0.0	0.1	0.2	0.1	0.3	0.1	0.5	0.5	0.2
	All	3.2	3.1	2.2	3.7	3.5	2.5	2.5	2.4	3.0
2003	YFT	1.7	1.8	1.1	3.0	2.1	2.0	0.8	0.6	1.9
	SKJ	2.9	2.4	1.8	0.6	0.9	0.4	1.8	1.3	1.3
	BET	0.0	0.2	0.3	0.1	0.2	0.1	0.5	0.4	0.2
	All	4.9	4.4	3.2	3.7	3.2	2.5	3.1	2.4	3.5
2004	YFT	1.1	1.2	1.0	1.8	1.6	1.2	0.6	0.8	1.3
	SKJ	1.7	1.6	1.3	0.6	0.8	0.5	1.3	1.3	0.9
	BET	0.1	0.3	0.3	0.1	0.3	0.1	0.6	0.6	0.2
	All	3.2	3.0	2.7	2.6	2.6	1.8	2.4	2.7	2.6
2005	YFT	1.2	1.2	0.8	1.7	1.4	1.5	0.8	0.7	1.3
	SKJ	3.0	2.1	1.6	0.7	0.9	0.8	2.1	1.6	1.3
	BET	0.0	0.2	0.3	0.1	0.2	0.1	0.6	0.9	0.2
	All	4.5	3.5	2.8	2.5	2.5	2.4	3.4	3.3	2.9
2006	YFT	0.9	0.7	0.6	1.0	0.9	0.9	0.5	0.6	0.8
	SKJ	2.4	2.1	1.6	0.8	0.8	1.1	2.3	1.3	1.4
	BET	0.1	0.3	0.3	0.1	0.2	0.2	0.6	0.6	0.3
	All	3.8	3.3	2.7	2.0	2.1	2.2	3.4	2.5	2.5

TABLE A-8. Estimated numbers of sets, by set type and vessel capacity category, and estimated retained catches, in metric tons, of yellowfin, skipjack, and bigeye tuna in the EPO, by purse-seine vessels. The data for 2006 are preliminary. The data for yellowfin, skipjack, and bigeye tunas have been adjusted to the species composition estimate and are preliminary.

TABLA A-8. Números estimados de lances, por tipo de lance y categoría de capacidad de buque, y capturas retenidas estimadas, en toneladas métricas, de atunes aleta amarilla, barrilete, y patudo en el OPO. Los datos de 2006 son preliminares. Los datos de los atunes aleta amarilla, barrilete, y patudo fueron ajustados a la estimación de composición por especie, y son preliminares.

	Number of sets—Número de lances			Retained catch—Captura retenida		
	Vessel capacity—Capacidad del buque			YFT	SKJ	BET
	≤363 t	>363 t	Total			
DEL	**Sets on fish associated with dolphins Lances sobre peces asociados con delfines**					
1989	33	12,827	12,860	191,623	1,728	26
1990	31	10,997	11,028	173,894	1,350	0
1991	0	9,661	9,661	155,283	1,332	0
1992	26	10,398	10,424	165,647	1,262	0
1993	34	6,953	6,987	110,893	587	51
1994	5	7,804	7,809	125,345	1,106	1
1995	0	7,185	7,185	132,710	2,548	1
1996	14	7,472	7,486	138,466	1,761	57
1997	43	8,977	9,020	152,240	8,160	0
1998	0	10,645	10,645	154,528	4,998	6
1999	0	8,648	8,648	143,166	1,705	5
2000	0	9,235	9,235	147,618	542	15
2001	0	9,823	9,823	238,094	1,805	6
2002	0	12,446	12,446	301,401	3,180	2
2003	0	13,839	13,839	264,599	13,323	1
2004	0	11,783	11,783	175,792	10,824	3
2005	0	12,173	12,173	165,131	11,716	4
2006	0	8,923	8,923	89,183	4,942	0
OBJ	**Sets on fish associated with floating objects Lances sobre peces asociados con objetos flotantes**					
1989	974	2,339	3,313	28,377	44,664	1,527
1990	719	2,558	3,277	35,527	35,552	3,995
1991	819	2,165	2,984	25,501	39,036	2,747
1992	868	1,763	2,631	15,010	49,144	2,048
1993	493	2,063	2,556	19,614	53,009	6,141
1994	668	2,770	3,438	20,843	51,125	33,960
1995	707	3,521	4,228	21,146	80,010	41,873
1996	1,230	4,007	5,237	27,842	69,614	58,371
1997	1,699	5,653	7,352	30,009	116,806	62,704
1998	1,198	5,481	6,679	26,286	110,297	41,909
1999	630	4,620	5,250	43,052	181,547	49,330
2000	504	3,916	4,420	42,688	121,036	91,474
2001	801	5,744	6,545	66,353	122,752	60,627
2002	857	5,781	6,638	37,797	116,656	55,916
2003	704	5,497	6,201	29,798	181,326	52,705
2004	615	5,083	5,698	27,595	117,669	65,829
2005	641	5,122	5,763	26,238	132,483	67,510
2006	1,086	7,140	8,226	35,642	194,679	69,564

TABLE A-8. (continued)
TABLA A-8 (continuación)

	Number of sets—Número de lances			Retained catch—Captura retenida		
	Vessel capacity—Capacidad del buque			YFT	SKJ	BET
	≤363 t	>363 t	Total			
NOA	**Sets on unassociated schools / Lances sobre cardúmenes no asociados**					
1989	2,955	5,878	8,833	57,996	48,542	477
1990	3,683	5,397	9,080	53,832	37,467	1,926
1991	3,571	3,612	7,183	50,473	21,860	2,123
1992	4,010	4,079	8,089	47,463	33,876	5,131
1993	5,739	6,267	12,006	88,985	30,234	3,465
1994	5,440	5,064	10,504	62,220	17,895	938
1995	6,120	4,782	10,902	61,578	44,489	3,447
1996	5,807	5,118	10,925	72,299	32,598	2,883
1997	5,334	4,693	10,027	62,629	28,490	1,568
1998	5,700	4,631	10,331	73,145	25,336	2,214
1999	5,632	6,143	11,775	95,702	78,313	1,823
2000	5,439	5,482	10,921	64,719	83,881	2,264
2001	3,958	3,030	6,988	77,782	19,227	775
2002	4,923	3,409	8,332	73,209	33,562	1,519
2003	7,284	5,083	12,367	86,750	79,841	1,803
2004	4,935	5,698	10,633	66,076	70,185	1,505
2005	6,099	7,857	13,956	77,216	117,400	1,185
2006	6,003	8,463	14,466	41,914	108,527	1,631
ALL	**Sets on all types of schools / Lances sobre todos tipos de cardumen**					
1989	3,962	21,044	25,006	277,996	94,934	2,030
1990	4,433	18,952	23,385	263,253	74,369	5,921
1991	4,390	15,438	19,828	231,257	62,228	4,870
1992	4,904	16,240	21,144	228,121	84,283	7,179
1993	6,266	15,283	21,549	219,492	83,830	9,657
1994	6,113	15,638	21,751	208,408	70,126	34,899
1995	6,827	15,488	22,315	215,434	127,047	45,321
1996	7,051	16,597	23,648	238,607	103,973	61,311
1997	7,076	19,323	26,399	244,878	153,456	64,272
1998	6,898	20,757	27,655	253,959	140,631	44,129
1999	6,262	19,411	25,673	281,920	261,565	51,158
2000	5,943	18,633	24,576	255,025	205,459	93,753
2001	4,759	18,597	23,356	382,229	143,784	61,408
2002	5,780	21,636	27,416	412,407	153,398	57,437
2003	7,988	24,419	32,407	381,147	274,490	54,509
2004	5,550	22,564	28,114	269,463	198,678	67,337
2005	6,740	25,152	31,892	268,585	261,599	68,699
2006	7,089	24,526	31,615	166,739	308,148	71,195

TABLE A-9. Types of floating objects on which sets were made. The 2006 data are preliminary.
TABLA A-9. Tipos de objetos flotantes sobre los que se hicieron lances. Los datos de 2006 son preliminares.

OBJ	Flotsam Naturales		FADs Plantados		Unknown Desconocido		Total
	No.	%	No.	%	No.	%	
1992	1,087	61.7	556	31.5	120	6.8	1,763
1993	1,138	55.2	825	40.0	100	4.8	2,063
1994	773	27.9	1,899	68.6	98	3.5	2,770
1995	729	20.7	2,704	76.8	88	2.5	3,521
1996	537	13.4	3,447	86.0	23	0.6	4,007
1997	832	14.7	4,768	84.3	53	0.9	5,653
1998	752	13.7	4,627	84.4	102	1.9	5,481
1999	833	18.0	3,758	81.4	29	0.6	4,620
2000	488	12.5	3,381	86.3	47	1.2	3,916
2001	567	9.9	5,076	88.4	102	1.8	5,744
2002	756	13.1	4,953	85.7	72	1.2	5,781
2003	713	13.0	4,744	86.3	40	0.7	5,497
2004	590	11.6	4,469	87.9	24	0.5	5,083
2005	593	11.6	4,421	86.3	108	2.1	5,122
2006	740	10.4	6,339	88.8	61	0.8	7,140

TABLE A-10. Reported nominal longline fishing effort (E; 1000 hooks), and catch (C; metric tons) of yellowfin, skipjack, bigeye, Pacific bluefin, and albacore tunas only, by flag, in the EPO.
TABLA A-10. Esfuerzo de pesca palangrero nominal reportado (E; 1000 anzuelos), y captura (C; toneladas métricas) de atunes aleta amarilla, barrilete, patudo, aleta azul del Pacífico, y albacora solamente, por bandera, en el OPO.

LL	CHN		JPN		KOR		PYF		TWN		USA		OTR[1]
	E	C	E	C	E	C	E	C	E	C	E	C	C
1977	0	0	132,875	83,725	10,958	5,628	0	0	11,973	7,789	0	0	0
1978	0	0	140,006	79,320	8,571	7,012	0	0	8,743	6,525	0	0	0
1979	0	0	137,769	67,932	5,021	2,305	0	0	3,138	2,293	0	0	0
1980	0	0	138,141	75,639	11,788	5,907	0	0	3,000	1,611	0	0	0
1981	0	0	131,275	59,226	19,731	6,539	0	0	5,952	2,949	0	0	0
1982	0	0	116,200	61,370	18,612	7,488	0	0	8,117	3,910	0	0	0
1983	0	0	127,176	69,563	14,675	6,479	0	0	4,850	2,311	0	0	49
1984	0	0	119,635	57,261	11,767	4,491	0	0	3,730	1,734	0	0	0
1985	0	0	106,758	74,348	19,785	10,508	0	0	3,126	1,979	0	0	2
1986	0	0	160,553	111,672	30,765	17,432	0	0	4,874	2,569	0	0	68
1987	0	0	188,393	104,053	36,436	19,405	0	0	12,267	5,335	0	0	273
1988	0	0	182,694	82,383	43,056	10,172	0	0	9,567	4,590	0	0	234
1989	0	0	170,373	84,961	43,365	4,879	0	0	16,360	4,962	0	0	9
1990	0	0	178,419	117,923	47,167	17,415	0	0	12,543	4,755	0	0	0
1991	0	0	200,365	112,337	65,024	24,644	0	0	17,969	5,862	43	12	0
1992	0	0	191,284	93,011	45,634	13,104	500	89	33,025	14,142	325	106	0
1993	0	0	159,955	87,977	46,375	12,843	2,605	79	18,064	6,566	417	81	2
1994	0	0	163,976	92,606	44,788	13,250	3,410	574	12,588	4,883	302	25	41
1995	0	0	129,598	69,435	54,979	12,778	3,452	559	2,910	1,639	823	180	7
1996	0	0	103,653	52,298	40,290	14,121	4,219	931	5,830	3,553	507	182	0
1997	0	0	96,383	59,325	30,493	16,663	5,490	1,941	8,720	5,673	462	215	28
1998	0	0	106,569	50,167	51,817	15,089	6,415	2,858	10,586	5,039	1,020	406	24
1999	0	0	80,958	32,886	54,269	13,294	9,190	4,446	23,247	7,865	1,680	469	100
2000	0	0	79,311	45,216	33,585	18,759	10,230	4,382	18,152	7,809	1,076	204	3,758
2001	13,056	5,162	102,219	54,775	72,261	18,201	11,200	5,086	53,224	20,060	1,400	238	14,452
2002	36,756	10,398	103,919	45,401	96,273	14,370	10,700	3,238	77,051	31,773	236	139	8,710
2003	43,289	14,548	101,242	36,104	71,006	15,551	14,048	4,101	74,322	28,328	1,314	262	10,159
2004	15,889	4,034	76,739	30,733	55,861	14,540	17,865	3,030	51,697	19,535	1,040	166	7,458
2005	16,895	3,681	71,679	28,295	16,828	12,284	13,359	2,515	38,345	12,229	2,601	553	3,629

[1] Includes the catches of Belize, Chile, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, and Vanuatu—Incluye las capturas de: Belice, Chile, Ecuador, El Salvador, Guatemala, Honduras, México, Nicaragua, Panamá, y Vanuatu.

TABLE A-11. Numbers and well volumes, in cubic meters, of purse-seine and pole-and line vessels of the EPO tuna fleet, 1976-2006. The data for 2006 are preliminary.
TABLA A-11. Número y volumen de bodega, en metros cúbicos, de buques cerqueros y cañeros de la flota atunera del OPO, 1976-2006. Los datos de 2006 son preliminares.

	PS		**LP**		**Total**	
	No.	**Vol. (m^3)**	**No.**	**Vol. (m^3)**	**No.**	**Vol. (m^3)**
1976	254	187,512	137	8,471	391	195,983
1977	253	189,967	116	6,780	369	196,746
1978	271	192,259	118	6,736	389	198,995
1979	282	195,494	50	4,341	332	199,835
1980	270	196,476	50	4,186	320	200,662
1981	251	196,484	41	3,308	292	199,792
1982	223	178,234	40	3,016	263	181,250
1983	215	149,404	60	3,940	275	153,344
1984	175	121,650	40	3,245	215	124,895
1985	178	137,814	25	2,574	203	140,387
1986	166	131,806	17	2,060	183	133,867
1987	177	152,351	29	2,376	206	154,727
1988	189	156,636	36	3,274	225	159,910
1989	178	141,956	30	3,135	208	145,091
1990	172	143,946	23	2,044	195	145,990
1991	155	124,501	19	1,629	174	126,131
1992	160	117,017	19	1,612	179	118,629
1993	152	118,730	15	1,543	167	120,272
1994	167	122,214	20	1,725	187	123,939
1995	175	124,096	20	1,784	195	125,880
1996	183	132,731	17	1,639	200	134,370
1997	194	146,533	23	2,105	217	148,637
1998	203	161,560	22	2,217	225	163,777
1999	208	180,652	14	1,656	222	182,308
2000	205	180,625	13	1,311	218	181,936
2001	205	189,966	10	1,259	215	191,225
2002	218	200,075	6	925	224	201,000
2003	215	202,674	3	338	218	203,012
2004	217	206,302	3	338	220	206,640
2005	220	213,005	4	498	224	213,503
2006	225	225,397	4	498	229	225,895

TABLE A-12a. Estimates of the numbers and well volume (cubic meters) of purse-seine (PS) and pole-and-line (LP) vessels that fished in the EPO in 2005, by flag and gear. Each vessel is included in the total for each flag under which it fished during the year, but is included only once in the "Grand total"; therefore the grand total may not equal the sums of the individual flags.

TABLA A-12a. Estimaciones del número y volumen de bodega (metros cúbicos) de buques cerqueros (PS) y cañeros (LP) que pescaron en el OPO en 2005, por bandera y arte de pesca. Se incluye cada buque en los totales de cada bandera bajo la cual pescó durante el año, pero solamente una vez en el "Total general"; por consiguiente, los totales generales no equivalen necesariamente a las sumas de las banderas individuales.

Flag Bandera	Gear Arte	Well volume—Volumen de bodega (m^3)					Total	
		<401	401-800	801-1300	1301-1800	>1800	No.	Vol. (m^3)
		Number—Número						
COL	PS	2	1	7	3	-	13	14,439
ECU	PS	36	18	16	4	7	81	55,075
ESP	PS	-	-	-	-	3	3	6,955
GTM	PS	-	-	-	1	-	1	1,475
HND	PS	-	1	2	-	-	3	2,810
MEX	PS	10	12	20	17	-	59	56,163
	LP	4	-	-	-	-	4	498
NIC	PS	-	-	4	2	-	6	8,060
PAN	PS	2	4	9	6	4	25	32,320
SLV	PS	-	1	1	-	2	4	6,324
USA	PS	1	-	1	-	-	2	1,365
VEN	PS	-	-	19	7	-	26	33,839
VUT	PS	-	-	1	1	-	2	2,163
UNK	PS	1	-	-	-	-	1	222
Grand total—Total general	PS	52	37	76	39	16	220	
	LP	4	-	-	-	-	4	
	PS + LP	56	37	76	39	16	224	
		Well volume—Volumen de bodega (m^3)						
Grand total—Total general	PS	13,345	22,271	85,251	58,025	34,113		213,005
	LP	498	-	-	-	-		498
	PS + LP	13,843	22,271	85,251	58,025	34,113		213,503

-: none—ninguno

TABLE A-12b. Estimates of the numbers and well volume (cubic meters) of purse-seine (PS) and pole-and-line (LP) vessels that fished in the EPO in 2006 by flag and gear. Each vessel is included in the total for each flag under which it fished during the year, but is included only once in the "Grand total"; therefore the grand total may not equal the sums of the individual flags.

TABLA A-12b. Estimaciones del número y volumen de bodega (metros cúbicos) de buques cerqueros (PS) y cañeros (LP) que pescaron en el OPO en 2006, por bandera y arte de pesca. Se incluye cada buque en los totales de cada bandera bajo la cual pescó durante el año, pero solamente una vez en el "Total general"; por consiguiente, los totales generales no equivalen necesariamente a las sumas de las banderas individuales.

Flag Bandera	Gear Arte	Well volume—Volumen de bodega (m^3)					Total	
		<401	401-800	801-1300	1301-1800	>1800	No.	Vol. (m^3)
		Number—Número						
BOL	PS	1	-	-	-	-	1	222
COL	PS	2	1	7	3	-	13	14,439
ECU	PS	36	19	17	4	8	84	58,087
ESP	PS	-	-	-	-	3	3	6,955
GTM	PS	-	-	-	1	-	1	1,475
HND	PS	-	1	2	-	-	3	2,729
MEX	PS	8	11	22	16	-	57	55,830
	LP	4	-	-	-	-	4	498
NIC	PS	-	1	4	2	-	7	8,308
PAN	PS	2	4	9	6	5	26	34,624
SLV	PS	-	1	1	-	3	5	8,184
USA	PS	-	-	-	1	-	1	1,593
VEN	PS	-	-	11	9	2	22	30,788
VUT	PS	-	-	1	1	-	2	2,163
Grand total—Total general	PS	49	38	74	43	21	225	
	LP	4	-	-	-	-	4	
	PS + LP	53	38	74	43	21	229	
		Well volume—Volumen de bodega (m^3)						
Grand total—Total general	PS	12,539	22,428	82,451	62,694	45,285		225,397
	LP	498	-	-	-	-		498
	PS + LP	13,037	22,428	82,451	62,694	45,285		225,895

-: none—ninguno

TABLE A-13. Minimum, maximum, and average capacity, in thousands of metric tons, of purse-seine and pole-and-line vessels at sea in the EPO during l996-2005 and in 2006, by month.
TABLA A-13. Capacidad mínima, máxima, y media, en miles de toneladas métricas, de los buques cerqueros y cañeros en el mar en el OPO durante 1996-2005 y en 2006 por mes.

Month Mes	1996-2005			2006
	Min.	Max.	Ave.-Prom.	
1	67.0	144.3	103.9	157.7
2	67.9	150.8	113.5	175.3
3	70.3	149.8	110.8	159.4
4	75.9	143.0	114.9	164.2
5	65.3	147.9	111.0	164.4
6	78.2	162.9	113.9	161.4
7	73.3	155.5	117.1	167.6
8	62.2	140.2	105.3	96.6
9	78.9	137.7	109.2	137.7
10	75.1	172.2	119.3	168.2
11	76.6	145.0	111.2	127.4
12	33.1	116.4	75.0	66.2
Ave.-Prom.	68.7	147.1	108.8	145.5

A. LA PESQUERÍA DE ATUNES Y PECES PICUDOS EN EL OCÉANO PACÍFICO ORIENTAL

En esta sección se presenta un resumen de las pesquerías de las especies amparadas por la Convención de la CIAT (atunes y otras especies capturadas por buques atuneros) en el Océano Pacífico oriental (OPO). Las más importantes de éstas son los escómbridos (familia Scombridae), que incluyen los atunes, bonitos, carites y caballas. Las especies principales de atunes capturadas son el aleta amarilla, barrilete, patudo y albacora, con capturas menores de los atunes aleta azul del Pacífico y barrilete negro y de melvas; se capturan también otros escómbridos, como el bonito y el peto.

El informe abarca también otras especies capturadas por buques atuneros en el OPO: peces picudos (pez espada, marlines y pez vela), carángidos (jureles y salmón), dorado, elasmobranquios (tiburones y rayas) y otros peces.

La mayor parte de las capturas es realizada por las flotas de cerco y palangrera; la flota cañera y varias pesquerías artesanales y deportivas toman un pequeño porcentaje de las capturas totales.

Se dispone de datos detallados de las pesquerías cerquera y cañera; los datos de las pesquerías palangreras, artesanales y deportivas son incompletos.

El Registro Regional de Buques de la CIAT contiene detalles de los buques autorizados para pescar atunes en el OPO. La CIAT cuenta con registros detallados de la mayoría de los buques cerqueros y cañeros que pescan atunes aleta amarilla, barrilete, patudo y/o aleta azul del Pacífico en el OPO. El Registro es incompleto para buques pequeños. Incluye los buques palangreros grandes (eslora total >24 m) de algunas naciones que pescan en el OPO y en otros océanos.

Los datos en el presente informe provienen de varias fuentes, entre ellas los cuadernos de bitácora de los buques, datos de observadores, registros de descargas provistos por empresas enlatadoras y otros procesadores, registros de importaciones y exportaciones, estimaciones derivadas del programa de muestreo de especies y composición por talla, informes de los gobiernos y otras entidades, e informes publicados.

1. CAPTURAS Y DESCARGAS DE ATUNES, PECES PICUDOS, Y ESPECIES ASOCIADAS

Estimar la captura total de una especie de pez es difícil, por varios motivos. Pescado es descartado en el mar, y los datos de algunas artes de pesca son a menudo incompletos. Desde 1993 los observadores han tomado datos sobre pescado descartado en el mar por buques cerqueros de más de 363 toneladas métricas (t) de capacidad de acarreo, lo cual permite una estimación más precisa de las cantidades totales de pescado capturadas por la flota de cerco. Las estimaciones de la cantidad total de la captura que se descarga (en lo sucesivo la “captura retenida”) se basan principalmente en datos de descarga. A partir del Informe de la Situación de la Pesquería 3, que abarca la pesquería en 2004, los datos de descargas de buques cerqueros y cañeros son ajustados con base en las estimaciones de composición por especies para los atunes aleta amarilla, barrilete, y patudo. El programa actual de muestreo de composición por especies, descrito en la Sección 1.3.1, comenzó en 2000, y por lo tanto los datos de captura de 2000-2006 son ajustados con base en las estimaciones obtenidas para cada año, por bandera. Para ajustar los datos de captura de los años previos, se aplicó la proporción media de especies de las estimaciones de 2000-2006, por bandera, y se sumó para todas las banderas. En general, esto ha incrementado las capturas estimadas de patudo, y reducido aquéllas de aleta amarilla y barrilete. Todos estos ajustes son preliminares, y podrían ser mejorados en el futuro. Todos los datos de 2006 de capturas y descargas de la flota cerquera y cañera son provisionales.

Se obtienen los datos de las capturas retenidas de la mayoría de los buques palangreros grandes de los gobiernos de las naciones que pescan atunes en el OPO. Los buques palangreros, particularmente los más grandes, dirigen su esfuerzo principalmente hacia los atunes patudo, aleta amarilla, y albacora, o el pez espada. Los datos de los buques palangreros pequeños, artesanales y otros que pescan atunes, peces picudos, dorado, y tiburones en el OPO fueron obtenidos directamente de los gobiernos, de los cuadernos de bitácora, o de informes publicados por los gobiernos. Los datos del Pacífico occidental y central (WCPO) fueron provistos por el Programa de Pesquerías Oceánicas de la Secretaría de la Comunidad del Pacífico (SPC). Todos los datos de palangre y otras artes de 2005 y 2006 son preliminares.

Los datos de todas estas fuentes fueron compilados en una base de datos por el personal de la CIAT y resumidos en el presente informe. En los últimos años, el personal de la CIAT ha incrementado sus esfuerzos por compilar datos sobre las capturas de atunes, peces picudos, y otras especies capturadas con otras artes, como curricán, arpón, y red de transmalle, y artes deportivas. En la Tabla A-1 se presentan las capturas totales de aleta amarilla, barrilete, y patudo en el Océano Pacífico entero, estimadas de todas las fuentes mencionadas; son tratadas en mayor detalle en las secciones siguientes.

En la Tabla A-2 se presentan estimaciones de las capturas anuales retenidas y descartadas de atunes y otras especies capturadas por buques atuneros en el OPO durante 1976-2006. En las Tablas A-3a-e se presentan las capturas de atunes y bonitos por todas las artes durante 2002-2006, por arte y bandera, y en las Tablas A-4a-b se resumen por bandera las capturas cerqueras y cañeras y las descargas deportivas de atunes y bonitos durante 2004-2006. No se restringió la pesca del atún en el OPO durante 1988-1997, pero las capturas de la mayoría de las especies fueron afectadas por las restricciones de la pesca durante partes, o la totalidad, del segundo semestre del año durante 1998-2006. Además, la reglamentación de aquellos cerqueros que dirigen su esfuerzo hacia atunes asociados con delfines afectó el modo de operación de esos buques, especialmente desde fines de los años 1980 (ver Sección 3).

Las capturas fueron afectadas también por perturbaciones climáticas, tales como los importantes eventos de El Niño que ocurrieron durante 1982-1983 y 1997-1998. Estos redujeron la vulnerabilidad de los peces a la captura con red de cerco debido a la mayor profundidad de la termoclina, pero aparentemente no tuvieron ningún efecto sobre las capturas palangreras. El reclutamiento de aleta amarilla suele ser mayor después de un evento de El Niño. En la Sección J.5, *Ambiente físico*, se comentan en mayor detalle los efectos de los eventos de El Niño y otras condiciones ambientales sobre la pesca en el OPO.

1.1. Capturas por especie

1.1.1. Atún aleta amarilla

En la Tabla A-1 y la Figura B-1 se presentan las capturas anuales de aleta amarilla durante 1977-2006. En general, las capturas han aumentado durante este período en el OPO y en el Pacífico occidental y central. En el OPO, el Niño de 1982-1983 causó una reducción de las capturas en esos años, mientras que las capturas en el resto del Pacífico aparentemente no fueron afectadas. Aunque el alcance del Niño de 1997-1998 fue mayor, no tuvo el mismo efecto sobre las capturas de aleta amarilla en el OPO. La captura de aleta amarilla en el OPO en 2002, 443 mil t, estableció un récord, pero en 2004 y 2005 disminuyó sustancialmente, y la captura en 2006, 175 mil t, fue la más baja desde 1984. En el Pacífico occidental y central alcanzaron 353 mil t en 1990 y un pico de 462 mil t en 1998, y siguieron altas hasta 2003; disminuyeron a 367 mil t en 2004, y en 2005 aumentaron a 426 mil t.

En la Tabla A-2a se presentan las capturas retenidas anuales de aleta amarilla en el OPO por buques cerqueros y cañeros durante 1977-2006. La captura retenida anual media durante 1991-2005 fue 276 mil t (rango: 212 a 413 mil t); la estimación preliminar de la captura retenida en 2006, 167 mil t, fue 38% menos que en 2005, y 39% menos que el promedio de 1991-2005. Los descartes medios de aleta amarilla en el mar durante 1993-2005 se cifraron en un 2% (rango: 1 a 3%) de la captura total cerquera (capturas retenidas más descartes) de la especie (Tabla A-2a).

En la Tabla A-2a se presentan las capturas retenidas anuales de aleta amarilla en el OPO por buques palangreros durante 1977-2006. Durante 1991-2005 fueron relativamente estables, con un promedio de unas 21 mil t (rango: 19 a 31 mil t), o un 7% de las capturas retenidas totales de la especie. El aleta amarilla es capturado también por buques de pesca deportiva, incidentalmente en redes de transmalle, y en pesquerías artesanales. En la columna de Otras artes (OTR) de la Tabla A-2a se presentan estimaciones de estas capturas; durante 1991-2005 fueron en promedio unas 2 mil t.

En la Sección B del presente informe se presenta mayor información sobre el atún aleta amarilla.

1.1.2. Atún barrilete

En la Tabla A-1 y la Figura C-1 se presentan las capturas anuales de barrilete durante 1977-2006. La mayoría de la captura de barrilete en el Pacífico proviene del Pacífico occidental y central. La mayor captura anual registrada en esa región, 1,5 millones de toneladas, ocurrió en 2005, mientras que la captura total récord en el OPO, 322 mil t, ocurrió en 2006.

En la Tabla A-2a se presentan las capturas retenidas anuales de barrilete en el OPO por buques cerqueros y cañeros durante 1977-2006. La captura retenida anual media durante 1991-2005 fue 157 mil t (rango: 64 a 275 mil t). La estimación preliminar de la captura retenida de barrilete en 2006 es de 309 mil t, un 97% más que el promedio de 1991-2005, y un 12% mayor que la captura retenida récord previa de 2003. Los descartes medios anuales de barrilete en el mar durante 1993-2005 se cifraron en un 11% (rango: 7 a 19%) de la captura total de la especie (Tabla A-2a).

Se capturan pequeñas cantidades de barrilete con palangre y otros tipos de arte (Tabla A-2a).

En la Sección C del presente informe se presenta mayor información sobre el atún barrilete.

1.1.3. Atún patudo

En la Tabla A-1 y la Figura D-1 se presentan las capturas anuales de patudo durante 1977-2006. En general, las capturas en el OPO y en el Pacífico occidental y central han aumentado, pero con fluctuaciones considerables. Las capturas en el OPO alcanzaron 105 mil t en 1986, y desde entonces han fluctuado entre unas 74 y 147 mil t, con la mayor captura en 2000. En el Pacífico occidental y central, las capturas de patudo aumentaron a más de 77 mil t a fines de la década de 1970, disminuyeron en los años 1980, y luego aumentaron, con fluctuaciones menores, hasta 1999, cuando llegaron a más de 116 mil t. La captura récord de patudo en esa región, unas 122 mil t, ocurrió en 2002. Las capturas de patudo en el Pacífico occidental y central aumentaron de forma significativa en 2004 y 2005, a 145 y 158 mil t, respectivamente.

Antes de 1994 la captura retenida media anual de patudo por buques cerqueros en el OPO fue alrededor de 8 mil t (rango: 1 a 22 mil t) (Tabla A-2a). Con el desarrollo de dispositivos agregadores de peces (plantados) colocados en el agua por los pescadores para atraer atunes, las capturas retenidas anuales de patudo aumentaron de 35 mil t en 1994 a entre 44 y 94 mil t durante 1995-2000. La estimación preliminar de la captura retenida en el OPO en 2006 es de 71 mil t. Los descartes medios anuales de patudo en el mar durante 1993-2005 se cifraron en un 5% de la captura cerquera de la especie (rango: 2 a 9%). Los buques cañeros capturaron pequeñas cantidades de patudo en algunos años (Tabla A-2a).

Durante el período de 1977-1993, antes del incremento en el uso de plantados y las mayores capturas cerqueras de patudo resultantes, las capturas palangreras de patudo en el OPO variaron de 46 a 104 mil t, con un promedio de 74 mil t, un 88%, en promedio, de las capturas retenidas de esta especie en el EPO. Entre 1994 y 2005 las capturas anuales retenidas de las pesquería palangreras oscilaron entre unas 36 y 74 mil t (promedio: 54 mil t), en promedio un 46% de la captura total de patudo en el OPO (Tabla A-2a). La estimación preliminar de la captura palangrera en el OPO en 2006 es de 30 mil t (Tabla A-2a).

Se capturan pequeñas cantidades de patudo con otros tipos de arte (Tabla A-2a).

En la Sección D del presente informe se presenta mayor información sobre el atún patudo.

1.1.4. Atún aleta azul

En la Tabla A-5 y la Figura E-1 se presentan las capturas de aleta azul del Pacífico en el Océano Pacífico entero, por bandera y arte. Los datos, obtenidos del Comité Científico Internacional sobre los Atunes y Especies Afines en el Océano Pacífico Norte (ISC) y son desglosados por nación o entidad pesquera, sin tener en cuenta la región del Pacífico donde fue capturado el pescado.

En la Tabla A-2a se presentan las capturas de atún aleta azul del Pacífico en el OPO durante 1977-2006, por arte de pesca. Durante 1991-2005 la captura anual retenida de la especie en el OPO por buques cerqueros y cañeros fue en promedio 3 mil t (rango: 400 t a 9 mil t). La estimación preliminar de la captura retenida de aleta azul en 2006, 10 mil t, es 7 mil t mayor que el promedio de 1991-2005. Pequeñas cantidades de aleta azul son descartadas en el mar por buques cerqueros (Tabla A-2a).

En la Sección E del presente informe se presenta información sobre el atún aleta azul del Pacífico.

1.1.5. Atún albacora

En la Tabla A-6 y en las Figuras F-1a-b se presentan las capturas de albacora en el Océano Pacífico entero, por arte y zona (al norte y al sur de la línea ecuatorial). En la Tabla A-2a se presentan las capturas de albacora en el OPO, por arte de pesca. Una porción importante de la captura de la especie es tomada con curricán, incluido en otras artes (OTR) en la Tabla A-2a. Los datos de capturas fuero obtenidos de datos de la CIAT en el caso del OPO, y de datos compilados por la SPC en el caso del Pacífico occidental y central.

En la Sección F del presente informe se presenta información sobre el atún albacora.

1.1.6. Otros atunes y especies afines

Los atunes aleta amarilla, barrilete, y patudo forman el componente más importante de las capturas retenidas de la flota cerquera y cañera en el OPO, pero otros atunes y especies afines, como el barrilete negro, bonito, peto, y las melvas, contribuyen a la captura general de la región. En la Tabla A-2a se presentan estimaciones de las capturas anuales retenidas y descartadas de estas especies durante 1977-2006. Las capturas incluidas en la categoría de atunes no identificados (TUN) en la Tabla A-2a contienen algunas capturas reportadas por especie (melvas o petos) junto con los atunes no identificados. La captura retenida total de estas otras especies en estas pesquerías fue de unas 6 mil toneladas en 2006, más que el promedio de 1991-2005 de unas 2 mil t (rango: 500 t a 9 mil t).

El barrilete negro es también capturado con otras artes en el OPO, principalmente en la pesca artesanal costera. El bonito es asimismo capturado en las pesquerías artesanales, y ha sido reportado como captura por buques palangreros en algunos años.

1.1.7. Peces picudos

En la Tabla A-2b y las Figuras G-1, H-1 e I-1 se presentan datos de captura de los peces picudos (pez espada, marlín azul, negro, rayado y trompa corta, y pez vela).

El pez espada es capturado en el OPO con palangres a gran escala y artesanales, red de transmalle, arpón y, de vez en cuando, por buques deportivos. La captura palangrera anual media de pez espada durante 1991-2005 fue 13 mil t, pero durante 2001-2005 unas 17 mil t. No queda claro si esto se debe a una mayor abundancia de la especie o a un aumento del esfuerzo dirigido hacia la misma.

Los demás peces picudos son capturados con palangres a gran escala y artesanales y por artes deportivas. Las capturas palangreras anuales medias de marlín azul y marlín rayado durante 1991-2005 fueron unas 5 mil y 3 mil t, respectivamente. Se capturan cantidades menores de otros peces picudos con palangre.

Desgraciadamente, se cuenta con muy poca información sobre las capturas deportivas de peces picudos, pero se cree que son sustancialmente menores que las capturas comerciales de todas estas especies.

Se capturan pequeñas cantidades de peces picudos con red de cerco, pero se consideran éstas descartadas, aunque es posible que parte de esta captura sea descargada sin ser reportada. Se incluyen estos datos en la Tabla A-2b.

En las Secciones G-I del presente informe se presenta información sobre las poblaciones del pez espada, marlín azul, y marlín rayado.

1.1.8. Otras especies

En la Tabla A-2c se presentan datos de las capturas y descartes de carángidos (jureles y salmón), dorado, elasmobranquios (tiburones y rayas) y otros peces capturados en el OPO.

Las capturas de dorado son descargadas principalmente en puertos de América Central y del Sur. Aunque en algunos años se capturas más que 10 mil t de la especie, rara vez se informa del tipo de arte.

1.2. Distribución de las capturas de atunes

1.2.1. Capturas cerqueras

En las Figuras A-1a, A-2a, y A-3a ilustran las distribuciones anuales medias de las capturas cerqueras de aleta amarilla, barrilete y patudo, por tipo de lance, en el OPO durante 1996-2005, y en las Figuras A-1b, A-2b, y A-3b estimaciones preliminares para 2006. Las capturas de aleta amarilla fueron bajas en las zonas del norte frente a México y Centroamérica en 2006, al igual que en 2004 y 2005. Las capturas de aleta amarilla frente a Sudamérica fueron asimismo más bajas que el promedio de 1996-2005. Las capturas de barrilete en 2006 fueron significativamente mayores que el promedio de 1996-2005. Se hicieron capturas significativas de barrilete durante todo el año entre 5°N y 15°S. Al igual que en 2004 y 2005, las capturas de barrilete en las zonas costeras de México fueron mayores, debido posiblemente a cambios en la estrategia de pesca motivados por una pesca pobre de aleta amarilla. No se captura a menudo patudo al norte de aproximadamente 7°N. Las capturas de la especie han disminuido en las zonas costeras de América del Sur desde hace varios años. Con el desarrollo de la pesquería sobre plantados, arriba descrita, la importancia relativa de las zonas costeras ha disminuido, mientras que la de las zonas de altura ha aumentado. La mayoría de las capturas de patudo provienen de lances sobre plantados entre 5°N y 5°S.

1.2.2. Capturas palangreras

Las bases de datos de la CIAT contienen datos sobre las distribuciones espacial y temporal de las capturas en el OPO de las flotas palangreras de aguas lejanas de China, la República de Corea, España, Estados Unidos, Japón, Polinesia Francesa, Taipei Chino, y Vanuatu. Los atunes patudo y aleta amarilla forman la mayor parte de las capturas de la mayoría de estos buques. En la Figura A-4 se ilustra la distribución de las capturas de atunes de estas dos especies por buques palangreros japoneses en el Océano Pacífico durante 2000-2004. Se presentan datos de la pesquería palangrera japonesa en el OPO durante 1956-1997 en los Boletines de la CIAT que describen esa pesquería.

1.3. Composición por tamaño de las capturas de atunes

1.3.1. Capturas de las pesquerías cerquera, cañera y deportiva

Las muestras de frecuencia de talla son la fuente básica de los datos usados para estimar la composición por talla y edad de las distintas especies de peces en las descargas. Esta información es necesaria para obtener estimaciones de la composición de las poblaciones por edad, usadas para varios propósitos, entre ellos el modelado integrado que el personal ha usado en los últimos años. Los resultados de estudios de este tipo han sido descritos en diversos Boletines de la CIAT, en sus Informes Anuales de 1954 a 2002, y en sus Informes de Evaluación de Poblaciones.

Las muestras de frecuencia de talla de aleta amarilla, barrilete, patudo, aleta azul del Pacífico y, ocasionalmente, barrilete negro de las capturas de buques cerqueros, cañeros, y deportivos en el OPO son tomadas por el personal de la CIAT en puertos de descarga en Ecuador, Estados Unidos, México, Panamá, y Venezuela. El muestreo de las capturas de aleta amarilla y barrilete fue iniciado en 1954, el de aleta azul en 1973, y el de patudo en 1975, y continúa actualmente.

En el Informe Anual de la CIAT de 2000 y los Informes de Evaluación de Stocks 2 y 4 se describen los métodos de muestreo de las capturas de atún. En breve, se selecciona para el muestreo pescado en las bodegas de buques cerqueros y cañeros solamente si todo el pescado en la bodega fue capturado durante un solo mes, en un solo tipo de lance (delfín, objeto flotante, o no asociado), y en la misma zona de muestreo. Se clasifican estos datos por pesquería (Figura A-5), con base en las evaluaciones más recientes de las poblaciones realizadas por el personal.

En este informe se presentan datos de peces capturados durante 2001-2006. Para cada especie, excepto el aleta azul y el barrilete negro, se presentan dos histogramas de frecuencia de talla: el primero presenta los datos por estrato (arte de pesca, tipo de lance, y zona) para 2006, y el segundo ilustra los datos combinados para cada año del período de 2001-2006. En el caso del aleta azul, se ilustran las capturas comerciales y deportivas de 2001-2006 combinadas. En el caso del barrilete negro, los histogramas ilustran as capturas por artes comerciales durante 2001-2006. Hubo muy poca captura por buques cañeros en 2006, y no se obtuvo ninguna muestra de los mismos.

Para la evaluación de las poblaciones de aleta amarilla se definen nueve pesquerías de cerco (cuatro asociadas con objetos flotantes, tres asociadas con delfines, dos de atunes no asociados) y una de caña (Figura A-5). La última abarca todas las 13 zonas de muestreo. De las 1.053 bodegas muestreadas, 739 contenían aleta amarilla. En la Figura A-6a se ilustran las composiciones por talla estimadas del pescado capturado durante 2006. La mayoría de la captura de aleta amarilla provino de lances asociados con delfines y no asociados. La mayor parte de los peces de mayor tamaño (>100 cm) fue capturada durante los trimestres tercero y cuarto en las pesquerías sobre delfines del Norte y Costera, y durante el primer trimestre en la pesquería sobre delfines del Sur. Fueron capturados peces más grandes en la pesquería no asociada del Sur también, principalmente en el cuarto trimestre. Una pequeña cantidad de aleta amarilla grande fue capturada en la pesquería sobre objetos flotantes del Sur durante el tercer trimestre. Fue evidente una moda de aleta amarilla más pequeño (50 cm) en todas las pesquerías sobre objetos flotantes durante todo el año y en la pesquería no asociada en el Sur durante el primer semestre. Fueron capturadas pequeñas cantidades de aleta amarilla en las pesquerías sobre objetos flotantes durante todo el año. Las capturas de los buques cañeros fueron insignificantes.

En la Figura A-6b se ilustra la composición por talla estimada del aleta amarilla capturado por todas las pesquerías combinadas durante 2001-2006. El peso medio del aleta amarilla capturado en 2006 fue considerablemente menor que aquéllos de los cinco años previos.

Para la evaluación de las poblaciones de barrilete se definen siete pesquerías de cerco (cuatro asociadas con objetos flotantes, dos de atunes no asociados, una asociada con delfines) y una de caña (Figura A-5). Las dos últimas abarcan todas las 13 zonas de muestreo. De las 1.053 bodegas muestreadas, 877 contenían barrilete. En la Figura A-7a se ilustran las composiciones por talla estimadas del pescado capturado durante 2006. Fueron capturadas grandes cantidades de barrilete de entre 40 y 50 cm de talla en todas las pesquerías sobre objetos flotantes y en la pesquería no asociada del Sur durante los tres primeros trimestres de 2006. Barrilete de mayor tamaño, entre 60 y 70 cm, fue capturado principalmente durante los trimestres tercero y cuarto en las pesquerías sobre objetos flotantes del Norte y Ecuatorial y en la pesquería no asociada del Sur. Fueron capturadas cantidades menores de barrilete más grande en la pesquería sobre objetos flotantes durante los trimestres primero y segundo y en la pesquería sobre delfines durante todo el año. Los buques cañeros capturaron cantidades insignificantes de barrilete.

En la Figura A-7b se ilustra la composición por talla estimada del barrilete capturado por todas las pesquerías combinadas durante 2001-2006. El peso medio del barrilete es considerablemente menor que aquéllos de los cinco años previos.

Para la evaluación de las poblaciones de patudo se definen seis pesquerías de cerco (cuatro asociadas con objetos flotantes, una de atunes no asociados, una asociada con delfines) y una de caña (Figura A-5). Las tres últimas abarcan todas las 13 zonas de muestreo. De las 1.053 bodegas muestreadas, 338 contenían patudo. En la Figura A-8a se ilustran las composiciones por talla estimadas del pescado capturado durante 2006. En 2000 la mayor parte de la captura provino de lances sobre objetos flotantes en la zona Ecuatorial, pero desde 2001 hasta 2003 provino de lances sobre objetos flotantes en la zona Sur. En 2006, al igual que en 2004 y 2005, las pesquerías sobre objetos flotantes en las zonas Norte, Ecuatorial, y Sur capturaron cantidades casi iguales de patudo. Se capturaron pequeñas cantidades de patudo en lances no asociados, en lances sobre objetos flotantes en la zona Costera, y en lances sobre atunes asociados con delfines. No se registró captura de patudo por barcos cañeros.

En la Figura A-8b se ilustra la composición por talla estimada del patudo capturado por todas las pesquerías combinadas durante 2001-2006. El peso medio del pescado fue máximo en 2000, cuando se logró la mayor captura de patudo jamás registrada. Desde 2002 hasta 2005 el peso promedio del patudo fue bastante constante, pero en 2006 fue considerablemente menor. Los patudos pequeños (40-60 cm) fueron capturados principalmente en lances sobre objetos flotantes durante el año entero, mientras que la mayoría de los peces más grandes (>80 cm) fue capturada durante los trimestres primero, segundo, y cuarto en lances sobre objetos flotantes en la zona Ecuatorial, y en la zona Sur durante la mayor parte del año.

El aleta azul del Pacífico es capturado con red de cerco y con artes deportivas frente a California y Baja California, entre 23°N y 35°N, aproximadamente, principalmente entre mayo y octubre. Durante 2006 fue capturado entre 26°N y 31°N desde marzo hasta agosto. La mayor parte de las capturas comerciales y deportivas fue lograda en junio, julio y agosto. Previamente se reportaban las tallas del pescado en las capturas comercial y deportiva por separado, pero en 2004, 2005 y 2006 el pequeño tamaño de las muestras imposibilita la estimación de la composición por talla por separado. Se combinaron por tanto las tallas del pescado en las capturas comercial y deportiva de aleta azul para cada año del período de 2000-2006. En la Figura A-9 se presentan las composiciones por talla estimadas.

El barrilete negro es capturado incidentalmente por pescadores que dirigen su esfuerzo hacia los atunes aleta amarilla, barrilete, y patudo. La demanda de la especie es baja, y la mayoría de la captura es desechada en el mar, pero a veces se retienen pequeñas cantidades, mezcladas con las especies más deseadas. En 2006 se tomaron 14 muestras de barrilete negro; en la Figura A-10 se ilustra la composición estimada por talla de la especie.

1.3.2. Capturas palangreras

En las Figuras A-11 y A-12 se ilustra la composición estimada por talla de las capturas de aleta amarilla y patudo por la pesquería palangrera japonesa en el OPO durante 2000-2004. El peso promedio de ambas especies en dicha pesquería ha sido la misma durante toda su historia. En los Boletines de la CIAT que describen esta pesquería se presenta información sobre la composición por talla del pescado capturado en el OPO durante 1958-1997.

1.4. Capturas de atunes y bonitos, por bandera y arte

En las Tablas A-3a-e se detallan las capturas retenidas anuales de atunes y bonitos en el OPO durante 2002-2006, clasificadas por bandera y arte. Las tablas incluyen todas las capturas conocidas de atunes, compiladas de registros obtenidos de gobiernos, compañías procesadoras de pescado, cuadernos de bitácora, y registros de importaciones y exportaciones. En el sitio web de la CIAT se presenta información similar de años anteriores a 2001 sobre los atunes y bonitos, y datos históricos de atunes, peces picudos, tiburones, carángidos, dorado, y peces misceláneos. En las Tablas A-4a-b (recuadro superior) se resumen las capturas cerqueras, cañeras, y deportivas de atunes y bonitos en 2005 y 2006, por bandera.

1.5. Descargas de atunes y bonitos por buques de cerco y caña

Las descargas representan pescado descargado de buques pesqueros en el año correspondiente, sin tener en cuenta el año de captura. El país de descarga es aquél en el cual el pescado fue descargado o, en el caso de transbordos, el que recibió el pescado transbordado. Los datos de descarga preliminares de 2005 y 2006 (Tablas A-4a-b, recuadro inferior) señalan que, de las 569 mil t de atunes y bonitos descargadas en 2006, el 59% fue descargado en Ecuador y el 18% en México. Otros países con descargas importantes de atunes y bonitos capturados en el OPO incluyeron Colombia y Venezuela (5% cada uno). Es importante notar que cuando se disponga de información final, las descargas asignadas ahora a varios países podrían cambiar debido a la exportación de pescado almacenado a procesadoras en otros países.

1.6. Capturas cerqueras por metro cúbico de volumen de bodega

En la Tabla A-7 se presenta la captura retenida total en el OPO, por metro cúbico de volumen de bodega (C/m^3) de los buques cerqueros que pescan atunes en el OPO, por clase de arqueo y especie, durante 2001-2006. Para proveer mayor detalle en este índice, se clasifica la flota en ocho clases de arqueo. La C/m^3 de los buques mayores consiste principalmente de aleta amarilla, barrilete, y patudo, mientras que las otras especies de atunes, como el barrilete negro, forman una parte importante de la C/m^3 de los buques más pequeños en muchos años.

2. ESFUERZO

2.1. Pesca de cerco

En la Tabla A-8 se presentan estimaciones del número de lances cerqueros de cada tipo (asociados con delfines, asociados con objetos flotantes (naturales y plantados), y no asociados) en el OPO durante 1989-2006 y de las capturas retenidas de esos lances (Figura 1). Se calcularon las estimaciones para los buques de ≤l363 t de capacidad de acarreo con datos de bitácora en la base de datos estadística de la CIAT, y aquéllos para los buques de >363 t de capacidad de acarreo a partir de las bases de datos de observadores de la CIAT y de los programas de observadores de la CIAT, Colombia, Ecuador, Estados Unidos, México, Nicaragua, Panamá, la Unión Europea y Venezuela. El número de lances sobre atunes asociados con objetos flotantes y no asociados fue máximo entre mediados de los años 1970 y principios de los 1980. A pesar de la oposición a la pesca de atunes asociados con delfines, y de la decisión de las enlatadoras de EE.UU. de no comprar atún capturado en viajes en los cuales se realizaron lances sobre delfines, el número de lances sobre delfines disminuyó tan sólo moderadamente a mediados de los años 1990, y en 2003 fue el mayor jamás registrado.

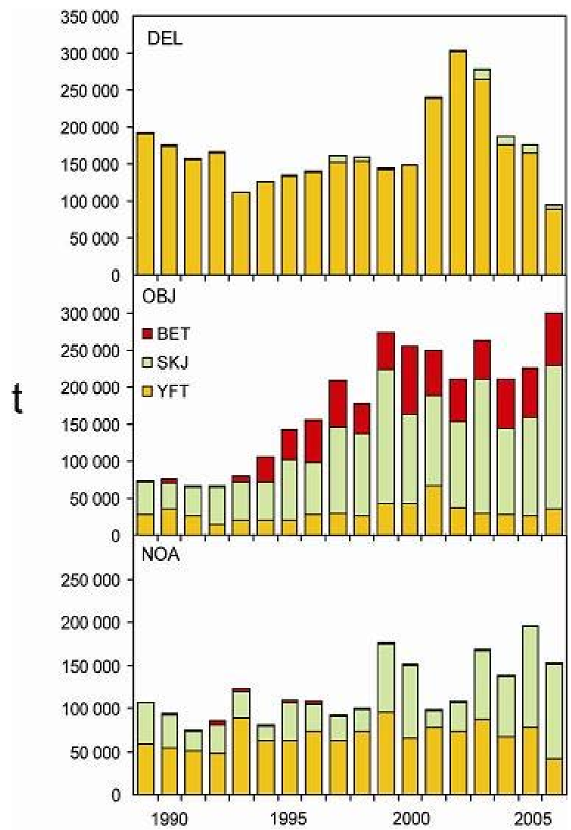

FIGURA 1. Capturas cerqueras de atunes, por especie y tipo de lance, 1989-2006.

Hay dos tipos de objetos flotantes, los “naturales” (que también incluyen desperdicios y otros objetos artificiales), que se encuentran en el mar por casualidad, del punto de vista de los pescadores, y los que son construidos por pescadores con el propósito específico de atraer peces. Se conocen estos últimos como dispositivos agregadores de peces (DAP), plantados, o FAD (del inglés *fish-aggregating device*). Hace unos doce años que se usan extensamente los plantados, y su importancia relativa ha aumentado en ese período, mientras que la de los objetos "naturales" ha disminuido, tal como indican los datos en la Tabla A-9.

2.2. Pesca palangrera

En la Tabla A-10 se presentan el esfuerzo nominal de los buques palangreros en el OPO, en miles de anzuelos, y sus capturas reportadas de las especies principales de atunes.

3. LAS FLOTAS

3.1. Las flotas de cerco y de caña

El personal de la CIAT mantiene registros detallados del arte de pesca, bandera, y capacidad de acarreo de la mayoría de los buques que pescan atunes aleta amarilla, barrilete, patudo, y/o aleta azul del Pacífico con red de cerco o caña en el OPO. La flota aquí descrita incluye buques cerqueros y cañeros que pescaron alguna de estas cuatro especies en el OPO durante el año entero o parte del mismo.

Históricamente, se usaron las estimaciones de la capacidad de acarreo de buques individuales provistas por el armador o astillero, en toneladas de pescado, hasta que los registros de descarga indicasen que era preciso modificarlas.

Desde 2000, el personal de la CIAT usa el volumen de bodegas, en metros cúbicos (m^3), en lugar de peso, en toneladas (t), para medir la capacidad de acarreo de los buques. Ya que la densidad de carga de pescado en una bodega puede variar, medir la capacidad de acarreo en peso es subjetivo, ya que un cargamento de pescado metido en una bodega a densidad alta pesa más que uno cargado a densidad menor. El uso de volumen como medida de capacidad elimina este problema.

El personal de la CIAT comenzó a reunir datos sobre la capacidad en volumen en 1999, pero todavía no ha obtenido esta información para todos los buques. En el caso de buques para los cuales no se dispone de información fidedigna sobre el volumen de bodega, se convirtió la capacidad estimada en toneladas en metros cúbicos.

Hasta aproximadamente 1960 predominaron en la pesca atunera en el OPO los buques cañeros, que faenaban en zonas costeras y cerca de islas y bancos de alta mar. Hacia fines de los años 1950 y a principios de los 1960, la mayoría de los buques cañeros grandes fue convertida a arte de cerco, y para 1961 este arte predominaba en la pesquería del OPO. Entre 1961 y 2006 el número de buques cañeros se redujo de 93 a 4, y su volumen total disminuyó de unos 11.000 m^3 a unos 500 m^3. Durante el mismo período el número de cerqueros aumentó de 125 a 225, y su volumen total de bodega de unos 32.000 m^3 a 225.000 m^3, un promedio de unos 1.000 m^3 por buque. Previamente ocurrió un pico en el número y volumen total de bodega de la flota cerquera entre mediados de los años 1970 y principios de los 1980, cuando llegó a haber 282 buques, y el volumen total de bodega alcanzó unos 195.000 m^3, un promedio de unos 691 m^3 por buque (Tabla A-11 y Figura 2).

Las tasas de captura en el OPO fueron bajas durante 1978-1981, debido a la concentración del esfuerzo de pesca sobre peces pequeños, y la situación se vio agravada por un evento importante de El Niño que comenzó a mediados de 1982 y persistió hasta fines de 1983, y que causó

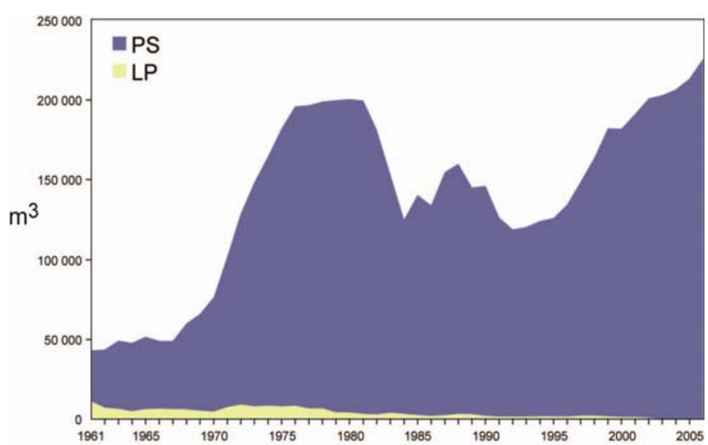

FIGURA 2. Capacidad de acarreo, en metros cúbicos de volumen de bodega, de las flotas cerquera y cañera en el OPO, 1961-2006.

que los peces fueran menos vulnerables a la captura. Luego disminuyó el volumen total de bodegas de los buques de cerco y caña, debido al retiro de buques o a su traslado a otras zonas de pesca, principalmente el Pacífico occidental, y en 1984 alcanzó el nivel más bajo desde 1971, unos 125.000 m^3. A principios de 1990 la industria enlatadora de Estados Unidos decidió no comprar más atún capturado en viajes en los que se pescaran atunes asociados con delfines. Esto llevó a que muchas embarcaciones de Estados Unidos abandonasen el OPO, y a una disminución consecuente en la flota a 119.000 m^3 en 1992. Con la mayor participación de buques de otras naciones en la pesquería, el volumen total de bodega ha aumentado progresivamente desde 1992, y en 2006 fue de unas 226.000 m^3.

En las Tablas A-12a-b se presentan los datos finales de 2005 y preliminares de 2006 del número y volumen total de bodega de los buques cerqueros y cañeros que pescaron atunes en el OPO. En 2006 predominaron las flotas de Ecuador y México, con el 26% y 25% del volumen total de bodega, respectivamente, seguidos por Panamá (15%), Venezuela (14%), Colombia (6%), Nicaragua y El Salvador (4% cada uno), y España (3%).

En la Figura 3 se compara la capacidad acumulativa en el mar durante 2006 con los cuatro años anteriores.

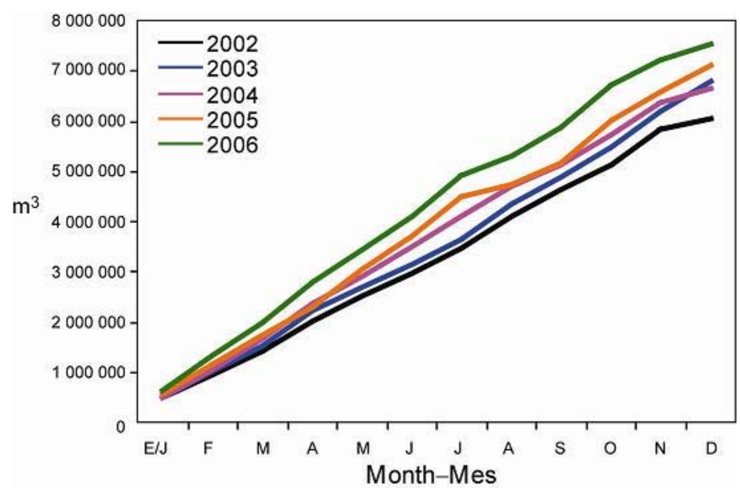

FIGURA 3. Capacidad acumulativa de la flota cerquera y cañera en el mar, por mes, 2002-2006.

En la Tabla A-13 se presentan los valores mensuales medios, mínimos, y máximos del volumen total de bodega en el mar (VEM), en miles de m^3, de los buques cerqueros y cañeros que pescaron atunes en el OPO durante 1996-2005, junto con los valores de 2006. Los valores mensuales son los promedios de las estimaciones de la VEM calculadas semanalmente por el personal de la CIAT. La pesca fue reglamentada en algunos de los últimos cuatro meses del año durante 1998-2006, por lo que los valores de la VEM para septiembre-diciembre de 2006 no son comparables con los valores medios del período correspondiente durante 1996-2005. Durante 1996-2005 y 2006 el valor medio del VEM fue 109 mil m^3 (60% de la capacidad total) y 146 mil m^3 (64% de la capacidad total), respectivamente.

3.2. Otras flotas del OPO

El registro regional de buques de la ciat, disponible en el sitio web de la Comisión, contiene información sobre otros tipos de buques que pescan atunes en el opo. El registro es incompleto para buques pequeños. En algunos casos, particularmente con respecto a los buques palangreros grandes, el registro regional contiene información de buques que están autorizados para pescar no sólo en el opo, sino también en otros océanos, y que posiblemente no hayan pescado en el opo en 2006, o jamás.

B. YELLOWFIN TUNA

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 stock assessment details are available on the IATTC web site, www.iattc.org.

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 to the east and to the west. The purse-seine catches of yellowfin tuna are lower close to the western boundary (150ºW) of the EPO (Figure A-1). 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 the 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 a substantial amount of information. This includes data on retained catch, discards, fishing effort, and the size compositions of the catches from several different fisheries. Assumptions have been made about processes such as growth, recruitment, movement, natural mortality, fishing mortality, and stock structure. Several inputs into the latest assessment differ from those used for 2005 (IATTC Fishery Status Report 4). Recent catch and effort data have been incorporated, and earlier data have been updated. The catches are shown in Figure B-1.

Significant levels of fishing mortality have been observed in the yellowfin tuna fishery in the EPO (Figure B-2). These levels are greatest for middle-aged yellowfin. Both recruitment (Figure B-3) and exploitation have had substantial impacts on the yellowfin biomass trajectory (Figure B-4). Most of the yellowfin catch is taken in sets associated with dolphins, and, accordingly, this fishery has the greatest impact on the yellowfin population (Figure B-4), although it has almost the least impact per weight captured of all fisheries. It appears that the yellowfin population has experienced two, or possibly three, different recruitment regimes (1975-1982, 1983-2001, and possibly 2002-2006) corresponding to low, high, and intermediate recruitments. The recruitment regimes correspond to regimes in biomass, with higher-recruitment regimes producing 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 yield (AMSY) during the lower productivity regime of 1975-1982 (which corresponds to SBR levels in 1977-1984), but above that level during the following years, except for the most recent period (2004-2007, Figure B-5). The 1984 increase in the SBR is attributed to the regime change, and the recent decrease may be a reversion to an intermediate recruitment regime. The two different productivity regimes may support two different AMSY levels and associated SBR levels.

The current SBR is estimated to be below the SBR level at AMSY (Figure B-5). However, there is substantial uncertainty in the most recent estimate of SBR, so there is a moderate probability that the current SBR is above the level that would support the AMSY. The effort levels are estimated to be above those capable of supporting the AMSY (Table B-1 based on the recent (2004-2006) distribution of effort among the different fisheries). However, there is substantial uncertainty in these estimates, so there is a moderate probability that the effort levels are less than those capable of supporting the AMSY (Figure B-8). Future projections under the current effort levels and average recruitment indicate that the population will remain at approximately the same level over the next five years (Figure B-6). These simulations were carried out using the average recruitment for the 1975-2006 period. Both the purse-seine and longline catches of 2007 are expected to be greater than those of 2006 (Figure B-6).

AMSY has been stable during the assessment period (Figure B-7), which suggests that the overall pattern of selectivity has not varied a great deal through time.

The analysis indicates that strong cohorts entered the fishery in 1998-2000, and that these cohorts increased the size of the spawning stock during 1999-2001. However, these have been followed by weaker recruitments, so the size of the spawning stock decreased during 2002-2006. The biomass in 2005-2007 was at levels similar to those prior to 1985.

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, or would be diminished if fishing effort were diverted to catching smaller fish. Any such changes would also affect the SBR levels in a similar way.

It is predicted that, with the 2006 level of fishing effort, the conservation measures imposed in 2004 under Resolution C-04-09 would maintain the stock at about the AMSY level, slightly higher than would otherwise have been the case.

The catches during 2006 and the first quarter of 2007 have been markedly less than those of the same period of 2004 and 2005. The most likely cause of the lesser catches is a decline in recruitment.

A sensitivity analysis was carried out to estimate the effect of a stock-recruitment relationship and alternative average maximum lengths of yellowfin. 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 a regime shift, since spawning biomass is low during the period of low recruitment and high during that of high recruitment. The results from the analysis with a stock-recruitment relationship are more pessimistic, suggesting that the effort level is greater than that corresponding to the AMSY (Table B-1). The spawning stock is estimated to have been less than the biomass that would permit the AMSY for most of the modeling period, except during 2000-2002.

Summary

1. The results are similar to those of the previous assessments, except that the current SBR is less than that corresponding to the AMSY.
2. There is uncertainty about recent and future recruitment and biomass levels.
3. The recent fishing mortality rates are about equal to those required to produce AMSY.
4. Increasing the average weight of the yellowfin caught could increase AMSY.
5. There have been two, and possibly three, different recruitment regimes, and the levels of AMSY and the biomasses corresponding to the AMSY may differ between the regimes. The population may have recently switched from the high to an intermediate recruitment regime.
6. The results are more pessimistic if a stock-recruitment relationship is assumed.

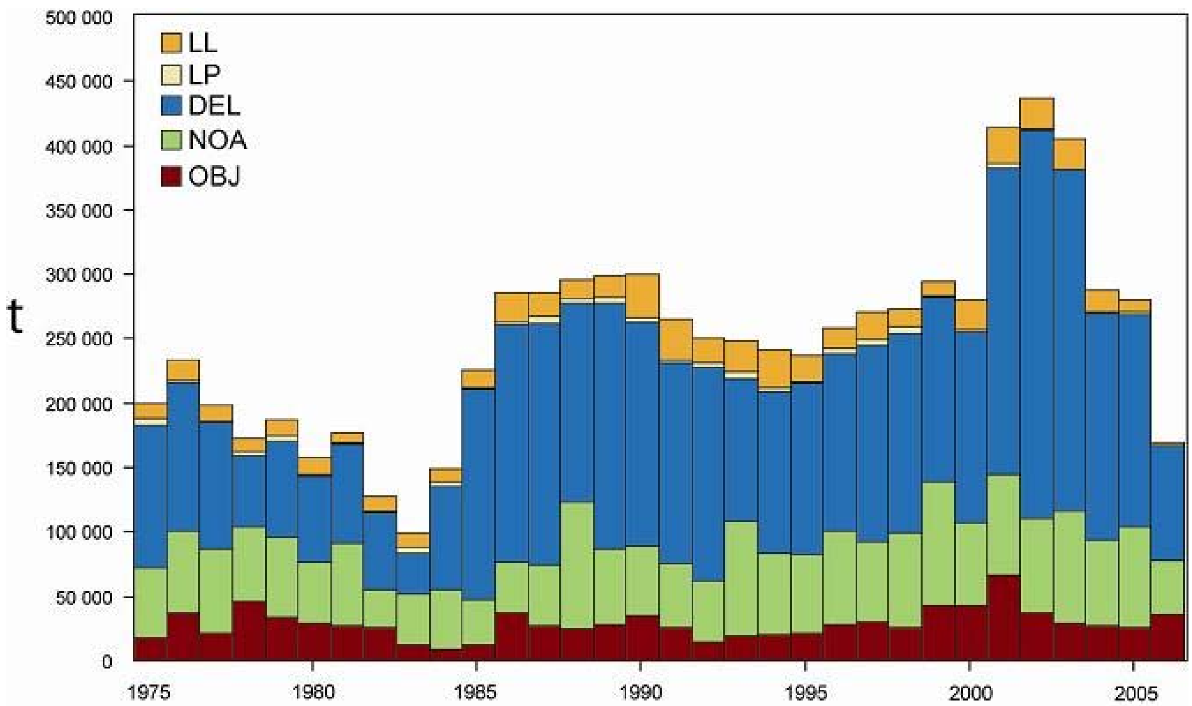

FIGURE B-1. Total catches (retained catches plus discards) for the purse-seine fisheries, and retained catches for the pole-and-line and longline fisheries, of yellowfin tuna in the eastern Pacific Ocean, 1975-2006. The purse-seine catches are adjusted to the species composition estimate obtained from sampling the catches. The 2006 catch data are provisional.

FIGURA B-1. Capturas totales (capturas retenidas más descartes) de las pesquerías de cerco, y capturas retenidas de las pesquerías cañera y palangreras, de atún aleta amarilla en el Océano Pacífico oriental, 1975-2006. Las capturas cerqueras están ajustadas a la estimación de la composición por especie obtenida del muestreo de las capturas. Los datos de captura de 2006 son provisionales.

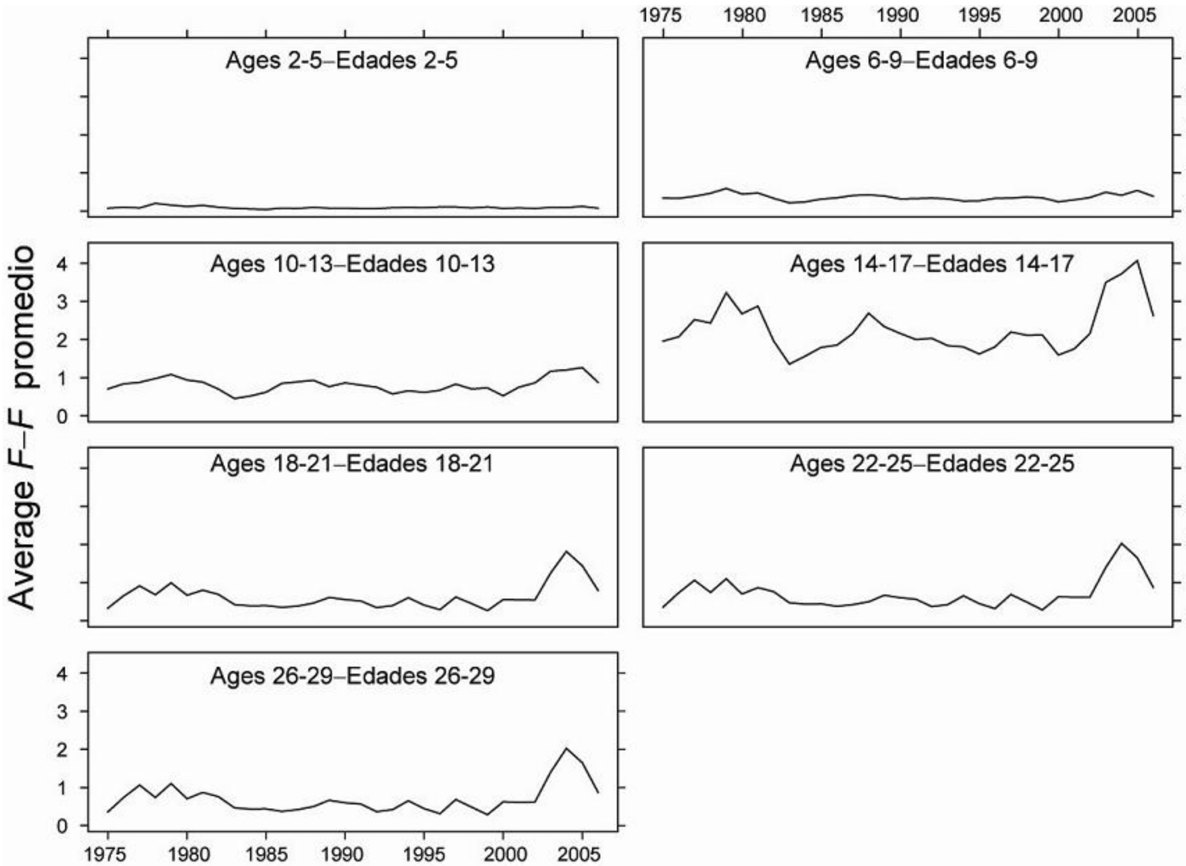

FIGURE B-2. Average total annual fishing mortality of yellowfin tuna that have been recruited to the fisheries of the EPO. Each panel illustrates an average of four annual fishing mortality vectors that affected the fish of the age range indicated in the title of each panel. For example, the trend illustrated in the upper left panel is an average of the fishing mortalities that affected fish that were 2-5 quarters old.

FIGURA B-2. Mortalidad por pesca anual total media de atún aleta amarilla reclutado a las pesquerías del OPO. Cada recuadro ilustra un promedio de cuatro vectores anuales 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.

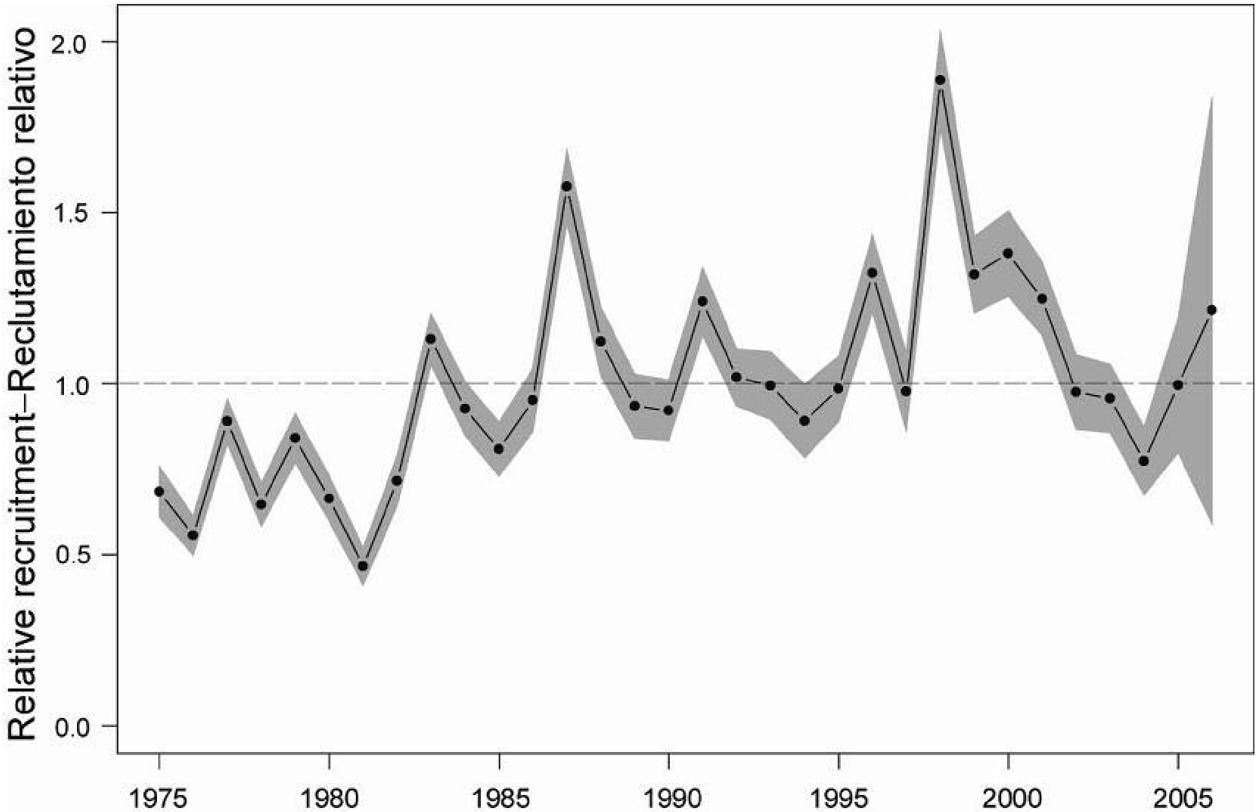

FIGURE B-3. Estimated recruitment of yellowfin tuna to the fisheries of the EPO. The estimates are scaled so that the average recruitment is equal to 1.0. The bold line illustrates the maximum likelihood estimates of recruitment, and the shaded area indicates the approximate 95% confidence intervals around those estimates.

FIGURA B-3. 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 indica los intervalos de confianza de 95% aproximados de esas estimaciones.

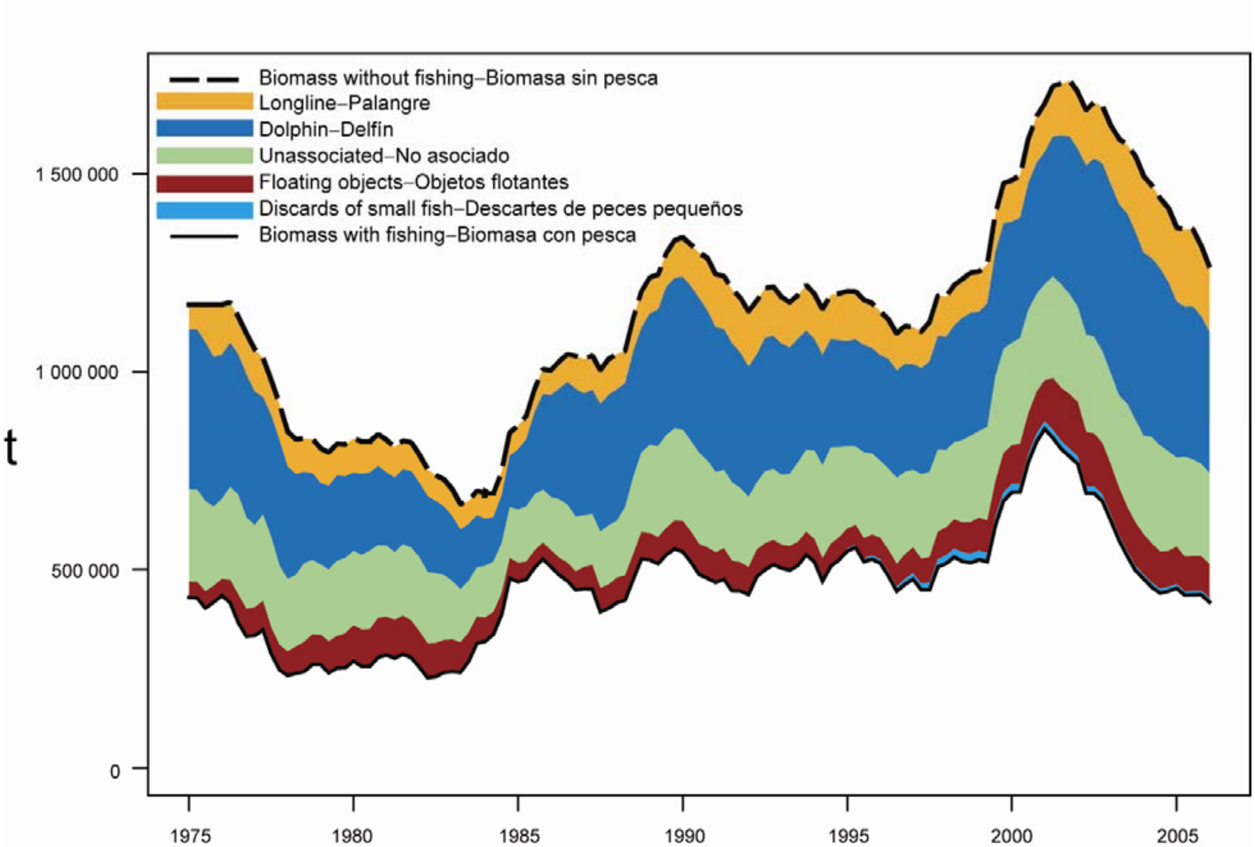

FIGURE B-4. Biomass trajectory of a simulated population of yellowfin tuna that was not exploited during 1975-2006 (dashed line) and that predicted by the stock assessment model (solid line). The shaded areas between the two lines represent the portion of the fishery impact attributed to each fishing method.

FIGURA B-4. Trayectoria de la biomasa de una población simulada de atún aleta amarilla no explotada durante 1975-2006 (línea de trazos) y la que predice el modelo de evaluación (línea sólida). Las áreas sombreadas entre las dos líneas represantan la porción del impacto de la pesca atribuida a cada método de pesca.

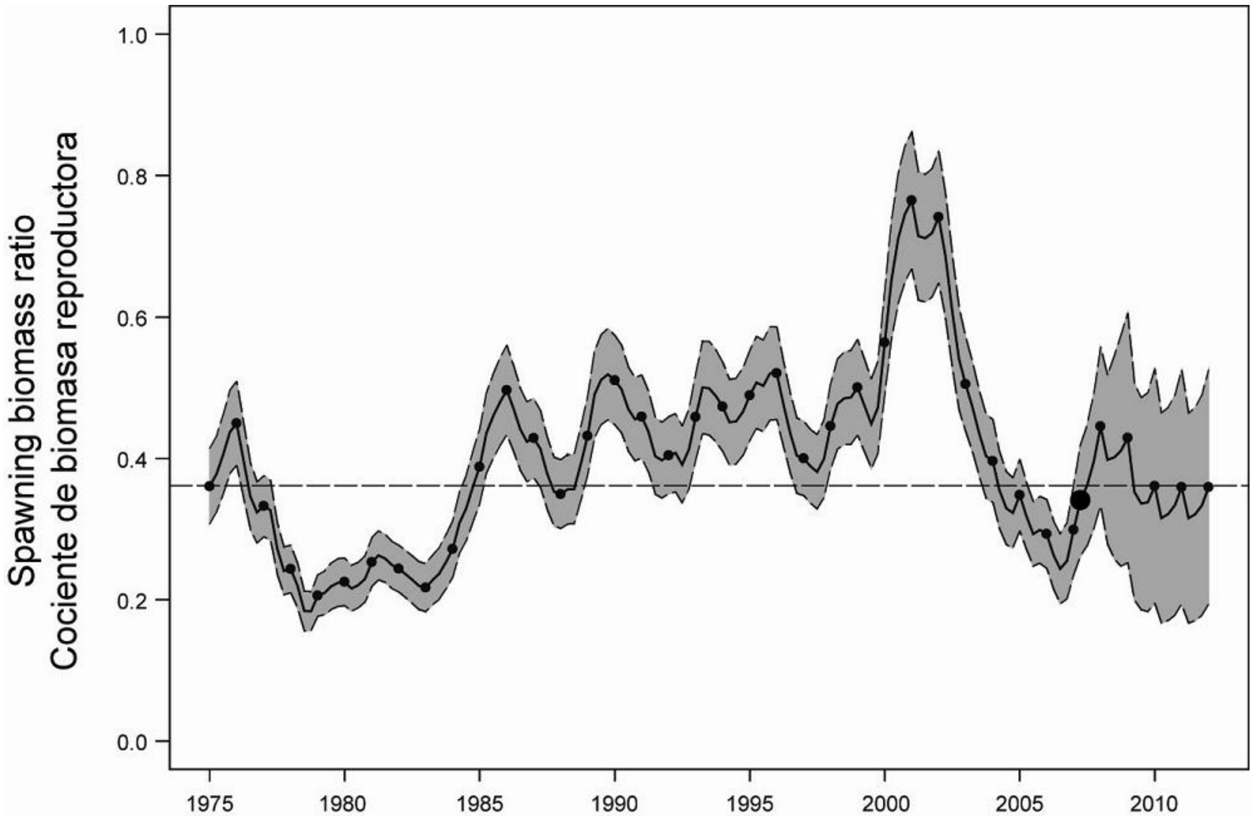

FIGURE B-5. Spawning biomass ratios (SBRs) for 1975-2006 and SBRs projected during 2007-2012 for yellowfin tuna in the EPO. The dashed horizontal line (at 0.37) identifies SBR_{AMSY}. The shaded area represents the 95% confidence limits of the estimates. The estimates after 2007 (the large dot represents the start of the second quarter of 2007) indicate the SBR predicted to occur if effort continues at the level of 2006, catchability (with effort deviates) continues at the average for 2004 and 2005, and average environmental conditions occur during the next five years.

FIGURA B-5. Cocientes de biomasa reproductora (SBR) de 1975-2006 y SBR proyectados durante 2007-2012 para el atún aleta amarilla en el OPO. La línea de trazos horizontal (en 0.37) identifica SBR_{RPMS}. El área sombreada representa los límites de confianza de 95% de las estimaciones. Las estimaciones a partir de 2007 (el punto grande representa el principio del segundo trimestre de 2007) señalan el SBR predicho si el esfuerzo continúa en el nivel observado en 2006, la capturabilidad (con desvíos de esfuerzo) continúa en el promedio de 2004 y 2005, y ocurren condiciones ambientales medias en los cinco años próximos.

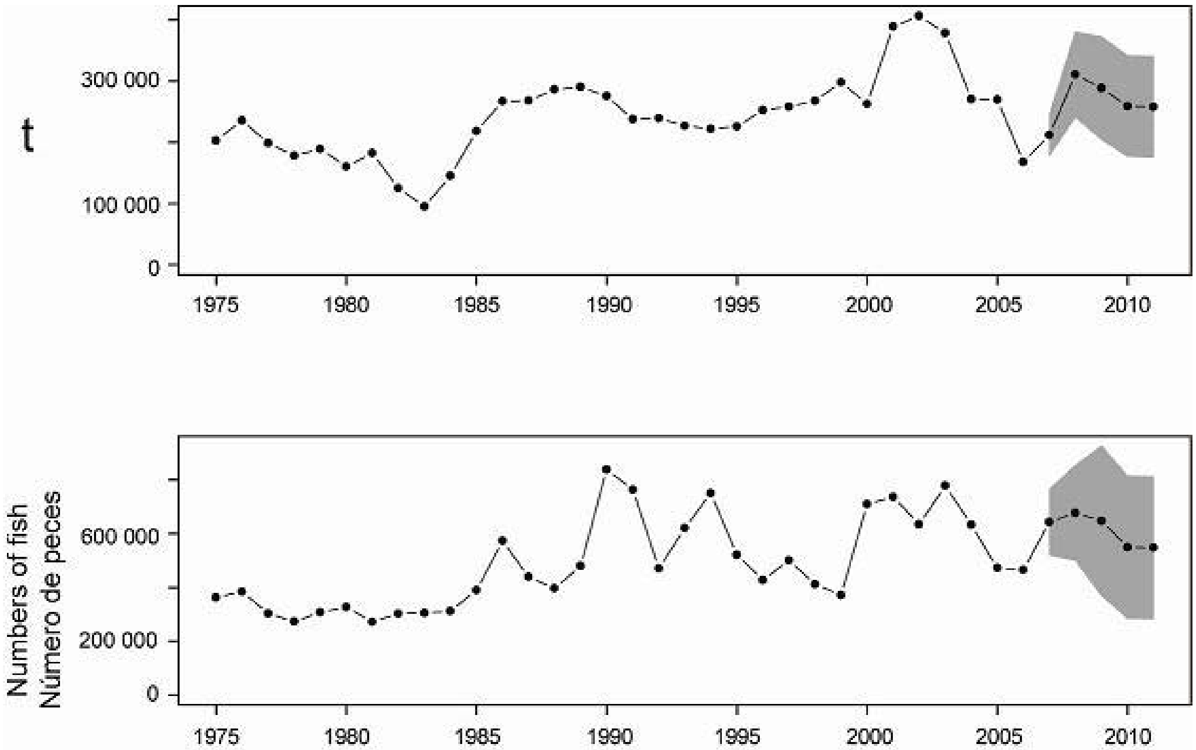

FIGURE B-6. Catches of yellowfin tuna during 1975-2006 and simulated catches of yellowfin tuna during 2007-2011 taken by the purse-seine and pole-and-line fleets (upper panel) and the longline fleet (lower panel). The shaded area represents the 95% confidence limits of the estimates.

FIGURA B-6. Capturas de atún aleta amarilla durante 1975-2006 y capturas simuladas de aleta amarilla durante 2007-2011 por las flotas de cerco y de caña (recuadro superior) y la flota palangrera (recuadro inferior). El área sombreada representa los límites de confianza de 95% de las estimaciones.

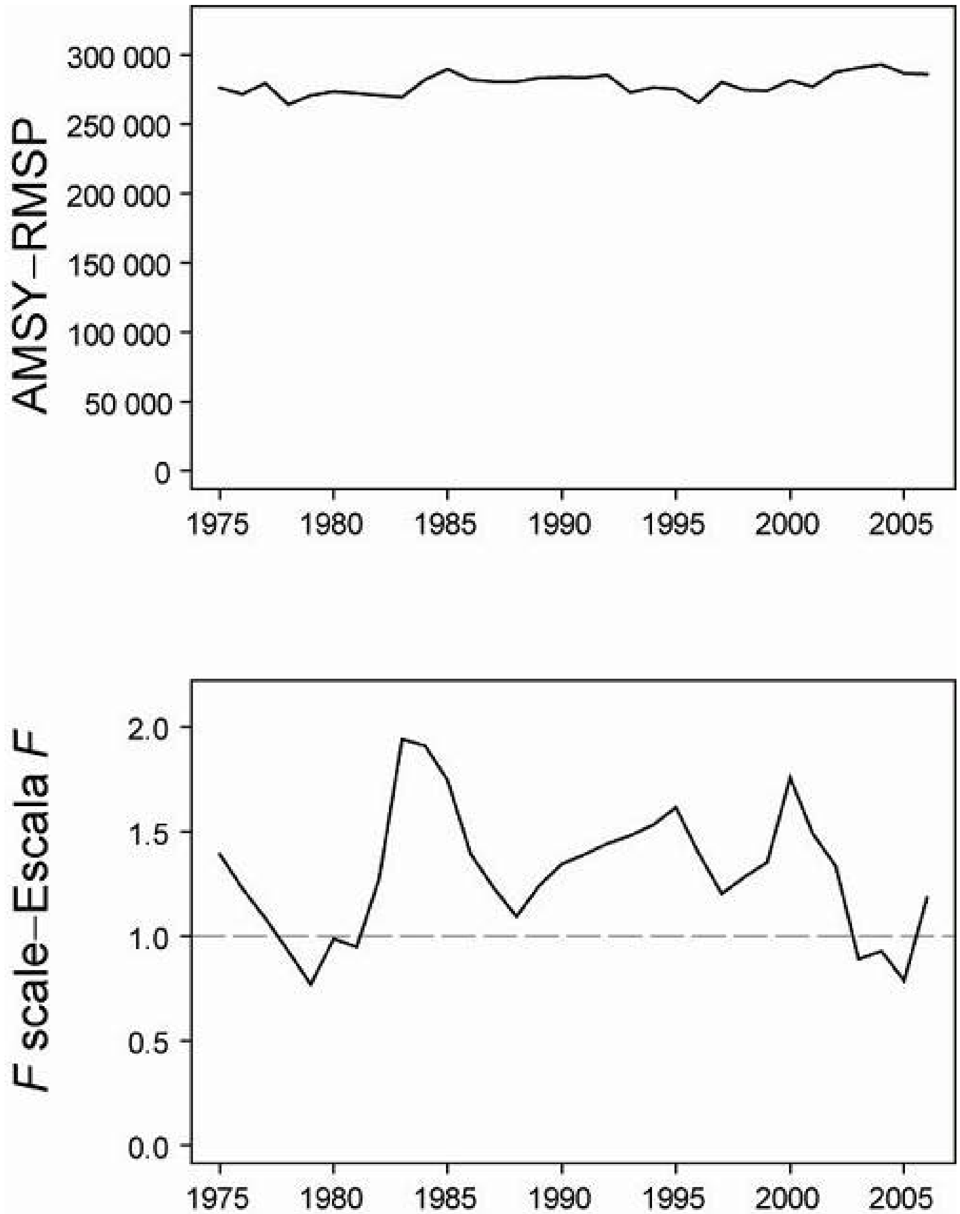

FIGURE B-7. AMSY of yellowfin tuna (upper panel), 1975-2006, and the change (increase or reduction) in the effort corresponding to the AMSY (lower panel), estimated separately for each year, using the average age-specific fishing mortality for that year.

FIGURA B-7. RMSP de atún aleta amarilla (recuadro superior), 1975-2006, y cambio (aumento o reducción) del esfuerzo correspondiente al RMSP (recuadro inferior), estimado por separado para cada año, usando la mortalidad por pesca promedio por edad de ese año.

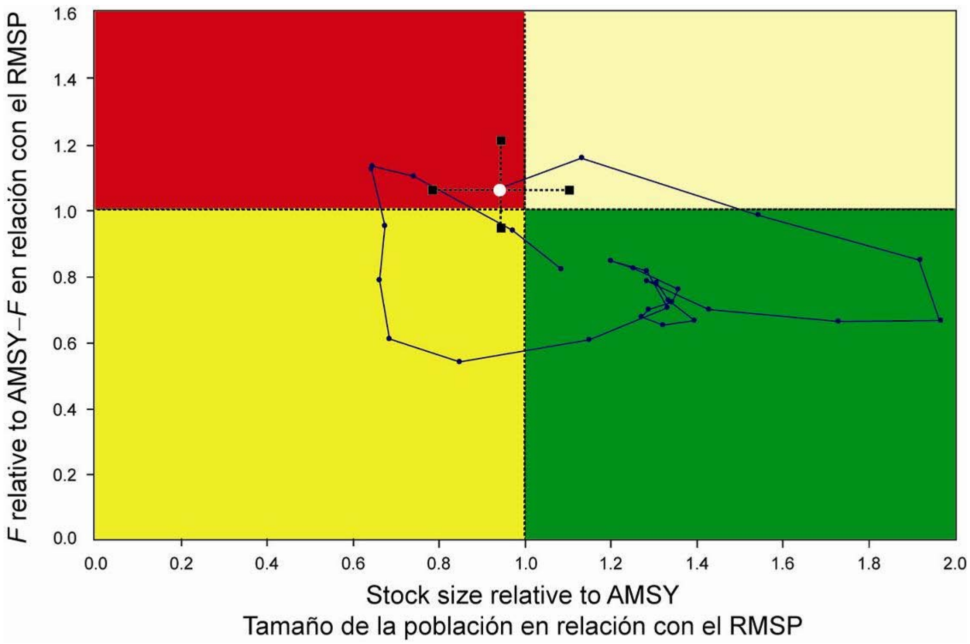

FIGURE B-8. Phase plot of the time series of estimates for stock size and fishing mortality of yellowfin tuna relative to their AMSY reference points. Each dot is a running average of three years; the large dot indicates the most recent estimate. The squares represent approximate 95% confidence intervals.
FIGURA B-8. Gráfica de fase de la serie de tiempo de las estimaciones del tamaño de la población y la mortalidad por pesca de atún aleta amarilla en relación con sus puntos de referencia de RMSP. Cada punto representa un promedio móvil de tres años; el punto grande indica la estimación más reciente. Los puntos cuadrados representan los intervalos de confianza de 95% aproximados.

TABLE B-1. AMSY and related quantities for the base case, the stock-recruitment relationship sensitivity analysis, and growth sensitivity analyses. All analyses are based on average fishing mortality for 2004 to 2006. B_{recent} and B_{AMSY} are the biomass of yellowfin tuna 2+ quarters old at the start of the second quarter of 2007 and at AMSY, respectively, and S_{2007}, S_{AMSY}, and $S_{F=0}$ are indices of spawning biomass (relative number of eggs) at the start of 2007, at AMSY, and without fishing, respectively. C_{2006} is the estimated total catch in 2006.
TABLA B-1. El RMSP y sus valores asociados para la evaluación del caso base y el análisis de sensibilidad que incluye una relación población-reclutamiento, y análisis de sensibilidad al crecimiento. Todos los análisis se basan en la mortalidad por pesca media de 2004-2006. $B_{reciente}$ y B_{RMSP} son la biomasa de atún aleta amarilla de 2+ trimestres de edad al principio del segundo trimestre de 2007 y en RMSP, respectivamente, y S_{2007}, S_{RMSP}, y $S_{F=0}$ son índices de la biomasa reproductora (número relativo de huevos) al principio de 2007, en RMSP, y sin pesca, respectivamente. C_{2006} es la captura total estimada en 2006.

	Base case Caso base	**h = 0.75**
AMSY–RMSP	288,569	300,990
B_{AMSY}–B_{RMSP}	416,324	549,570
S_{AMSY}—S_{RMSP}	4,712	6,519
C_{2006}/AMSY—C_{2006}/RMSP	0.59	0.56
B_{recent}/B_{AMSY}–$B_{reciente}/B_{RMSP}$	0.96	0.73
S_{2007}/S_{AMSY}–S_{2007}/S_{RMSP}	0.95	0.68
$S_{AMSY}/S_{F=0}$–$S_{RMSP}/S_{F=0}$	0.36	0.42
F multiplier—Multiplicador de *F*	0.96	0.65

B. ATÚN ALETA AMARILLA

Se usó un análisis de la captura por talla y edad, A-SCALA (del inglés *age-structured, catch-at-length analysis*) para evaluar el atún aleta amarilla en el Océano Pacífico oriental (OPO). Se describen los métodos analíticos en el Boletín de la CIAT, Vol. 22, No. 5, y se refiere a los lectores a los detalles técnicos en dicho informe. Para mayor detalle de la evaluación más reciente, ver el Informe de Evaluación de Stocks 6, disponible en la página web de la CIAT.

La evaluación presentada en este informe se basa en el supuesto que existe una sola población de atún aleta amarilla en el OPO. El aleta amarilla se encuentra distribuido por todo el Océano Pacífico, pero la mayor parte de la captura proviene de las zonas oriental y occidental del mismo. Las capturas cerqueras de aleta amarilla son menores cerca del límite occidental del OPO (150ºO; Figura A-1). Los desplazamientos de aletas amarillas marcados suelen ser de centenares, no miles, de kilómetros, y el intercambio entre el OPO y el Pacífico occidental parece ser limitado. Esto es consistente con que las tendencias de la CPUE palangrera varíen entre áreas. Es probable que exista una población continua en el Océano Pacífico entero, con intercambio de individuos a nivel local, aunque existe cierta evidencia genética de aislamiento local. No es posible estimar las tasas de desplazamiento entre el OPO y el Pacífico occidental con los datos de marcado actualmente disponibles.

La evaluación de poblaciones requiere cantidades sustanciales de información, incluyendo datos de capturas retenidas, descartes, esfuerzo de pesca, y composición por tamaño de las capturas de las distintas pesquerías. Se hicieron supuestos sobre procesos tales como crecimiento, reclutamiento, desplazamiento, mortalidad natural, mortalidad por pesca, y estructura de poblaciones. Varios insumos de esta última evaluación son diferentes de aquéllos usados para 2005 (Informe de la Situación de la Pesquería 4). Fueron incorporados datos recientes de esfuerzo y captura, y los datos anteriores fueron actualizados. En la Figura B-1 se detallan las capturas.

Se han observado niveles significativos de mortalidad por pesca en la pesquería de aleta amarilla en el OPO (Figura B-2). Fueron máximos para peces de edad mediana. Tanto el reclutamiento (Figura B-3) como la explotación han ejercido impactos sustanciales sobre la trayectoria de la biomasa de la especie (Figura B-4). La mayoría de la captura de aleta amarilla proviene de lances asociados con delfines, y por lo tanto esta pesquería ha ejercido el mayor impacto sobre la población de aleta amarilla (Figura B-4), aunque su impacto por unidad de peso capturado es casi el menor de todas las pesquerías. Parece que la población de aleta amarilla ha pasado por dos, o posiblemente tres, regímenes distintos de reclutamiento (1975-1982, 1983-2001, y posiblemente 2002-2006), correspondientes a reclutamientos bajo, alto, e intermedio. Los regímenes de reclutamiento (Figura B-3) corresponden a regímenes de biomasa (Figura B-4): el régimen de reclutamiento alto produce biomasas grandes. El cociente de biomasa reproductora (el cociente de la biomasa reproductora actual a la de la población no explotada, denominado SBR (*spawning biomass ratio*)) de aleta amarilla en el OPO estuvo por debajo del nivel correspondiente al rendimiento máximo sostenible promedio (RMSP) durante el régimen de reclutamiento bajo (que corresponde a niveles de SBR durante 1977-1984), pero por encima de dicho nivel durante los años subsiguientes, excepto el período más reciente (2004-2007, Figura B-5). Se atribuye el aumento del SBR en 1984 al cambio de régimen, y la disminución reciente podría indicar una reversión a un régimen de reclutamiento intermedio. Es posible que los dos regímenes de productividad soporten dos niveles distintos de RMSP y de SBR asociados. Se estima que el SBR al principio de 2007 está por debajo del nivel correspondiente al RMSP.

Se estima que el SBR actual está por debajo del nivel de SBR correspondiente al RMSP (Figura B-5). Sin embargo, hay una incertidumbre sustancial en la estimación más reciente de SBR, y existe una probabilidad moderada de que el SBR actual esté por encima del nivel correspondiente al RMSP. Se estima que los niveles de esfuerzo están por encima de aquéllos correspondientes al RMSP (Tabla B-1, a partir de la distribución reciente (2004-2006) del esfuerzo entre las varias pesquerías). No obstante, hay una incertidumbre sustancial en estas estimaciones, por lo que existe una probabilidad moderada que los niveles de esfuerzo sean menores que aquéllos correspondientes al RMSP (Figura B-8). Proyecciones a futuro con los niveles actuales de esfuerzo y reclutamiento medio señalan que la población permanecerá probablemente en aproximadamente el mismo nivel durante los próximos cinco años (Figura B-6). Se realizaron estas simulaciones usando el reclutamiento medio del período de 1975-2006. Se espera que las capturas en 2007, tanto las de cerco como la de palangre, sean mayores que aquéllas de 2006 (Figura B-6).

El RMSP ha sido estable durante el período de la evaluación (Figura B-7), lo cual sugiere que el patrón general de selectividad no ha variado mucho con el tiempo.

El análisis indica que cohortes fuertes ingresaron a la pesquería durante 1998-2000 y que incrementaron el tamaño de la población reproductora durante 1999-2001, pero fueron seguidas por reclutamientos más bajos, y el tamaño de la población reproductora disminuyó durante 2002-2006. La biomasa en 2005-2007 estuvo en niveles similares a aquéllos de antes de 1985.

El peso medio de los aletas amarillas en la captura ha sido siempre muy inferior a aquél que incrementaría el RMSP al máximo, indicando que, desde el punto de vista de rendimiento por recluta, el aleta amarilla en el OPO no es pescado al tamaño óptimo. Hay una variabilidad sustancial en el peso promedio del aleta amarilla capturado por las distintas pesquerías. En general, las pesquerías sobre objetos flotantes, no asociadas, y cañera capturan peces más jóvenes y pequeños que las pesquerías asociadas con delfines y palangreras. En las pesquerías palangreras y en los lances sobre delfines en la zona Sur se capturan aletas amarillas de mayor edad y tamaño que en las pesquerías sobre delfines Costera y Norte. Los cálculos de RMSP indican que se podrían incrementar los niveles de rendimiento si se desviara el esfuerzo de pesca hacia las pesquerías que capturan aleta amarilla de mayor tamaño, o reducirlos si el esfuerzo de pesca fuera dirigido hacia la captura de peces pequeños Cualquier cambio de este tipo afectaría también los niveles de SBR de forma similar.

Se predice que, con el nivel de esfuerzo de pesca de 2006, las medidas de conservación impuestas en 2004 de conformidad con la Resolución C-04-09 de la CIAT mantendrían a la población en aproximadamente el nivel de RMSP, ligeramente mayor de lo que hubiese sido sin las medidas. .

Las capturas durante 2006 y el primer trimestre de 2007 han sido marcadamente menores que aquéllas de los períodos correspondientes de 2004 y 2005. La causa más probable de la disminución de las capturas es una disminución del reclutamiento.

Se realizó un análisis de sensibilidad para estimar el efecto de una relación población-reclutamiento y tallas máximas medias alternativas del aleta amarilla. Los resultados sugieren que el modelo con una relación población-reclutamiento se ajusta a los datos ligeramente mejor que el caso base, pero este resultado podría también ser explicado por un cambio de régimen, ya que la biomasa reproductora es baja durante el período de reclutamiento bajo y alto durante el reclutamiento alto. Los resultados del análisis con una relación población-reclutamiento sugieren que el nivel de esfuerzo está por encima del nivel correspondiente al RMSP (Tabla B-1). Se estima que la población reproductora fue menor que la biomasa que permitiría el RMSP durante la mayor parte del período del modelo, excepto durante 2000-2003.

RESUMEN

1. Los resultados son similar a aquéllos de las evaluaciones previas, excepto que el SBR actual es inferior a aquél correspondiente al RMSP.
2. Existe incertidumbre acerca de los niveles recientes y futuros de reclutamiento y biomasa.
3. Las tasas recientes de mortalidad por pesca son aproximadamente iguales a aquéllas necesarias para producir el RMSP.
4. Un aumento del peso medio del aleta amarilla capturado podría incrementar el RMSP.
5. Hubo dos, y posiblemente tres, regímenes distintos de reclutamiento, y los niveles de RMSP y la biomasa correspondiente al RMSP podrían ser diferentes entre los regímenes. Es posible que la población haya cambiado recientemente de un régimen de reclutamiento alto a uno intermedio.
6. Los resultados son más pesimistas si se supone una relación población-reclutamiento.

C. SKIPJACK TUNA

An age-structured catch-at-length analysis (A-SCALA) has been used to assess skipjack 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. This method was used most recently for skipjack tuna in 2004 (IATTC Stock Assessment Report 5, available on the IATTC web site), and included data up to and including 2003.

The stock assessment requires substantial amounts of information, including data on retained catch, discards, fishing effort, and the size compositions of the catches of the various fisheries. The catches used in the assessment are presented in Figure C-1. Several assumptions regarding processes such as growth, recruitment, movement, natural mortality, fishing mortality, and stock structure have also been made. The assessment is considered preliminary because (1) it is not known whether the catch per day of fishing for the purse-seine fisheries is proportional to the abundance of skipjack, (2) it is possible that there is a population of large skipjack that is invulnerable to the fisheries, and (3) the stock structure in relation to fish in the EPO and in the western and central Pacific Ocean is uncertain. However, the results from sensitivity analyses for this assessment are more consistent than those of previous years.

The recruitment of skipjack tuna to the fisheries of the EPO (Figure C-2) is highly variable, and greater-than-average recruitment has been estimated for the period following the introduction of the use of fish-aggregating devices (FADs) in the early 1990s, which was associated with a southward expansion of the fishery (Figure A-2). The fishing mortality (Figure C-3) was estimated to be about the same or less than the rate of natural mortality. These estimates of fishing mortality are supported by estimates from tagging data. The biomass fluctuates in response to variations in both recruitment and exploitation (Figure C-4). The estimates of absolute biomass are moderately sensitive to weights given to the information about abundance in the catch and effort data for the floating-object fisheries and the monotonic selectivity assumption, but the trends in biomass are not.

The analysis indicates that a group of relatively strong cohorts (but not as strong as that of 1998) entered the fishery in 2002-2003, and that these cohorts increased the biomass and catches during 2003. There is an indication that the most recent recruitments are about average, which may lead to lower biomasses and catches. However, these estimates of recruitment are based on limited information, and are therefore uncertain.

There is considerable variation in spawning biomass ratio (ratio of the current spawning biomass to that for the unfished stock; SBR) for skipjack tuna in the EPO (Figure C-5). In 2003 the SBR was at a high level (about 0.61). Estimates based on average maximum sustainable yield (AMSY) and yield-per-recruit indicate that maximum yields are achieved with infinite fishing mortality because the critical weight (weight at which the gain to the total weight of a cohort due to growth is equal to the weight loss to that cohort due to natural mortality) is less than the average weight at recruitment to the fishery. However, this is uncertain because of uncertainties in the estimates of natural mortality and growth. The estimates of SBR are not sensitive to weights given to the information about abundance in the catch and effort data for the floating-object fisheries and the monotonic selectivity assumption.

The results of an analysis described in IATTC Stock Assessment Report 7, in which an index of relative abundance was developed from the ratio of skipjack to bigeye tuna in the floating-object fishery, were consistent with previous assessments, and suggest that there is no management concern for skipjack tuna, apart from the associated catch of bigeye in floating-object sets.

In 2007, trends in several indicators of stock status were examined (Figure C-6). Recent increases in catch per unit effort (CPUE), which suggested a healthy stock, contrasted with increased fishing effort and decreased average weight, suggesting high exploitation rates. A simple population model fitted to CPUE and catch data showed that the inconsistency could be explained by increases in both exploitation rate and abundance. Alternatively, it is possible that the vulnerability of skipjack to purse-seine fishing is increasing. Further work is needed for this analysis to provide clear information about the state of the stock.

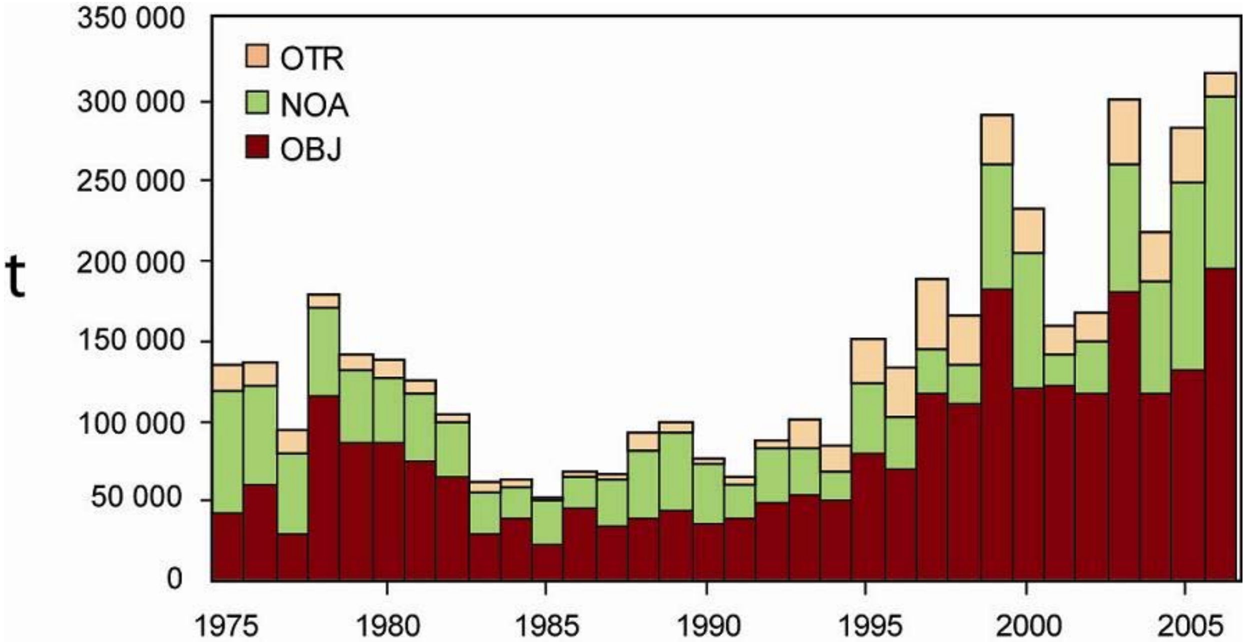

FIGURE C-1. Total catches (retained catches plus discards) of skipjack tuna by the purse-seine fisheries on floating objects and unassociated schools, and by other fisheries combined, in the eastern Pacific Ocean, 1975-2006. The purse-seine catches for 1975-2006 are adjusted to the species composition estimate.

FIGURA C-1. Capturas totales (capturas retenidas más descartes) de atún barrilete por las pesquerías de cerco sobre objetos flotantes y cardúmenes no asociados, y de las demás pesquerías combinadas, en el Océano Pacífico oriental, 1975-2006 Las capturas cerqueras de 1975-2006 fueron ajustadas a la estimación de composición por especies.

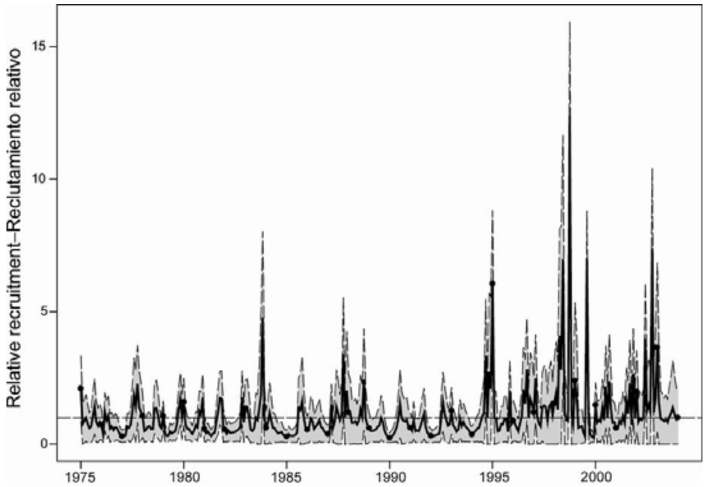

FIGURE C-2. Estimated recruitment of skipjack tuna to the fisheries of the EPO. The estimates are scaled so that the average recruitment is equal to 1.0. The solid line illustrates the maximum-likelihood estimates of recruitment, and the shaded area the 95% confidence intervals. The labels on the time axis are drawn at the start of each year, but, since the assessment model represents time on a monthly basis, there are 12 estimates of recruitment for each year.

FIGURA C-2. Reclutamiento estimado de atún barrilete a las pesquerías del OPO. Se escalan las estimaciones para que el reclutamiento medio equivalga a 1,0. La línea sólida ilustra las estimaciones de reclutamiento de probabilidad máxima, y el área sombreada los intervalos de confianza de 95%. 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 meses, hay 12 estimaciones de reclutamiento para cada año.

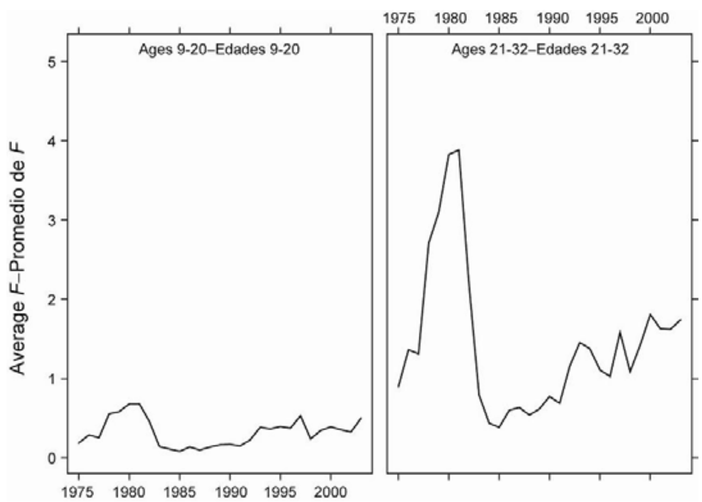

FIGURE C-3. Average total monthly fishing mortality of skipjack tuna recruited to the fisheries of the EPO. Each panel illustrates an average of 12 monthly fishing mortality vectors that affected fish of the age range indicated in the title of each panel. For example, the trend illustrated in the left panel is an average of the fishing mortalities that affected fish that were 9-20 months old.

FIGURA C-3. Series de tiempo de la mortalidad por pesca mensual total media de atún barrilete reclutado a las pesquerías del OPO. Cada recuadro ilustra un promedio de 12 vectores mensuales 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 izquierdo es un promedio de las mortalidades por pesca que afectaron a los peces de entre 9 y 20 meses de edad.

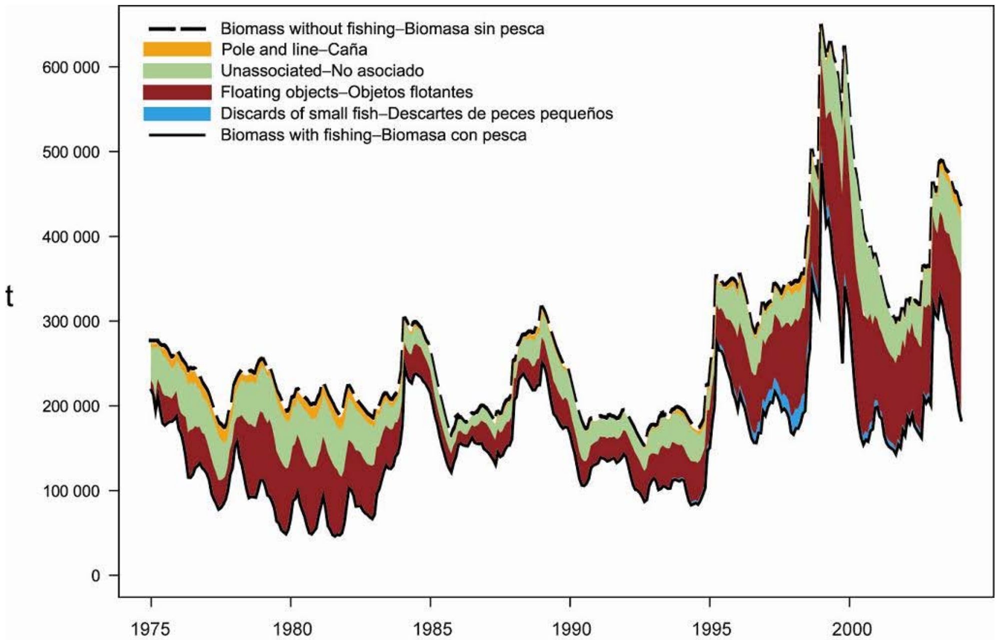

FIGURE C-4. Biomass trajectory of a simulated population of skipjack tuna that was not exploited during 1975-2004 (dashed line) and that predicted by the stock assessment model (solid line). The shaded areas between the two lines represent the portion of the fishery impact attributed to each fishing method.
FIGURA C-4. Trayectoria de la biomasa de una población simulada de atún barrilete no explotada durante 1975-2004 (línea de trazos) y la que predice el modelo de evaluación (línea sólida). Las áreas sombreadas entre las dos líneas represantan la porción del impacto de la pesca atribuida a cada método de pesca.

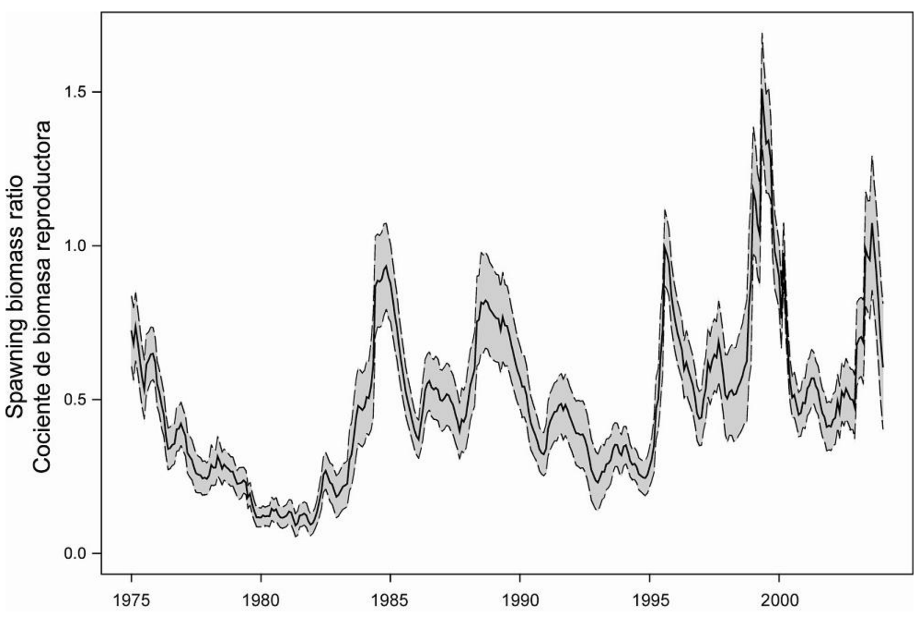

FIGURE C-5. Estimated spawning biomass ratios (SBRs) for skipjack tuna in the EPO, from the monotonic selectivity assessment. The shaded area represents the 95% confidence limits of the estimates.
FIGURA C-5. Series de tiempo estimadas de los cocientes de biomasa reproductora (SBR) de atún barrilete en el OPO, de la evaluación de selectividad monotónica. El área sombreada representa los intervalos de confianza de 95% de las estimaciones.

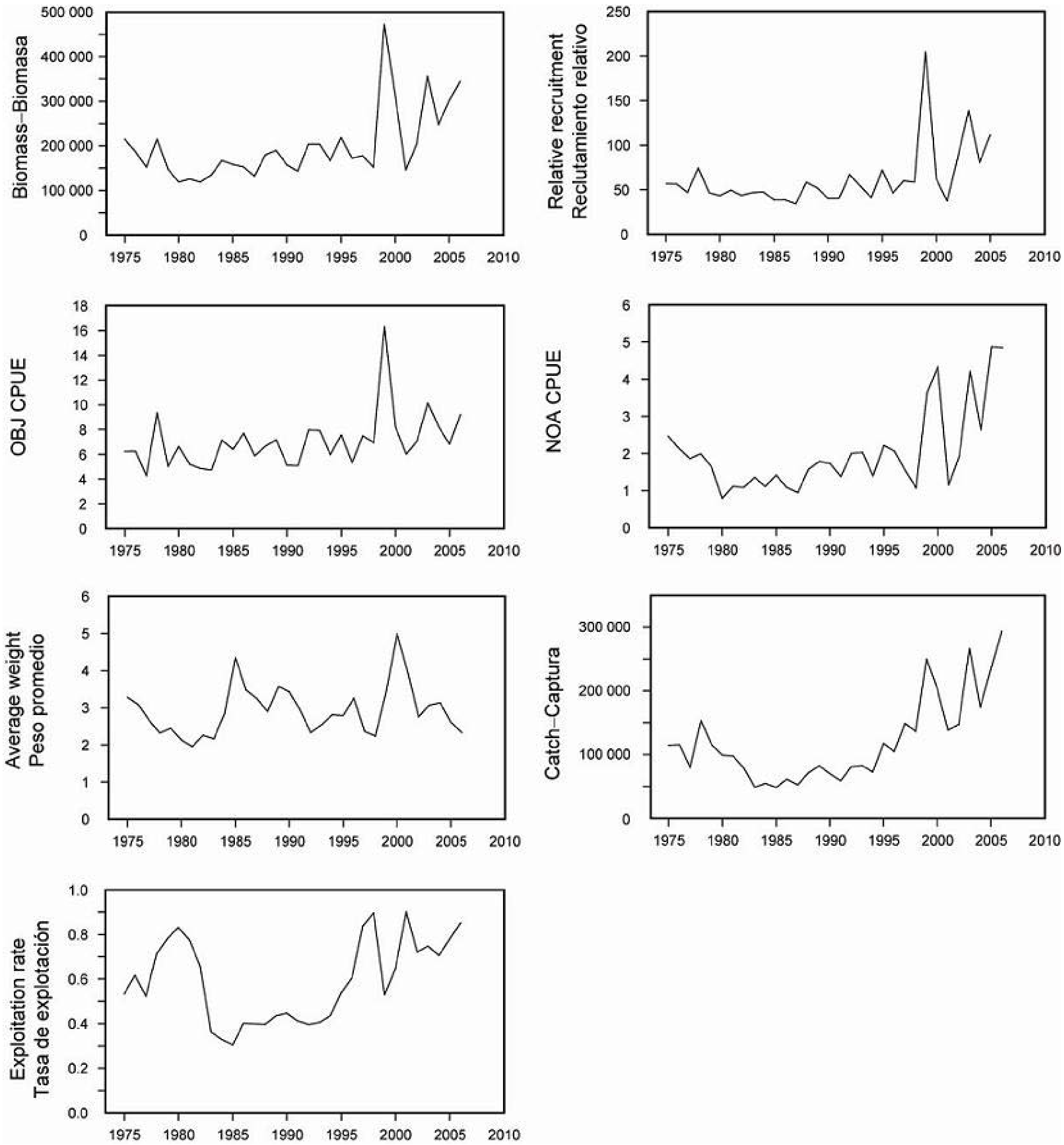

FIGURE C-6. Indicators of the stock status of skipjack tuna based on data and/or a simple stock assessment model.

FIGURA C-6. Indicadores de la condición de la población de atún barrilete basados en datos y/o en un modelo sencillo de evaluación de población.

C. ATÚN BARRILETE

Se ha usado un análisis de la captura por talla y edad, A-SCALA (del inglés *age-structured, catch-at-length analysis*) para evaluar el atún barrilete en el Océano Pacífico oriental (OPO). Se describen los métodos analíticos en el Boletín de la CIAT, Vol. 22, No. 5, y se refiere a los lectores a los detalles técnicos en dicho informe. La última vez que se usó este método para el barrilete fue en 2004 (Informe de Evaluación de Stocks 5, disponible en la página web de la CIAT), e incluyó datos hasta 2003, inclusive.

La evaluación de poblaciones requiere cantidades sustanciales de información, incluyendo datos de capturas retenidas, descartes, esfuerzo de pesca, y composición por tamaño de las capturas de las distintas pesquerías. En la Figura C-1 se ilustran las capturas usadas en la evaluación. Se hicieron también varios supuestos sobre procesos tales como crecimiento, reclutamiento, desplazamiento, mortalidad natural, mortalidad por pesca, y estructura de poblaciones. La evaluación es considerada preliminar porque (1) no se sabe si la captura por día de pesca de las pesquerías de cerco es proporcional a la abundancia del barrilete, (2) es posible que exista una población de barrilete grande que es invulnerable a las pesquerías, y (3) la estructura de la población con respecto a los peces en el OPO y en el Océano Pacífico occidental y central es incierta. Sin embargo, los resultados de los análisis de sensibilidad para la presente evaluación son más consistentes con aquéllos de años anteriores.

El reclutamiento del atún barrilete a las pesquerías en el OPO (Figure C-2) es altamente variable, y se ha estimado un reclutamiento mayor al promedio para el período después de la introducción de los dispositivos agregadores de peces (plantados) a principios de los años 1990, asociada con una expansión de la pesquería hacia el sur (Figura A-2). Se estimó que la mortalidad por pesca (Figura C-3) es aproximadamente igual, o mayor, que la tasa de mortalidad natural. Estas estimaciones de la mortalidad por pesca son respaldadas por estimaciones de datos de marcado. La biomasa fluctúa en reacción a variaciones en el reclutamiento la explotación (Figura C-4). Las estimaciones de biomasa absoluta son moderadamente sensibles a la ponderación asignada a la información sobre abundancia en los datos de captura y esfuerzo de las pesquerías sobre objetos flotantes y el supuesto de selectividad monotónica, pero las tendencias en la biomasa no lo son.

El análisis indica que un grupo de cohortes relativamente fuertes (pero no tan fuertes como aquél de 1998) ingresó a la pesquería en 2002-2003, y esas cohortes incrementaron la biomasa y las capturas durante 2003. Existe una indicación de que los reclutamientos más recientes fueron aproximadamente medios, lo cual podría llevar a biomasas y capturas más bajas, pero estas estimaciones de reclutamiento se basan en información limitada, y son por lo tanto inciertas.

Hay una variación considerable en el cociente de la biomasa reproductora actual a la biomasa reproductora de la población no explotada (*spawning biomass ratio*, SBR) del atún barrilete en el OPO (Figura C-5). En 2003 el SBR estuvo en un nivel alto (aproximadamente 0.61). Las estimaciones basadas en el rendimiento máximo sostenible promedio (RMSP) y el rendimiento por recluta señalan que se logra el rendimiento máximo con una mortalidad por pesca infinita porque el peso crítico (el peso al cual el incremento del peso total de una cohorte debido al crecimiento es igual a la pérdida de peso de la cohorte debida a la mortalidad natural) es menor que el peso medio de reclutamiento a la pesquería. Sin embargo, esto no es seguro debido a incertidumbres en las estimaciones de mortalidad natural y crecimiento. Las estimaciones de SBR no son sensibles a la ponderación asignada a la información sobre abundancia en los datos de captura y esfuerzo de las pesquerías sobre objetos flotantes y el supuesto de selectividad monotónica.

Los resultados de un análisis descrito en el Informe de Evaluación de Stocks 7 de la CIAT, en el cual se elaboró un índice de abundancia relativa a partir de las proporciones de los atunes barrilete y patudo en la pesca sobre objetos flotantes, fueron consistentes con las evaluaciones previas, y sugieren que no existe motivo de preocupación con respecto a la ordenación del atún barrilete, aparte de la captura asociada de patudo en los lances sobre objetos flotantes.

En 2007 se examinaron las tendencias en varios indicadores de la condición de la población (Figura C-6). Los incrementos recientes de la captura por unidad de esfuerzo (cpue), que sugieren una población en buenas condiciones, hacen contraste con el aumento del esfuerzo de pesco y la disminución del peso promedio, que sugieren tasas de explotación elevadas. Un modelo sencillo de población ajustado a los datos de cpue y captura señaló que la inconsistencia podía ser explicada por aumentos de la tasa de explotación y de la abundancia. Alternativamente, es posible que la vulnerabilidad del barrilete a la pesca de cerco esté en aumento. Es necesaria una mayor investigación para que este análisis produzca información clara sobre la condición de la población.

D. BIGEYE TUNA

There have been substantial changes in the bigeye tuna fishery in the eastern Pacific Ocean (EPO) over the last 15 years. Initially, the majority of the bigeye catch was taken by longline vessels, but with the expansion of the fishery on fish associated with fish-aggregating devices (FADs) since 1993, the purse-seine fishery has taken an increasing proportion of the bigeye catch (Figure D-1). The FAD fishery captures smaller bigeye, and has therefore reduced the yield per recruit and the average maximum sustainable yield (AMSY). On average, the fishing mortality of bigeye less than about four and a half years old has increased substantially since 1993, and that of older fish has increased slightly (Figure D-2).

An age-structured catch-at-length model, Stock Synthesis II (SS2), was used in this assessment of the bigeye stock of the EPO. Previous assessments were conducted with the A-SCALA model. There are several differences between the two models, but their general structure and the data used are the same (see Report of Workshop on Stock Assessment Methods[1]). The details of the stock assessment are available on the IATTC web site[2].

Bigeye are distributed across the Pacific Ocean, but the bulk of the catch is made to the east and to the west. The purse-seine catches of bigeye are substantially lower close to the western boundary (150ºW) of the EPO (Figure A-3); the longline catches are more continuous, but show lower levels between 160ºW and 180º (Figure A-4). Bigeye are not often caught by purse seiners in the EPO north of 10ºN (Figure A-3), but a substantial portion of the longline catches of bigeye in the EPO is made north of that parallel (Figure A-4). Bigeye tuna do not move long distances (95% of tagged bigeye showed net movements of less than 1000 nautical miles), and current information indicates little exchange between the eastern and western Pacific Ocean (Figure D-3). 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 local levels. The assessment reported here is conducted as if there were a single stock in the EPO. Its results are consistent with results of other analyses of bigeye tuna on a Pacific-wide basis. In addition, analyses have shown that the results are insensitive to the spatial structure of the analysis. Currently, there are not enough tagging data to provide adequate estimates of movement between the eastern and western Pacific Ocean.

Several inputs into the current assessment differ from that for 2005. Recent catch and CPUE data have been incorporated, and earlier data have been updated.

There are several important features in the estimated time series of bigeye recruitment (Figure D-4). The estimates of recruitment before 1993 are very uncertain, as the FAD fisheries, which catch small bigeye, were not operating. There was a period of above-average recruitment in 1995-1998, followed by a period of below-average recruitment in 1999-2000. Recruitment has been above average since 2000. The most recent recruitment is very uncertain, due to the fact that recently-recruited bigeye are represented in only a few length-frequency data sets. The extended period of relatively high recruitment during 1995-1998 coincided with the expansion of the fisheries that catch bigeye in association with floating objects.

The biomass of 3+-quarter-old bigeye increased during 1983-1984, and reached its peak of about 615,000 t in 1986, after which it decreased to an historic low of about 279,000 t at the beginning of 2005. Spawning biomass has generally followed a trend similar to that for the biomass of 3+-quarter-olds, but lagged by 1-2 years. The biomasses of both 3+-quarter-old fish and spawners are estimated to have increased slightly after 2005.

The estimated trajectory of the spawning biomass that would have occurred without fishing and that projected by the assessment model, together with an estimate of the impacts attributed to each fishing gear, are shown in Figure D-5.

At the beginning of 2007, the spawning biomass of bigeye in the EPO (Figure D-6) had recovered slightly

[1] http://www.iattc.org/PDFFiles2/Assessment-methods-WS-Nov05-ReportENG.pdf
[2] http://www.iattc.org/StockAssessmentReportsENG.htm

from the lowest level previously seen. At that time the spawning biomass ratio (the ratio of current spawning biomass to biomass of spawners in the absence of fishing mortality; SBR) was estimated to be about 0.20, about 10% less than the level corresponding to the AMSY (SBR_{AMSY}).

Recent spikes in recruitment are predicted to result in increased levels of SBR and longline catches for the next few years. However, high levels of fishing mortality are expected to subsequently reduce the SBR. Under current effort levels, the population is unlikely to remain at levels corresponding to AMSY unless fishing mortality is greatly reduced or recruitment is above average for several consecutive years (Figure D-6).

In the base case assessment, recent catches are estimated to have been at about the AMSY level (Table D-1). If fishing mortality is proportional to fishing effort, and the current patterns of age-specific selectivity are maintained, the level of fishing effort corresponding to the AMSY is about 83% of the current (2004-2006) level of effort. The AMSY of bigeye in the EPO could be maximized if the age-specific selectivity pattern were similar to that for the longline fishery that operates south of 15°N because it catches larger individuals that are close to the critical weight. Before the expansion of the FAD fishery, beginning in 1993, the AMSY was greater than the current AMSY and the fishing mortality (F) was less than F_{AMSY} (Figure D-8). The historical status of the stock is shown in Figure D-9. The two most recent estimates indicate that the bigeye stock in the EPO is overfished ($S < S_{AMSY}$) and that overfishing is taking place ($F > F_{AMSY}$).

Analyses were carried out to assess the sensitivity of the stock assessment results to: 1) incorporating a stock-recruitment relationship; 2) using the CPUE data from the southern longline fishery only; 3) either estimating the growth parameters or assuming estimates for the asymptotic length parameter of the von Bertalanffy growth curve; 4) fitting to initial equilibrium catch; 5) iterative reweighing of the data; 6) using two time blocks for selectivity and catchability of the southern longline fishery; and 7) including the new Japanese longline data.

Of the ten analyses conducted, seven estimated that at the start of 2007 the spawning biomass was below the level corresponding to the AMSY. AMSY and the fishing mortality (F) multiplier are sensitive to how the assessment model is parameterized, the data that are included in the assessment, and the periods assumed to represent average fishing mortality, but under eight of the scenarios considered, fishing mortality is above the level corresponding to the AMSY.

The estimates of recruitment and biomass were moderately sensitive to the steepness (h) of the stock-recruitment relationship. The current status and future projections are considerably more pessimistic, in terms of stock status relative to the levels that support AMSY, if a stock-recruitment relationship (h = 0.75) exists.

The effects of Resolution C-04-09 are insufficient to maintain the stock at levels that will permit the AMSY.

Summary:

1. Recent fishing mortality levels are about 20% greater than those corresponding to the AMSY.
2. As a consequence, if the fishing effort is not reduced, the total biomass and spawning biomass will eventually decline to levels at least as low as that observed in 2004.
3. The current status and future projections are considerably more pessimistic in terms of stock status if a stock-recruitment relationship (h = 0.75) exists.
4. These conclusions are robust to all but two alternative models and data formulations considered in this and previous analyses.

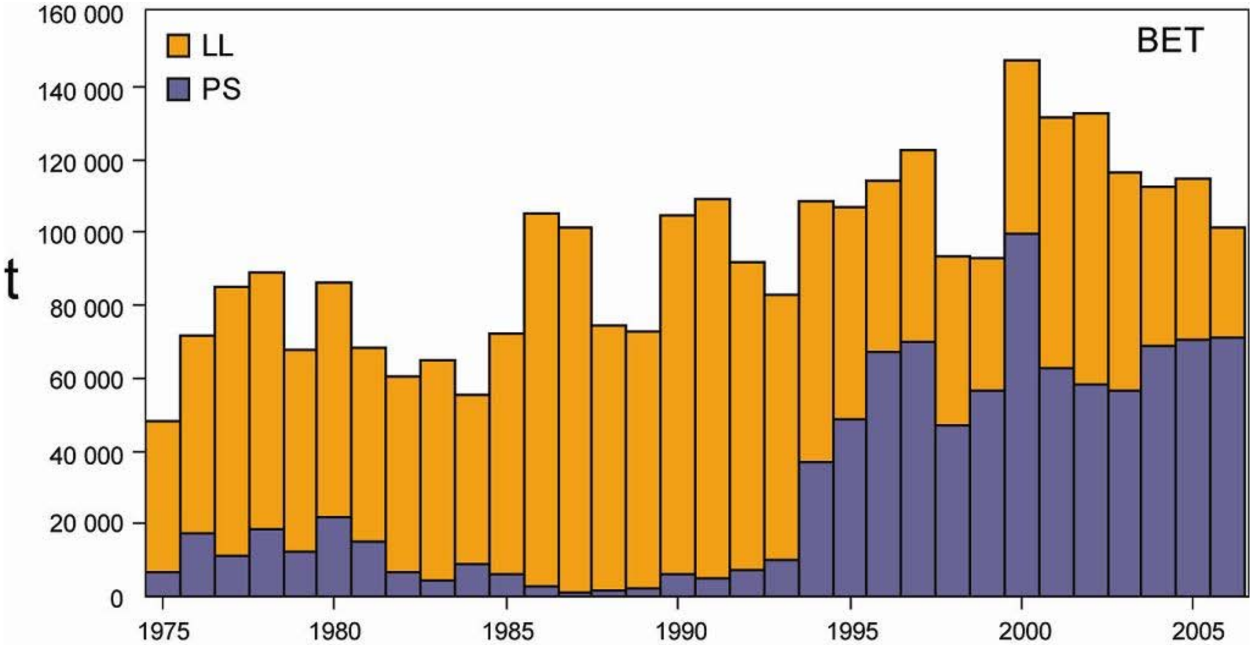

FIGURE D-1. Total catches (retained catches plus discards) of bigeye tuna by the purse-seine fisheries, and retained catches for the longline fisheries, in the eastern Pacific Ocean, 1975-2006. The purse-seine catches are adjusted to the species composition estimate. The 2006 catch data are provisional.

FIGURA D-1. Capturas totales (capturas retenidas más descartes) de atún patudo por las pesquerías de cerco y capturas retenidas de las pesquerías palangreras en el Océano Pacífico oriental, 1975-2006. Las capturas cerqueras están ajustadas a la estimación de la composición por especie. Los datos de captura de 2006 son provisionales.

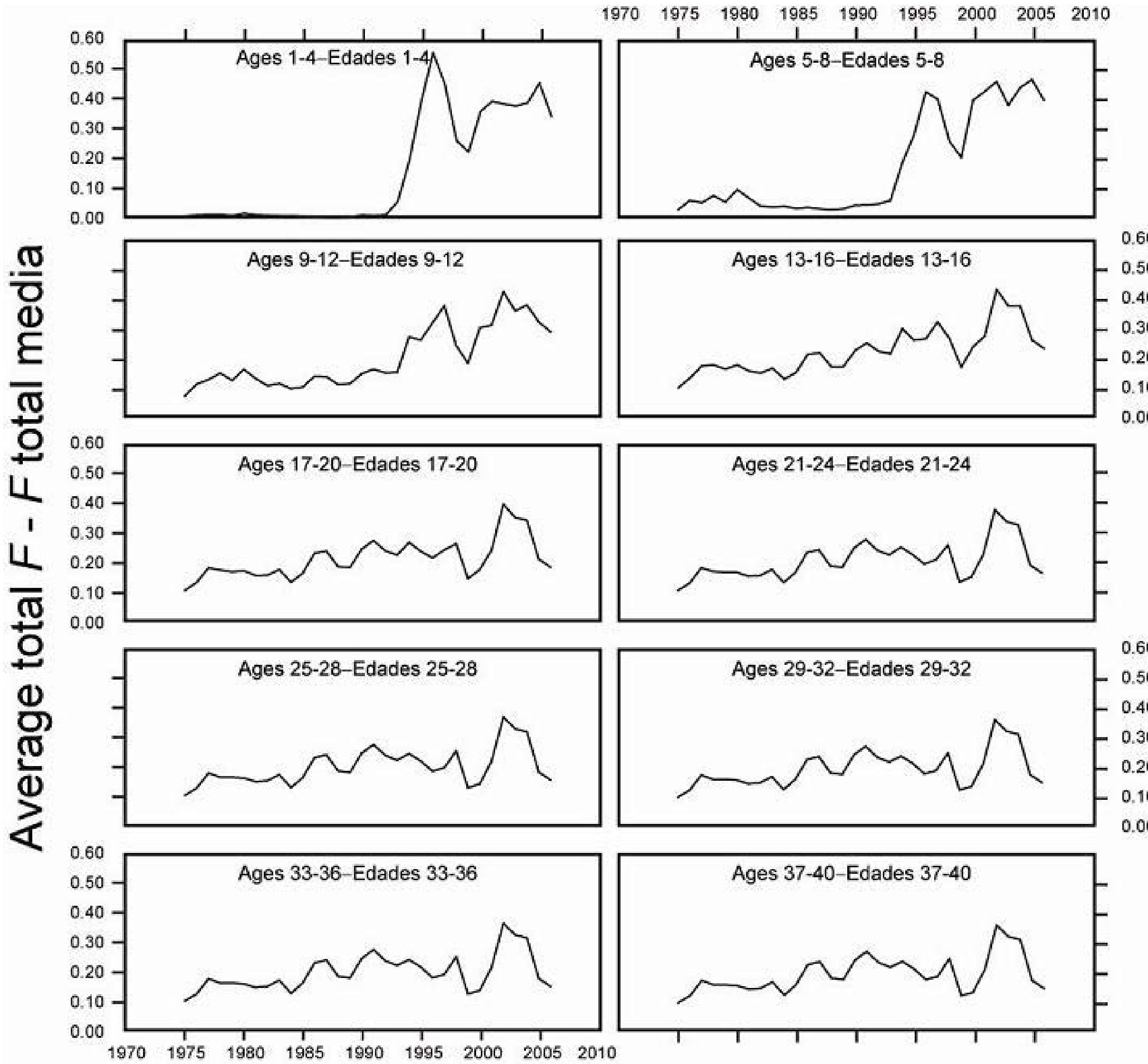

FIGURE D-2. Average annual fishing mortality, by all gears, of bigeye tuna recruited to the fisheries of the EPO. Each panel illustrates an average of four annual fishing mortality vectors that affected the fish in the range of ages indicated in the title of each panel. For example, the trend illustrated in the upper left panel is an average of the fishing mortalities that affected fish that were 1-4 quarters old.

FIGURA D-2. Mortalidad por pesca anual media, por todas las artes, de atún patudo reclutado a las pesquerías del OPO. Cada recuadro ilustra un promedio de cuatro vectores anuales 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 peces de entre 1-4 trimestres de edad.

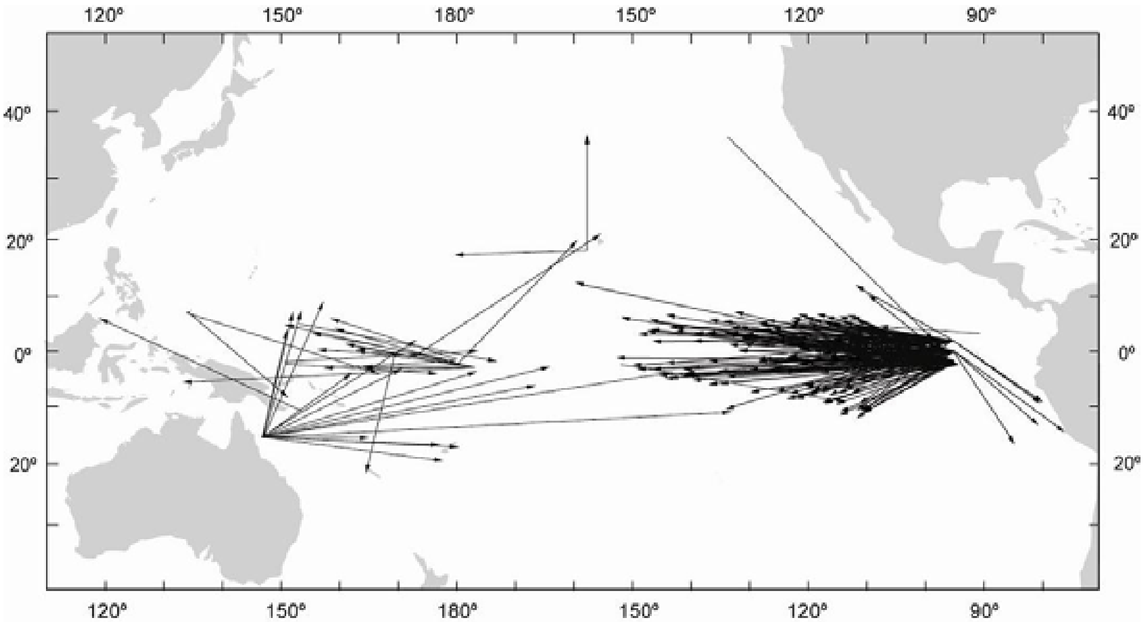

FIGURE D-3. Movements of more than 1000 nm by tagged bigeye tuna in the Pacific Ocean.
FIGURA D-3. Desplazamientos de más de 1000 mn de atunes patudo marcados en el Océano Pacífico.

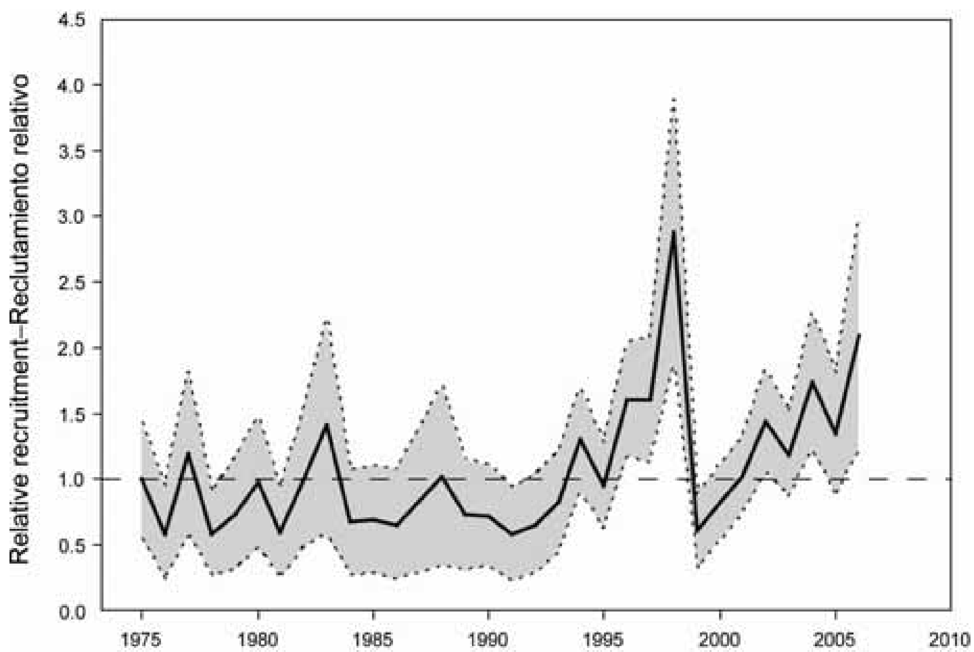

FIGURE D-4. Estimated recruitment of bigeye tuna to the fisheries of the EPO. The estimates are scaled so that the estimate of virgin recruitment is equal to 1.0. The solid line shows the maximum likelihood estimates of recruitment, and the shaded area indicates the approximate 95% confidence intervals around those estimates.
FIGURA D-4. Reclutamiento estimado de atún patudo a las pesquerías del OPO. Se escalan las estimaciones para que la estimación de reclutamiento virgen equivalga a 1,0. La línea sólida indica las estimaciones de reclutamiento de verosimilitud máxima, y el área sombreada indica los intervalos de confianza de 95% aproximados de esas estimaciones.

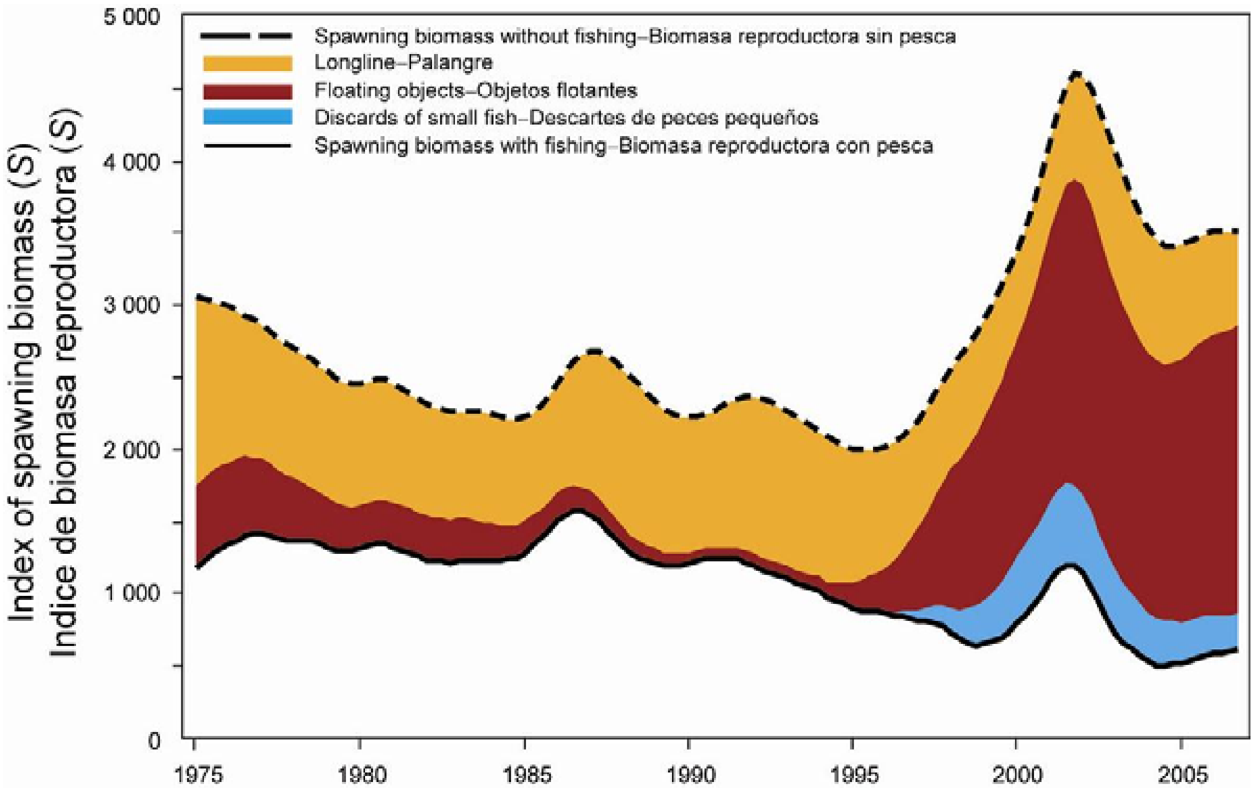

FIGURE D-5. Index of spawning biomass (*S*) of a simulated population of bigeye tuna that was not exploited during 1975-2006 (dashed line) and that predicted by the stock assessment model (solid line). The shaded areas between the two lines show the portions of the fishery impact attributed to each fishery.

FIGURA D-5. Indice de biomasa reproductora (*S*) de una población simulada de atún patudo no explotada durante 1975-2006 (línea de trazos) y la que predice el modelo de evaluación (línea sólida). Las áreas sombreadas entre las dos líneas señalan la porción del impacto de la pesca atribuida a cada método de pesca.

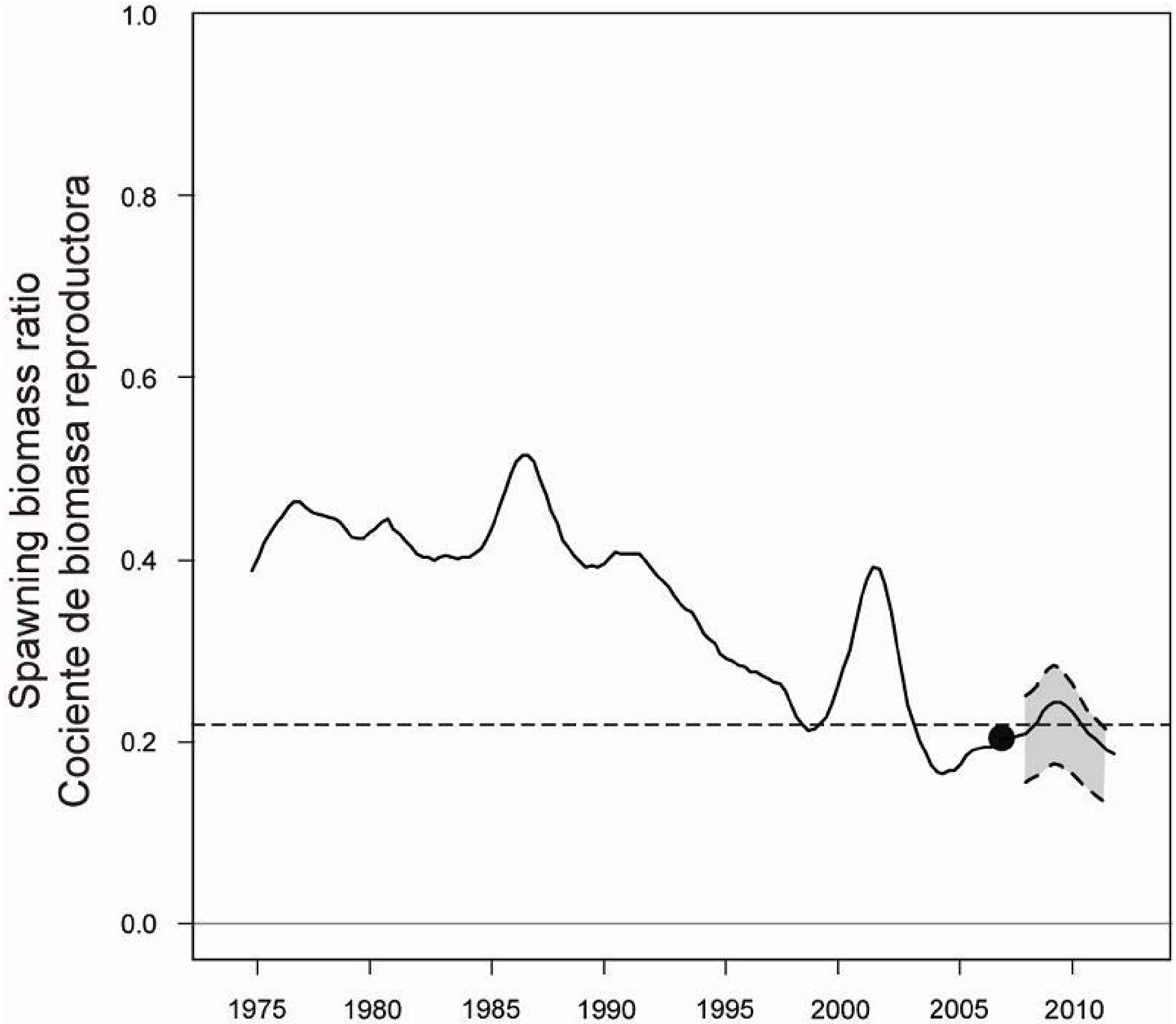

FIGURE D-6. Estimated spawning biomass ratios (SBRs) for bigeye tuna in the EPO. The dashed horizontal line (at about 0.22) identifies the SBR at AMSY. The solid line shows the maximum likelihood estimate. The estimates after 2007 (the large dot) indicate the SBR predicted to occur if fishing mortality continues at the average for 2004-2006, and average environmental conditions occur during the next five years. The shaded area represents the 95% confidence limits of the estimates.

FIGURA D-6. Cocientes de biomasa reproductora (SBR) estimados del atún patudo en el OPO. La línea de trazos horizontal (en aproximadamente 0.22) identifica el SBR en RMSP. La línea sólida señala las estimaciones de verosimilitud máxima. Las estimaciones a partir de 2007 (el punto grande) señalan el SBR predicho si la mortalidad por pesca continúa en el promedio de 2004-2006, y con condiciones ambientales promedio en los cinco próximos años. El área sombreada representa los límites de confianza de 95% de las estimaciones.

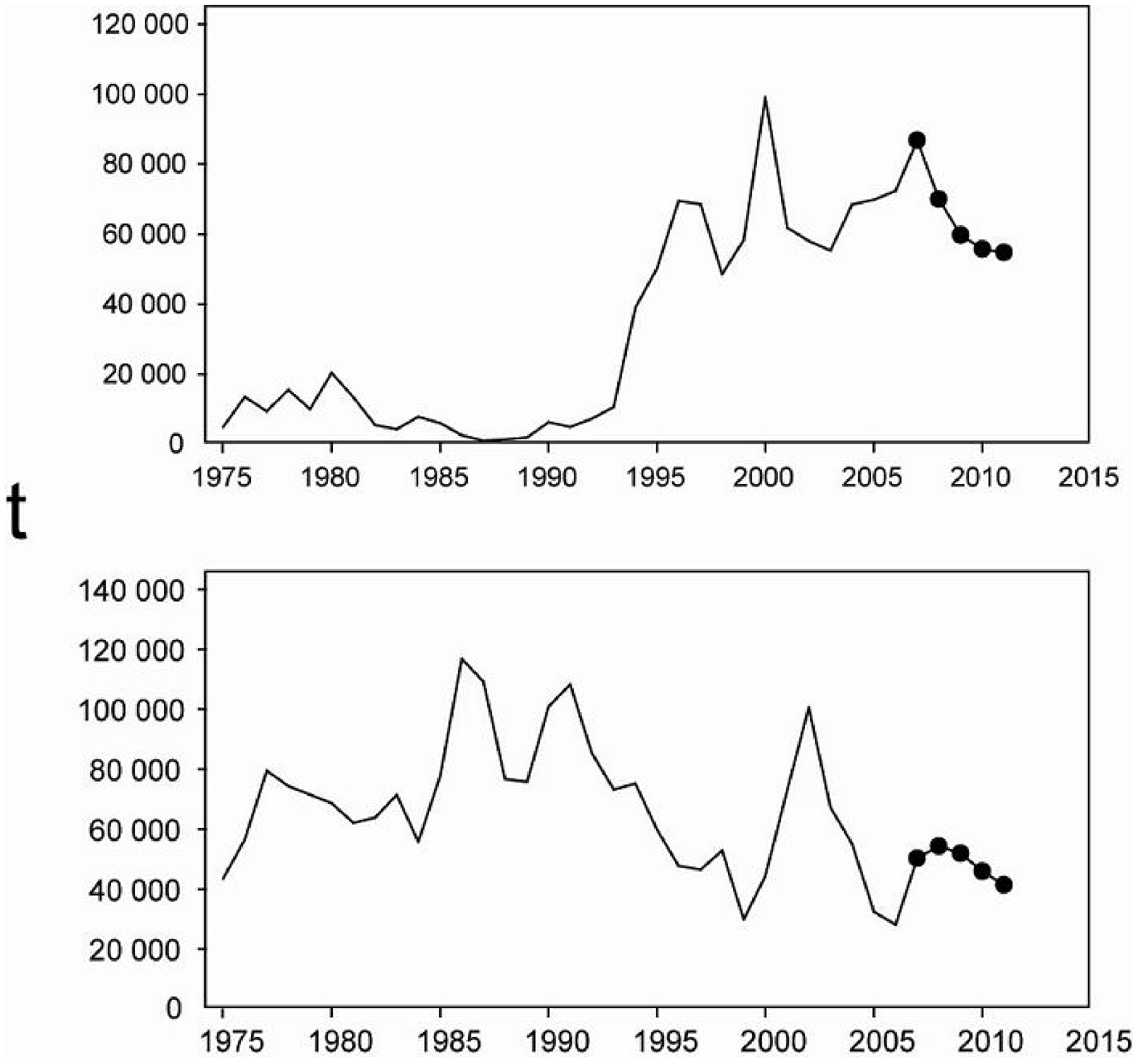

FIGURE D-7. Catches for 1975-2006, and predicted catches for 2007-2012, of bigeye tuna by the purse-seine and pole-and-line (upper panel) and longline (lower panel) fisheries. The predicted catches are based on average fishing mortality for 2004 and 2005.

FIGURA D-7. Capturas de atún patudo durante 1975-2006, y predichas para 2007-2012, por las pesquerías de cerco y de caña (recuadro superior) y de palangre (recuadro inferior). Las capturas predichas se basan en la mortalida por pesca promedio de 2004 y 2005.

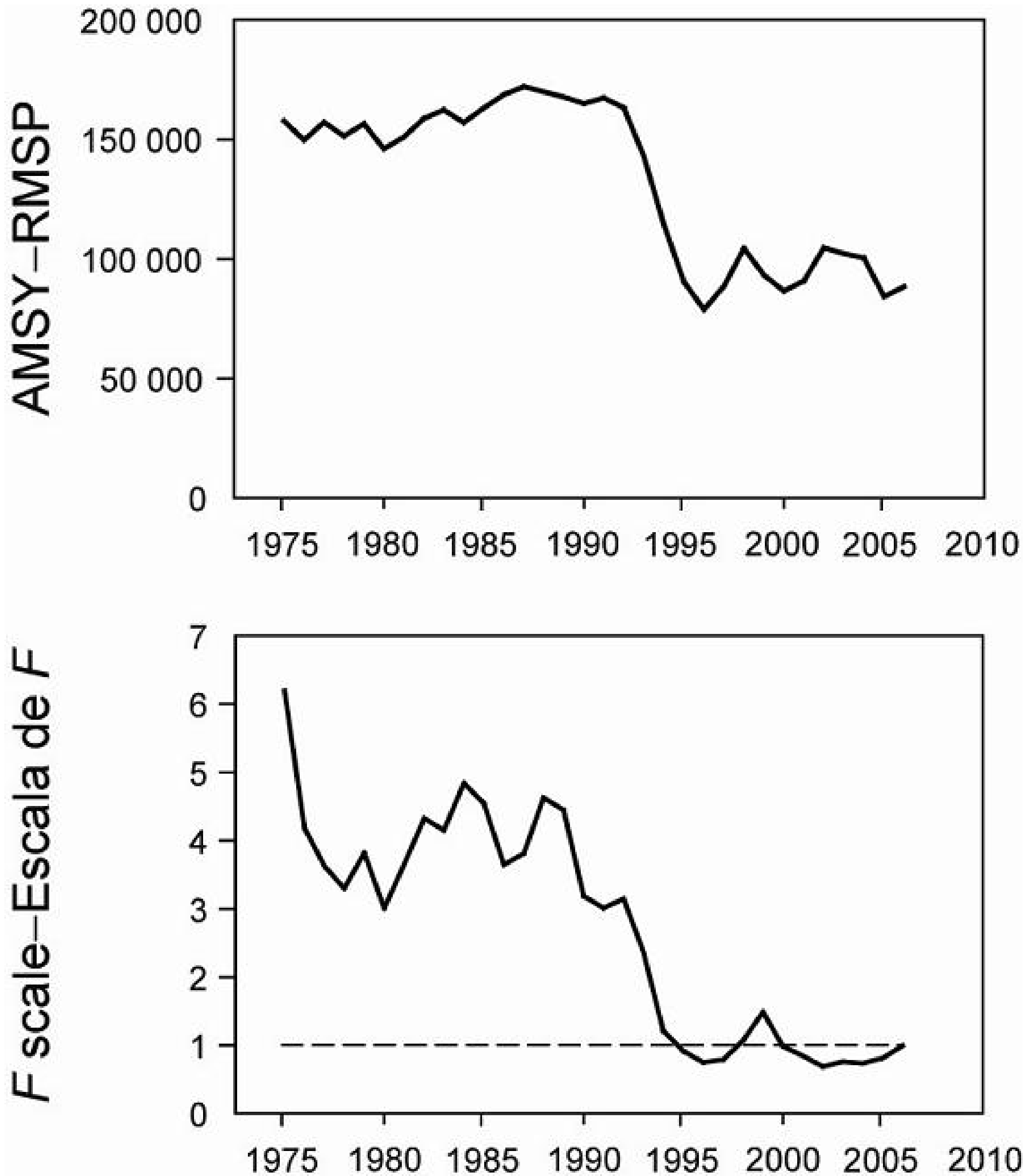

FIGURE D-8. AMSY (upper panel), 1975-2006, and the change (increase or reduction) in the effort required to produce the AMSY (lower panel) for bigeye tuna, estimated separately for each year, using the average age-specific fishing mortality for that year.

FIGURA D-8. RMSP (recuadro superior), 1975-2006, y cambio (aumento o reducción) del esfuerzo necesario para producir el RMSP (recuadro inferior), de atún patudo, estimado por separado para cada año, usando la mortalidad por pesca promedio por edad de ese año.

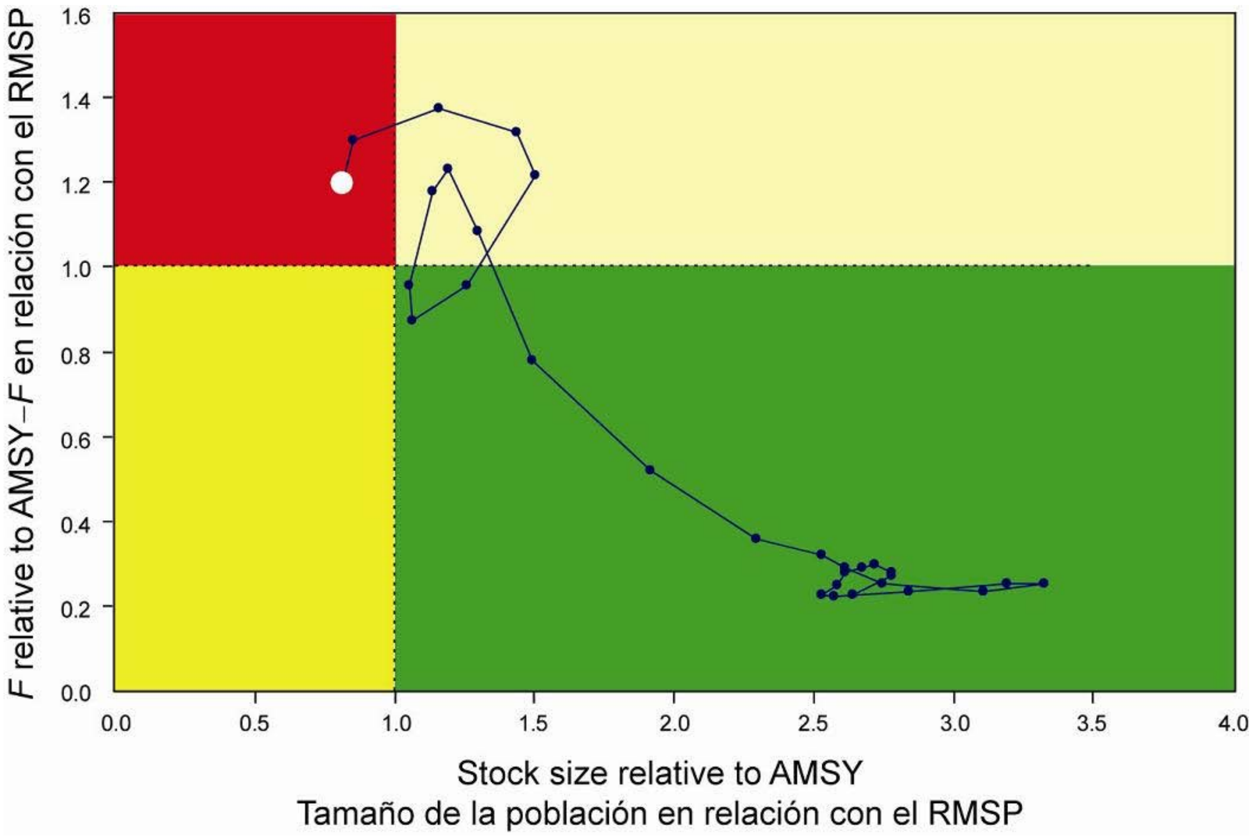

FIGURE D-9. Phase plot of the time series of estimates of stock size and fishing mortality of bigeye tuna relative to their AMSY reference points. Each dot is a running average of three years. The large dot indicates the most recent estimate.

FIGURA D-9. Gráfica de fase de la serie de tiempo de las estimaciones del tamaño de la población y la mortalidad por pesca de atún patudo en relación con sus puntos de referencia de RMSP. Cada punto representa un promedio móvil de tres años. El punto grande indica la estimación más reciente.

TABLE D-1. Estimates of the AMSY of bigeye tuna, and associated quantities for the base case assessment and the sensitivity analysis including a stock-recruitment relationship with steepness (*h*) of 0.75. All analyses are based on average fishing mortality for 2004-2006. B_{2007}, B_{AMSY}, and B_0 are the biomass of bigeye 3+ quarters old at the start of 2007, at AMSY, and without fishing, respectively, and S_{2007}, S_{AMSY}, and S_0 are the relative number of eggs (index of spawning biomass) at the start of 2007, at AMSY, and without fishing, respectively. C_{2006} is the estimated total catch in 2006.

TABLA D-1. Estimaciones del RMSP de atún patudo y valores asociados para la evaluación del caso base y el análisis de sensibilidad que incluye una relación población-reclutamiento con una inclinación (*h*) de 0.75. Todos los análisis se basan en la mortalidad por pesca media de 2004-2006. B_{2007}, B_{RMSP}, y B_0 son la biomasa de patudo de edad 3+ trimestres al principio de 2006, en RMSP, y sin pesca, respectivamente, y S_{2007}, S_{RMSP}, y S_0 son el número relativo de huevos (índice de biomasa relativa) al principio de 2007, en RMSP, y sin pesca, respectivamente. C_{2006} es la captura total estimada en 2006.

	Caso base **Basecase**	**Inclinación = 0.75** **Steepness = 0.75**
AMSY—RMSP	91,519	87,013
B_{AMSY}—B_{RMSP}	309,473	490,423
S_{AMSY}—S_{RMSP}	678	1,175
B_{AMSY}/B_0—B_{RMSP}/B_0	0.27	0.34
S_{AMSY}/S_0—S_{RMSP}/S_0	0.22	0.31
C_{2006}/AMSY—C_{2006}/RMSP	1.11	1.18
B_{2007}/B_{AMSY}—B_{2007}/B_{RMSP}	1.10	0.76
S_{2007}/S_{AMSY}—S_{2007}/S_{RMSP}	0.92	0.61
F multiplier—Multiplicador de *F*	0.83	0.59

D. ATÚN PATUDO

Han ocurrido cambios sustanciales en la pesquería de atún patudo en el Océano Pacífico oriental (OPO) en los últimos 15 años. Al principio, los buques de palangre tomaron la mayor parte de la captura de patudo, pero con la expansión de la pesca sobre dispositivos agregadores de peces (plantados) desde 1993, la pesquería de cerco ha tomado una proporción creciente de la captura (Figura D-1). Esta pesquería captura patudo de menor tamaño, y por lo tanto ha reducido el rendimiento por recluta y el rendimiento máximo sostenible promedio (RMSP). En promedio, la mortalidad por pesca de patudo de menos de unos cuatro años y medio de edad ha aumentado sustancialmente desde 1993, y la de los peces mayores ha aumentado ligeramente (Figura D-2).

Para la presente evaluación de la población de patudo del OPO se usó un análisis de la captura por talla y edad, *Stock Synthesis II* (SS2). Para las evaluaciones previas se usó el modelo A-SCALA. Hay varias diferencias entre los dos modelos, pero su estructura general y los datos usados son iguales (ver Informe de la Reunión sobre Métodos de Evaluación de Poblaciones[1]). En la página web de la CIAT[2] se presentan los detalles de la evaluación de la población.

El patudo se encuentra distribuido por todo el Océano Pacífico, pero la mayor parte de la captura proviene de las zonas oriental y occidental del mismo. Las capturas cerqueras de patudo son sustancialmente menores alrededor del límite occidental del OPO (150ºO; Figura A-3); las capturas palangreras son más continuas, pero muestran niveles más bajos entre 160ºO y 180º (Figura A-4). En el OPO, los buques de cerco rara vez capturan patudo al norte de 10ºN (Figura A-3), pero una porción sustancial de las capturas palangreras de patudo en el OPO proviene de la zona al norte de ese paralelo (Figura A-4). El patudo no se desplaza grandes distancias (el 95% de los especimenes marcados mostraron desplazamientos netos de menos de 1000 millas náuticas) y la información actual indica poco intercambio entre el Pacífico oriental y occidental (Figura D-3). Esto es consistente con las diferencias de las tendencias de la captura por unidad de esfuerzo (CPUE) palangrera entre zonas. Es probable que exista una población continua en el Océano Pacífico entero, con intercambio de individuos a nivel local. La evaluación aquí descrita fue realizada como si hubiese una sola población en el OPO. Los resultados son consistentes con los resultados de otros análisis del atún patudo en el Pacífico entero. Además, los análisis han demostrado que los resultados no son sensibles a la estructura espacial del análisis. En la actualidad, no existen suficientes datos de marcado para generar estimaciones adecuadas de desplazamientos entre el Océano Pacífico oriental y occidental.

Varios insumos de la presente evaluación son diferentes de aquéllos de 2005. Fueron incorporados datos recientes de captura y CPUE, y los datos anteriores fueron actualizados.

La serie de tiempo de estimaciones del reclutamiento de patudo tiene varias características importantes (Figura D-4). Las estimaciones del reclutamiento antes de 1993 son muy inciertas, ya que las pesquerías sobre plantados, que capturan patudo pequeño, no estaban en operación. Hubo un período de reclutamiento superior al promedio en 1995-1998, seguido por un período de reclutamiento inferior al promedio en 1999-2000. El reclutamiento ha sido superior al promedio desde 2000. La estimación del reclutamiento más reciente es incierta, debido a que el patudo reclutado recientemente se encuentra representado en solamente unos pocos muestras de frecuencia de talla. El período extendido de reclutamientos relativamente altos durante 1995-1998 coincidió con la expansión de las pesquerías que capturan patudo en asociación con objetos flotantes.

La biomasa de patudo de edad 3+ trimestres aumentó durante 1983-1984, y alcanzó su pico de unas 615.000 t en 1986, tras lo cual disminuyó a una mínima histórica de unas 279.000 t al principio de 2005. La biomasa reproductora ha seguido generalmente una tendencia similar a aquélla de la biomasa de peces de edad 3+ trimestres, pero con un retraso de 1 a 2 años. Se estima que la biomasa de los peces de edad 3+ trimestres y de los reproductores ha aumentado ligeramente a partir de 2005.

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[1] http://www.iattc.org/PDFFiles2/Assessment-methods-WS-Nov05-ReportSPN.pdf
[2] http://www.iattc.org/StockAssessmentReportsSPN.htm

En la Figura D-5 se ilustra la trayectoria estimada de la biomasa reproductora que hubiera ocurrido en ausencia de pesca y aquélla predicha por el modelo de evaluación, junto con una estimación de los impactos atribuidos a cada arte de pesca.

Al principio de 2007, la biomasa reproductora del patudo en el OPO (Figura D-6) se había recuperado ligeramente del nivel más bajo observado previamente. En ese momento se estimó que el cociente de biomasa reproductora (el cociente de la biomasa reproductora actual a la de la población no explotada, denominado SBR (*spawning biomass ratio*)) era aproximadamente 0,20, un 10% menos que el nivel correspondiente al RMSP (SBR_{RMSP}).

Se predice que los picos recientes del reclutamiento resultarán en niveles de SBR y de capturas palangreras mayores en los próximos pocos años. Sin embargo, se espera que el SBR será reducido subsecuentemente por altos niveles de mortalidad por pesca. Con los niveles actuales de esfuerzo, es poco probable que la población permanezca en niveles correspondientes al RMSP, a menos que se reduzca mucho la mortalidad por pesca o el reclutamiento sea mayor al promedio durante varios años consecutivos (Figura D-6).

En la evaluación del caso base se estima que las capturas recientes estuvieron alrededor del nivel del RMSP (Tabla D-1). Si la mortalidad por pesca es proporcional al esfuerzo de pesca, y se mantienen los patrones actuales de selectividad por edad, el nivel de esfuerzo de pesca correspondiente al RMSP es un 83% del nivel de esfuerzo actual (2004-2006). Se podría incrementar al máximo el RMSP de patudo en el OPO si el patrón de selectividad por edad fuese similar a aquél de la pesquería palangrera que faena al sur de 15°N porque captura peces más grandes que están cerca del peso crítico. Antes de la expansión de la pesquería sobre plantados, iniciada en 1993, el RMSP fue mayor que el RMSP actual, y la mortalidad por pesca (F) fue menor que F_{RMSP} (Figura D-8). En la Figura D-9 se ilustra la condición histórica de la población. Las dos estimaciones más recientes indican que la población de patudo en el OPO es sobrepescado ($S < S_{RMSP}$) y que está ocurriendo sobrepesca ($F>F_{RMSP}$).

Se realizaron análisis para evaluar la sensibilidad de los resultados de la evaluación de la población a: 1) la incorporación de una relación población-reclutamiento; 2) el uso de los datos de CPUE de la pesquería de palangre del sur solamente; 3) la estimación de los parámetros de crecimiento o la suposición de estimaciones del parámetro de talla asintótica de la curva de crecimiento de von Bertalanffy; 4) ajuste a la captura de equilibrio inicial; 5) la reponderación iterativa de los datos; 6) el uso de dos bloques de tiempo para la selectividad y capturabilidad de la pesquería de palangre del sur; y 7) la inclusión de los nuevos datos de palangre japoneses.

De los 10 análisis realizados, 7 estimaron que, al principio de 2007, la biomasa reproductora estuvo por debajo del nivel correspondiente al RMSP. El RMSP y el multiplicador de mortalidad por pesca (F) son sensibles a la parametrización del modelo, a los datos que se incluyen en la evaluación, y a los períodos que se supone representan la mortalidad por pesca media, pero en ocho de los escenarios considerados, la mortalidad por pesca actual está por encima del nivel correspondiente al RMSP.

Las estimaciones de reclutamiento y biomasa fueron moderadamente sensibles a la inclinación de la relación población-reclutamiento. La condición actual y las proyecciones a futuro son considerablemente más pesimistas, en términos de la condición de la población relativa a los niveles que soportan el RMSP, si existe una relación población-reclutamiento (h = 0.75).

Los efectos de la Resolución C-04-09 de la CIAT son insuficientes para mantener a la población en los niveles que permitirán el RMSP.

RESUMEN:

1. Los niveles recientes de mortalidad por pesca son aproximadamente un 20% mayores que los que corresponden al RMSP.
2. Como consecuencia, si no se reduce el esfuerzo de pesca, la biomasa total y la biomasa reproductora disminuirán a la larga al menos al nivel observado en 2004.

3. La situación actual y las proyecciones a futuro son considerablemente más pesimistas, en términos de la condición de la población, si existe una relación población-reclutamiento (h = 0.75).
4. Estas conclusiones son robustas a todos los modelos y formulaciones de datos alternativos considerados en el presente análisis y en análisis previos, menos dos.

E. PACIFIC BLUEFIN TUNA

Tagging studies have shown that there is exchange of Pacific bluefin between the eastern and western Pacific Ocean. Larval, postlarval, and early juvenile bluefin have been caught in the WCPO but not the EPO, so it is likely that there is a single stock of bluefin in the Pacific Ocean.

Most of the catches of bluefin in the EPO are taken by purse seiners. Nearly all of the purse-seine catch is made west of Baja California and California, within about 100 nautical miles of the coast, between about 23°N and 35°N. Ninety percent of the catch is estimated to have been between 60 and 100 cm in length, representing mostly fish 1 to 3 years old. In recent years a considerable portion of the purse-seine catch of bluefin has been transported to holding pens, where the fish are held for fattening and later sale to sashimi markets. Lesser amounts of bluefin are caught by recreational, gillnet, and longline gear. Bluefin have been caught during every month of the year, but most of the fish are taken during May through October.

Bluefin are exploited by various gears in the WCPO from Taiwan to Hokkaido. Age-0 fish about 15 to 30 cm in length are caught by trolling during July-October south of Shikoku Island and south of Shizuoka Prefecture. During November-April age-0 fish about 35 to 60 cm in length are taken by trolling south and west of Kyushu Island. Age-1 and older fish are caught by purse seining, mostly during May-September, between about 30°-42°N and 140°-152°E. Bluefin of various sizes are also caught by traps, gillnets, and other gear, especially in the Sea of Japan. Small amounts of bluefin are caught near the southeastern coast of Japan by longlining. The Chinese Taipei small-scale longline fishery, which has expanded since 1996, takes bluefin tuna over 180 cm in length from late April to June, when they are aggregated for spawning in the waters east of the northern Philippines and Taiwan.

The high-seas longline fisheries are directed mainly at tropical tunas, albacore, and billfishes, but small amounts of Pacific bluefin are caught by these fisheries. Small amounts of bluefin are also caught by Japanese pole-and-line vessels on the high seas.

Tagging studies, conducted with conventional and archival tags, have revealed a great deal of information about the life history of bluefin. Some fish apparently remain their entire lives in the WCPO, while others migrate to the EPO. These migrations begin mostly during the first and second years of life. The first- and second-year migrants are exposed to various fisheries before beginning their journey to the EPO. The migrants, after crossing the ocean, are exposed to commercial and recreational fisheries off California and Baja California. Eventually, the survivors return to the WCPO.

Bluefin are most often found in waters where the sea-surface temperatures (SSTs) are between 17° and 23°C. Fish 15 to 31 cm in length are found in the WCPO in waters where the SSTs are between 24° and 29°C. The survival of larval and early juvenile bluefin is undoubtedly strongly influenced by the environment. Conditions in the WCPO probably influence the portions of the juvenile fish there that move to the EPO, and also the timing of these movements. Likewise, conditions in the EPO probably influence the timing of the return of the juvenile fish to the WCPO.

An index of abundance for the predominantly young bluefin in the EPO has been calculated, based on standardization of catch per vessel day using a generalized linear model, and including the variables latitude, longitude, SST, SST^2, month, and vessel identification number. The index is highly variable, but shows a peak in the early 1960s, very low levels for a period in the early 1980s, and some increase since that time.

A preliminary stock assessment carried out by the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) has indicated that the biomass of the spawning stock had local peaks during the early 1960s, late 1970s and late 1990s, with a decline after the last peak. However, the relative strengths of these peaks are highly uncertain. The recruitment was estimated to be highly variable, with four to seven strong cohorts produced during the 1960-2003 period. A strong recruitment event that may have occurred in 2001 would maintain spawning stock biomass above recent levels until about 2010. Further work is necessary to provide a scientific basis for any management actions.

The total catches of bluefin have fluctuated considerably during the last 50 years (Figure E-1). The presence of consecutive years of above-average catches (mid-1950s to mid-1960s) and below-average catches (early 1980s to early 1990s) could be due to consecutive years of above-average and below-average recruitment. The results of yield-per-recruit and cohort analyses indicate that greater catches could be obtained if the catches of age-0 and age-1 fish were reduced or eliminated.

Spawner-recruit analyses do not indicate that the recruitment of Pacific bluefin could be increased by permitting more fish to spawn.

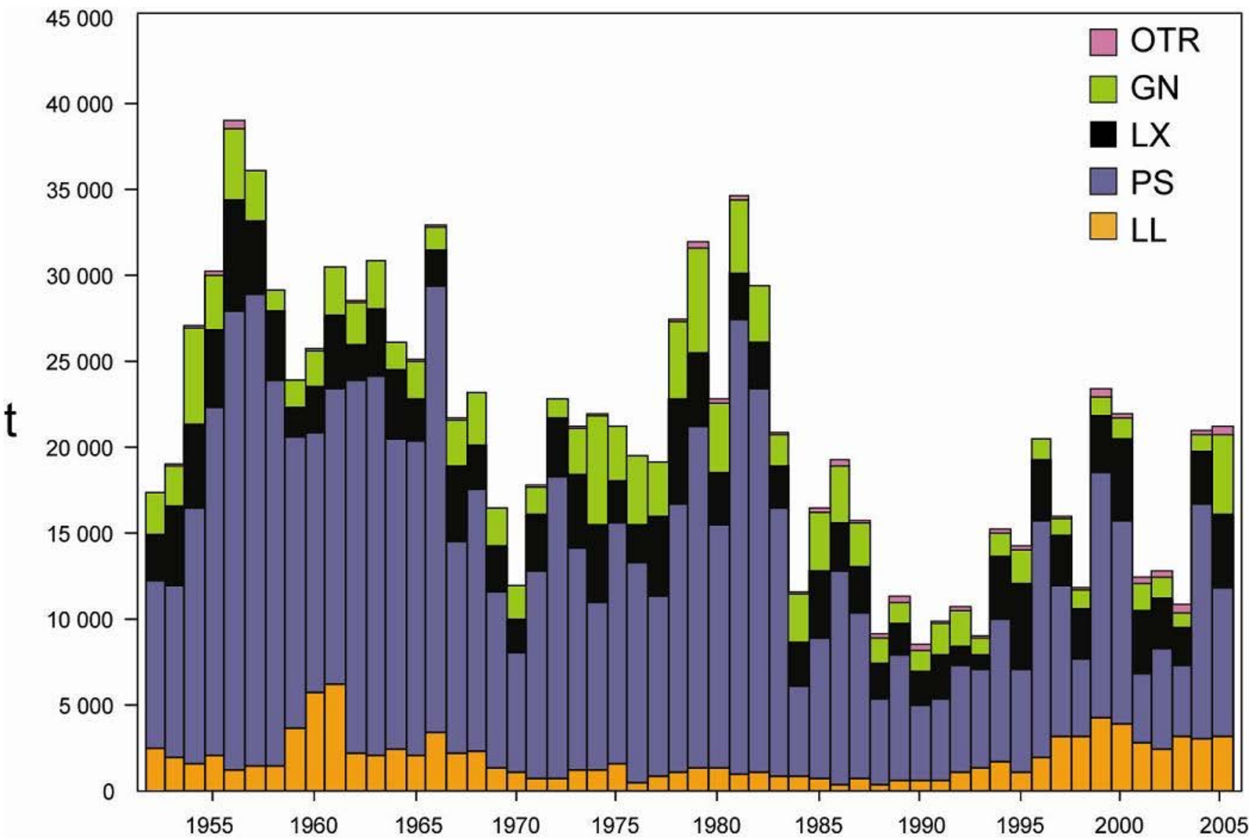

FIGURE E-1. Retained catches of Pacific bluefin, 1952-2005.
FIGURA E-1. Capturas retenidas de aleta azul del Pacífico, 1952-2005.

E. ATÚN ALETA AZUL DEL PACÍFICO

Estudios de marcado han demostrado que ocurre intercambio de aleta azul del Pacífico entre el Océano Pacífico oriental y occidental. Se han capturado aletas azules larvales, poslarvales, y juveniles tempranos en el Pacífico occidental pero no en el OPO, por lo que es probable que exista una sola población de aleta azul en el Océano Pacífico.

La mayoría de las capturas de aleta azul en el OPO es realizada por buques cerqueros. Casi toda la captura cerquera proviene de una zona frente a Baja California y California, a menos de unas 100 millas náuticas de la costa, entre 23°N y 35°N. Se estima que el 90% de la captura midió entre 60 y 100 cm de talla, representando principalmente peces de entre 1 y 3 años de edad. En los últimos años una porción considerable de la captura cerquera de aleta azul ha sido transportada a corrales marinos, donde se mantienen los peces para engordarlos y luego venderlos en el mercado de *sashimi*. Se capturan cantidades menores de aleta azul con arte de pesca deportiva, redes de transmalle, y palangres. Se captura la especie en todos los meses del año, pero la mayor parte de la captura es lograda entre mayo y octubre.

El aleta azul es pescado con varias artes en el Pacífico occidental y central desde Taiwán hasta Hokkaido. Peces de 0 años de edad de entre unos 15 y 30 cm de talla son capturados con curricán durante julio-octubre al sur de Shikoku y al sur de la Prefectura de Shizuoka. Durante noviembre-abril peces de edad 0 de entre unos 35 y 60 cm son capturados con curricán al sur y oeste de Kyushu. Peces de edad 1 y mayores son capturados con redes de cerco, principalmente durante mayo-septiembre, entre 30°-42°N y 140°-152°E. Se capturan también aletas azules de varios tamaños con trampas, redes de transmalle, y otras artes de pesca, especialmente en el Mar de Japón. Se capturan pequeñas cantidades de la especie con palangre cerca del litoral sudeste de Japón. La pesquería palangrera a pequeña escala de Taipei Chino, que se ha expandido desde 1996, captura atunes aleta azul de más de 180 cm desde fines de abril hasta junio, cuando se agregan para el desove en las aguas al este del norte de Filipinas y Taiwán.

Las pesquerías palangreras de alta mar están dirigidas principalmente hacia los atunes tropicales, la albacora, y los peces picudos, pero capturan pequeñas cantidades de aleta azul del Pacífico. Buques cañeros japoneses capturan asimismo pequeñas cantidades de aleta azul en alta mar.

Estudios de marcado, con marcas convencionales y archivadoras, han arrojado una gran cantidad de información sobre el ciclo vital del aleta azul. Algunos peces permanecen aparentemente toda la vida en el Pacífico occidental, mientras que otros migran al OPO; estas migraciones comienzan principalmente durante el primer y segundo año de vida. Los migrantes de primer o segundo año están expuestos a varias pesquerías antes de iniciar su migración al OPO. Después de cruzar el océano, están expuestos a las pesquerías comercial y deportiva frente a California y Baja California. Posteriormente, los supervivientes regresan al Pacífico occidental.

Se encuentra el aleta azul con mayor frecuencia en aguas de entre 17° y 23°C de temperatura de superficie. En el Pacífico occidental se encuentran peces de entre 15 y 31 cm en aguas de entre 24° y 29°C de temperatura de superficie. La supervivencia de las larvas y juveniles tempranos de la especie es indudablemente afectada de manera importante por las condiciones ambientales. Las condiciones en el Pacífico occidental afectan probablemente cuáles porciones de los peces juveniles migran al OPO, y cuándo. Asimismo, las condiciones en el OPO probablemente afectan cuándo los peces juveniles regresan al Pacífico occidental.

Se ha calculado un índice de abundancia para el aleta azul predominantemente joven en el OPO, basado en una estandarización de la captura por día de buque usando un modelo lineal generalizado, y incluyendo las variables latitud, longitud, TSM, TSM^2, mes, y número de identificación del buque. El índice es altamente variable, pero señala un pico a principios de los años 1960, niveles muy bajos durante un período a principios de los años 1980, y cierto aumento desde entonces.

Una evaluación de la población realizada por el Comité Científico Internacional del Pacífico Norte indicó que la biomasa de la población reproductora mostró picos locales a principios de los años 1960 y a fines de los 1970 y 1990, con una disminución después del último pico, pero la fuerza relativo de estos picos es altamente incierta. Se estimó que el reclutamiento fue altamente variable, con de cuatro a siete cohortes fuertes producidas entre 1960 y 2003. Un evento fuerte de reclutamiento que parece haber ocurrido en 2001 mantendría a la biomasa de la población reproductora por encima de los niveles recientes hasta aproximadamente 2010. Es necesario más trabajo para establecer las bases científicas para cualquier acción de ordenación.

Las capturas totales de aleta azul han fluctuado considerablemente en los últimos 50 años (Figura E-1). La presencia de años consecutivos de capturas superiores al promedio (mediados de la década de 1950 a mediados de la siguiente) e inferiores al mismo (principios de los 1980 a principios de los 1990) podría deberse a años consecutivos de reclutamiento superior e inferior al promedio. Los resultados de análisis de rendimiento por recluta y de cohortes indican que sería posible obtener capturas mayores si se redujeran o eliminaran las capturas de peces de edad 0 y de edad 1.

Los análisis reproductor-recluta no indican que aumentaría el reclutamiento del aleta azul del Pacífico si se permitiera a más peces desovar.

F. ALBACORE TUNA

There are two stocks of albacore in the Pacific Ocean, one occurring in the northern hemisphere and the other in the southern hemisphere. Albacore are caught by longline gear in most of the North and South Pacific, but not often between about 10°N and 5°S, by trolling gear in the eastern and central North and South Pacific, and by pole-and-line gear in the western North Pacific. In the North Pacific about 60% of the fish are taken in pole-and-line and troll fisheries that catch smaller, younger albacore, whereas about 90% of the albacore caught in the South Pacific are taken by longline. The total annual catches of North Pacific albacore peaked in 1976 at about 125,000 t, and have declined since, reaching levels of about 85,000 t in 2005. The catches increased during the 1990s, reaching 121,500 t in 1999 (Figure F-1a). The total annual catches of South Pacific albacore have ranged between about 25,000 and 65,000 t since 1980 (Figure F-1b).

Juvenile and adult albacore are caught mostly in the Kuroshio Current, the North Pacific Transition Zone, and the California Current in the North Pacific and the Subtropical Convergence Zone in the South Pacific, but spawning occurs in tropical and subtropical waters, centering around 20ºN and 20ºS latitudes. North Pacific albacore are believed to spawn between March and July in the western and central Pacific.

The movements of North Pacific albacore are strongly influenced by oceanic conditions, and migrating albacore tend to concentrate along oceanic fronts in the North Pacific Transition Zone. Most of the catches are made in water temperatures between 15º and 19.5ºC. Details of the migration remain unclear, but juvenile fish (2- to 5-year-olds) are believed to move into the EPO in the spring and early summer, and return to the western and central Pacific, perhaps annually, in the late fall and winter, where they tend to remain as they mature. It has been hypothesized that there are two subgroups of North Pacific albacore, separated at about 40ºN in the EPO, with the northern subgroup more likely to migrate to the western and central Pacific Ocean.

Less is known about the movements of albacore in the South Pacific Ocean. The juveniles move southward from the tropics when they are about 35 cm long, and then eastward along the Subtropical Convergence Zone to about 130°W. When the fish approach maturity they return to tropical waters, where they spawn. Recoveries of tagged fish released in areas east of 155°W were usually made at locations to the east and north of the release site, whereas those of fish released west of 155°W were usually made at locations to the west and north of the release site.

New age-structured stock assessments were presented for the South and North Pacific stocks of albacore in 2003 and 2004, respectively.

The South Pacific assessment, carried out with MULTIFAN-CL by the Secretariat of the Pacific Community, incorporated catch and effort, length-frequency, and tagging data. The stock was estimated to be well above the level corresponding to the average maximum sustainable yield (AMSY). The catches would continue to increase with further increases in effort, though the extent to which the sustainable yield could increase as total biomass decreases is not well determined. Although the recent recruitments are estimated to be slightly below average, there currently appears to be no need to restrict the fisheries for albacore in the South Pacific Ocean.

Virtual population analyses of the North Pacific stock of albacore were carried out during the 19th North Pacific Albacore Workshop in 2004. The estimated 2004 biomass, 438,000 t (Figure F-2), was about 25% greater than that estimated for 1975, the first year of the period modeled. The estimated recruitments since 1990 have generally been greater than those of the 1980s, and the catches per unit effort (CPUEs) for most of the pole-and-line and troll fisheries have increased in recent years. However, the longline CPUEs have declined since the mid-1990s. The Workshop estimated low (0.43) and high (0.68) levels for fishing mortality (F) at full recruitment, and noted that if the rates of F continue at assumed levels, it is unlikely that the spawning stock biomass (SSB) will rebuild to SSB_{AMSY} levels within five years.

The 2005 meeting of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) gave the following advice:

> "Future SSB can be maintained at or above the minimum 'observed' SSB (43,000 t in 1977) with F's slightly higher than the current F range. However, the lowest 'observed' SSB estimates all occurred in late 1970's and may be the least reliable estimates of SSB. A more robust SSB threshold could be based on the lower 10th or 25th percentile of 'observed' SSB. If so done, current F should maintain SSB at or above the 10th percentile threshold but a modest reduction from current F may be needed to maintain SSB at or above the 25th percentile threshold."

The IATTC staff considers the higher level for current fishing mortality (0.68) to be more likely, based on the methods used to calculate the estimates. Furthermore, even the high estimate may be too low, given the retrospective bias shown by the model. According to the estimates of the 2004 North Pacific Albacore Workshop, the higher fishing mortality of 0.68 implies an equilibrium spawning stock biomass at 17% of unfished levels. Projections assuming fishing mortality of 0.68, under scenarios of low and high future recruitment, suggest that the biomass may decline if the current levels of fishing mortality persist.

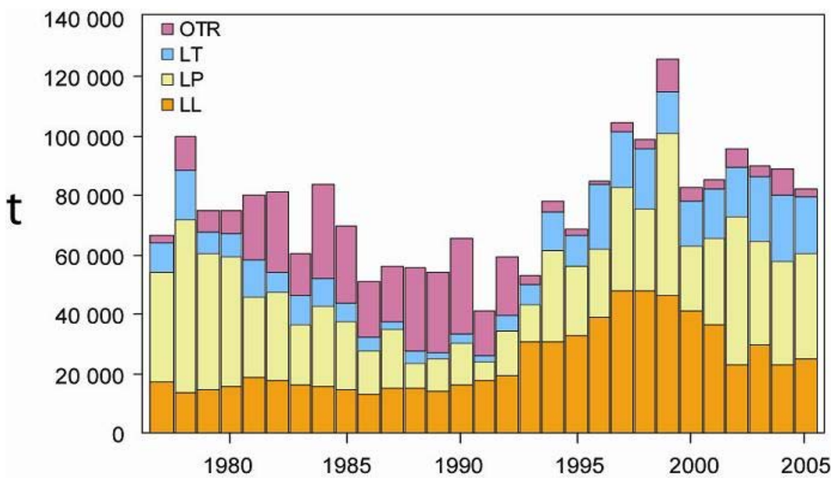

FIGURE F-1a. Retained catches of North Pacific albacore, 1977-2005.
FIGURA F-1a. Capturas retenidas de albacora del Pacífico norte, 1977-2005.

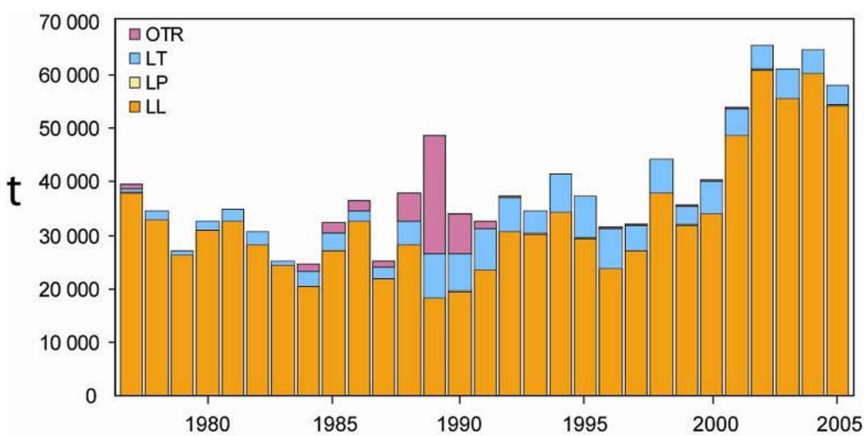

FIGURE F-1b. Retained catches of South Pacific albacore, 1977-2005.
FIGURA F-1b. Capturas retenidas de albacora del Pacífico sur, 1977-2005.

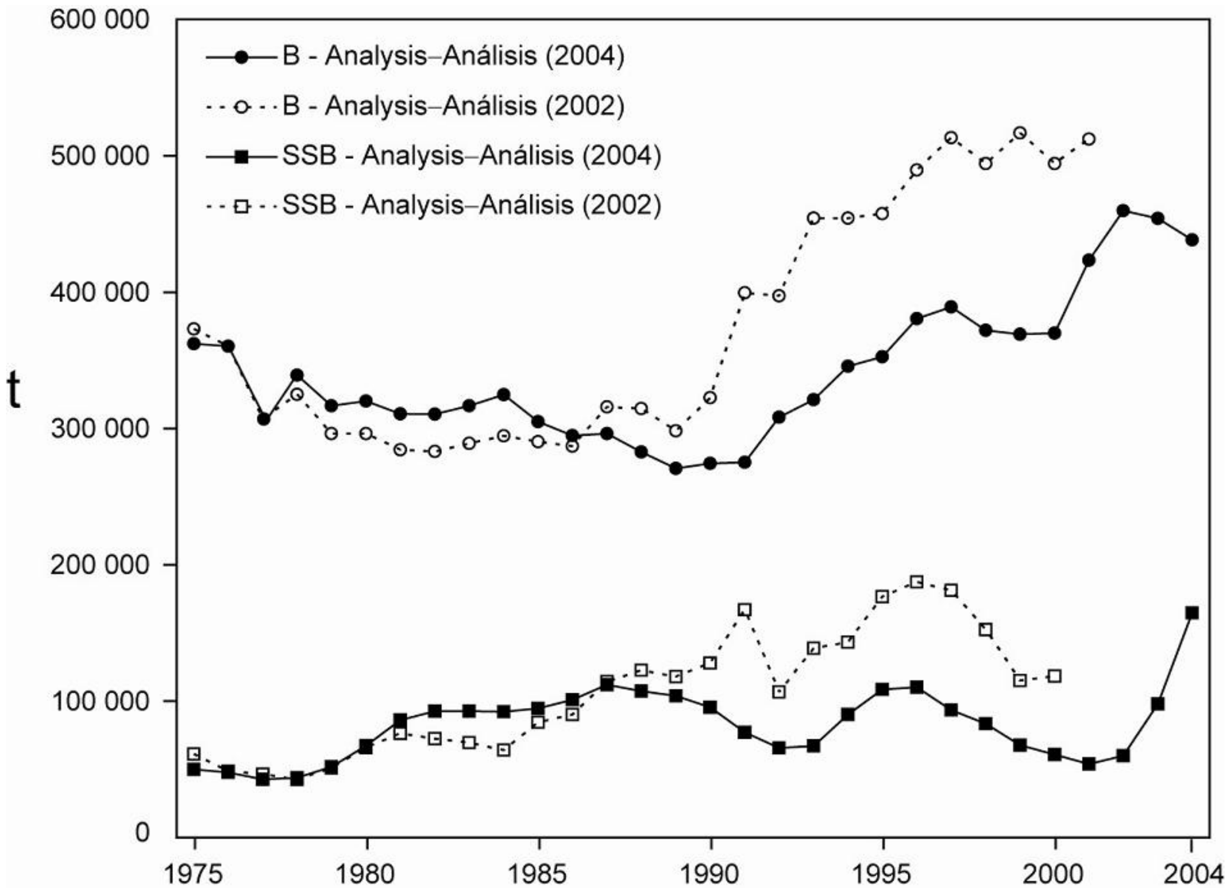

FIGURE F-2. Total biomass (B), and spawning stock biomass (SSB) of North Pacific albacore tuna from the North Pacific Albacore Workshop analyses of 2002 and 2004. The values of B are based on estimates of the 1 January biomass, and those for SSB on estimates at the beginning of the spawning season ("mid-year").

FIGURA F-2. Biomasa total (B) y biomasa de la población reproductora (SSB) del atún albacora del Pacífico Norte de los análisis de la Reunión Técnica sobre el Albacora del Pacífico Norte de 2002 y 2004. Los valores de B se basan en estimaciones de la biomasa al 1 de enero, y aquéllas de SSB en estimaciones al principio de la temporada de desove ("medio año").

F. ATÚN ALBACORA

Hay dos poblaciones de atún albacora en el Océano Pacífico, una en el hemisferio norte y la otra en el hemisferio sur. La especie es capturada con palangre en la mayor parte del Pacífico Norte y Sur, pero rara vez entre aproximadamente 10°N y 5°S, con curricán en el Pacífico Norte y Sur oriental y central, y con caña en el Pacífico Norte occidental. En el Pacífico Norte un 60% del pescado es capturado con caña y curricán, que capturan albacora más joven de menor tamaño, mientras que en el Pacífico Sur un 90% de la captura de albacora es tomada con palangre. Las capturas totales anuales de albacora del Pacífico Norte alcanzaron su nivel máximo de más de 125.000 t anuales en 1976, y han disminuido desde entonces, a unas 85.000 t en 2005. En los años 1990 volvieron a aumentar, y en 1999 alcanzaron 121.500 t (Figura F-1a). Las capturas anuales totales de albacora del Pacífico Sur han variado entre unas 25 mil y 65 mil t desde 1980 (Figura F-1b).

El atún albacora juvenil y adulto es capturado principalmente en la Corriente de Kuroshio, la Zona de Transición del Pacífico Norte, y la Corriente de California en el Pacífico norte y la Zona de Convergencia Subtropical en el Pacífico sur, pero el desove ocurre en aguas tropicales y subtropicales, y se centra en los paralelos de 20ºN y 20ºS. Se cree que el albacora del Pacífico Norte desova entro marzo y julio en el Pacífico occidental y central.

Los desplazamientos del albacora del Pacífico Norte son fuertemente afectados por las condiciones oceánicas, y los migrantes suelen estar concentrados en frentes oceánicos en la Zona de Transición del Pacífico Norte. La mayoría de las capturas tienen lugar en aguas de entre 15º y 19.5ºC. No quedan claros los detalles de la migración, pero se cree que peces juveniles (de entre 2 y 5 años de edad) se trasladan al OPO en la primavera y a principios del verano, y vuelven al Pacífico occidental y central, tal vez anualmente, a fines de otoño y en el invierno, donde suelen permanecer cuando maduran. Se ha propuesto la hipótesis de dos subgrupos de albacora del Pacífico Norte, separados en aproximadamente 40ºN en el Pacífico oriental, y que el subgrupo del norte tiene la mayor probabilidad de migrar al Pacífico occidental y central.

Se sabe menos acerca de los desplazamientos de albacora en el Pacífico sur. Los juveniles se desplazan de los trópicos hacia el sur cuando miden unos 35 cm, y luego hacia el este por la Zona de Convergencia Subtropical hasta aproximadamente 130°O. Poco antes de alcanzar la madurez vuelven a aguas tropicales, donde desovan. Marcas fijadas en peces liberados al este de 155°O fueron recuperadas generalmente en lugares al este y norte del punto de liberación, mientras que aquéllas fijadas al oeste de 155°O fueron recuperadas generalmente en lugares al oeste y norte del punto de liberación.

En 2002 y 2003 fueron presentadas nuevas evaluaciones por edad de las poblaciones de albacora del Pacífico Sur y Norte, respectivamente.

La evaluación del Pacífico Sur, realizada con MULTIFAN-CL por la Secretaría de la Comunidad del Pacífico, incorporó datos de captura y esfuerzo, frecuencia de talla, y marcado. Se estimó que la población está bastante por encima del nivel correspondiente al rendimiento máximo sostenible promedio (RMSP). Las capturas seguirían aumentando con aumentos del esfuerzo, aunque no se sabe bien hasta cuál punto el rendimiento sostenible podría aumentar a medida que disminuye la biomasa total. Aunque se estima que los reclutamientos recientes fueron ligeramente inferiores al promedio, no parece haber en la actualidad ninguna necesidad de limitar la pesca de albacora en el Pacífico Sur.

Durante la 19ª Reunión Técnica sobre el Albacora del Pacífico Norte en 2004 se realizaron análisis de poblaciones virtuales de dicha población. La biomasa estimada de 2004, 438.000 t (Figura F-2), es un 25% mayor que la que se estimó para 1975, el primer año del período modelado. Los reclutamientos estimados desde 1990 fueron generalmente mayores que los de la década de 1980, y las capturas por unidad de esfuerzo (CPUE) de la mayoría de las pesquerías cañeras y curricaneras han aumentado en los últimos años. No obstante, las CPUE palangreras han disminuido desde mediados de los años 1990. La reunión estimó tasas de mortalidad por pesca (F) baja (0,43) y alta (0,68) con pleno reclutamiento, y notó que si F

continúa en los niveles supuestos, es poco probable que la biomasa de la población reproductora (*spawning stock biomass*, SSB) se recupere al niveles de SSB_{RMSP} dentro de cinco años.

La reunión de 2005 del Comité Científico Internacional Comité Científico Internacional sobre los Atunes y Especies Afines en el Océano Pacífico Norte (ISC) asesoró como sigue:

> "El SSB futuro puede ser mantenido en el SSB mínimo 'observado' (43.000 t en 1977), o por encima de ese nivel, con F ligeramente más altos que el rango de F actuales. Sin embargo, las estimaciones de SSB más bajas observadas ocurrieron todas a fines de la década de 1970 y podrían ser las estimaciones menos confiables de SSB. Un nivel umbral de SSB más robusto podría basarse en el 10° o 25° percentil inferior del SSB 'observado'. Si se hiciera esto, el F actual debería mantener el SSB en, o por encima de, el umbral del 10° percentil pero una modesta reducción del F actual podría ser necesaria para mantener el SSB en o por encima del umbral del 25° percentil."

El personal de la CIAT considera que el nivel más alto de *F* actual (0,68) es más probable, con base en los métodos usados para calcular las estimaciones. Además, es posible que hasta la estimación alta sea demasiado baja, dado el sesgo retrospectivo demostrado por el modelo. Según las estimaciones de la Reunión Técnica de 2004, la *F* actual de 0,68 implica una biomasa de equilibrio de la población reproductora en el 17% de los niveles sin explotación, y las proyecciones que suponen una *F* de 0,68, con escenarios de reclutamiento futuro alto y bajo, sugieren que la biomasa podría disminuir si persisten los niveles actuales de mortalidad por pesca.

G. SWORDFISH

Swordfish occur throughout the Pacific Ocean between about 50°N and 50°S. They are caught mostly by the longline fisheries of Far East and Western Hemisphere nations. Lesser amounts are taken by gillnet and harpoon fisheries. They are seldom caught by recreational fishermen. During the most recent three-year period the greatest catches in the EPO have been taken by vessels of Spain, Chile, and Japan, which together harvest about 70% of the total swordfish catch taken in the region. Of these three, Spain and Chile have fisheries that target swordfish, while the swordfish taken in the Japanese fishery are incidental catches of a fishery that targets predominantly bigeye tuna. Other nations with fisheries known to target swordfish are Mexico and the United States.

Swordfish reach maturity at about 5 to 6 years of age, when they are about 150 to 170 cm in length. They probably spawn more than once per season. Unequal sex ratios occur frequently. For fish greater than 170 cm in length, the proportion of females increases with increasing length.

Only fragmentary data are available on the movements of swordfish. They tend to inhabit waters further below the surface during the day than at night.

Swordfish tend to inhabit frontal zones. Several of these occur in the eastern Pacific Ocean (EPO), including areas off California and Baja California, off Ecuador, Peru, and Chile, and in the equatorial Pacific. Swordfish tolerate temperatures of about 5° to 27°C, but their optimum range is about 18° to 22°C. Swordfish larvae have been found only at temperatures exceeding 24°C.

The best available scientific information from genetic and fishery data indicate that the swordfish of the southeastern Pacific Ocean (SEPO, south of 5°S) and the northeastern Pacific Ocean constitute two distinct stocks. Also, there may be movement of a northwestern Pacific stock of swordfish into the EPO at various times.

The results of preliminary modeling with MULTIFAN-CL of a North Pacific swordfish stock in the area north of 10°N and west of 140°W indicate that in recent years the biomass level has been stable and well above 50% of the unexploited levels of stock biomass, indicating that these swordfish are not overexploited at current levels of fishing effort.

The standardized catches per unit of effort of the longline fisheries in the northern region of the EPO and trends in relative abundance obtained from them do not indicate declining abundances. Attempts to fit production models to the data failed to produce estimates of management parameters, such as average maximum sustainable yield (AMSY), under reasonable assumptions of natural mortality rates, due to lack of contrast in the trends. This lack of contrast suggests that the fisheries in this region have not been of magnitudes sufficient to cause significant responses in the populations. Based on these considerations, and the long period of relatively stable catches in the northern region (Figure G-1), it appears that swordfish are not overfished in the northern region of the EPO.

An assessment of the southern stock of swordfish in the EPO was carried out with Stock Synthesis II (SS2), version 1.23b, with the following results. The population has undergone considerable changes in biomass, and is currently at a moderate level of depletion. There is strong evidence of one or two large cohorts entering the fishery recently, but their strengths are uncertain. The trend in spawning biomass ratio (the ratio of the spawning biomass of the current stock to that of the unfished stock; SBR) for this stock is estimated to have been between about 0.5 and 0.9 during the entire period of monitoring (1945-2003), and to have decreased to its lowest levels during the mid-1960s and again during the mid-1990s.

The AMSY for the southern EPO swordfish stock is about 13,000-14,000 t, and the SBR at AMSY is about 0.26. The current spawning biomass is estimated to be well above the biomass corresponding to the AMSY.

The average annual catch from the this stock during 1993-2000 was about 7,000 t (range ~ 4,800-8,900 t). Catches in recent years have been on the order of 12,000-16,000 t (Figure G-1), which is about the estimated AMSY catch. There have been indications of increasing efficiency at targeting of swordfish in the southern EPO, which has resulted in increased harvests of this stock. Some of the increased catch may have resulted from the above-average recruitment noted previously. It is not expected that further increases in the catch levels observed in recent years would be sustainable.

No attempts have been made to estimate the level of AMSY that could be obtained by each fishery operating exclusively. However, it is likely that the fisheries that capture younger fish (*e.g.* the longline fisheries of Chile, Japan, and Spain) are less efficient at maximizing yield.

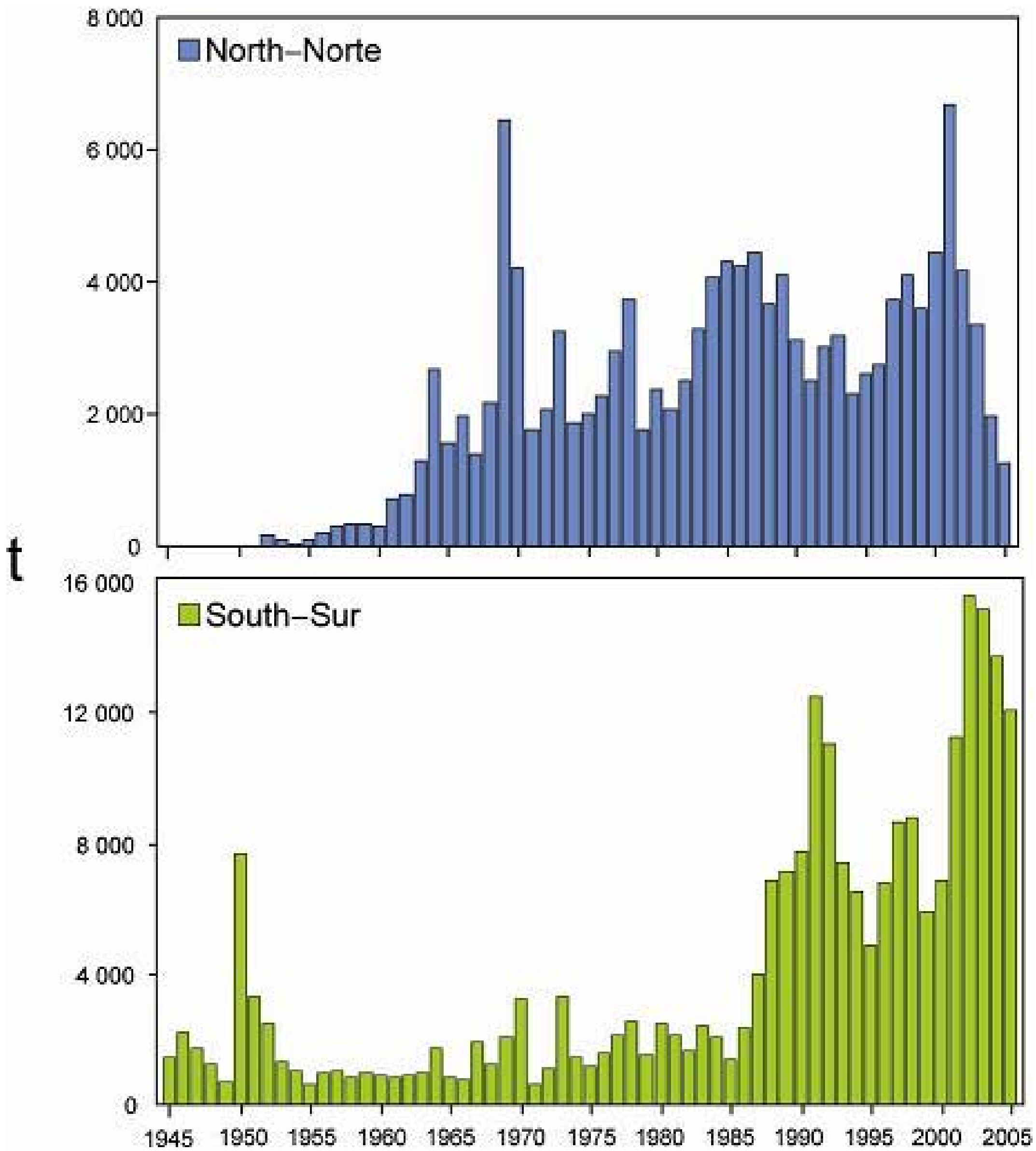

FIGURE G-1. Retained catches of swordfish in the eastern Pacific Ocean, 1945-2005, by stock (north and south).
FIGURA G-1. Capturas retenidas de pez espada en el Océano Pacífico oriental, 1945-2005, por población (norte y sur).

G. PEZ ESPADA

El pez espada ocurre en todo el Océano Pacífico entre 50°N y 50°S, aproximadamente. Es capturado principalmente por las pesquerías palangreras de países de Lejano Oriente y del hemisferio occidental. Las pesquerías de red de transmalle y arpón capturan cantidades menores. Es rara vez capturado en la pesca deportiva. En los últimos tres años buques de Chile, España y Japón lograron las mayores capturas en el OPO, en conjunto un 70% de la captura total en la región. El pez espada es el objetivo de las pesquerías española y chilena, mientras que es capturado incidentalmente en la pesquería japonesa, cuyo objetivo principal es el atún patudo. Otras naciones con pesquerías dirigidas hacia el pez espada son México y Estados Unidos.

El pez espada alcanza la madurez a la edad de 5 a 6 años, cuando mide unos 150 a 170 cm de talla. Es probable que desove más de una vez por temporada. Ocurren frecuentemente proporciones desiguales de sexos. En el caso de peces de más de 170 cm, la proporción de hembras aumenta con el aumento en la talla.

Existen solamente datos fragmentarios sobre los desplazamientos del pez espada. Suele permanecer a mayor profundidad de día que de noche.

El pez espada suele vivir en zonas frontales. Hay varias en el Océano Pacífico oriental (OPO), entre ellas zonas frente a California y Baja California, frente a Ecuador, Perú, y Chile, y en el Pacífico ecuatorial. El pez espada tolera temperaturas de entre unos 5° y 27°C, pero su rango óptimo es de 18° a 22°C. Se han encontrado larvas de la especie únicamente a temperaturas de más de 24°C.

La mejor información científica disponible, basada en datos genéticos y de la pesca, indica que el pez espada del Océano Pacífico sudeste (SEPO, al sur de 5°S) y el Pacífico noreste constituyen dos poblaciones separadas. Además, es posible que una población del Pacífico noroeste se desplace al OPO en varias ocasiones.

Los resultados de un modelado preliminar con MULTIFAN-CL de una población de pez espada del Pacífico Norte en el área al norte de 10°N y al oeste de 140°O indican que en los últimos años el nivel de biomasa ha sido estable y ha estado por encima del 50% del nivel de la biomasa no explotada, lo cual indica que con los niveles actuales de esfuerzo de pesca, la explotación de estos peces espada no es excesiva.

Las tasas de captura por unidad de esfuerzo estandarizadas de las pesquerías palangreras en la región norte del OPO, y las tendencias en la abundancia relativa derivadas de las mismas, no señalan que la abundancia esté disminuyendo. Intentos de ajuste de modelos de producción a los datos, con tasas de mortalidad natural razonables supuestas, no produjeron estimaciones de parámetros de ordenación (rendimiento máximo sostenible promedio (RMSP), por ejemplo), debido a la falta de contraste en las tendencias. Esta falta de contraste sugiere que las pesquerías en esta región no son de magnitud suficiente como para causar reacciones significativas en la población. A partir de estas consideraciones, y del período de capturas relativamente estables en la región norte (Figura G-1), parece que la pesca del pez espada no es excesiva en la región norte del OPO.

Se realizó una evaluación de la población sureña del pez espada en el OPO con *Stock Synthesis II* (SS2), versión 1.23b, con los resultados preliminares siguientes. La biomasa de la población ha pasado por cambios considerables, y se encuentra actualmente en un nivel de disminución moderado. Hay evidencias fuertes de que una ó dos cohortes fuertes ingresaron a la pesquería recientemente, pero su fuerza es incierta. Se estima que la tendencia del cociente de biomasa reproductora (el cociente de la biomasa reproductora actual a la de la población no explotada, denominado SBR (*spawning biomass ratio*)) de esta población fue entre 0,5 y 0,9 durante todo el período observado (1945-2003), y que disminuyó a su nivel mínimo a mediados de los años 1960 y de nuevo a mediados de los 1990.

El RMSP de la población sureña del pez espada en el OPO es aproximadamente 13.000-14.000 t, y el

SBR en RMSP en aproximadamente 0,26. Se estima que la biomasa reproductora actual es bien mayor a aquélla correspondiente al RMSP.

La captura anual media de esta población durante 1993-2000 fue aproximadamente 7.000 t (rango: ~ 4.800-8.900 t). Las capturas en los últimos años han sido alrededor de 12.000-16.000 t (Figura G-1), o aproximadamente la captura de RMSP. Ha habido indicaciones de mayor eficacia en la pesca dirigida al pez espada en el sur del OPO, resultando en mayores capturas de esta población. Parte del aumento podría ser debido al mayor reclutamiento antes comentado. No se espera que mayores aumentos de los niveles de captura observados en los últimos años sean sostenibles.

No se ha intentado estimar el nivel de RMSP que podría conseguir cada pesquería si operase exclusivamente, pero es probable que las pesquerías que capturan los peces más jóvenes (las pesquerías palangreras de Chile, España y Japón, por ejemplo) sean menos eficaces con respecto a la maximización del rendimiento.

H. BLUE MARLIN

The best knowledge currently available indicates that blue marlin constitutes a single world-wide species and that there is a single stock of blue marlin in the Pacific Ocean. For this reason, statistics on catches (Figure H-1) are compiled, and analyses of stock status are made, for the entire Pacific Ocean, even though it is important to know how the catches in the eastern Pacific Ocean (Figure H-2) have varied over time.

Blue marlin are taken mostly by longline vessels of many nations that fish for tunas and billfishes between about 50°N and 50°S. Lesser amounts are taken by recreational fisheries and by various other commercial fisheries.

Small numbers of blue marlin have been tagged, mostly by recreational fishermen, with conventional tags. A few of these fish have been recaptured long distances from the locations of release. In addition, blue marlin have been tagged with electronic tags and their activities monitored for short periods of time.

Blue marlin usually inhabit regions where the sea-surface temperatures (SSTs) are greater than 24°C, and they spend about 90% of their time at depths in which the temperatures are within 1° to 2° of the SSTs.

The Deriso-Schnute delay-difference population dynamics model, a form of production model, was used to assess the status of the blue marlin stock in the Pacific Ocean. Data for the estimated annual total retained catches for 1951-1997 and standardized catches per unit of effort developed from catch and nominal fishing effort data for the Japanese longline fishery for 1955-1997 were used. It was concluded that the levels of biomass and fishing effort were near those corresponding to the average maximum sustainable yield (AMSY).

A more recent analysis of data from the same years, but using MULTIFAN-CL, was conducted to assess the status of blue marlin in the Pacific Ocean and to evaluate the efficacy of habitat-based standardization of longline effort. There is considerable uncertainty regarding the levels of fishing effort that would produce the AMSY. However, it was determined that blue marlin in the Pacific Ocean are close to fully exploited, *i.e*. that the population is near the top of the yield curve. It was also found that standardization of effort, using a habitat-based model, allowed estimation of parameters within reasonable bounds and with reduced confidence intervals about the estimates.

The fisheries in the EPO have historically captured about 10 to 18% of the total harvest of blue marlin from the Pacific Ocean, with captures in the most recent 5-year period for which total Pacific Ocean catch data are available (1998-2003) averaging about 3,000 t, or 14% of the total harvest. Average annual catch of blue marlin in the EPO since 2001 is about 4,000 t.

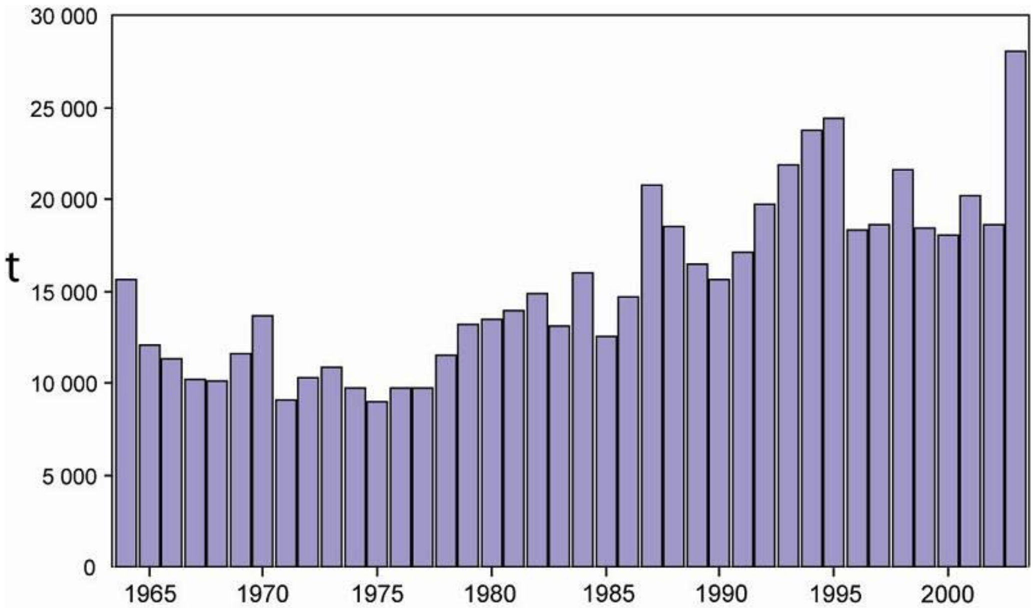

FIGURE H-1. Retained catches of blue marlin in the Pacific Ocean, 1964-2003.
FIGURA H-1. Capturas retenidas de marlín azul en el Océano Pacífico, 1964-2003.

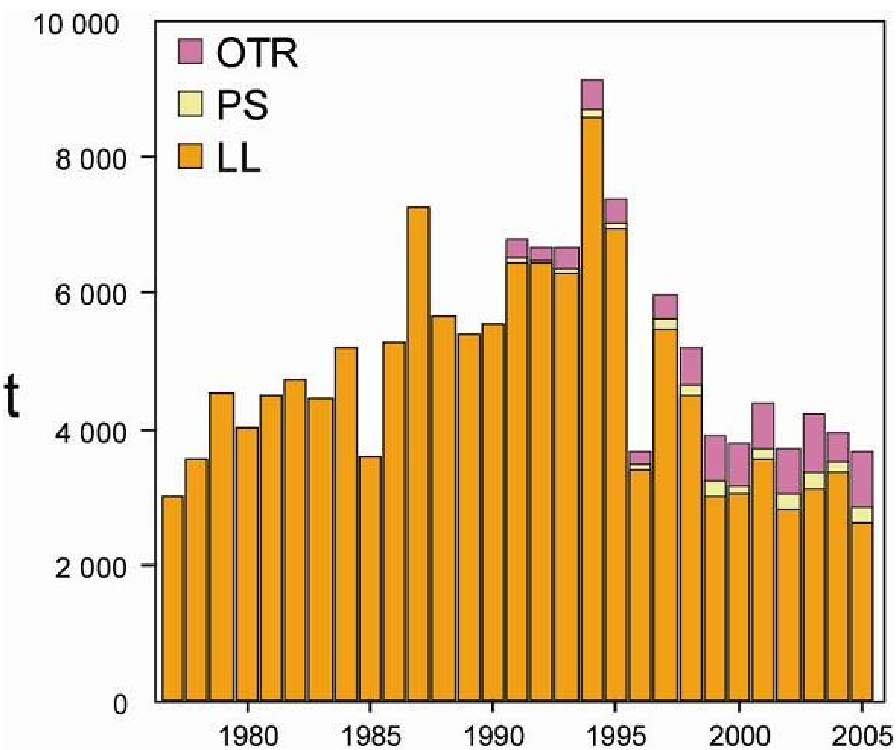

FIGURE H-2. Retained catches of blue marlin in the eastern Pacific Ocean, 1977-2005, by gear type.
FIGURA H-2. Capturas retenidas de marlín azul en el Océano Pacífico oriental, 1977-2005, por arte de pesca.

H. MARLÍN AZUL

La mejor información ahora disponible indica que el marlín azul constituye una sola especie a nivel mundial, y que existe una sola población de la especie en el Océano Pacífico. Por este motivo, se compilan estadísticas de capturas (Figura H-1), y se realizan análisis de la condición de la población, para el Océano Pacífico entero, aunque es importante saber cómo han variado con el tiempo las capturas en el Pacífico oriental (Figura H-2).

El marlín azul es capturado principalmente por buques palangreros de muchas naciones que pescan atunes y peces picudos entre aproximadamente 50°N y 50°S. Las pesquerías deportivas y varias otras pesquerías comerciales capturan cantidades menores.

Pequeñas cantidades de marlines azules han sido marcadas con marcas convencionales, principalmente por pescadores deportivos. Algunos de estos peces han sido recapturados a grandes distancias del punto de liberación. Además, se han marcado marlines azules con marcas electrónicas y se han seguido sus actividades durante períodos cortos.

El marlín azul vive generalmente en regiones con temperaturas superficiales del mar (TSM) de más de 24°C, y pasa un 90% del tiempo a profundidades donde la temperatura es de 1° a 2° menos que la TSM.

Se usó el modelo de poblaciones con retardos temporales de Deriso y Schnute, una forma de modelo de producción, para evaluar la condición de la población de marlín azul en el Océano Pacífico. Se usaron datos de las capturas anuales totales estimadas para 1951-1997 y la captura por unidad de esfuerzo estandarizada elaborada de datos de captura y esfuerzo de pesca nominal de la pesquería palangrera japonesa de 1955-1997. Se concluyó que los niveles de biomasa y esfuerzo de pesca eran cercanos a aquéllos correspondientes al rendimiento máximo sostenible promedio (RMSP).

Un análisis más reciente de los datos de los mismos años, pero usando MULTIFAN-CL, fue realizado para evaluar la condición del marlín azul en el Océano Pacífico y evaluar la eficacia de la estandarización basada en hábitat del esfuerzo palangrero. Existe una incertidumbre considerable con respecto a los niveles de esfuerzo de pesca que producirían el RMSP. Sin embargo, se determinó que marlín azul en el Océano Pacífico está casi plenamente explotado, es decir, la población está cerca de la cima de la curva de rendimiento. Se descubrió también que la estandarización del esfuerzo, usando un modelo basado en hábitat, permitió estimar los parámetros dentro de límites razonables y con intervalos de confianza reducidos alrededor de las estimaciones.

Históricamente, las pesquerías en el OPO han capturado del 10 al 18% de la captura total de marlín azul del Océano Pacífico; en el quinquenio más reciente para el cual se dispone de datos de captura del Océano Pacífico entero (1998-2003), fueron en promedio unas 3.000 toneladas, o un 14% de la captura total. La captura anual media de marlín azul en el OPO desde 2001 ha sido aproximadamente 4.000 t.

I. STRIPED MARLIN

Striped marlin occur throughout the Pacific Ocean between about 45°N and 45°S. They are caught mostly by the longline fisheries of Far East and Western Hemisphere nations. Lesser amounts are caught by recreational, gillnet, and other fisheries. During recent years the greatest catches (Figure I-1) in the EPO have been taken by fisheries of Costa Rica, Japan, and the Republic of Korea.

Striped marlin reach maturity when they are about 140 cm long, and spawning occurs in widely-scattered areas of the Pacific Ocean.

The stock structure of striped marlin in the Pacific Ocean is not well known. There are indications that there is only limited exchange of striped marlin between the EPO and the WCPO, so it is considered in this report that examinations of local depletions and independent assessments of the striped marlin of the EPO are meaningful. An analysis of trends in catches per unit of effort in several subareas suggest that the fish in the EPO constitute a single stock. Genetic studies have suggested that there are separate populations in the eastern and western South Pacific and that there may be a separate populations with centers of distribution in the regions proximate to Hawaii in the north-central Pacific and to Ecuador and to Mexico in the EPO. However, preliminary results of more recent analyses suggest that the fish in the Ecuador and Mexico regions are from a single stock.

Few tagging data are available for striped marlin. Most recaptures of fish tagged with conventional tags and released off the tip of the Baja California peninsula have been made in the general area of release, but some have been recaptured around the Revillagigedo Islands, a few around Hawaii, and one near Norfolk Island, north of New Zealand. Data on daily activities of striped marlin have been obtained by electronic tags, but these have not provided information on movements over long time periods.

Thus the conclusions reached for a EPO stock model, chosen on the basis of trends in catch rates, should be considered tentative.

Standardized catch rates were obtained from a general linear model and from a statistical habitat-based standardization method. Analyses of stock status made using two production models, taking into account the period when billfish were targeted by longline fishing in the EPO, were considered the most plausible. A Pella-Tomlinson model yielded estimates of the average maximum sustainable yield (AMSY) in the range of 3,700 to 4,100 t, with the current biomass being about 47% of the unfished biomass. The current biomass is estimated to be greater than that corresponding to the AMSY. An analysis, using the Deriso-Schnute delay-difference model, yielded estimates of AMSY in the range of 8,700 to 9,200 t, with the current biomass being greater than that needed to produce the AMSY and about 70% of the size of the unexploited biomass.

An analysis of the status of a hypothesized stock of striped marlin spanning the North Pacific was conducted by the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC). The results of all assessment models indicated that the biomass has been reduced. For models that provided estimates of the current biomass relative to the unfished biomass, the results indicated that the population has declined to 10 to 45% of the initial biomass. In contrast, “splitting” the abundance series in the mid-1970s, and assuming that this represented a change in targeting, indicated a more optimistic view (current biomass greater than that corresponding to the AMSY). While the results of these assessments are considered provisional, the ISC recommended that fishing mortality for striped marlin in the North Pacific not be permitted to exceed current levels.

The results of the EPO and North Pacific assessments of stocks are consistent. The stock of striped marlin in the EPO is probably in good condition, at or above the AMSY level.

The catches and standardized fishing effort for striped marlin decreased in the EPO from 1990-1991 through 1998, and this decline has continued, with annual catches during 2001-2005 between about 1,600 and 2,200 t, well below estimated AMSY. This may result in a continued increase in the biomass of the stock in the EPO.

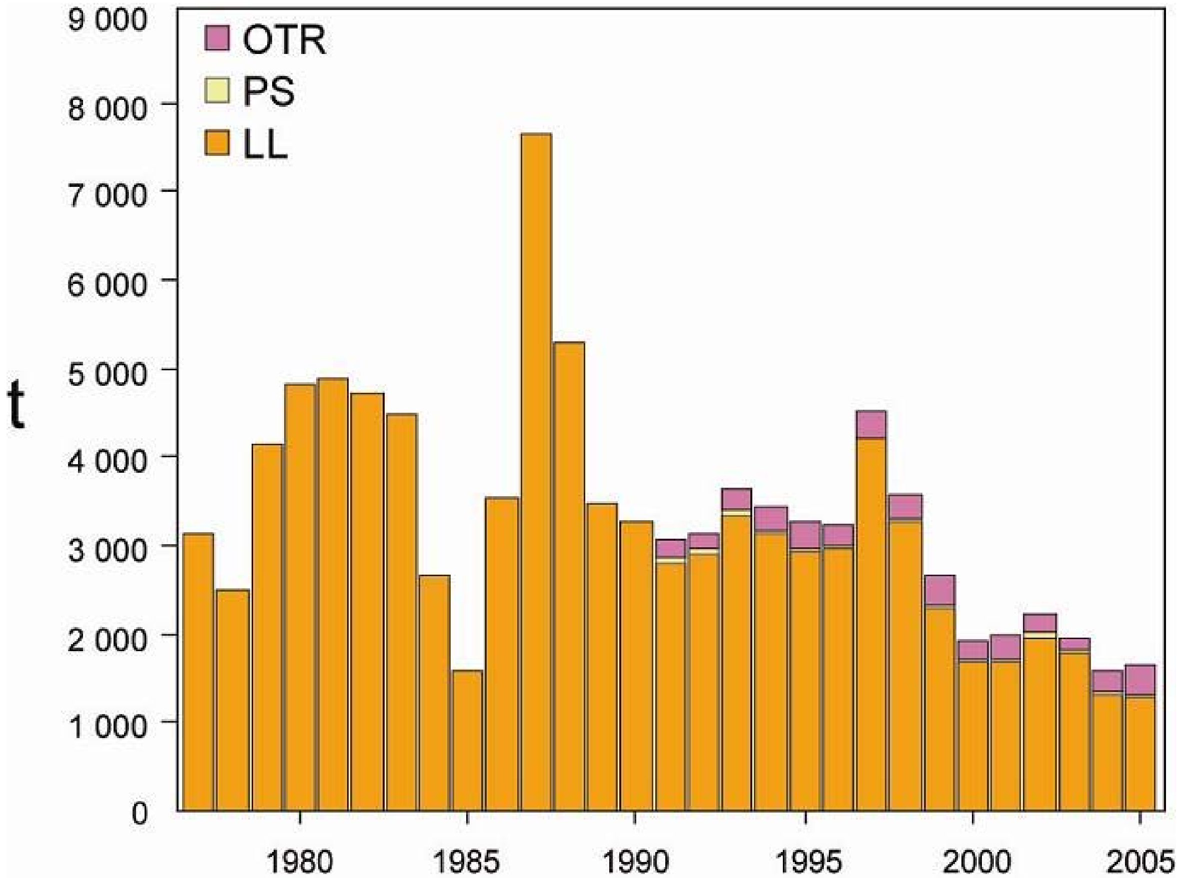

FIGURE I-1. Retained catches of striped marlin in the eastern Pacific Ocean, 1977-2005, by gear type.
FIGURA I-1. Capturas retenidas de marlín rayado en el Océano Pacífico oriental, 1977-2005, por arte de pesca.

I. MARLÍN RAYADO

El marlín rayado ocurre por todo el Océano Pacífico entre 45°N y 45°S. Es capturado principalmente por las pesquerías palangreras de naciones de Lejano Oriente y del hemisferio occidental. Las pesquerías de red de transmalle, deportiva, y otras capturan cantidades menores. En años recientes las pesquerías de la República de Corea, Costa Rica, y Japón han realizado las mayores capturas en el OPO (Figura I-1).

El marlín rayado alcanza la madurez cuando mide unos 140 cm de talla, y el desove ocurre en zonas ampliamente esparcidas del Océano Pacífico.

La estructura de la población de marlín rayado es incierta. Existen indicaciones de que ocurre solamente intercambio limitado de la especie entre el OPO y el Pacífico central y occidental, por lo que se considera en este informe que estudios de reducciones locales y evaluaciones independientes del marlín rayado del OPO son importantes. Un análisis de las tendencias de las captura por unidad de esfuerzo en varias subáreas señaló que los peces en el OPO constituyen una sola población. Estudios genéticos sugirieron que hay poblaciones separadas en el Pacífico Sur oriental y occidental y que pudiera haber poblaciones separados centradas en la región cerca de Hawai en el Pacífico central norte y cerca de Ecuador y México en el OPO, pero los resultados preliminares de análisis más recientes sugieren que los peces en las regiones de Ecuador y México son de una sola población.

Se dispone de pocos datos de marcado del marlín rayado. Se realizó la mayoría de las recapturas de peces marcados con marcas convencionales y liberados frente a la punta de la península de Baja California en la misma zona general de liberación, pero otros fueron recapturados cerca de las Islas Revillagigedo, otros cerca de Hawai, y uno cerca de la Isla de Norfolk, al norte de Nueva Zelanda. Se han obtenido con marcas electrónicas datos sobre las actividades diarias de los marlines azules, pero estas marcas no han brindado información sobre desplazamientos durante períodos largos de tiempo.

Por estos motivos las conclusiones alcanzadas por un modelo de una sola población en el OPO, seleccionado sobre la base de tendencias en tasas de captura, deben ser consideradas preliminares.

Se obtuvieron tasas de captura estandarizadas de un modelo lineal general y de un método estadístico de estandarización basado en hábitat. Análisis de la condición de la población realizados con dos modelos de producción, tomando en cuenta el período cuando los peces picudos eran objetivo de la pesca palangrera en el OPO, fueron considerados los más verosímiles. Un modelo de Pella-Tomlinson produjo estimaciones del rendimiento máximo sostenible promedio (RMSP) de entre 3,700 y 4,100 t, con la biomasa actual en un 47% de la biomasa no explotada. Se estima que la biomasa actual es mayor que aquélla correspondiente al RMSP. Un análisis usando el modelo con retardos temporales de Deriso y Schnute produjo estimaciones de RMSP de entre 8,700 y 9,200 t, con la biomasa actual mayor que la necesaria para producir el RMSP y un 70% del tamaño de la biomasa no explotada.

El Comité Científico Internacional sobre los Atunes y Especies Afines en el Océano Pacífico Norte (ISC) realizó un análisis de la condición de una población hipotética de marlín rayado que abarca el Pacífico Norte. Los resultados de todos los modelos de evaluación indicaron que la biomasa ha sido reducida. En el caso de los modelos que producen estimaciones de la biomasa actual relativa a la inicial, los resultados indicaron que la población ha disminuido a entre el 10 y el 45% de su biomasa sin pesca. Por contraste, si se divide la serie de abundancia a mediados de los años 1970, y se supone que esto representa un cambio en el blanco de la pesquería, el resultado es más optimista (biomasa actual mayor que aquélla correspondiente al RMSP). Aunque los resultados de estas evaluaciones son considerados provisionales, el ISC recomendó que no se permitiera a la mortalidad por pesca del marlín rayado en el Pacífico Norte rebasar los niveles actuales.

Los resultados de las evaluaciones del OPO y el Pacífico norte son consistentes. La población de marlín rayado en el OPO está probablemente en buen estado, en el nivel de RMSP o por encima del mismo.

Las capturas y el esfuerzo de pesca estandarizado de marlín rayado disminuyeron en el OPO entre 1990-1991 y 1998, y esta disminución ha continuado, con las capturas anuales durante 2001-2005 entre unas

1.600 y 2.200 toneladas, nivel muy inferior al RMSP estimado. Esto podría resultar en un aumento continuado de la biomasa de la población en el OPO.

J. ECOSYSTEM CONSIDERATIONS

1. INTRODUCTION

The FAO Code of Conduct for Responsible Fisheries provides that management of fisheries should ensure the conservation not only of target species, but also of the other species belonging to the same ecosystem. In 2001, the Reykjavik Declaration on Responsible Fisheries in the Ecosystem elaborated this standard with a commitment to incorporate an ecosystem approach into fisheries management.

The IATTC has taken account of ecosystem issues in many of its decisions, and this report on the ecosystem that includes the tunas and billfishes has been available since 2003 to assist in making its management decisions. This section provides a coherent view, summarizing what is known about the direct impact of the fisheries upon various species and species groups of the ecosystem, and reviews what is known about the environment and about other species that are not directly impacted by the fisheries.

This review does not suggest objectives for the incorporation of ecosystem considerations into the management of tuna or billfish fisheries, nor any new management measures. Rather, its prime purpose is to offer the Commission the opportunity to ensure that ecosystem considerations are part of its agenda.

It is important to remember that the view that we have of the ecosystem is based on the recent past; we have almost no information about the ecosystem before exploitation began. Also, the environment is subject to change on a variety of time scales, including the well-known El Niño fluctuations and more recently recognized longer-term changes, such as the Pacific Decadal Oscillation and other climate changes.

In addition to reporting the catches of the principal species of tunas and billfishes, the staff has reported the bycatches of other species that are normally discarded. In this section, data on these bycatches are presented in the context of the effect of the fishery on the ecosystem. Unfortunately, while relatively good information is available for the tunas and billfishes, information for the entire fishery is not available. The information is comprehensive for large (carrying capacity greater than 363 metric tons) purse seiners that carry observers under the Agreement on the International Dolphin Conservation Program (AIDCP), and information on retained catches is also reported for other purse seiners, pole-and-line vessels, and much of the longline fleet. Some information is available on sharks that are retained by parts of the longline fleet. Information on bycatches and discards is also available for large purse-seiners, and for some smaller ones. There is little information available on the bycatches and discards for other fishing vessels.

2. IMPACT OF CATCHES

2.1. Single-species assessments

This section provides a summary of current information on the effects of the tuna fisheries on the stocks of individual species in the eastern Pacific Ocean (EPO). It focuses on the current biomass of each stock considered, compared to what it might have been in the absence of a fishery. The intention is to show how the fishery may have altered the components of the ecosystem, rather than the detailed assessments, which can be found in other sections of this report and in other IATTC documents. The section below frequently refers to comparisons with the estimated unexploited stock size. There are no direct measurements of the stock size before the fishery began, and, in any case, it would have varied from year to year. In addition, the unexploited stock size may be influenced by predator and prey abundance, which is not included in the single-species analyses.

2.2. Tunas

2.2.1. Yellowfin

The yellowfin stock changed into a higher recruitment regime in about 1983, but may have recently moved back into an intermediate recruitment regime. During 2004-2006, the yellowfin stock has been below the level corresponding to the average maximum sustainable yield (36% of its unexploited size). One estimate of the effect of this reduced stock size is that the predation by adult yellowfin on other parts of the ecosystem is reduced to about 34% of what it was in the absence of a fishery.

2.2.2. Skipjack

Skipjack assessments are far less certain than those for yellowfin and bigeye, in part because the fishery in the EPO does not appear to be having much impact on the stock. However, it appears that fluctuations in recruitment cause large variations in stock size.

2.2.3. Bigeye

Up to 1993, bigeye were taken mostly by longline fishing. The stock size in 1993 is estimated to have been 36% of its unexploited size. After 1993, purse seining for tunas associated with fish-aggregating devices (FADs) took significant quantities of small and medium-sized bigeye. In 2004, after several years of poor recruitment and excessive levels of fishing mortality, the stock size was estimated to be at about 17% of its unexploited size. Due to recent spikes in recruitment, the current level has increased to 20%.

2.2.4. Pacific bluefin

It is considered that there is a single stock of Pacific bluefin tuna in the Pacific Ocean, given that spawning apparently occurs only in the western Pacific Ocean. However, tagging studies have shown that there is exchange of bluefin between the eastern and western Pacific Ocean. A preliminary stock assessment, carried out by the International Scientific Committee for Tuna and Tuna-like species in the North Pacific (ISC) in 2005, has indicated that the biomass of the spawning stock had local peaks during the early 1960s, late 1970s, and late 1990s, with a decline after the last peak. A strong recruitment event that may have occurred in 2001 would maintain spawning stock biomass above recent levels until 2010.

2.2.5. Albacore

It is generally considered that there are two stocks of albacore in the Pacific Ocean, one in the North Pacific and the other in the South Pacific. An assessment for South Pacific albacore, done by the Secretariat of the Pacific Community in 2003, showed that the South Pacific stock was at about 60% of its unexploited size. An assessment by the 19th North Pacific Albacore Workshop in 2004 indicated that the North Pacific stock is at about 45% of its unexploited size.

2.3. Billfishes

2.3.1. Swordfish

The northeastern and southeastern Pacific Ocean stocks of swordfish are distinctly identifiable by genetics and fisheries analyses. Preliminary analyses of the status of the southeastern Pacific Ocean stock of swordfish indicate that the spawning biomass has declined over the 1945-2003 period, and is now at about twice the level (~0.26) that will support the average maximum sustainable yield (AMSY = 13,000-14,000 metric tons (t)). Catches have increased substantially since 2001. Recent harvests are on the order of 12,000-16,000 t annually.

The variations in standardized catch per unit of effort (CPUE) of swordfish in the northern EPO show no trend, suggesting that the catches to date have not affected the stock significantly.

2.3.2. Blue marlin

Recent stock assessments of blue marlin suggest that the current stock size is between 50 and 90% of the unexploited stock size.

2.3.3. Striped marlin

A preliminary genetics analysis suggested that there are multiple stocks of striped marlin in the Pacific Ocean. Assessments for an EPO stock suggested that the current stock size is about 50 to 70% of the unexploited stock size. An analysis by the ISC of the status of an hypothesized single stock of striped marlin spanning the entire north Pacific is in progress, and the results were expected to be available in July 2007.

2.3.4. Black marlin, sailfish, and shortbill spearfish

No recent stock assessments have been made for these species, although there are some data published jointly by scientists of the National Research Institute of Far Seas Fisheries (NRIFSF) of Japan and the IATTC in the IATTC Bulletin series that show trends in catches, effort, and CPUEs.

2.4. Summary

Preliminary estimates of the catches (including purse-seine discards), in metric tons, of tunas during 2006 and billfishes during 2005 in the EPO are as follows.

	PS			LP	LL	OTR	Total
	OBJ	NOA	DEL				
Yellowfin tuna	36,772	42,200	89,261	693	3,976	1,878	174,780
Skipjack tuna	206,693	109,638	4,971	429	184	89	322,004
Bigeye tuna	71,399	1,644	0	0	30,271	8	103,322
Pacific bluefin	0	9,795	0	0	0	96	9,891
Albacore tuna	0	109	0	0	6,390	6,402	12,901
Swordfish	<1	<1	1	0	8,797	4,490	13,289
Blue marlin	203	16	17	0	2,619	820	3,676
Striped marlin	12	14	13	0	1,278	328	1,645
Black marlin	81	8	15	0	41	0	145
Sailfish	3	7	30	0	37	782	859
Shortbill spearfish	<1	<1	<1	0	276	0	276

2.5. Marine mammals

Marine mammals, especially spotted dolphins (*Stenella attenuata*), spinner dolphins (*S. longirostris*), and common dolphins (*Delphinus delphis*), are frequently found associated with yellowfin tuna in the size range of about 10 to 40 kg in the EPO. Purse-seine fishermen have found that their catches of yellowfin in the EPO can be maximized by setting their nets around herds of dolphins and the associated schools of tunas, and then releasing the dolphins while retaining the tunas. The incidental mortality of dolphins in this operation was high during the early years of the fishery, and the populations of dolphins were reduced from their unexploited levels during the 1960s and 1970s. After the late 1980s the incidental mortality decreased precipitously, and there is now evidence that the populations are recovering. Preliminary mortality estimates of dolphins in the fishery in 2006 are as follows:

Species and stock	Incidental mortality	
	Number	Metric tons
Offshore spotted dolphin		
Northeastern	144	9
Western-southern	135	9
Spinner dolphin		
Eastern	155	7
Whitebelly	157	9
Common dolphin		
Northern	130	9
Central	87	6
Southern	38	3
Other dolphins[1]	40	4
Total	**886**	**57**

Studies of the association of tunas with dolphins have been an important component of the staff's long-term approach to understanding key interactions in the ecosystem. The extent to which yellowfin tuna and dolphins compete for resources, or whether either or both of them benefits from the interaction, remain critical pieces of information, given the large biomasses of both groups and their high rates of prey consumption. Diet and stable isotope analyses of yellowfin tuna and spotted and spinner dolphins caught in polyspecific aggregations by purse-seine vessels in the EPO demonstrate significant differences in food habits and trophic position of the three species, suggesting that the tuna-dolphin association is probably not maintained by feeding advantages. This conclusion is supported by radio tracking studies of spotted dolphins outfitted with time-depth recorders, which indicate that the dolphins feed primarily at night on organisms associated with the deep scattering layer, while food habits studies of yellowfin tuna show primarily daytime feeding.

During 2006, scientists of the U.S. National Marine Fisheries Service (NMFS) conducted the latest in a series of research cruises under the *Stenella* Abundance Research (STAR) project. The primary objective of the multi-year study is to investigate trends in population size of the dolphins that have been taken as incidental catch by the purse-seine fishery in the EPO. Data on cetacean distribution, herd size, and herd composition were collected to estimate dolphin abundance. The 2006 survey covered the same areas and used the same methods as past surveys. Data from the large-scale line-transect survey of 2003 produced abundance estimates for 10 dolphin species and/or stocks. The estimates for northeastern offshore spotted and eastern spinner dolphins for 2003 were somewhat greater than the estimates from the previous surveys in 1998-2000, and weighted linear regressions indicated a slight positive trend in the abundance over the 1979-2003 period. The estimates for western-southern offshore spotted, whitebelly spinner, striped (*S. coeruleoalba*), rough-toothed (*Steno bredanensis*), common, bottlenose (*Tursiops truncatus*), and Risso's (*Grampus griseus*) dolphins were generally similar to previous estimates obtained with the same methods.

Scientists of the NMFS have made estimates of the abundances of several other species of marine mammals based on data from research cruises made between 1986 and 2000 in the EPO. The STAR 2003 and 2006 cruises will provide further estimates of abundance of these mammals. Of the species not significantly affected by the tuna fishery, short-finned pilot whales (*Globicephala macrorhynchus*) and three stocks of common dolphins showed increasing trends in abundance during that 15-year period. The apparent increased abundance of these mammals may have caused a decrease in the carrying capacity of the EPO for other predators that overlap in diet, including spotted dolphins. Bryde's whales (*Balaenoptera*

[1] "Other dolphins" includes the following species and stocks, whose observed mortalities were as follows: striped dolphins 6 (0.4 t); Central American spinner dolphins (*Stenella longirostris centroamericana*) 6 (0.3 t); bottlenose dolphins 3 (0.3 t), shortfin pilot whales (*Globicephala macrorhynchus*) 2 (1.3 t), coastal spotted dolphins 3 (0.3 t); unidentified dolphins 20 (1.1 t).

edeni) also increased in estimated abundance, but there is very little diet overlap between these baleen whales and the upper-level predators impacted by the fisheries. Striped dolphins (*Stenella coeruleoalba*) showed no clear trend in estimated abundance over time, and the estimates of abundance of sperm whales (*Physeter macrocephalus*) have tended to decrease in recent years.

Some marine mammals are adversely affected by reduced food availability during El Niño events, especially in coastal ecosystems. Examples that have been documented include dolphins, pinnipeds, and Bryde's whales off Peru, and pinnipeds around the Galapagos Islands. Large whales are able to move in response to changes in prey productivity and distribution.

2.6. Sea turtles

Sea turtles are caught on longlines when they take the bait on hooks, are snagged accidentally by hooks, or are entangled in the lines. Estimates of incidental mortality of turtles due to longline and gillnet fishing are few. At the 4th meeting of the IATTC Working Group on Bycatch in January 2004, it was reported that 166 leatherback (*Dermochelys coriacea*) and 6,000 other turtle species, mostly olive Ridley (*Lepidochelys olivacea*), were incidentally caught by Japan's longline fishery in the EPO during 2000, and that, of these, 25 and 3,000, respectively, were dead. At the 6th meeting of the Working Group in February 2007, it was reported that the Spanish longline fleet targeting swordfish in the EPO averaged 65 interactions and 8 mortalities per million hooks during 1990-2005. The mortality rates due to longlining in the EPO are likely to be similar for other fleets targeting bigeye tuna, and possibly greater for those that set their lines at shallower depths for albacore and swordfish. About 23 million of the 200 million hooks set each year in the EPO by distant-water longline vessels target swordfish with shallow longlines.

In addition, there is a sizeable fleet of artisanal longline vessels that fish for tunas, billfishes, sharks, and dorado (*Coryphaena* spp.) in the EPO. Since 2005, staff members of the IATTC and some other organizations, together with the governments of several coastal Latin American nations, have been engaged in a program to reduce the hooking rates and mortalities of sea turtles in these fisheries. Additional information on this program can be found in Section 8.2.

Sea turtles are occasionally caught in purse seines in the EPO tuna fishery. Most interactions occur when the turtles associate with floating objects, and are captured when the object is encircled. In other cases, nets set around unassociated schools of tunas or schools associated with dolphins may capture sea turtles that happen to be at those locations. The olive Ridley turtle is, by far, the species of sea turtle taken most often by purse seiners. It is followed by black or green sea turtles (*Chelonia agassizi*), and, very occasionally, by loggerhead (*Caretta caretta*) and hawksbill (*Eretmochelys imbricata*) turtles. Only one mortality of a leatherback turtle has been recorded during the 10 years that IATTC observers have been recording this information. Some of the turtles are unidentified because they were too far from the vessel or it was too dark for the observer to identify them. Sea turtles, at times, become entangled in the webbing under fish-aggregating devices (FADs) and drown. In some cases, they are entangled by the fishing gear and may be injured or killed. Preliminary estimates of the mortalities (in numbers) of turtles caused by large purse-seine vessels during 2006 are as follows:

	Set type			
	OBJ	**NOA**	**DEL**	**Total**
Olive Ridley	9.7	4.3	4.3	18.3
Black or eastern Pacific green	0.0	0.0	0.0	0.0
Loggerhead	1.2	0.0	0.0	1.2
Hawksbill	0.0	0.0	0.0	0.0
Leatherback	0.0	0.0	0.0	0.0
Unidentified	1.0	0.0	0.0	1.0
Total	11.9	4.3	4.3	20.5

The mortalities of sea turtles due to purse seining for tunas are probably less than those due to other types of human activity, which include exploitation of eggs and adults, beach development, pollution, entanglement in and ingestion of marine debris, and impacts of other fisheries.

The populations of olive Ridley, black, and loggerhead turtles are designated as endangered, and those of the hawksbill and leatherback turtles as critically endangered, by the International Union for the Conservation of Nature.

2.7. Sharks and other large fishes

Sharks and other large fishes are taken by both purse-seine and longline vessels. Silky sharks (*Carcharhinus falciformis*) are the most commonly-caught species of shark in the purse-seine fishery, followed by oceanic whitetip sharks (*C. longimanus*). The longline fisheries also take significant quantities of silky sharks, and a Pacific-wide analysis of longline and purse-seine fishing is necessary to estimate the impact of fishing on the stock(s). Preliminary estimates of indices of relative abundance of silky sharks, based on data for purse-seine sets on floating objects, show a decreasing trend during 1994-2006; the trends in unstandardized bycatch per set are similar for the other two types of purse-seine sets (standardized trends are not yet available). The unstandardized average bycatch per set of oceanic whitetip sharks also shows decreasing trends for all three set types during the same period. It is not known whether these decreasing trends are due to incidental capture by the fisheries, changes in the environment (perhaps associated with the 1997-1998 El Niño event), or other processes. They do not appear to be due to changes in the density of floating objects.

Scientists at the University of Washington are conducting an analysis of the temporal frequency of areas of high bycatches of silky sharks in purse-seine sets on floating objects, which will be useful for determining the effectiveness of area-time closures as a means of mitigating shark bycatch. Preliminary results show that both model predictions and observed data tend to indicate that these bycatches occur most frequently north of 4°N and west of 100-105°W. However, due to large tuna catches south of 5°N, the greatest reduction in bycatch from sets on floating objects with the least loss of tuna catch would be achieved north of approximately 6°N.

A sampling project has been initiated by scientists of the IATTC and the NMFS to collect and archive tissue samples for sharks, rays, and other large fishes for future genetics analysis. Data from the archived samples will be used in studies of large-scale stock structure of these taxa in the EPO, information that is vital for stock assessments and is generally lacking throughout the Pacific Ocean. .

A stock assessment for blue sharks (*Prionace glauca*) in the North Pacific Ocean has been conducted by scientists of the NMFS and the NRIFSF. Preliminary results provided a range of plausible values for maximum sustainable yield (MSY) of 1.8 to nearly 4 times the 2001 catch of blue shark per year.

Preliminary estimates of the discards (in metric tons) of sharks and other large fishes in the EPO during 2006, other than those discussed above, by large purse-seine vessels are as follows. Complete data are not available for small purse-seine, longline, and other types of vessels.

	Set type			
	OBJ	**NOA**	**DEL**	**Total**
Sharks	951	247	107	1,306
Rays (Mobulidae and Dasyatidae)	3	50	14	67
Dorado (*Coryphaena* spp.)	1,240	55	1	1,295
Wahoo (*Acanthocybium solandri)*	462	1	1	464
Rainbow runner (*Elagatis bipinnulata*) and yellowtail (*Seriola lalandi*)	245	228	<1	474
Black skipjack	1,647	132	10	1,789
Bonito	<1	84	0	84
Unidentified tunas	14,979	1,410	107	16,496
Billfishes	9	1	2	12
Other large fishes	47	14	2	62

Apart from the assessments of billfishes, summarized in Sections G-I of this report, and blue shark, there are no stock assessments available for these species in the EPO, and hence the impacts of the bycatches on the stocks are unknown.

The catch rates of species other than tunas in the purse-seine fishery are different for each type of set. With a few exceptions, the bycatch rates are greatest in sets on floating objects, followed by unassociated sets and, at a much lower level, dolphin sets. Dolphin bycatch rates are greatest for dolphin sets, followed by unassociated sets and, at a much lower level, floating-object sets. The bycatch rates of sailfish (*Istiophorus platypterus*), manta rays (Mobulidae), and stingrays (Dasyatidae) are greatest in unassociated sets, followed by dolphin sets, and lowest in floating-object sets. Because of these differences, it is necessary to follow the changes in frequency of the different types of sets to interpret the changes in bycatch figures. The estimated numbers of purse-seine sets of each type in the EPO during 1989-2006 are shown in Table A-8.

In October 2006, the NMFS hosted a workshop on bycatch reduction in the EPO purse-seine fishery. The attendees agreed to support a proposal for research on methods to reduce bycatches of sharks by attracting them away from floating objects prior to setting the purse seine. A feasibility study has been planned. The attendees also supported a suite of field experiments on bycatch reduction devices and techniques; these would include FAD modifications and manipulations, assessing behavioral and physiological indicators of stress, and removing living animals from the seine and deck (*e.g.* sorting grids, bubble gates, and vacuum pumps). A third proposal, which was likewise supported by the attendees, involves using IATTC data to determine if spatial, temporal, and environmental factors can be used to predict bycatches in FAD sets and to determine to what extent time/area closures would be effective in reducing bycatches.

3. OTHER ECOSYSTEM COMPONENTS

3.1. Seabirds

There are approximately 100 species of seabirds in the tropical EPO. Some seabirds associate with epipelagic predators near the sea surface, such as fishes (especially tunas) and marine mammals. Subsurface predators often drive prey to the surface to trap them against the air-water interface, where the prey become available to the birds. Most species of seabirds take prey within a half meter of the sea surface or in the air (flying fishes (Exocoetidae) and squids (Ommastrephidae)). In addition to driving the prey to the surface, subsurface predators make prey available to the birds by injuring or disorienting the prey, and by leaving scraps after feeding on large prey. Feeding opportunities for some seabird species are dependent on the presence of tuna schools feeding near the surface.

Seabirds are affected by the variability of the ocean environment. During the 1982-1983 El Niño event, seabird populations throughout the tropical and northeastern Pacific Ocean experienced breeding failures and mass mortalities, or migrated elsewhere in search of food. Some species, however, are apparently not affected by El Niño episodes. In general, seabirds that forage in upwelling areas of the tropical EPO and

Peru Current suffer reproductive failures and mortalities due to food shortage during El Niño events, while seabirds that forage in areas less affected by El Niño episodes may be relatively unaffected.

According to the *Report of the Scientific Research Program under the U.S. International Dolphin Conservation Program Act*, prepared by the NMFS in September 2002, there were no significant temporal trends in abundance estimates over the 1986-2000 period for any species of seabird, except for a downward trend for the Tahiti petrel (*Pseudobulweria rostrata*), in the tropical EPO. Population status and trends are currently under review for waved (*Phoebastria irrorata*), black-footed (*P. nigripes*), and Laysan (*P. immutabilis*) albatrosses.

Some seabirds, especially albatrosses and petrels, are susceptible to being caught on baited hooks in pelagic longline fisheries. Satellite tracking and at-sea observation data have identified the importance of the IATTC area for waved, black-footed, Laysan, and black-browed (*Thalassarche melanophrys*) albatrosses, plus several other species that breed in New Zealand, yet forage off the coast of South America. There is particular concern for the waved albatross because it is endemic to the EPO and nests only in the Galapagos Islands. Observer data from artisanal vessels show no interactions with waved albatross during these vessels' fishing operations. Data from the US pelagic longline fishery in the northeastern Pacific Ocean indicate that bycatches of black-footed and Laysan albatrosses occur. Few comparable data for the longline fisheries in the central and southeastern Pacific Ocean are available. At the 6th meeting of the IATTC Working Group on Bycatch in February 2007, it was reported that the Spanish surface longline fleet targeting swordfish in the EPO averaged 40 seabird interactions per million hooks, virtually all resulting in mortality, during 1990-2005. In 2007, the IATTC Stock Assessment Working Group has identified areas of vulnerability to industrial longline fishing for several species of albatross and proposed mitigation measures. In an externally-funded study, the IATTC staff is currently investigating the population status of the black-footed albatross in the entire North Pacific Ocean, taking into account the effects of fisheries bycatch.

3.2. Forage

The forage taxa occupying the middle trophic levels in the EPO are obviously important components of the ecosystem, providing a link between primary production at the base of the food web and the upper-trophic-level predators, such as tunas and billfishes. Indirect effects on those predators caused by environmental variability are transmitted to the upper trophic levels through the forage taxa. Little is known, however, about fluctuations in abundance of the large variety of prey species in the EPO. Scientists from the NMFS have recorded data on the distributions and abundances of common prey groups, including lantern fishes (Myctophidae), flying fishes (Exocoetidae), and some squids, in the tropical EPO during 1986-1990 and 1998-2000. Mean abundance estimates for all fish taxa and, to a lesser extent, for squids increased from 1986 through 1990. The estimates were low again in 1998, and then increased through 2000. Their interpretation of this pattern was that El Niño events in 1986-1987 and 1997-1998 had negative effects on these prey populations. More data on these taxa were collected during the NMFS STAR 2003 and 2006 cruises, and are currently being analyzed.

The Humboldt or jumbo squid (*Dosidicus gigas*) populations in the EPO have increased in size and geographic range in recent years. In addition, in 2002 observers on tuna purse-seine vessels reported increased incidental catches of Humboldt squid caught primarily with tunas, primarily skipjack, off Peru. Juvenile stages of these squid are common prey for yellowfin and bigeye tunas, and other predatory fishes, and they are also voracious predators of small fishes and cephalopods throughout their range. Large Humboldt squid have been observed attacking skipjack and yellowfin inside a purse seine. Not only have these squid impacted the ecosystems that they have expanded into, but they are also thought to have the capability of affecting the trophic structure in pelagic regions. Changes in the abundance and geographic range of Humboldt squid could affect the foraging behavior of the tunas and other predators, perhaps changing their vulnerability to capture, and could also reduce the recruitment of the exploited fishes. A recent sampling program by the IATTC staff, to examine possible changes in foraging behavior of yellowfin tuna, is described in Section 4.

Some small fishes, many of which are forage for the larger predators, are incidentally caught by purse-seine vessels in the EPO. Frigate and bullet tunas (*Auxis* spp.), for example, are a common prey of many of the animals that occupy the upper trophic levels in the tropical EPO. In the tropical EPO ecosystem model (Section 7), frigate and bullet tunas comprise 10% or more of the diet of eight predator categories. Small quantities of frigate and bullet tunas are captured by purse-seine vessels on the high seas and by artisanal fisheries in some coastal regions of Central and South America. The vast majority of frigate and bullet tunas captured by tuna purse-seine vessels is discarded at sea. Preliminary estimates of the discards, in metric tons, of small fishes by large purse-seine vessels with observers aboard in the EPO during 2006 are as follows:

	Set type			
	OBJ	**NOA**	**DEL**	**Total**
Triggerfishes (Balistidae) and filefishes (Monacanthidae)	167	<1	<1	167
Other small fishes	155	4	1	160
Frigate and bullet tunas (*Auxis* spp.)	1,273	751	19	2,043

3.3. Larval fishes and plankton

Larval fishes have been collected by manta (surface) net tows in the EPO for many years by personnel of the NMFS Southwest Fisheries Science Center. Of the 314 taxonomic categories identified, 17 were found to be most likely to show the effects of environmental change. The occurrence, abundance, and distribution of these key taxa revealed no consistent temporal trends.

The phytoplankton and zooplankton populations in the tropical EPO are variable. For example, chlorophyll concentrations on the sea surface (an indicator of phytoplankton blooms) and the abundance of copepods were markedly reduced during the El Niño event of 1982-1983, especially west of 120°W. Similarly, surface concentrations of chlorophyll decreased during the 1986-1987 El Niño episode and increased during the 1988 La Niña event due to changes in nutrient availability.

The species and size composition of zooplankton is often more variable than the zooplankton biomass. When the water temperatures increase, warm-water species often replace cold-water species at particular locations. The relative abundance of small copepods off northern Chile, for example, increased during the 1997-1998 El Nino event, while the zooplankton biomass did not change.

4. TROPHIC INTERACTIONS

Tunas and billfishes are wide-ranging, generalist predators with high energy requirements, and, as such, are key components of pelagic ecosystems. The ecological relationships among large pelagic predators, and between them and animals at lower trophic levels, are not well understood. Given the need to evaluate the implications of fishing activities on the underlying ecosystems, it is essential to acquire accurate depictions of trophic links and biomass flows through the food web in open-ocean ecosystems, and a basic understanding of the natural variability forced by the environment.

Knowledge of the trophic ecology of predatory fishes has historically been derived from stomach contents analysis. Large pelagic predators are considered efficient biological samplers of micronekton organisms, which are poorly sampled by nets and trawls. Diet studies have revealed many of the key trophic connections in the pelagic EPO, and have formed the basis for representing food-web interactions in an ecosystem model (IATTC Bulletin, Vol. 22, No. 3) to explore indirect ecosystem effects of fishing. The most common prey items of yellowfin tuna caught by purse seines offshore are frigate and bullet tunas, squids and argonauts (cephalopods), and flyingfishes and other epipelagic fishes. Bigeye tuna feed at greater depths than do yellowfin and skipjack, and consume primarily cephalopods and mesopelagic fishes. The most important prey of skipjack overall were euphausiid crustaceans in a study during the late 1950s, whereas the small mesopelagic fish *Vinciguerria lucetia* appeared dominant in the diet during the early 1990s. Tunas that feed inshore utilize different prey than those caught offshore. For example, yellowfin and skipjack caught off Baja California feed heavily on red crabs, *Pleuroncodes planipes*. More recently, diet studies have become focused on understanding entire food webs, initially by describing the inter-specific connections among the predator communities, comprising tunas, sharks, billfishes, dorado, wahoo (*Acanthocybium solandri*), rainbow runner (*Elagatis bipinnulata*), and others. In general, considerable resource partitioning is evident among the components of these communities, and researchers seek to understand the spatial scale of the observable trophic patterns, and also the role of climate variability in influencing the patterns.

While diet studies have yielded many insights, stable isotope ratios of carbon and nitrogen provide an ideal complement to stomach contents for studying food webs. Stomach contents represent a relative snapshot of the most recent meal at the time of day an animal is captured, and under the conditions required for its capture. Stable carbon and nitrogen isotopes, however, integrate information on all components of the diet into the animal's tissues, providing a recent history of trophic interactions and information on the structure and dynamics of ecological communities. Recent stable isotope studies place the average trophic position of yellowfin tuna in the EPO at 4.2-4.5, whereas previous diet analysis suggest that it averages 4.6-4.7.

A short-term study was initiated during the fourth quarter of 2006 to examine the stomach contents of recently-captured yellowfin tuna to detect possible changes in their foraging behavior relative to previous years. Single-species stock assessments are not designed to consider the effect of trophic interactions (*e.g.* predation, competition, and changes in trophic structure) on the stock in question. Prey populations that feed the apex predators also vary over time (see 3.2 Forage), and some prey impart considerable predation pressure on animals that occupy the lower trophic levels (including the early life stages of large fishes). Stomach samples of a ubiquitous predator, such as yellowfin tuna, compared with prevous diet data, can be used to infer changes in prey populations by identifying changes in foraging behavior. Changes in foraging behavior could cause the tunas, for example, to alter the typical depth distributions while foraging, and this could affect their vulnerability to capture. Stomach samples of yellowfin tuna were collected from purse-seine sets made on fish associated with dolphins during the fourth quarter of 2006, and compared with samples from dolphin sets made during 2003-2005 in the same fishing area. Of special interest were the inter-annual differences in predation on the Humboldt or jumbo squid because of recent changes in its abundance and geographical range (see 3.2 Forage). The amount of fresh squid tissue in the yellowfin stomachs was very low, and there were no differences in the diet proportions by weight from year to year. Cephalopod mandibles (or beaks), however, are retained in the stomachs and the percent occurrence of jumbo squid mandibles decreased by 21 percent between 2004 and 2006. Interannual differences in predation on other diet components were small. *Auxis* spp. were eaten in significantly greater quantities ($P<0.05$) in 2005 and 2006 compared to 2003 and 2004, and significantly more Pacific flatiron herring (*Harengula thrissina*) and chub mackerel (*Scomber japonicus*) were eaten in 2006 than in the previous three years. Overall, there is no convincing evidence of substantial changes in the trophic structure having taken place during 2003-2006, based on the food habits of yellowfin tuna caught in association with dolphins.

5. PHYSICAL ENVIRONMENT[2]

Environmental conditions affect marine ecosystems, the dynamics and catchability of tunas and billfishes, and the activities of the fishermen. Tunas and billfishes are pelagic during all stages of their lives, and the physical factors that affect the tropical and sub-tropical Pacific Ocean can have important effects on their distribution and abundance. Environmental conditions are thought to cause considerable variability in the recruitment of tunas and billfishes. Stock assessments by the IATTC have often included the assumption that oceanographic conditions might influence recruitment in the EPO.

Different types of climate perturbations may impact fisheries differently. It is thought that a shallow thermocline in the EPO contributes to the success of purse-seine fishing for tunas, perhaps by acting as a thermal barrier to schools of small tunas, keeping them near the sea surface. When the thermocline is

[2] Much of the information in this section is from Fiedler, P.C. 2002. Environmental change in the eastern tropical Pacific Ocean: review of ENSO and decadal variability. Mar. Ecol. Prog. Ser. 244: 265-283.

deep, as during an El Niño event, tunas seem to be less vulnerable to capture, and the catch rates have declined. Warmer- or cooler-than-average sea-surface temperatures (SSTs) can also cause these mobile fishes to move to more favorable habitats.

The ocean environment varies on a variety of time scales, from seasonal to interannual, decadal, and longer (*e.g.* climate phases or regimes). The dominant source of variability in the upper layers of the EPO is often called the El Niño-Southern Oscillation (ENSO). The ENSO is an irregular fluctuation involving the entire tropical Pacific Ocean and global atmosphere. It results in variations of the winds, rainfall, thermocline depth, circulation, biological productivity, and the feeding and reproduction of fishes, birds, and marine mammals. El Niño events occur at 2- to 7-year intervals, and are characterized by weaker trade winds, deeper thermoclines, and abnormally-high SSTs in the equatorial EPO. El Niño's opposite phase, often called La Niña, is characterized by stronger trade winds, shallower thermoclines, and lower SSTs. Research has documented a connection between the ENSO and the rate of primary production, phytoplankton biomass, and phytoplankton species composition. Upwelling of nutrient-rich subsurface water is reduced during El Niño episodes, leading to a marked reduction in primary and secondary production. ENSO also directly affects animals at middle and upper trophic levels. Researchers have concluded that the 1982-1983 El Niño event, for example, deepened the thermocline and nutricline, decreased primary production, reduced zooplankton abundance, and ultimately reduced the growth rates, reproductive successes, and survival of various birds, mammals, and fishes in the EPO. In general, however, the ocean inhabitants recover within short periods because their life histories are adapted to respond to a variable habitat.

The IATTC reports monthly average oceanographic and meteorological data for the EPO, including a summary of current ENSO conditions, on a quarterly basis. During 2005 the SSTs were nearly normal, although there were small areas of cool water, mostly near the coast, and small areas of warm water, mostly offshore, during nearly every month. Weak La Niña (or anti-El Niño) conditions developed during the first quarter of 2006. Conditions became neutral during the second quarter of 2006, and weak El Niño conditions developed during the third quarter and continued during the rest of the year.

Variability on a decadal scale (*i.e.* 10 to 30 years) also affects the EPO. During the late 1970s there was a major shift in physical and biological states in the North Pacific Ocean. This climate shift was also detected in the tropical EPO by small increases in SSTs, weakening of the trade winds, and a moderate change in surface chlorophyll levels. Some researchers have reported another major shift in the North Pacific in 1989. Climate-induced variability in the ocean has often been described in terms of "regimes," characterized by relatively stable means and patterns in the physical and biological variables. Analyses by the IATTC staff have indicated that yellowfin tuna in the EPO have experienced regimes of lower (1975-1982) and higher (1983-2001) recruitment, and possibly intermediate (2002-2006) recruitment. The increased recruitment during the latter period is thought to be due to a shift to a higher productivity regime in the Pacific Ocean. Decadal fluctuations in upwelling and water transport are simultaneous to the higher-frequency ENSO pattern, and have basin-wide effects on the SSTs and thermocline slope that are similar to those caused by ENSO, but on longer time scales.

There is evidence that the North Pacific Ocean is currently in a cool regime, while no such evidence is apparent for the equatorial Pacific.

Environmental variability in the tropical EPO is manifested differently in different regions in which tunas are caught. For example, SST anomalies in the tropical EPO warm pool (5° to 20°N, east of 120°W) have been about one-half the magnitude and several months later than those in the equatorial Pacific NIÑO3 area (5°S to 5°N, 90° to 150°W).

6. AGGREGATE INDICATORS

Recognition of the consequences of fishing for marine ecosystems has stimulated considerable research in recent years. Numerous objectives have been proposed to evaluate fishery impacts on ecosystems and to define over-fishing from an ecosystem perspective. Whereas reference points have been used primarily for single-species management of target species, applying performance measures and reference points to non-target species is believed to be a tractable first step. Current examples include incidental mortality limits for dolphins in the EPO purse-seine fishery under the AIDCP. Another area of interest is whether useful performance indicators based on ecosystem-level properties might be developed. Several ecosystem metrics or indicators, including community size structure, diversity indices, species richness and evenness, overlap indices, trophic spectra of catches, relative abundance of an indicator species or group, and numerous environmental indicators, have been proposed. Whereas there is general agreement that multiple system-level indicators should be used, there is concern over whether there is sufficient practical knowledge of the dynamics of such metrics and whether a theoretical basis for identifying precautionary or limit reference points based on ecosystem properties exists. Ecosystem-level metrics are not yet commonly used for managing fisheries.

New methods of ordination, developed by scientists at the Institute of Statistical Mathematics in Tokyo, Japan, have produced indices of association related to different groupings of catch and bycatch species for floating-object sets of the purse-seine fishery. The preliminary indices show clear large-scale spatial patterns, and relationships to environmental variables, such as SST, chlorophyll-a density, and mixed layer depth. Information on relationships between indices of species association and environmental characteristics may help to guide the development of approaches for bycatch reduction.

Ecologically-based approaches to fisheries management place renewed emphasis on achieving accurate depictions of trophic links and biomass flows through the food web in exploited systems. Trophic levels (TLs) are used in food-web ecology to characterize the functional role of organisms and to facilitate estimates of energy or mass flow through communities. A simplified food-web diagram, with approximate TLs, of the pelagic tropical EPO, is shown in Figure J-1. Toothed whales (Odontoceti, average TL 5.2), large squid predators (large bigeye tuna and swordfish, average TL 5.2), and sharks (average TL 5.0) are top-level predators. Other tunas, large piscivores, dolphins (average TL 4.8), and seabirds (average TL 4.5) occupy slightly lower TLs. Smaller epipelagic fishes (*e.g. Auxis* spp. and flyingfishes, average TL 3.2), cephalopods (average TL 4.4), and mesopelagic fishes (average TL 3.4) are the principal forage of many of the upper-level predators in the ecosystem. Small fishes and crustaceans prey on two zooplankton groups, and the herbivorous micro-zooplankton (TL 2) feed on the producers, phytoplankton and bacteria (TL 1).

In exploited pelagic ecosystems, fisheries that target large piscivorous fishes act as apex predators in the ecosystem. Over time, fishing can cause the overall size composition of the catch to decrease, and, in general, the TLs of smaller organisms are lower than those of larger organisms. The mean TL of the organisms taken by a fishery is a potentially useful metric of ecosystem change and sustainability because it integrates an array of biological information about the components of the system. There has been increasing attention to analyzing the mean TL of fisheries catches and discards since a study demonstrated that, according to FAO landings statistics, the mean TL of the fishes and invertebrates landed globally had declined between 1950 and 1994, which was hypothesized by the authors of that study to be detrimental to the ecosystems. Some ecosystems, however, have changed in the other direction, from lower to higher TL communities. Given the potential utility of this approach, TLs were estimated for a time series of annual catches and discards by species from 1993 to 2006 for three purse-seine fishing modes and the pole-and-line fishery in the EPO. The estimates were made by applying the TL values from the EPO ecosystem model (see Section 7), weighted by the catch data by fishery and year for all model groups from the IATTC tuna, bycatch, and discard data bases. The TLs from the ecosystem model were determined by average diet estimates for all species groups. The TLs of the summed catches of all purse-seine and pole-and-line fisheries were fairly constant from year to year, varying by less than 0.1 TL (Figure J-2: Average PS+LP). The catches of large yellowfin (≥90 cm, TL 4.66), skipjack (TL 4.57), small yellowfin (<90 cm, TL 4.57), and large bigeye (≥80 cm, TL 5.17) contributed 36, 34, 19, and 6 percent, respectively, to the overall TL (4.63) during 1993-2006. The retained and discarded catches of all other species and groups contributed less than 5 percent of the overall TL of the catches, including small bigeye (4.7%, TL 4.53) and all the bycatch species. In general, the TLs of the unassociated sets and the pole-and-line fishery were below average and those of the dolphin sets were above average for most years (Figure J-2). The TLs of the floating-object sets varied more than those of the other set types and fisheries, primarily due to the inter-annual variability in the size of bigeye and the amount of skipjack caught in those sets. The TLs of floating-object sets were positively related to the percentage of the total catch comprised of large bigeye (P<0.001) and negatively related to the percentage of the catch comprised of skipjack (P<0.001) (Figure J-3).

The TLs were also estimated separately for the time series of retained and discarded catches of the purse-seine fishery each year from 1993 to 2006 (Figure J-4). The discarded catches were much less than the retained catches, and thus the TL patterns of the total (retained plus discarded) catches (Figure J-2) were determined primarily by the retained catches (Figure J-4). The TLs of the discarded catches varied more year-to-year than those of the retained catches. The greatest variation occurred for sets on fish associated with floating objects, and those sets also had the greatest bycatch species diversity. The lowest TL of the discarded catches occurred for both unassociated and floating objects sets in 1998. For unassociated sets, the marked reduction in TL during 1998 was due to increased bycatches of rays (TL 3.68), which feed on plankton and other small animals that occupy low TLs, and a reduction in the catches of large sharks (TL 4.93). From 1998 to 2001, the discarded catches of rays gradually declined in unassociated sets and those of large sharks and small yellowfin increased, resulting in a gradually increasing TL of the discarded catches over that interval. For floating-object sets, the discards of small epipelagic fishes (*e.g.* Clupeiformes, Nomeidae, Tetraodontiformes, and others; TL 3.19) increased and of large bigeye decreased from 1996 to 1998, lowering the TL over that interval. The TL increase in floating-object sets from 1998 to 2000 resulted from a reduction in the bycatch of small epipelagic fishes and an increase in discarded dorado (TL 4.66) and large bigeye.

7. ECOSYSTEM MODELING

It is clear that the different components of an ecosystem interact. Ecosystem-based fisheries management is facilitated through the development of multi-species, ecosystem models that represent ecological interactions among species or guilds. Our understanding of the complex maze of connections in open-ocean ecosystems is at an early stage, and, consequently, the current ecosystem models are most useful as descriptive devices for exploring the effects of a mix of hypotheses and established connections among the ecosystem components. Ecosystem models must be compromises between simplistic representations on the one hand and unmanageable complexity on the other.

The IATTC staff has developed a model of the pelagic ecosystem in the tropical EPO (IATTC Bulletin, Vol. 22, No. 3) to explore how fishing and climate variation might affect the animals at middle and upper trophic levels. The ecosystem model has 38 components, including the principal exploited species (*e.g.* tunas), functional groups (*e.g.* sharks and flying fishes), and sensitive species (*e.g.* sea turtles). Some taxa are further separated into size categories (*e.g.* large and small marlins). The model has finer taxonomic resolution at the upper trophic levels, but most of the system's biomass is contained in the middle and lower trophic levels. Fisheries landings and discards were estimated for five fishing "gears": pole-and-line, longline, and purse-seine sets on tunas associated with dolphins, with floating objects, and in unassociated schools. The model focuses on the pelagic regions; localized, coastal ecosystems are not adequately described by the model.

Most of the information describing inter-specific interactions in the model comes from a joint IATTC-NMFS project, which included studies of the food habits of co-occurring yellowfin, skipjack, and bigeye tuna, dolphins, pelagic sharks, billfishes, dorado, wahoo, rainbow runner, and others. The impetus of the project was to contribute to the understanding of the tuna-dolphin association, and a community-level sampling design was adopted.

The ecosystem model has been used to evaluate the possible effects of variability in bottom-up forcing by the environment on the middle and upper trophic levels of the pelagic ecosystem. Predetermined time series of producer biomasses were put into the model as proxies for changes in primary production that have been documented during El Niño and La Niña events, and the dynamics of the remaining components of the ecosystem were simulated. The model was also used to evaluate the relative contributions of fishing and the environment in shaping ecosystem structure in the tropical pelagic EPO. This was done by using the model to predict which components of the ecosystem might be susceptible to top-down effects of fishing, given the apparent importance of environmental variability in structuring the ecosystem. In general, animals with relatively low turnover rates were influenced more by fishing than by the environment, and animals with relatively high turnover rates more by the environment than by fishing.

8. ACTIONS BY THE IATTC AND THE AIDCP ADDRESSING ECOSYSTEM CONSIDERATIONS

Both the IATTC convention and the AIDCP have objectives that address the incorporation of ecosystem considerations into the management of the tuna fisheries in the EPO. Actions taken in the past include:

8.1. Dolphins

a. For many years, the impact of the fishery on the dolphin populations has been assessed, and programs to reduce or eliminate that impact have met with considerable success.

b. The incidental mortalities of all stocks of dolphins have been limited to levels that are insignificant relative to stock sizes.

8.2. Sea turtles

a. A data base on all sea turtle sightings, captures, and mortalities reported by observers has been compiled.

b. In June 2003 the IATTC adopted a Recommendation on Sea Turtles, which contemplates "the development of a three-year program that could include mitigation of sea turtle bycatch, biological research on sea turtles, improvement of fishing gears, industry education and other techniques to improve sea turtle conservation." In January 2004, the Working Group on Bycatch drew up a detailed program that includes all these elements, and urges all nations with vessels fishing for tunas in the EPO to provide the IATTC with information on interactions with sea turtles in the EPO, including both incidental and direct catches and other impacts on sea turtle populations. Resolution C-04-07 on a three-year program to mitigate the impact of tuna fishing on sea turtles was adopted by the IATTC in June 2004; it includes requirements for data collection, mitigation measures, industry education, capacity building, and reporting.

c. Resolution C-04-05, adopted by the IATTC in June 2006, contains provisions on releasing and handling of sea turtles captured in purse seines. The resolution also prohibits vessels from disposing of plastic containers and other debris at sea, and instructs the Director to study and formulate recommendations regarding the design of FADs, particularly the use of netting attached underwater to FADs.

d. In response to a request made by the Subsecretaría de Recursos Pesqueros of Ecuador, the IATTC began a program, supported by the World Wildlife Fund and the government of the United States, to mitigate the incidental capture of sea turtles, to reduce the mortality of sea turtles due to longline fishing, and to compare the catch rates of tunas, billfishes, and dorado using circle and J hooks of two sizes. Circle hooks do not hook as many turtles as the J hooks currently used in the longline fishery, and the chance of serious injury to the sea turtles that bite the hooks is reduced because they are wider and they tend to hook the lower jaw, rather than the more dangerous deep hookings in the esophagus and other areas, which are more common with the J hooks. Improved procedures and instruments to release hooked and entangled sea turtles have also been disseminated to the longline fleets of the region.

   Observers have recorded data on almost 400 fishing trips of the vessels that are testing the different hooks. The program was actively running in Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Panama, and Peru and under development in Mexico and Nicaragua in 2006. The program in Ecuador is being carried out in partnership with the government and the Overseas Fishery Cooperation Foundation of Japan, while those in other countries are currently funded by U.S. agencies. Initial results show that, in the fisheries that target tunas, billfishes, and sharks (Figure J-4), there was a significant reduction in the hooking rates of sea turtles with the circle hooks, and fewer hooks lodged in the esophagus or other areas detrimental to the turtles. The catch rates of the target species are, in general, similar to the catch rates with the J-hooks. An experiment was also carried out in the dorado fishery (Figure J-4) using smaller circle hooks. There were reductions in turtle hooking rates, but the reductions were not as great as for the fisheries that target tunas, billfishes, and sharks. In addition, workshops and presentations were conducted by IATTC staff members and others in all the countries participating in the program.

8.3. Sea birds

a. Resolution C-05-01, adopted by the IATTC in June 2005, recommends that IATTC Parties and cooperating non-Parties, fishing entities, and regional economic integration organizations implement, if appropriate, the International Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries; collect and provide information to the Commission on interactions with seabirds; and for the Working Group on Stock Assessment to present to the Commission an assessment of the impact of incidental catches of seabirds resulting from the activities of all the vessels fishing for tunas and tuna-like species in the EPO. This assessment should include an identification of the geographic areas in which there could be interactions between longline fisheries and seabirds.

b. The sixth meeting of the IATTC Working Group on Bycatch recommended that the Stock Assessment Working Group suggest possible mitigation measures in areas in which seabird distributions and longline effort overlap, and that the IATTC consider mitigation measures at its June 2007 meeting. It also recommended that seabird bycatch data be collected from all tuna longliners in the EPO.

c. A population model for black-footed albatross is being developed to assess whether past and present levels of bycatch are likely to significantly affect their populations and to generate a protected species model that can be applied to multiple species and used to provide management advice. IATTC purse-seine observer data are being used also to plot seabird distributions.

8.4. Other species

a. In June 2000, the IATTC adopted a resolution on live release of sharks, rays, billfishes, dorado, and other non-target species.

b. Resolution C-04-05, adopted by the IATTC in June 2006, instructs the Director to seek funds for reduction of incidental mortality of juvenile tunas, for developing techniques and equipment to facilitate release of billfishes, sharks, and rays from the deck or the net, and to carry out experiments to estimate the survival rates of released billfishes, sharks, and rays.

8.5. All species

a. Data on the bycatches of large purse-seine vessels are being collected, and governments are urged to provide bycatch information for other vessels.

b. Data on the spatial distributions of the bycatches and the bycatch/catch ratios have been collected for analyses of policy options to reduce bycatches.

c. Information to evaluate measures to reduce the bycatches, such as closures, effort limits, *etc*., has been collected.

d. Assessments of habitat preferences and the effect of environmental changes have been made.

9. FUTURE DEVELOPMENTS

It is unlikely, in the near future at least, that there will be stock assessments for most of the bycatch species. In lieu of formal assessments, it may be possible to develop indices to assess trends in the status of these species. The IATTC staff's experience with dolphins suggests that the task is not trivial if relatively high precision is required.

An array of measures has been proposed to study changes in ecosystem properties. This could include studies of average trophic level, size spectra, dominance, diversity, *etc*., to describe the ecosystem in an aggregate way.

The distributions of the fisheries for tunas and billfishes in the EPO are such that several regions with different ecological characteristics may be included. Within them, water masses, oceanographic or topographic features, influences from the continent, *etc*., may generate heterogeneity that affects the distributions of the different species and their relative abundances in the catches. It would be desirable to increase our understanding of these ecological strata so that they can be used in our analyses.

It is important to continue studies of the ecosystems in the EPO. The power to resolve issues related to fisheries and the ecosystem will increase with the number of habitat variables, taxa, and trophic levels studied and with longer time series of data.

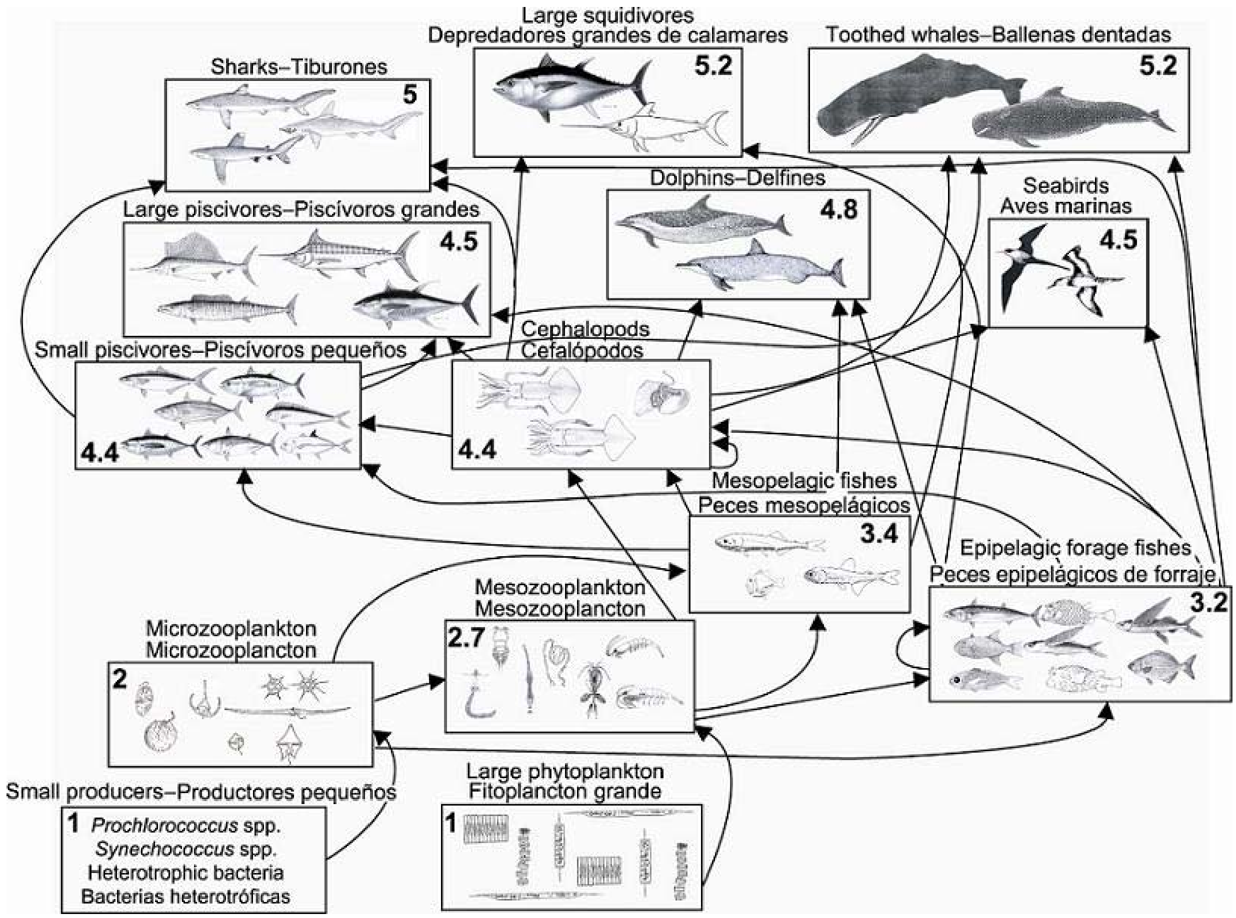

FIGURE J-1. Simplified food-web diagram of the pelagic ecosystem in the tropical eastern Pacific Ocean. The numbers inside the boxes indicate the approximate trophic levels of each group.
FIGURA J-1. Diagrama simplificado de la red trófica del ecosistema pelágico en el Océano Pacífico oriental tropical. Los números en los recuadros indican el nivel trófico aproximado de cada grupo.

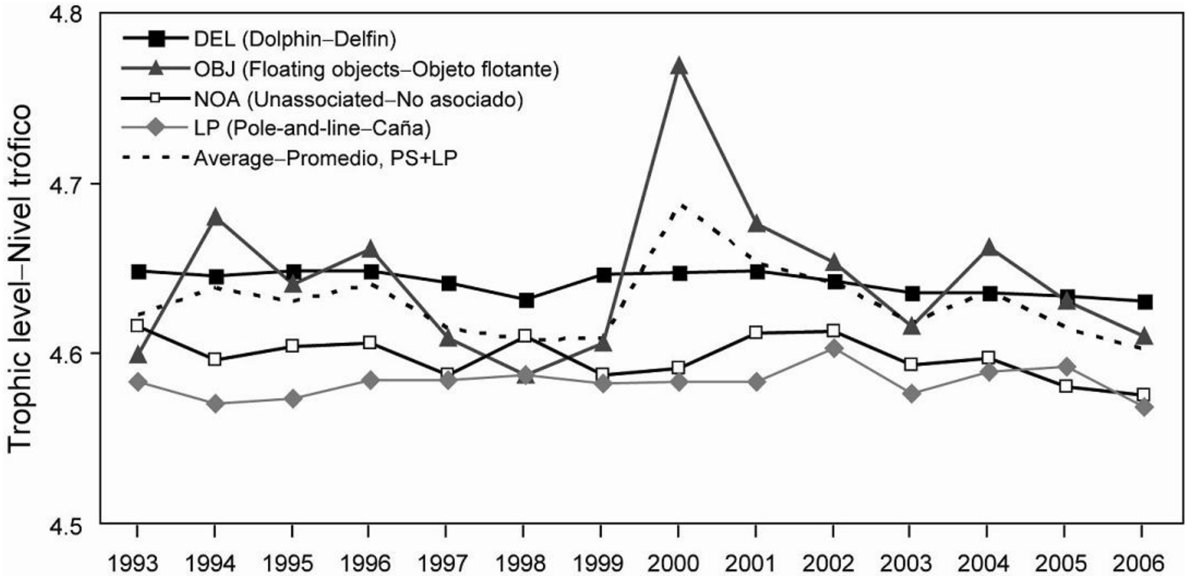

FIGURE J-2. Yearly trophic level estimates of the catches (retained and discarded) by the purse-seine and pole-and-line fisheries in the tropical eastern Pacific Ocean, 1993-2006.
FIGURA J-2. Estimaciones anuales del nivel trófico de las capturas (retenidas y descartadas) de las pesquerías cerquera y cañera en el Océano Pacífico oriental tropical, 1993-2006.

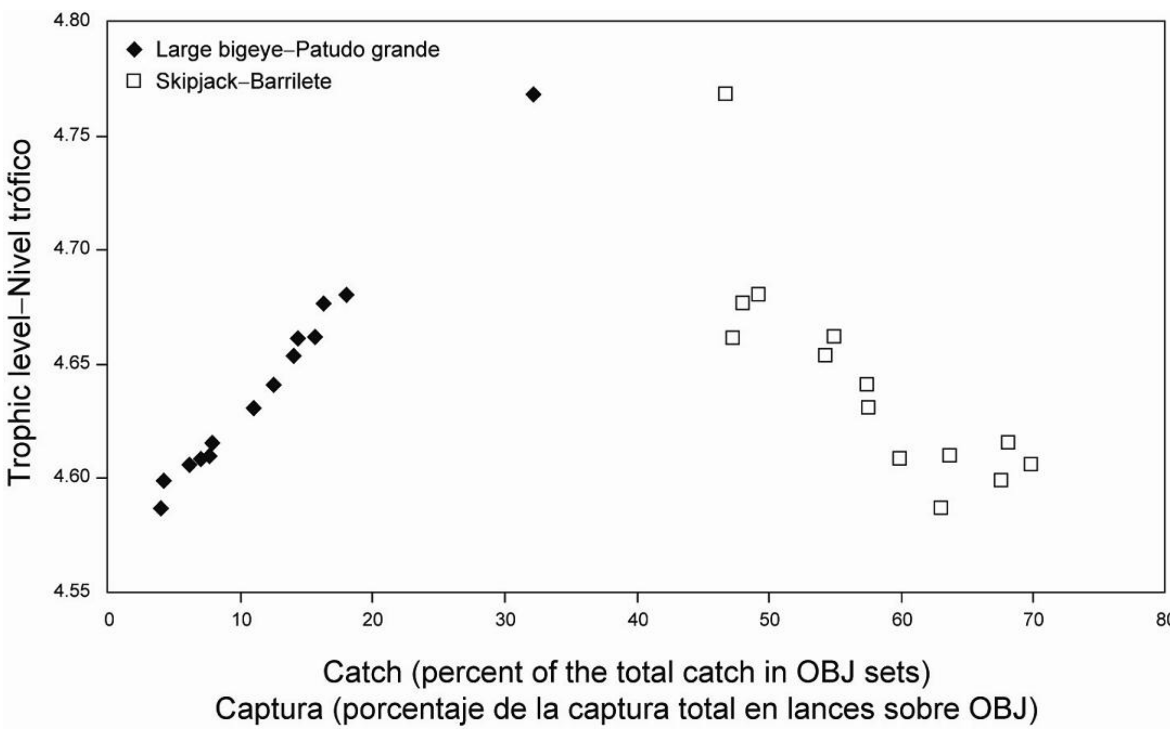

FIGURE J-3. Estimates of the trophic levels of the retained catches of large bigeye and of skipjack in floating-object sets (OBJ) in the tropical eastern Pacific Ocean, 1993-2006, versus the catches of large bigeye and of skipjack calculated as percentages of the total catches in floating-object sets each year.
FIGURA J-3. Estimaciones de los niveles tróficos de las capturas retenidas y descartadas en lances sobre objetos flotantes (OBJ) en el Océano Pacífico oriental tropical, 1993-2006, relativas a las capturas de patudo grande y barrilete, calculadas como porcentajes de las capturas totales en lances sobre objetos flotantes cada año.

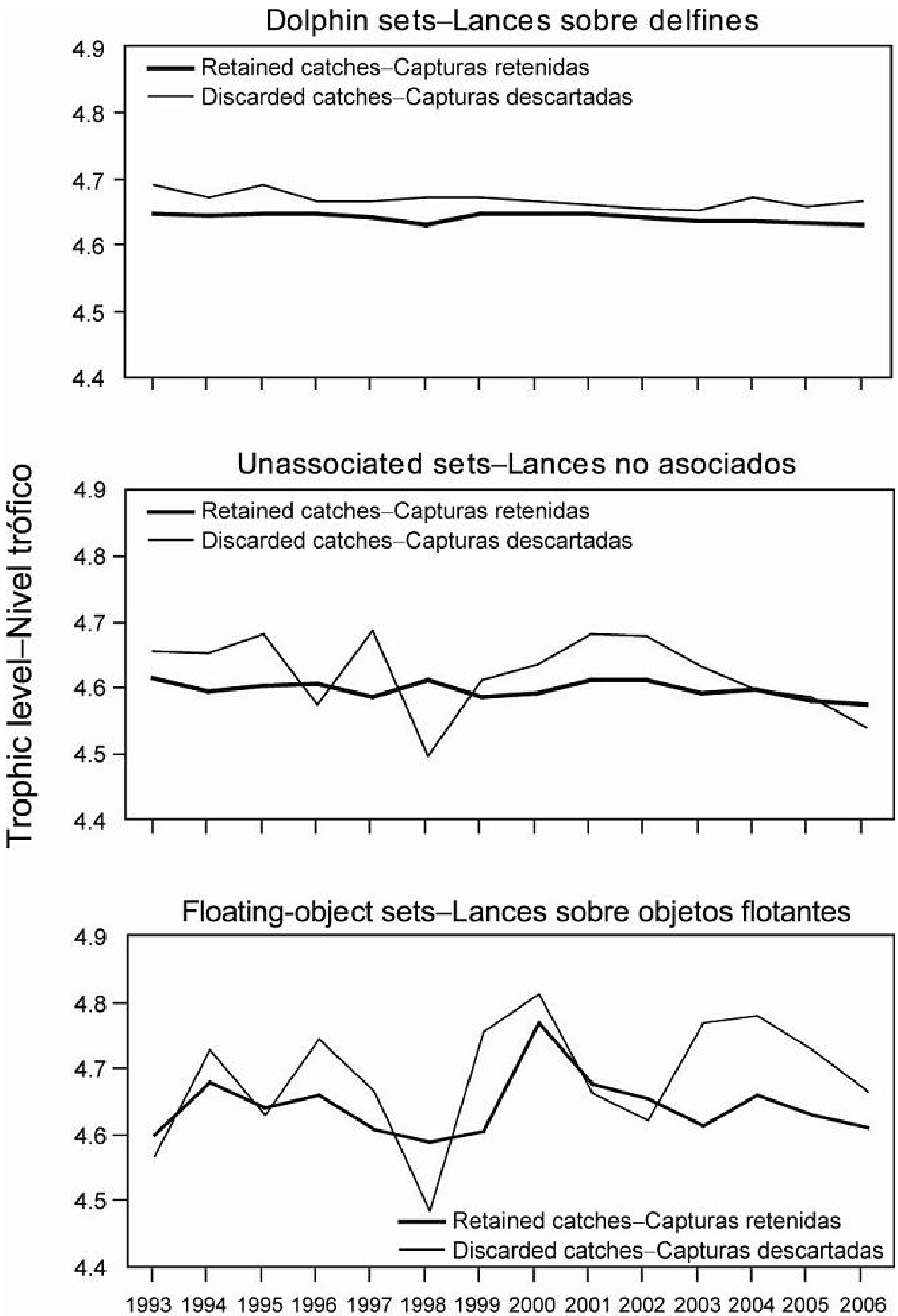

FIGURE J-4. Trophic level estimates of the retained catches and discarded catches by purse-seine fishing modes in the tropical eastern Pacific Ocean, 1993-2006.

FIGURA J-4. Estimaciones del nivel trófico de las capturas retenidas y descartadas por modalidad de pesca cerquera en el Océano Pacífico oriental tropical, 1993-2006.

J. CONSIDERACIONES DE ECOSISTEMA

1. INTRODUCCIÓN

El Código de Conducta para la Pesca Responsable de FAO dispone que la ordenación de pesquerías debería asegurar la conservación de no sólo las especies objetivo, sino también de las otras especies que pertenecen al mismo ecosistema. En 2001, la Declaración de Reykiavik sobre la Pesca Responsable en el Ecosistema elaboró esta norma con un compromiso de incorporar un enfoque de ecosistema en la ordenación de las pesquerías.

La CIAT ha tomado cuestiones de ecosistema en cuenta en muchas de sus decisiones, y el presente informe sobre el ecosistema que incluye los atunes y peces picudos ha estado disponible desde 2003 para ayudar en la toma de decisiones de ordenación. Esta sección brinda un panorama coherente, resumiendo los conocimientos del impacto directo de la pesca sobre varias especies y grupos de especies en el ecosistema, y presenta los conocimientos del medio ambiente y de otras especies que no son afectadas directamente por la pesca.

Este análisis no sugiere objetivos para la incorporación de consideraciones de ecosistema en la ordenación de las pesquerías de atunes o peces picudos ni nuevas medidas de ordenación. Su propósito principal es más bien brindar a la Comisión la oportunidad de asegurar que dichas consideraciones formen parte de su agenda.

Es importante tener en cuenta que la perspectiva que tenemos del ecosistema se basa en el pasado reciente; disponemos de muy poca información sobre el ecosistema antes de que comenzara la explotación. Además, el medio ambiente está sujeto a cambios en varias escalas temporales, entre ellas las conocidas fluctuaciones de El Niño y cambios a plazo mayor recientemente reconocidos, tales como la Oscilación Decadal del Pacífico y otros cambios climáticos.

Además de reportar las capturas de las especies principales de atunes y peces picudos, el personal reporta las capturas incidentales de otras especies que normalmente son descartadas. En la presente sección, se presentan datos sobre dichas capturas incidentales en el contexto del efecto de la pesca sobre el ecosistema. Desgraciadamente, mientras que se cuenta con información relativamente buena para los atunes y peces picudos, no se dispone de información para la pesquería entera. La información es completa para los buques cerqueros grandes (de más de 363 toneladas de capacidad de acarreo) que llevan observadores bajo el Acuerdo sobre el Programa Internacional para la Conservación de los Delfines (APICD), y se registra información sobre capturas retenidas también para otros buques cerqueros, barcos cañeros, y gran parte de la flota palangrera. Se dispone de cierta información sobre tiburones retenidos por partes de la flota palangrera. Se cuenta también con información sobre capturas incidentales y descartes de los cerqueros grandes y de algunos de menor tamaño. Se dispone de poca información sobre las capturas incidentales y descartes de otros buques pesqueros.

2. IMPACTO DE LAS CAPTURAS

2.1 Evaluaciones de especies individuales

Esta sección presenta un resumen de la información actual sobre el efecto de las pesquerías atuneras sobre las poblaciones de especies individuales en el Océano Pacífico oriental (OPO). Se enfoca en la biomasa actual de cada población considerada comparada con lo que hubiera sido en ausencia de una pesquería. La intención es señalar cómo la pesca puede haber alterado los componentes del ecosistema, y no evaluaciones detalladas, presentadas en otras secciones de este informe y en otros documentos de la CIAT. En la sección siguiente se hace referencia a menudo a comparaciones con el tamaño estimado de la población sin explotación. No hay medidas directas del tamaño de la población antes de que comenzara la pesca, y en todo caso hubiese variado entre años. Además, el tamaño de la población sin explotación podría ser afectado por la abundancia de los depredadores y las presas, la cual no es incluida en los análisis de las especies individuales.

2.2. Atunes

2.2.1. Aleta amarilla

La población de aleta amarilla cambió a un régimen de reclutamiento más alto alrededor de 1983, pero es posible que haya vuelto a cambiar recientemente a un régimen de reclutamiento intermedio. Durante 2004-2006 ha estado por debajo del nivel correspondiente al rendimiento máximo sostenible promedio (36% de su tamaño sin explotación). Una estimación del efecto de este tamaño de población reducido es que la depredación por aletas amarillas adultos sobre otras partes del ecosistema es reducida a aproximadamente el 34% de lo que fue en ausencia de una pesquería.

2.2.2. Barrilete

Las evaluaciones del barrilete son mucho menos ciertas que las de aleta amarilla y patudo, en parte porque la pesquería en el OPO no parece tener mucho impacto sobre la población. Sin embargo, parece que fluctuaciones en el reclutamiento causan grandes variaciones en el tamaño de la población.

2.2.3. Patudo

Hasta 1993, el patudo fue capturado principalmente por la pesquería palangrera, y se estima que en ese año el tamaño de la población era el 36% de su tamaño sin explotación. A partir de 1993, la pesca con red de cerco de atunes asociados con dispositivos agregadores de peces (plantados) capturó cantidades importantes de patudo pequeño y mediano. En 2004, después de varios años de reclutamiento pobre y niveles excesivos de mortalidad por pesca, se estimó que el tamaño de la población era un 17% de su tamaño sin explotación. Debido a picos recientes en el reclutamiento, el nivel actual ha aumentado al 20%.

2.2.4. Aleta azul del Pacífico

Se considera que hay una sola población de atún aleta azul del Pacífico en el Océano Pacífico, dado que el desove ocurre aparentemente en el Pacífico occidental solamente. Los estudios de marcado han demostrado que existe intercambio de aletas azules entre el Pacífico oriental y occidental. Una evaluación preliminar de la población, realizada por el Comité Científico Internacional para los Atunes y Especies Afines en el Océano Pacífico Norte (ISC) en 2005, ha indicado que la biomasa de la población reproductora mostró picos locales a principios de los 1960, fines de los 1970, y fines de los 1990, con una disminución después del último pico. Un evento de reclutamiento fuerte que posiblemente ocurrió en 2001 mantendría a la biomasa de la población reproductora por encima de los niveles recientes hasta 2010.

2.2.5. Albacora

En general, se considera que hay dos poblaciones de albacora en el Océano Pacífico, una en el Pacífico Norte y la otra en el Pacífico Sur. Una evaluación de la población del sur, realizada por la Secretaría de la Comunidad del Pacífico en 2003, señaló que estaba en un 60% de su tamaño no explotado. Una evaluación por el 19° *North Pacific Albacore Workshop* en 2004 indicó de la población del norte está en un 45%

de dicho tamaño.

2.3. Peces picudos

2.3.1. Pez espada

Las poblaciones de pez espada del Océano Pacífico nordeste y sudeste son identificables a partir de análisis genéticos y de la pesca. Análisis preliminares de la condición de la población del Pacífico sudeste de la especie indican que la biomasa reproductora ha disminuido durante el período de 1945-2003, y está ahora en aproximadamente el doble del nivel (~0.26) que produciría el rendimiento máximo sostenible promedio (RMSP = 13.000-14.000 toneladas (t)). Las capturas han aumentado sustancialmente desde 2001, y recientemente han estado por las 12.000-16.000 t anuales.

Las variaciones en la captura por unidad de esfuerzo (CPUE) estandarizada de pez espada en el OPO norte no muestran ninguna tendencia, lo cual sugiere que las capturas hasta la fecha no han afectado la población de forma significativa.

2.3.2. Marlín azul

Evaluaciones recientes de la población de marlín azul sugieren que su tamaño actual está entre el 50 y 90% de su tamaño no explotado.

2.3.3. Marlín rayado

Un análisis genético preliminar sugirió que existen varias poblaciones de marlín rayado en el Océano Pacífico. Las evaluaciones de una población en el OPO sugirieron que el tamaño actual está entre el 50 y 70% del tamaño no explotado. El ISC está realizando un análisis de la condición de una sola población hipotética que abarca el Pacífico norte entero; se esperaba tener los resultados en julio de 2007.

2.3.4. Marlín negro, pez vela, y marlín trompa corta

No se han realizado recientemente evaluaciones de las poblaciones de estas especies, pero hay ciertos datos, publicados conjuntamente por científicos del Instituto Nacional de Investigación de Pesquerías de Ultramar (NRIFSF) del Japón y la CIAT en la serie de Boletines de la CIAT, que indican tendencias en capturas, esfuerzo, y CPUE.

2.4. Resumen

Las estimaciones preliminares de las capturas (incluyendo descartes de la pesca de cerco), en toneladas, de atunes en 2006 y peces picudos en 2005 en el OPO son:

	PS			LP	LL	OTR	Total
	OBJ	NOA	DEL				
Atún aleta amarilla	36,772	42,200	89,261	693	3,976	1,878	174,780
Atún barrilete	206,693	109,638	4,971	429	184	89	322,004
Atún patudo	71,399	1,644	0	0	30,271	8	103,322
Aleta azul del Pacífico	0	9,795	0	0	0	96	9,891
Atún albacora	0	109	0	0	6,390	6,402	12,901
Pez espada	<1	<1	1	0	8,797	4,490	13,289
Marlín azul	203	16	17	0	2,619	820	3,676
Marlín rayado	12	14	13	0	1,278	328	1,645
Marlín negro	81	8	15	0	41	0	145
Pez vela	3	7	30	0	37	782	859
Marlín trompa corta	<1	<1	<1	0	276	0	276

2.5 Mamíferos marinos

En el OPO, se encuentran frecuentemente mamíferos marinos, especialmente delfines manchados (*Stenella attenuata*), tornillo (*S. longirostris*), y comunes (*Delphinus delphis*), asociados con atunes aleta amarilla de entre unos 10 y 40 kg. Los pescadores con red de cerco descubrieron que podían lograr las capturas máximas de aleta amarilla en el OPO si cercaran manadas de delfines asociadas con atunes, y luego liberaran los delfines sin dejar al pescado escapar. La mortalidad incidental de delfines en esta operación fue alta en los primeros años de la pesquería, y las poblaciones de delfines fueron reducidas de sus niveles sin explotación durante las décadas de 1960 y 1970. A partir de fines de la década de los 1980 la mortalidad incidental disminuyó precipitadamente, y ahora hay evidencias de una recuperación de las poblaciones. En la tabla se presenta la estimación preliminar de la mortalidad de delfines ocasionada por la pesca en 2006.

Especie y población	**Mortalidad incidental**	
	Número	**Toneladas métricas**
Delfín manchado de altamar		
Nororiental	144	9
Occidental/sureño	135	9
Delfín tornillo		
Oriental	155	7
Panza blanca	157	9
Delfín común		
Norteño	130	9
Central	87	6
Sureño	38	3
Otros delfines[1]	40	4
Total	886	57

Los estudios de la asociación de atunes con delfines forman un componente importante del enfoque a largo plazo del personal para comprender las interacciones clave en el ecosistema. El grado al cual los atunes aleta amarilla y los delfines compiten por recursos, o si uno u otro se beneficia de la interacción, constituyen información crítica, en vista de la gran biomasa de ambos grupos, y su altas tasas de consumo de presas. Análisis de la dieta y de isótopos estables de atunes aleta amarilla y delfines manchado y tornillo capturados en agregaciones multiespecíficas por buques cerqueros en el OPO demuestran diferencias importantes en los hábitos de alimentación y en la posición trófica de las tres especies, lo cual sugiere que la asociación atún-delfín probablemente no es mantenida por ventajas de alimentación. Esta conclusión es apoyada por estudio de rastreo por radio de delfines manchados con grabadoras de tiempo y profundidad, que indican que los delfines se alimentan principalmente de noche con organismos asociados con la capa profunda de dispersión, mientras que estudios de los hábitos de alimentación del atún aleta amarilla señalan una alimentación principalmente diurna.

Durante 2006, científicos del Servicio Nacional de Pesquerías Marinas (NMFS) de EE.UU. realizaron un crucero de investigación como parte del proyecto STAR (*Stenella Abundance Research*). La meta principal de este estudio plurianual es investigar tendencias en el tamaño de las poblaciones de delfines que son capturadas incidentalmente en la pesquería de cerco en el OPO. Se tomaron datos sobre la distribución y el tamaño y composición de manadas de cetáceos para estimar la abundancia de los delfines. El estudio de 2006 cubrió las mismas zonas y usó los mismos métodos que los estudios anteriores. Los datos de los estudios de transectos lineales a gran escala de 2003 produjeron estimaciones de abundancia para 10 especies y/o poblaciones de delfines. Las estimaciones para los delfines manchado nordeste de altamar y tornillo oriental en 2003 fueron algo mayores que aquéllas de los estudios previos en 1998-2000, y regresiones lineales ponderadas indicaron una ligera tendencia positiva en la abundancia durante el período de

[1] “Otros delfines" incluye las siguientes especies y poblaciones, con las mortalidades observadas correspondientes: delfín listado, 6 (0,4 t); delfín tornillo centroamericano (*Stenella longirostris centroamericana*), 6 (0,3 t); delfín tonina, 3 (0,3 t); ballena piloto de aleta corta (*Globicephala macrorhynchus*) 2 (1,3 t), delfín manchado costero 3 (0,3 t); delfines no identificados, 20 (1,1 t).

1979-2003, Las estimaciones para los delfines manchado de altamar occidental-sureño, tornillo panza blanca, listado (*S. coeruleoalba*), de dientes rugosos (*Steno bredanensis*), común, tonina (*Tursiops truncatus*), y de Risso (*Grampus griseus*), fueron generalmente similares a estimaciones previas obtenidas con los mismos métodos.

Científicos del NMFS han calculado estimaciones de la abundancia de varias otras especies de mamíferos marinos a partir de datos de cruceros de investigación realizados entre 1986 y 2000 en el OPO. Los cruceros STAR de 2003 y 2006 proveerán más estimaciones de la abundancia de estos mamíferos. De las especies no afectadas significativamente por la pesquería atunera, las ballenas piloto de aletas cortas (*Globicephala macrorhynchus*) y tres poblaciones de delfines comunes presentaron tendencias crecientes en abundancia durante esos 15 años. La mayor abundancia aparente de estos mamíferos podría haber causado una disminución en la capacidad de carga del OPO para otros depredadores que comparten su dieta, entre ellos el delfín manchado. La abundancia estimada de la ballena de Bryde (*Balaenoptera edeni*) también aumentó, pero coinciden muy poco las dietas de estas ballenas barbadas y de los depredadores de alto nivel afectados por las pesquerías. La abundancia estimada del delfín listado (*Stenella coeruleoalba*) no demostró ninguna tendencia clara con el tiempo, y las estimaciones de abundancia del cachalote (*Physeter macrocephalus*) han tendido a disminuir en los últimos años.

Ciertos mamíferos marinos son afectados adversamente por la reducción en la disponibilidad de alimento durante eventos de El Niño, especialmente en ecosistemas costeros. Ejemplos documentados incluyen delfines y pinnípedos frente a Perú, pinnípedos en las Islas Galápagos, y ballenas de Bryde frente a Perú. Las ballenas grandes pueden desplazarse en reacción a cambios en la productividad y distribución de sus presas.

2.6. Tortugas marinas

Las tortugas marinas son capturadas en los palangres cuando toman el cebo en los anzuelos, se traban al dar accidentalmente con un anzuelo, o se enredan en una línea. Hay pocas estimaciones de la mortalidad incidental de tortugas causada por la pesca con palangre o red de transmalle. En la cuarta reunión del Grupo de Trabajo sobre Captura Incidental de la CIAT en enero de 2004 se informó que la captura incidental de tortugas en la pesquería palangrera japonesa en el OPO en 2000 consistió de 166 tortugas laúd (*Dermochelys coriacea*), de las cuales 25 estaban muertas, y unas 6,000 tortugas de todas las otras especies, principalmente golfinas (*Lepidochelys olivacea*), de las cuales aproximadamente la mitad estaba muerta. En la sexta reunión del Grupo de Trabajo en febrero de 2007, se informó que la flota española de palangre de superficie que pesca pez espada en el OPO tuvo en promedio 65 interacciones y 8 mortalidades por millón de anzuelos durante 1990-2005. Es probable que las tasas de mortalidad sean similares para otras flotas que pescan atún patudo, y posiblemente mayores que aquéllas flotas que pescan albacora y pez espada a menor profundidad. Unos 23 millones de los 200 millones de anzuelos calados cada año en el OPO por buques palangreros de aguas lejanas están dirigidos hacia el pez espada en palangres poco profundos.

Además, hay una flota considerable de buques palangreros artesanales que pescan atunes, peces picudos, tiburones y dorado (*Coryphaena* spp.) en el OPO. Desde 2005, miembros del personal de la CIAT y de otras organizaciones, junto con los gobiernos de varias naciones costeras de Latinoamérica, han participado en un programa para reducir las tasas de enganche y la mortalidad de tortugas marinas en estas pesquerías. En la sección 8.2 se presenta información adicional sobre este programa.

Las tortugas marinas son capturadas ocasionalmente en redes de cerco en la pesquería atunera del OPO. La mayoría de las interacciones ocurren cuando las tortugas se asocian con objetos flotantes, y son capturados cuando el objeto es cercado; en otros casos, una red calada alrededor de un cardumen de atunes no asociados, o un cardumen asociado con delfines, captura tortugas marinas que están presentes. La tortuga golfina es, por mucho, la especie de tortuga marina capturada con mayor frecuencia por buques cerqueros; la siguen la tortuga negra (*Chelonia agassizii*), y, muy ocasionalmente, las tortugas caguama (*Caretta caretta*) y carey (*Eretmochelys imbricata*). Se ha registrado mortalidad de solamente una tortuga laúd en los 10 años en que los observadores de la CIAT registran esta información. Algunas tortugas no son identificadas por estar demasiado lejos del buque o porque no había suficiente luz para permitir al observador identificarla. A veces las tortugas marinas se enredan en malla debajo de dispositivos agregadotes de peces (plantados) y se ahogan. En unos pocos casos, son sacadas del agua por el aparejo de pesca mientras están enmalladas, y pueden caer de la red de alturas considerables y ser heridas, o ser pasadas por la pasteca hidráulica. Las estimaciones preliminares de la mortalidad de tortugas, en número, causada por buques cerqueros grandes durante 2006 fueron:

	Tipo de lance			
	OBJ	**NOA**	**DEL**	**Total**
Golfina	9.7	4.3	4.3	18.3
Negra	0.0	0.0	0.0	0.0
Caguama	1.2	0.0	0.0	1.2
Carey	0.0	0.0	0.0	0.0
Laúd	0.0	0.0	0.0	0.0
No identificada	1.0	0.0	0.0	1.0
Total	11.9	4.3	4.3	20.5

La pesca atunera de cerco es probablemente una causa de mortalidad de tortugas marinas menos importante que otros tipos de actividad humana, entre ellas el aprovechamiento de huevos y adultos, utilización de playas, contaminación, enmalle en detritos en el mar, ingestión de los mismos, y los impactos de otras pesquerías.

Las poblaciones de tortugas golfina, negra, y caguama están designadas como en peligro, y las de carey y laúd como en peligro crítico, por la Unión Mundial para la Naturaleza (UICN).

2.7 Tiburones y otros peces grandes

Los tiburones y otros peces grandes son capturados por buques cerqueros y palangreros. El tiburón jaquetón (*Carcharhinus falciformis*) es la especie de tiburón capturada con mayor frecuencia en la pesquería de cerco, seguido por el tiburón oceánico (*C. longimanus*). Las pesquerías palangreras capturan también cantidades importantes de esta especie, y es necesario un análisis de la pesca palangrera y cerquera en el Pacífico entero para estimar el impacto de la pesca sobre la población. Estimaciones preliminares de los índices de abundancia relativa de tiburones jaquetón grandes, basadas en datos de lances cerqueros sobre objetos flotantes, señalan una tendencia decreciente durante 1994-2006; las tendencias son similares en los datos no estandarizados de captura incidental por lances en los dos otros tipos de lance cerquero (no se dispone todavía de datos estandarizados). Se ignora si dicha tendencia se debe a la captura incidental en las pesquerías, a cambios en el medio ambiente (quizá asociados con el Niño de 1997-1998), o a otros procesos. La tendencia no parece ser debida a cambios en la densidad de objetos flotantes.

Científicos en la Universidad de Washington están realizando un análisis de la frecuencia temporal de zonas de captura incidental elevada del tiburón jaquetón en los lances cerqueros sobre objetos flotantes, el cual será útil para determinar la eficacia de las vedas de tiempo y zona como método de mitigación de la captura incidental de tiburones. Los resultados preliminares señalan que tanto las predicciones del modelo como los datos observados suelen indican que la frecuencia de estas capturas incidentales es máxima al norte de 4°N y al oeste de 100-105°O. Sin embargo, debido a las grandes capturas de atún al sur de 5°N, se lograría la mayor reducción de esta captura incidental con la menor pérdida de captura de atún al norte de aproximadamente 6°N.

Científicos de la CIAT y del NMFS iniciaron un proyecto para obtener y archivar muestras de tejido de tiburones, rayas y otros peces grandes, para análisis genéticos futuros. Los datos de las muestras archivadas serán usados en estudios de la estructura de las poblaciones de estos grupos a gran escala, información esencial para las evaluaciones de las poblaciones y que falta generalmente en todo el Océano Pacífico.

Una evaluación de la población del tiburón azul (*Prionace glauca*) en el Océano Pacífico Norte ha sido realizada por científicos del NMFS y del NRIFSF. Los resultados preliminares brindan un rango de valores verosímiles del rendimiento máximo sostenible (RMS) de 1,8 a casi 4 veces la captura anual de la especie en 2001.

Las estimaciones preliminares de los descartes (en toneladas) de tiburones y otros peces grandes en el OPO durante 2006 (aparte de aquéllos comentados en lo anterior) por buques cerqueros grandes son las siguientes. No se dispone de datos completos de buques cerqueros pequeños, palangreros y otros.

	Tipo de lance			
	OBJ	**NOA**	**DEL**	**Total**
Tiburones	951	247	107	1,306
Rayas (Mobulidae y Dasyatidae)	3	50	14	67
Dorado (*Coryphaena* spp.)	1,240	55	1	1,295
Peto (*Acanthocybium solandri*)	462	1	1	464
Salmón (*Elagatis bipinnulata*) y jurel (*Seriola lalandi*)	245	228	<1	474
Barrilete negro	1,647	132	10	1,789
Atunes no identificados	<1	84	0	84
Peces picudos	14,979	1,410	107	16,496
Otros peces grandes	47	14	2	62

Aparte de los peces picudos resumidos en las Secciones G-I del presente informe, y el tiburón azul, no existen evaluaciones de las poblaciones de estas especies en el OPO, y por lo tanto se ignoran los impactos de las capturas incidentales sobre las mismas.

Las tasas de captura de especies aparte de los atunes en la pesquería cerquera son diferentes para cada tipo de lance. Con unas pocas excepciones, las tasas de captura incidental son máximas en lances sobre objetos flotantes, seguidos por lances no asociados y, en un nivel mucho más bajo, lances sobre delfines. Las tasas de captura incidental de delfines son máximas en lances sobre delfines, seguidos por lances no asociados y, en un nivel mucho más bajo, lances sobre objetos flotantes. Las tasas de captura incidental de pez vela (*Istiophorus platypterus*), rayas (Mobulidae), y mantarrayas (Dasyatidae) son máximas en lances no asociados, seguidos por lances sobre delfines, y mínimas en lances sobre objetos flotantes. Debido a estas diferencias, es necesario seguir los cambios en la frecuencia de los distintos tipos de lance para poder interpretar los cambios en las cifras de captura incidental. En la Tabla A-8 se detalla el número estimado de lances cerqueros de cada tipo realizados durante 1989-2006 en el OPO.

En octubre de 2006, el NMFS convocó una reunión técnica sobre la reducción de la captura incidental en la pesquería de cerco en el OPO. Los asistentes acordaron apoyar una propuesta de investigación de métodos para reducir la captura incidental de los tiburones, alejándolos de los objetos flotantes antes de calar la red. Se tiene planeado un estudio de factibilidad. Los asistentes apoyaron también una serie de experimentos de campo sobre aparejos y técnicas para reducir la captura incidental; incluirían modificación y manipulación de los plantados, una evaluación de indicadores de comportamiento y fisiológicos de estrés, y sacar los animales vivos de la red y de la cubierta (por ejemplo, rejas clasificadoras, puertas de burbujas, y bombas de vacío). En una tercera propuesta, asimismo apoyada por los asistentes, se usarían los datos de la CIAT para determinar si los factores espaciales, temporales, y ambientales pueden ser usados para predecir las capturas incidentales en los lances sobre plantados y para determinar en cuál grado las vedas de temporada o zona serían eficaces para reducir dichas capturas incidentales.

3. OTROS COMPONENTES DEL ECOSISTEMA

3.1. Aves marinas

Hay aproximadamente 100 especies de aves marinas en el OPO tropical. Algunas aves marinas se asocian con depredadores epipelágicos cerca de la superficie del agua, tales como peces (especialmente atunes) y mamíferos marinos. Estos depredadores arrean a las presas a la superficie para atraparles en la interfaz entre el agua y el aire, donde las aves las pueden alcanzar. La mayoría de las especies de aves marinas capturan sus presas a menos de medio metro de la superficie del mar o en el aire (peces voladores (Exocoetidae) y calamares (Ommastrephidae)). Los depredadores subsuperficiales causan que las aves puedan conseguir las presas más fácilmente no sólo al arrearlas a la superficie, sino también al herirlas o desorientarlas y al dejar restos después de alimentarse de presas grandes. Las oportunidades de alimentación de algunas especies de aves marinas dependen de la presencia de cardúmenes de atunes alimentándose cerca de la superficie.

Las aves marinas son afectadas por la variabilidad del ambiente oceánico. Durante el Niño de 1982-1983, las poblaciones de aves marinas en todo el Océano Pacífico tropical y noreste padecieron fracasos de reproducción y mortalidades masivas, o migraron a otros lugares en busca de alimento. Algunas especies, empero, aparentemente no son afectadas por eventos de El Niño. En general, las aves marinas que se alimentan en las zonas de afloramiento del OPO tropical y la Corriente de Perú padecen fracasos de reproducción y mortalidades debido a falta de alimento durante eventos de El Niño, mientras que aquéllas que se alimentan en zonas menos afectadas por El Niño podrían resultar relativamente ilesas.

Según el *Informe del Programa de Investigación Científica bajo la Ley sobre el Programa Internacional para la Conservación de los Delfines de EE.UU.*[2], preparado por el NMFS en septiembre de 2002, no hubo tendencias temporales significativas en las estimaciones de abundancia del período de 1986-2000 de ninguna especie de ave marina en el OPO tropical, excepto una tendencia decreciente en caso del petrel de Tahití (*Pseudobulweria rostrata*). Se están revisando la condición y las tendencias de las poblaciones de albatros de las Galápagos (*Phoebastria irrorata*), patinegro (*P. nigripes*), y de Laysan (*P. immutabilis*).

Algunas aves marinas, especialmente los albatros y petreles, son susceptibles a la captura en los anzuelos cebados en las pesquerías palangreras pelágicas. Datos de rastreo por satélite y de observaciones en el mar han identificado la importancia del Área de la CIAT para los albatros de las Galápagos, de Laysan, y ojeroso (*Thalassarche melanophrys*), más varias especies que se crían en Nueva Zelanda pero que se alimentan frente a Sudamérica. El albatros de las Galápagos es motivo de preocupación especial, por ser endémico del OPO y anidar únicamente en Galápagos. Los datos de observadores en buques artesanales no indicaron interacciones del albatros de Galápagos con las faenas de pesca de estos buques. Los datos de la pesquería palangrera pelágica de EE.UU. in el Pacífico nordeste indican que ocurren capturas incidentales de albatros patinegro y de Laysan. Se dispone de pocos datos comparables de las pesquerías palangreras en el Pacífico central y sudeste. En la sexta reunión del Grupo de Trabajo en febrero de 2007, se informó que la flota española de palangre de superficie que pesca pez espada en el OPO tuvo en promedio 40 interacciones con aves marinas por millón de anzuelos durante 1990-2005, casi todas de las cuales resultaron en mortalidad. En 2007, el Grupo de Trabajo sobre Evaluaciones de Poblaciones de la CIAT identificó áreas de vulnerabilidad a la pesca industrial de palangre para varias especies de albatros, y propuso medidas de mitigación. En un estudio financiado de fuentes externas, el personal de la CIAT está investigando la condición de la población del albatros patinegro y en Pacífico norte entero, tomando en cuenta los efectos de la captura incidental en la pesca.

Ciertas aves marinas son susceptibles captura en anzuelos cebados en las pesquerías palangreras pelágicas. Se analizaron datos sobre las capturas incidentales del albatros de patas negras (*Phoebastria nigripes*) por la pesquería palangrera pelágica de EE.UU. en el Pacífico Norte, pero no se dispone de datos comparables para las pesquerías palangreras en el OPO. En un estudio financiado de fuentes externas, el personal de la CIAT está investigando la condición de la población de esta especie en el Pacífico Norte entero, tomando en cuenta los efectos de la captura incidental en la pesca.

3.2. Forraje

Los grupos taxonómicos de forraje que ocupan los niveles tróficos medios en el OPO son obviamente

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[2] *Report of the Scientific Research Program under the U.S. International Dolphin Conservation Program Act*

componentes importantes del ecosistema, formando un vínculo entre la producción primaria en la base de la red trófica y los depredadores de nivel trófico superior, como los atunes y peces picudos. Los efectos indirectos sobre estos depredadores causados por la variabilidad ambiental son transmitidos a los niveles tróficos superiores por medio de los grupos taxonómicos de forraje. Sin embargo, se sabe poco acerca de las fluctuaciones en abundancia de la gran variedad de especies de presas en el OPO. Científicos del NMFS registraron datos sobre la distribución y abundancia de grupos de presas comunes, entre ellos peces linterna (Myctophidae), peces voladores (*Exocoetidae*), y ciertos calamares, en el OPO tropical durante 1986-1990 y 1998-2000. Las estimaciones de abundancia media de todos los grupos taxonómicos de peces, y en menor grado los calamares, aumentaron durante 1986-1990; fueron bajas de nuevo en 1998, y luego aumentaron hasta 2000. Su interpretación de este patrón fue que los eventos de El Niño en 1986-1987 y 1997-1998 ejercieron efectos negativos sobre estas poblaciones de presas. Durante los cruceros STAR de NMFS en 2003 y 2006 se reunieron más datos sobre estos grupos taxonómicos, y están siendo analizados.

El tamaño y la distribución geográfica de las poblaciones del calamar gigante o de Humboldt (*Dosidicus gigas*) en el OPO han aumentado en los últimos años. Además, en 2002 los observadores en buques atuneros de cerco reportaron incrementos de las capturas incidentales de la especie con los atunes, principalmente el barrilete, frente al Perú. Las etapas juveniles de este calamar constituyen una presa común de los atunes aleta amarilla y patudo, y de otros peces depredadores, y son también depredadores voraces de peces pequeños y de cefalópodos en toda su zona de distribución. Han sido observados atacando a los atunes aleta amarilla y barrilete en una red de cerco. Estos calamares no sólo han afectado los ecosistemas a los cuales se han expandido, sino que se piensa que son capaces de afectar la estructura trófica en las regiones pelágicas. Cambios en la abundancia y distribución geográfica del calamar de Humboldt podrían afectar el comportamiento de alimentación de los atunes y otros depredadores, cambiando quizá su vulnerabilidad a la captura, y podría también reducir el reclutamiento de los peces explotados. En la Sección 4 se describe un programa de muestreo reciente del personal de la CIAT para examinar posibles cambios en el comportamiento de alimentación del atún aleta amarilla.

Algunos peces pequeños, muchos de los cuales son alimento para los depredadores más grandes, son capturados por buques cerqueros en el OPO. Las melvas (*Auxis* spp.), por ejemplo, son presas comunes de muchos de los animales que ocupan los niveles tróficos superiores en el OPO tropical. En el modelo del ecosistema del OPO tropical (Sección 7), las melvas forman el 10% a más de la dieta de ocho categorías de depredadores. Pequeñas cantidades de melvas son capturadas por buques cerqueros en alta mar, y por pesquerías artesanales locales en algunas regiones costeras de América Central y del Sur. La gran mayoría de las melvas capturadas por buques atuneros de cerco es descartada en el mar. Las estimaciones preliminares de los descartes de peces pequeños, en toneladas, por buques cerqueros grandes con observadores a bordo en el OPO durante 2005 son:

	Tipo de lance			
	OBJ	**NOA**	**DEL**	**Total**
Peces ballesta (Balistidae) y cachúas (Monacanthidae)	167	<1	<1	167
Otros peces pequeños	155	4	1	160
Melvas (*Auxis* spp.)	1,273	751	19	2,043

3.3. Peces larvales y plancton

Desde hace muchos años, el personal del Southwest Fisheries Science Center del NMFS captura peces larvales en el OPO con redes de arrastre de superficie. De las 314 categorías taxonómicas identificadas, se descubrió que 17 tenían la mayor probabilidad de mostrar los efectos de cambios ambientales. La frecuencia, abundancia, y distribución de estos grupos clave no mostró ninguna tendencia temporal consistente.

Las poblaciones de fitoplancton y zooplancton en el OPO tropical son variables. Por ejemplo, las concentraciones de clorofila en la superficie del mar (un indicador de afloramientos de fitoplancton) y la abundancia de copépodos fueron reducidas marcadamente durante el Niño de 1982-1983, especialmente al oeste de 120°O. Similarmente, las concentraciones de clorofila en la superficie disminuyeron durante el Niño de 1986-1987 y aumentaron durante la Niña de 1988 debido a cambios en la disponibilidad de nutrientes.

La composición por especies y tamaños del zooplancton es a menudo más variable que la biomasa de zooplancton. Cuando aumenta la temperatura del agua, especies de agua cálida a menudo reemplazan especies de agua fría en lugares particulares. La abundancia relativa de copépodos pequeños frente al norte de Chile, por ejemplo, aumentó durante el Niño de 1997-1998, mientras que la biomasa de zooplancton no cambió.

4. INTERACCIONES TRÓFICAS

Los atunes y peces picudos son depredadores generalistas de gran alcance con requisitos energéticos elevados, y como tal, son componentes clave de los ecosistemas pelágicos. No se entienden bien las relaciones ecológicas entre estos grandes depredadores pelágicos, y entre ellos y los animales de niveles tróficos más bajos. A la luz de la necesidad de evaluar las implicaciones de las actividades de pesca sobre los ecosistemas subyacentes, es esencial adquirir representaciones exactas de los vínculos tróficos y los flujos de la biomasa por la red de alimentación en los ecosistemas del océano abierto, así como conocimientos básicos de la variabilidad natural impuesta por el medio ambiente.

Históricamente, los conocimientos de la ecología trófica de los peces depredadores se basaron en análisis del contenido de los estómagos. Los depredadores pelágicos grandes son considerados muestreadotes eficaces de los organismos micronécticos, que son mal muestreados por redes y arrastres. Los estudios de las dietas han descubierto muchos de los vínculos tróficos clave en el OPO pelágico, y han formado la base para la representación de las interacciones de las red de alimentación en un modelo de ecosistema (Boletín de la CIAT, Vol. 22, No. 3) para explorar los efectos indirectos de la pesca sobre el ecosistema. La presa más común de los atunes aleta amarilla capturados por buques cerqueros en alta mar son melvas (*Auxis* spp.), calamares y argonautas (cefalópodos), y peces voladores y otros peces epipelágicos. El atún patudo se alimenta a mayor profundidad que el aleta amarilla y barrilete, y consume principalmente cefalópodos y peces mesopelágicos. La presa más importante del barrilete fueron, en general, los crustáceos eufásidos en un estudio realizado a fines de los años 1950, mientras que a principios de los 1990 el pequeño pez mesopelágico *Vinciguerria lucetia* pareció predominar en la dieta. Los atunes que se alimentan cerca de la costa utilizan presas diferentes a aquéllos capturados mar afuera. Por ejemplo, atunes aleta amarilla y barrilete capturados frente a Baja California se alimentan fuertemente del cangrejo rojo, *Pleuroncodes planipes*. Más recientemente, los estudios de dieta se han enfocado en entender redes de alimentación enteras, inicialmente con descripciones de las conexiones interespecíficas entre las comunidades de depredadores, formadas por los atunes, tiburones, peces picudos, el dorado, peto (*Acanthocybium solandri*), salmón (*Elagatis bipinnulata*), y otros. En general, es evidente una repartición considerable de recursos entre los componentes de estas comunidades, y los investigadores buscan comprender la escala espacial de los patrones tróficos que se pueden observar, así como la influencia de la variabilidad climática sobre estos patrones.

Mientras que los estudios de la dieta han contribuido mucho a los conocimientos de la materia, las proporciones de los isótopos estables de carbono y nitrógeno son el complemento ideal al contenido de los estómagos para el estudio de las redes de alimentación. El contenido de los estómagos representa solamente una imagen relativa del alimento más reciente en el momento en el que fue capturado el animal, y bajo las condiciones necesarias para su captura. Los isótopos estables de carbono y nitrógeno, en cambio, integran información sobre todos los componentes de la dieta en el tejido del animal, brindando así un historial reciente de las interacciones tróficas e información sobre la estructura y dinámica de las comunidades ecológicas. Estudios recientes de isótopos estables indican una posición trófica media de 4,2-4,5 para el atún aleta amarilla en el OPO, mientras que los análisis previos de la dieta sugieren que es en promedio 4,6-4,7.

Durante el cuarto trimestre de 2006 se inició un estudio a corto plazo para examinar el contenido del estómago de atunes aleta amarillas recién capturados, con el objeto de detectar posibles cambios en su comportamiento de alimentación con respecto a años anteriores. Las evaluaciones de poblaciones de especies individuales no están diseñadas para considerar el efecto de las interacciones tróficas (por ejemplo, depredación, competición, y cambios en la estructura trófica) sobre la población en cuestión. Las poblaciones de presas que alimentan a los depredadores ápice también cambian con el tiempo (ver 3.2, Forraje), y algunas presas ejercen una presión de depredación considerable sobre los animales que ocupan los niveles tróficos más bajos (incluyendo las etapas tempranas de vida de los peces grandes). Muestras de estómago de un depredador ubicuo, como el atún aleta amarilla, comparadas con datos de dieta previos, pueden ser usadas para inferir cambios en las poblaciones de presas mediante la identificación de cambios en el comportamiento de alimentación. Cambios en el comportamiento de alimentación podrían causar que los atunes, por ejemplo, cambiasen su distribución típica de profundidad mientras se alimentan, y esto podría afectar su vulnerabilidad a la captura. Las muestras de estómago de los aletas amarillas fueron obtenidas de lances cerqueros sobre atunes asociados con delfines durante el cuarto trimestre de 2006, y comparadas con muestras de lances sobre delfines realizados durante 2003-2005 en la misma zona de pesca. De interés especial fueron las diferencias interanuales en la depredación sobre el calamar de Humboldt o gigante debido a cambios recientes en su abundancia y distribución geográfica (ver 3.2 Forraje). La cantidad de tejido fresco de calamar en los estómagos de los aletas amarillas fue muy baja, y no hubo diferencias de año en año en las proporciones en la dieta por peso. Las mandíbulas (o picos) de los cefalópodos son retenidas en el estómago, y la frecuencia porcentual de las mandíbulas de calamares gigantes disminuyó un 21% entre 2004 y 2006. Las diferencias interanuales en la depredación sobre otros componentes de la dieta fueron pequeñas. La cantidad de *Auxis* spp. consumida fue significativamente mayor ($P<0.05$) en 2005 y 2006 que en 2003 y 2004, y en 2006 el consumo de la sardineta plumilla (*Harengula thrissina*) y el estornino (*Scomber japonicus*) fue significativamente mayor que en los tres años anteriores. En general, no existe evidencia convincente de que hayan ocurrido cambios sustanciales en la estructura trófica durante 2003-2006, a partir de los hábitos de alimentación de los atunes aleta amarilla capturados en asociación con delfines.

5. AMBIENTE FÍSICO[3]

Las condiciones ambientales afectan a los ecosistemas marinos, la dinámica y capturabilidad de los atunes y peces picudos, y las actividades de los pescadores. Los atunes y peces picudos son pelágicos durante todas las etapas de la vida, y los factores físicos que afectan al Océano Pacífico tropical y subtropical pueden ejercer efectos importantes sobre su distribución y abundancia. Se cree que las condiciones ambientales causan una variabilidad considerable en el reclutamiento de los atunes y peces picudos. Las evaluaciones de las poblaciones realizadas por la CIAT a menudo han incluido el supuesto que las condiciones oceanográficas podrían afectar el reclutamiento en el OPO.

Distintos tipos de perturbaciones climáticas podrían afectar la pesca de distintas formas. Se cree que una termoclina poco profunda en el OPO contribuye al éxito de la pesca atunera de cerco, actuando tal vez de barrera térmica para los cardúmenes de atunes pequeños, manteniéndolos cerca de la superficie del agua. Cuando la termoclina se hunde, como durante un evento de El Niño, los atunes parecen ser menos vulnerables a la captura, y las tasas de captura disminuyen. Temperaturas superficiales del mar (TSM) cálidas o frías pueden asimismo causar que estos peces móviles se desplacen a un hábitat más favorable.

El ambiente oceánico varía en una variedad de escalas temporales, de estacional a interanual, decadal, y mayores (por ejemplo, fases o regímenes climáticos). La causa dominante de variabilidad en las capas superiores del OPO es denominada a menudo El Niño-Oscilación del Sur (ENOS). El ENOS es una fluctuación irregular que afecta al Océano Pacífico tropical entero y la atmósfera global. Resulta en variaciones de los vientos, la precipitación, profundidad de la termoclina, circulación, productividad biológica, y

[3] Gran parte de la información en esta sección proviene de Fiedler, P.C. 2002. *Environmental change in the eastern tropical Pacific Ocean: review of ENOS and decadal variability*. Mar. Ecol. Prog. Ser. 244: 265-283.

la alimentación y reproducción de peces, aves y mamíferos marinos. Los eventos de El Niño ocurren a intervalos de entre 2 y 7 años, y son caracterizados por vientos alisios más débiles, una termoclina más profunda, y TSM anormalmente elevadas en el OPO ecuatorial. La fase contraria de El Niño, denominado comúnmente La Niña, es caracterizada por vientos alisios más fuertes, una termoclina menos profunda, y TSM más bajas. La investigación ha documentado una conexión entre el ENOS y la tasa de producción primaria, la biomasa de fitoplancton, y la composición por especies del fitoplancton. Durante los episodios de El Niño disminuye el afloramiento de agua subsuperficial, rica en nutrientes, lo cual lleva a una reducción notoria en la producción primaria y secundaria. El ENOS también afecta directamente a los animales en los niveles tróficos medianos y altos. Los investigadores han concluido que el Niño de 1982-1983, por ejemplo, incrementó la profundidad de la termoclina y nutriclina, redujo la producción primaria, redujo la abundancia de zooplancton, y al final redujo las tasas de crecimiento, el éxito reproductivo, y la supervivencia de varias aves, mamíferos, y peces en el OPO. Sin embargo, en general los habitantes del océano se recuperan en períodos cortos, porque su ciclo vital está adaptado para responder a un hábitat variable.

La CIAT informa trimestralmente de los datos oceanográficos y metereológicos mensuales medios del OPO, incluyendo un resumen de las condiciones actuales del ENOS. Durante 2005 las TSM fueron casi normales, aunque ocurrieron pequeñas áreas de agua fría, principalmente cerca de la costa, y de agua cálida, principalmente en alta mar, en casi cada mes. Durante el primer trimestre de 2006 se desarrollaron condiciones débiles de La Niña. Las condiciones se volvieron neutras durante el segundo trimestre, y durante el tercer trimestre se desarrollaron condiciones débiles de El Niño que continuaron durante el resto del año.

La variabilidad a escala decadal (o sea, de 10 a 30 años) también afecta al OPO. A fines de la década de 1970 ocurrió en el Pacífico Norte un cambio importante en las condiciones físicas y biológicas. Este cambio de clima fue detectado en el OPO tropical también, mediante pequeños aumentos de las TSM, un debilitamiento de los vientos alisios, y un cambio moderado en los niveles de clorofila en la superficie. Algunos investigadores han reportado otro cambio importante en el Pacífico Norte en 1989. La variabilidad en el océano causada por el clima ha sido descrita a menudo en términos de "regímenes" caracterizados por promedios y patrones relativamente estables en las variables físicas y biológicas. Análisis realizados por el personal de la CIAT indican que el atún aleta amarilla en el OPO ha pasado por regímenes de reclutamiento bajo (1975-1982) y alto (1983-2001), y posiblemente otro intermedio (2002-2006). Se cree que el mayor reclutamiento durante este segundo período se debe a un cambio a un régimen de productividad más alta en el Océano Pacífico. Las fluctuaciones decídales en el afloramiento y transporte de agua son simultáneas con el patrón de ENOS más frecuentes y tienen efectos en toda la cuenca sobre las TSM y la pendiente de la termoclina que son similares a los que causa el ENOS, pero a escala temporal mayor.

Existen evidencias que el Océano Pacífico Norte se encuentra actualmente en un régimen frío, mientras que no son aparentes evidencias similares en el caso del Pacífico ecuatorial.

La variabilidad ambiental en el OPO tropical es manifestada de forma diferente en las diferentes regiones donde se capturan los atunes. Por ejemplo, las anomalías de la TSM en la zona cálida del OPO (5° a 20°N, al este de 120°O) han ocurrido con la mitad de la magnitud y varios meses después de aquéllas en el área NIÑO3 en el Pacífico ecuatorial (5°S a 5°N, 90° a 150°O).

6. INDICADORES AGREGADOS

El reconocimiento de las consecuencias de la pesca para los ecosistemas marinos ha fomentado una investigación considerable en los últimos años. Han sido propuestos numerosos objetivos para evaluar los impactos de la pesca sobre los ecosistemas y para definir la sobrepesca desde una perspectiva ecosistémica. Mientras que se han usado los puntos de referencia principalmente para la ordenación de especies objetivo individuales, se cree que un primer paso factible sería aplicar medidas de desempeño y puntos de referencia a especies no objetivo. Ejemplos actuales incluyen límites de mortalidad incidental de delfines en la pesquería cerquera del OPO bajo el APICD. Otra área de interés es la posibilidad de elaborar indicadores útiles de desempeño basados en propiedades a nivel de ecosistema. Han sido propuestos varios indicadores de ecosistema, entre ellos la estructura del tamaño de la comunidad, índices de diversidad, riqueza y uniformidad de especies, índices de solape, espectros tróficos de la captura, abundancia relativa de una especie o un grupo indicador, y numerosos indicadores ambientales. Se opina generalmente que se debería usar indicadores múltiples a nivel de sistema, pero existen dudas sobre la suficiencia de los conocimientos prácticos de la dinámica de estos indicadores, y sobre la existencia de un fundamento teórico para identificar puntos de referencia precautorios o límite basados en las propiedades de los ecosistemas. El uso de indicadores basados en ecosistemas para la ordenación de pesquerías todavía no es común.

Nuevos métodos de ordinación, elaborados por científicos del Instituto de Matemática Estadística en Tokio (Japón), han producido índices de asociación relacionados con distintas agrupaciones de especies de captura y de captura incidental en los lances sobre objetos flotantes en la pesca de cerco. Los índices preliminares señalan patrones espaciales claros a gran escala, y relaciones con variables ambientales, tales como TSM, densidad de clorofila-a, y profundidad de la capa de mezcla. Información sobre las relaciones entre índices de asociación de especies y características ambientales podrían ayudar a guiar el desarrollo de métodos para reducir la captura incidental.

Los enfoques ecosistémicos a la ordenación de la pesca ponen énfasis de nuevo en lograr representaciones fieles de los vínculos tróficos y los flujos de biomasa por la red alimenticia en los sistemas explotados. En la ecología de las redes tróficos se usan los niveles tróficos (TL) para caracterizar el papel funcional de los organismos y para facilitar las estimaciones del flujo de energía o masa por las comunidades. En la Figura J-1 se presenta un diagrama simplificado, con NT aproximados, de la red trófica del OPO tropical pelágico. Las ballenas dentadas (Odontoceti, NT medio 5.2), depredadores de calamar grande (atún patudo grande y pez espada, NT medio 5.2) y tiburones (NT medio 5.0) son depredadores ápice. Los otros atunes y peces piscívoros grandes, delfines (NT medio 4.8), y aves marinas (NT medio 4.5) ocupan NT ligeramente más bajos. Peces epipelágicos menores (melvas y peces voladores (NT medio 3.2), por ejemplo), cefalópodos (NT medio 4.4), y peces mesopelágicos (NT medio 3.4) son el alimento principal de muchos de los depredadores de alto nivel en el ecosistema. Los peces pequeños y crustáceos se alimentan de dos grupos de zooplancton, y el microzooplancton herbívoro (NT 2) se alimenta de los productores, fitoplancton y bacterias (NT 1).

En los ecosistemas pelágicos explotados, las pesquerías dirigidas hacia peces piscívoros grandes funcionan de depredadores ápice del ecosistema. Con el tiempo, la pesca puede causar una disminución de la composición por tamaño general de la captura, y en general, los NT de los organismos pequeños son más bajos que los de los más grandes. El NT medio de los organismos capturados por una pesquería es un indicador potencialmente útil de cambios en el ecosistema y de su sustentabilidad, porque integra una variedad de información biológica sobre los componentes del mismo. Se está prestando mayor atención al análisis del NT medio de las capturas y descartes de la pesca desde que un estudio demostró que, según estadísticas de descargas de FAO, el NT medio de los peces e invertebrados descargados a nivel mundial disminuyó entre 1950 y 1994, y la hipótesis de los autores del estudio es que esto perjudica los ecosistemas. Sin embargo, algunos ecosistemas han cambiado en la otra dirección, de comunidades de NT bajo a comunidades de NT más alto. En vista de la utilidad potencial de este enfoque, se estimaron los NT de una serie de tiempo de capturas y descartes anuales por especie desde 1993 hasta 2006 para tres modalidades de pesca cerquera y la pesquería cañera en el OPO. Se calcularon las estimaciones mediante la aplicación de los NT del modelo de ecosistema del OPO (Sección 7), ponderados por los datos de captura por pesquería y año correspondientes a todos los grupos del modelo de las bases de datos de la CIAT de atún, captura incidental, y descartes. Se determinaron los NT del modelo ecosistémico mediante estimaciones de la dieta media de todos los grupos de especies. Los NT de las capturas sumadas de todas las pesquerías de cerco y de caña fueron bastante constantes de año a año, con menos de un 0.1 NT de variación (Figura J-2: promedio PS-LP). Las capturas de aleta amarilla grande (≥90 cm, NT 4.66), barrilete (NT 4.57), aleta amarilla pequeño (<90 cm, NT 4.57), y patudo grande (≥80 cm, NT 5.17) contribuyeron el 36, 34, 19, y 6%, respectivamente, al NT general (4.63) durante 1993-2006. Las capturas retenidas y descartadas de todas las otras especies y grupos contribuyeron menos del 5% del NT general de las capturas, incluyendo el patudo pequeño (4.7%, NT 4.53) y todas las especies de captura incidental. En general, los NT de los lances no asociados y la pesquería de caña fueron inferiores al promedio, y aquéllos de los lances sobre delfines superiores al promedio en la mayoría de los años (Figura J-2). Los NT de los lances sobre objetos flotantes varió más que los de los otros tipos de lance y las otras pesquerías, debido principalmente a la variabilidad interanual en el tamaño del patudo y la cantidad de barrilete capturada en esos lances. Los NT de los lances sobre objetos flotantes estuvieron positivamente relacionados con el porcentaje de la captura total formado por patudo grande ($P<0.001$) y negativamente relacionado con el porcentaje de la captura formado por barrilete ($P<0.001$) (Figura J-3).

Se estimaron también por separado NT para la serie de tiempo de capturas retenidas y descartadas de la pesquería de cerco en cada año del período de 1993 a 2006 (Figura J-4). Las capturas descartadas fueron mucho menores que las capturas retenidas, y por lo tanto los patrones de los NT de las capturas totales (retenidos más descartadas) (Figura J-2) fueron determinados principalmente por las capturas retenidas (Figura J-4). Los NT de las capturas descartadas variaron entre años que aquéllos de las capturas retenidas. La mayor variación ocurrió en el caso de los lances sobre peces asociados con objetos flotantes, y esos lances también tuvieron la mayor diversidad de especies de captura incidental. El NT más bajo de las capturas descartadas ocurrió en tanto los lances sobre peces no asociados como en los lances sobre objetos flotantes en 1998. En el caso de los lances no asociados, la disminución notoria del NT durante 1998 se debió a una mayor captura incidental de rayas (NT 3.68), que se alimentan de plancton y otros animales pequeños que ocupan NT bajos, y una disminución de las capturas de tiburones grandes (NT 4.93). Desde 1998 hasta 2001, las capturas descartadas de rayas disminuyeron paulatinamente en los lances no asociados y aquéllas de tiburones grandes y aletas amarillas pequeños aumentaron, resultando en un aumento progresivo de los NT de las capturas descartadas durante ese intervalo. En el caso de los lances sobre objetos flotantes, los descartes de peces epipelágicos pequeños (por ejemplo, Clupeiformes, Nomeidae, Tetraodontiformes y otros; NT 3.19) aumentaron, y aquéllos de patudo grande disminuyeron de 1996 a 1998, lo cual redujo el NT durante ese período. El incremento del NT en los lances sobre objetos flotantes durante 1998-2000 resultó de una reducción de la captura incidental de peces epipelágicos pequeños y un aumento de dorado (TL 4.66) y patudo grande descartados.

7. MODELADO DE ECOSISTEMAS

Es evidente que los distintos componentes de un ecosistema interactúan. La ordenación ecosistémica de la pesca es facilitada por la elaboración de modelos ecosistémicos multiespecíficos que representan las interacciones ecológicas entre las especies o gremios. Nuestros conocimientos del complicado laberinto de conexiones en los ecosistemas del océano abierto están en su etapa temprana, y, por lo tanto, la mayor utilidad de los modelos de ecosistema actuales es como instrumentos descriptivos para explorar los efectos de una mezcla de hipótesis y conexiones establecidas entre los componentes del ecosistema. Los modelos de ecosistema necesitan mantener un equilibrio entre representaciones simplistas por un lado y una complejidad imposible de manejar por el otro.

El personal de la CIAT ha desarrollado un modelo del ecosistema pelágico en el OPO tropical (Boletín de la CIAT, Vol. 22, No. 3) para explorar cómo la pesca y la variación climática podrían afectar los animales en los niveles tróficos medianos y altos. El modelo tiene 38 componentes, entre ellos las principales especies explotadas (atunes, por ejemplo), grupos funcionales (tiburones y peces voladores, por ejemplo), y especies sensibles (tortugas marinas, por ejemplo). Algunos grupos taxonómicos están subdivididos en categorías (marlines grandes y pequeños, por ejemplo). La resolución taxonómica del modelo es más fina en los niveles tróficos superiores, pero la mayor parte de la biomasa del sistema está en los niveles tróficos medianos y bajos. Se estimaron las descargas y descartes para cinco "artes" de pesca: caña, palangre, y tres tipos de lances cerqueros: sobre atunes asociados con delfines, con objetos flotantes, y no asociados. El modelo está enfocado en las regiones pelágicas; no describe adecuadamente los ecosistemas locales costeros.

La mayor parte de la información que describe las interacciones interespecíficas en el modelo proviene de un proyecto conjunto CIAT-NMFS, el que incluyó estudios de los hábitos alimenticios de atunes aleta amarilla, barrilete, y patudo, delfines, tiburones pelágicos, peces picudos, dorados, petos, salmones, y otros. El objetivo del proyecto fue contribuir a los conocimientos de la asociación atún-delfín, y se adoptó un diseño de muestreo a nivel de comunidad.

Se usó el modelo de ecosistema para evaluar los posibles efectos de variabilidad en los procesos forzados desde abajo por el medio ambiente sobre los niveles tróficos medianos y altos del ecosistema pelágico. Se incorporaron en el modelo series de tiempo predeterminadas de biomasa de productores para aproximar los cambios en la producción primaria documentados durante eventos de El Niño y La Niña, y se simuló la dinámica de los demás componentes del ecosistema. Se usó el modelo también para evaluar las contribuciones relativas de la pesca y el medio ambiente en la formación de la estructura del ecosistema en el OPO pelágico tropical. Se hizo esto usando el modelo para predecir cuáles componentes del ecosistema podrían ser susceptibles a efectos de la pesca de arriba hacia abajo, dada la importancia aparente de la variabilidad ambiental en la estructuración del ecosistema. En general, los animales con tasas de cambio relativamente bajas fueron afectados más por la pesca que por el medio ambiente, y aquéllos con tasas relativamente altas más por el medio ambiente que por la pesca.

8. ACCIONES DE LA CIAT Y EL APICD RELATIVAS A CONSIDERACIONES DE ECOSISTEMA

Tanto la Convención de la CIAT como el APICD tienen objetivos que versan sobre la incorporación de consideraciones de ecosistema en la ordenación de las pesquerías atuneras en el OPO. Acciones tomadas en el pasado incluyen:

8.1. Delfines

a. Desde hace muchos años se evalúa el impacto de la pesquería sobre las poblaciones de delfines, y los programas para reducir o eliminar ese impacto han tenido un éxito considerable.

b. Se ha limitado la mortalidad incidental de todas las poblaciones de delfines a niveles insignificantes con respecto al tamaño de las poblaciones.

8.2. Tortugas marinas

a. Se ha compilado una base de datos sobre todos los avistamientos, capturas, y mortalidades de tortugas marinas reportadas por observadores.

b. En junio de 2003, la CIAT adoptó una *Recomendación sobre tortugas marinas*, en la que se contempla "el desarrollo de un programa de tres años que podría incluir la reducción de capturas incidentales de tortugas marinas, investigaciones biológicas de tortugas marinas, perfeccionamiento de artes de pesca, educación de la industria y otras técnicas para mejorar la conservación de tortugas marinas." En enero de 2004, el Grupo de Trabajo sobre Captura Incidental propuso un programa detallado que incluye todos estos elementos e insta a todas las naciones con buques que pescan atunes en el OPO a que provean a la CIAT información sobre interacciones de las pesquerías con tortugas marinas en el OPO, incluyendo capturas tanto incidentales como directas, y otros impactos sobre las poblaciones de tortugas marinas. En junio de 2004, la CIAT adoptó la Resolución C-04-07 sobre un programa de tres años para mitigar el impacto de la pesca atunera sobre las tortugas marinas; incluye disposiciones sobre la toma de datos, medidas de mitigación, educación de la industria, fomento de capacidad, e informes.

c. La Resolución C-04-05, adoptada por la CIAT en junio de 2006, contiene disposiciones relativas a la liberación y tratamiento de tortugas marinas capturadas en redes de cerco. Prohíbe también a los buques desechar bolsas y otra basura plástica en el mar, y encarga al Director estudiar y formular recomendaciones acerca del diseño de plantados, particularmente el uso de malla de red sujetada bajo el agua a los mismos.

d. En respuesta a una solicitud de la Subsecretaría de Recursos Pesqueros del Ecuador, la CIAT inició un programa, apoyado por World Wildlife Fund y el gobierno de Estados Unidos, para mitigar la captura incidental de tortugas marinas, reducir la mortalidad de tortugas marinas causadas por la pesca con palangre, y comparar las tasas de captura de atunes, peces picudos, y dorado con anzuelos J y circulares de dos tamaños. Los anzuelos circulares no enganchan tantas tortugas como los anzuelos J usados actualmente en la pesca palangrera, y la probabilidad de herir gravemente a las tortugas que muerden los anzuelos es menor porque son más anchos y suelen engancharse en la mandíbula inferior, en lugar de internarse en el esófago y otras áreas, evento más peligroso y más común con los anzuelos J. Se difundieron además a las flotas palangreras de la región procedimientos y herramientas para liberar tortugas marinas enganchadas y enmalladas.

Observadores han tomado datos en casi 400 viajes de pesca de los buques que están probando los varios anzuelos. El programa está funcionando en Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Panamá, y Perú, está en desarrollo en México y Nicaragua en 2006. El programa en Ecuador se está realizando en conjunto con el gobierno y la Overseas Fishery Cooperation Foundation del Japón, mientras que en los otros países es financiado por agencias de EE.UU. Los resultados iniciales señalan que, en las pesquerías dirigidas hacia los atunes, peces picudos y tiburones (Figura J-4), ocurrió una reducción importante en las tasas de enganche de las tortugas marinas con los anzuelos circulares, y que menos anzuelos se alojaron en el esófago u otras áreas perjudiciales para las tortugas. Las tasas de captura de las especies objetivo son, en general, similares a aquéllas de los anzuelos J. Se realizó también un experimento en la pesquería de dorado (Figura J-4) con anzuelos circulares más pequeños; las tasas de enganche de tortugas disminuyeron, pero menos que en las pesquerías de atunes, peces picudos y tiburones. Además, miembros del personal de la CIAT y otros dirigieron talleres e hicieron presentaciones en todos los países que participan en el programa.

8.3. Aves marinas

a. La Resolución C-05-01, adoptada por la CIAT en junio de 2005, recomienda que las Partes de la CIAT y las no Partes, entidades pesqueras u organizaciones regionales de integración económica cooperantes (CPC) apliquen, en caso apropiado, el *Plan de Acción Internacional para reducir las capturas incidentales de aves marinas en la pesca con palangre* de la FAO; que recopilen y presenten a la Comisión información sobre las interacciones con aves marinas; y que el Grupo de Trabajo sobre las Evaluaciones de las Poblaciones presente a la Comisión una evaluación del impacto de la captura incidental de aves marinas resultante de las actividades de los buques que pescan atunes y especies afines en el OPO. Dicha evaluación debería incluir una identificación de las áreas geográficas en las que pudieran ocurrir interacciones entre la pesca palangrera y aves marinas
b. La sexta reunión del Grupo de Trabajo de la CIAT sobre Captura Incidental recomendó que el Grupo de Trabajo sobre la Evaluación de Poblaciones sugiriese posibles medidas de mitigación en áreas en las que coinciden las distribuciones de aves marinas y esfuerzo palangrero, y que la CIAT considerase medidas de mitigación en su reunión en junio de 2007. Recomendó también que se obtuviesen datos sobre la captura incidental de aves marinas de todos los buques palangreros atuneros en el OPO.
c. Se está elaborando un modelo de población para el albatros patinegro, a fin de evaluar la probabilidad de que los niveles actuales y pasados de captura incidental afecten de forma significativa las poblaciones de la especie, y generar un modelo de especie protegida que pueda ser aplicado a varias especies y usado para proveer asesoramiento sobre la ordenación. Se están usando los datos de los observadores de la CIAT en buques cerqueros para trazar las distribuciones de las aves marinas.

8.4. Otras especies

a. En junio de 2000, la CIAT adoptó una resolución sobre la liberación de tiburones, rayas, peces picudos, dorados, y otras especies no objetivo.
b. La Resolución C-04-05, adoptada por la CIAT en junio de 2006, encarga al Director buscar fon-

dos para la reducción de la mortalidad incidental de atunes juveniles, para desarrollar técnicas y/o equipo para facilitar la liberación de peces picudos, tiburones y rayas de la cubierta o de la red, y para realizar experimentos para estimar las tasas de supervivencia de peces picudos, tiburones y rayas liberados.

8.5. Todas especies

a. Se está recabando datos sobre las capturas incidentales por buques cerqueros grandes, y se insta a los gobiernos a proveer información sobre las capturas incidentales de otros buques.
b. Se han recabado datos sobre la distribución espacial de las capturas incidentales y las proporciones de captura incidental a captura para análisis de opciones de políticas de reducción de capturas incidentales.
c. Se ha recabado información para evaluar medidas para reducir las capturas incidentales, tales come vedas, límites de esfuerzo, etc.
d. Se han realizado evaluaciones de preferencias de hábitat y el efecto de cambios ambientales.

9. ACONTECIMIENTOS FUTUROS

Es poco probable, al menos en el futuro cercano, que se disponga de evaluaciones de las poblaciones de la mayoría de las especies de captura incidental. Es posible que en lugar de evaluaciones formales se puedan desarrollar índices para evaluar tendencias en la condición de estas especies. La experiencia del personal de la CIAT con los delfines sugiere que la tarea no es trivial si se desea una precisión relativamente alta.

Han sido propuestas varias medidas para estudiar cambios en las características del ecosistema, entre ellas estudios del nivel trófico medio, espectros de tamaño, dominancia, diversidad, y otros, para describir el ecosistema de forma agregada.

La distribución de las pesquerías de atunes y peces picudos en el OPO es tal que incluye probablemente varias regiones con características ecológicas diferentes. Es posible que, dentro de éstas, masas de agua, características oceanográficas o topográficas, influencias del continente, etcétera, generen heterogeneidad que afecte la distribución de las distintas especies y su abundancia relativa en las capturas. Sería ventajoso incrementar los conocimientos de estos estratos ecológicos para poder usarlos en nuestros análisis.

Es importante continuar los estudios de los ecosistemas en el OPO. La capacidad de resolver problemas relacionados con la pesca y el ecosistema crecerá con el número de variables de hábitat, grupos taxonómicos y niveles tróficos estudiados y con series de tiempo de datos más largas.

Agenda Item J.2.a
Attachment 3
April 2008

INTER-AMERICAN TROPICAL TUNA COMMISSION
COMISIÓN INTERAMERICANA DEL ATÚN TROPICAL

77TH MEETING

LA JOLLA, CALIFORNIA (USA)
5-7 MARCH 2008

DOCUMENT IATTC-77-04 REV

PROPOSAL FOR CONSERVATION OF YELLOWFIN AND BIGEYE TUNA IN THE EASTERN PACIFIC OCEAN

This paper evaluates the effect of a proposal for the conservation of bigeye and yellowfin tuna in the eastern Pacific Ocean (EPO).

For the purse-seine fishery in the EPO during 2008, 2009, and 2010, the proposal consists of two components: a 12-week closure in the entire EPO from 20 June through 11 September, and a closure of the offshore area (Figure 1; proposal D2A in Document IATTC-76-04) during 12 September through 31 December.

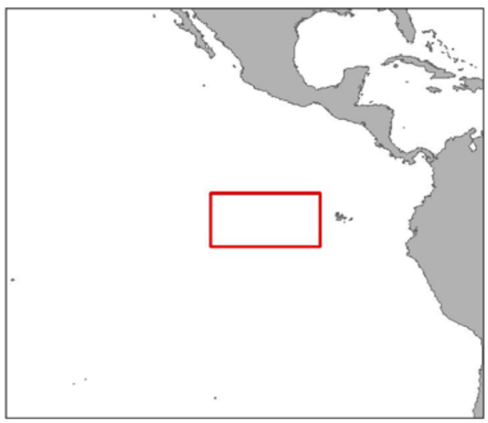


FIGURE 1. Proposed closure area between 94° and 110°W and from 3°N to 5°S.

For the longline fishery:

1. China, Japan, Korea, and Chinese Taipei shall take the measures necessary to ensure that their total annual longline catches of bigeye tuna in the EPO during 2008, 2009, and 2010 do not exceed the following levels:

China	2,190 metric tons
Japan	28,283 metric tons
Korea	10,438 metric tons
Chinese Taipei	6,601 metric tons

2. Other CPCs shall take the measures necessary to ensure that their total annual longline catches of bigeye tuna in the EPO during 2008, 2009, and 2010 do not exceed the greater of 83% of 2001 catches or 500 t.

Method

The method employed to evaluate the proposed conservation measure is focused upon the change expected from the purse-seine fishery. The longline measures are the same as those proposed at the 2007 annual meeting (Document IATTC 75-07b). The evaluation was made by estimating the reduction in catch due to the closures and comparing this with the desired reduction in fishing mortality (*F*). The advantage of this approach is that we have fine-scale temporal and spatial information on catch and effort that can be used to provide estimates that are more exact than those based on forward projections, such as were presented in Document IATTC-76-04.

Reference points for conservation

The target reference point for conservation purposes is the *F* multiplier obtained in the previous stock assessment for yellowfin and bigeye (IATTC, 2007), which corresponds to the effort reduction necessary to attain F_{MSY}, the fishing mortality that will produce the maximum sustainable yield (MSY). The *F* multiplier is then adjusted to account for the increase in fishing capacity in 2007. The percentage reduction in fishing mortality needed to achieve the conservation targets were 9% and 21% for yellowfin and bigeye tunas, respectively. When evaluating years prior to the implementation of the six-week closures (1995-2003), an adjustment is needed to produce comparable expected catch reductions in those years. The expected catch reductions were increased to reflect the absence of closures, so that in years prior to 2003 the conservation targets were 20% and 30% for yellowfin and bigeye tunas, respectively.

Results

Table 1 presents the estimated annual proportional reduction in catch of yellowfin, skipjack and bigeye tuna if the proposal is implemented. These values are also plotted in Figure 2. The threshold values to attain for conservation purposes are 20% and 30% for yellowfin and bigeye tunas, respectively. These values should be applied only to the 1995-2003 period.

For yellowfin, the proposal would achieve the conservation goals (reduction in catch ≥20%) in all years of the the 1995-2003 period. With respect to bigeye, it would achieve the conservation goals (reduction in catch ≥30%) on average; however, there is inter-annual variability, and in four out of nine years the reduction in catch would be insufficient. The effect of the proposal on skipjack catch would be an average reduction in catch of 23%.

The effect of temporal closures is related to the temporal distribution of catch and effort. Effort is constant throughout most of the year, except for a major reduction around the start and end of the year (Figure 3). There is more variation in catch per day fished (CPDF; Figure 4). Yellowfin catch rates decline gradually thoughout the year, while the CPDF of skipjack peaks around the end of the first quarter. The CPDF of both skipjack and bigeye increase at the start and end of the year. This indicates that the reduction in effort seen at the start and the end of the year (Figure 3) is predominantly a reduction in effort targeting yellowfin. The impact of 12- and 6-week temporal closures at different times of the year is shown in Figure 5. In general, temporal closures in the first half of the year are more effective for yellowfin and skipjack, and closures in the middle of the year are more effective for bigeye.

The spatial distribution of the catches of bigeye, yellowfin and skipjack in the EPO during the offshore closure period (12 September–31 December) are shown in Appendix 2.

TABLE 1. Proportional reduction in catch of yellowfin (YFT), bigeye (BET) and skipjack (SKJ) resulting from implementation of the conservation proposal.

	YFT	SKJ	BET
1995	0.20	0.32	0.31
1996	0.20	0.21	0.25
1997	0.20	0.26	0.31
1998	0.25	0.23	0.23
1999	0.22	0.25	0.28
2000	0.21	0.17	0.30
2001	0.21	0.23	0.27
2002	0.22	0.22	0.36
2003	0.22	0.26	0.33
2004	0.17	0.20	0.38
2005	0.13	0.21	0.28
2006	0.17	0.23	0.27
2007	0.17	0.20	0.17
1995-2003 average	0.20	0.23	0.29

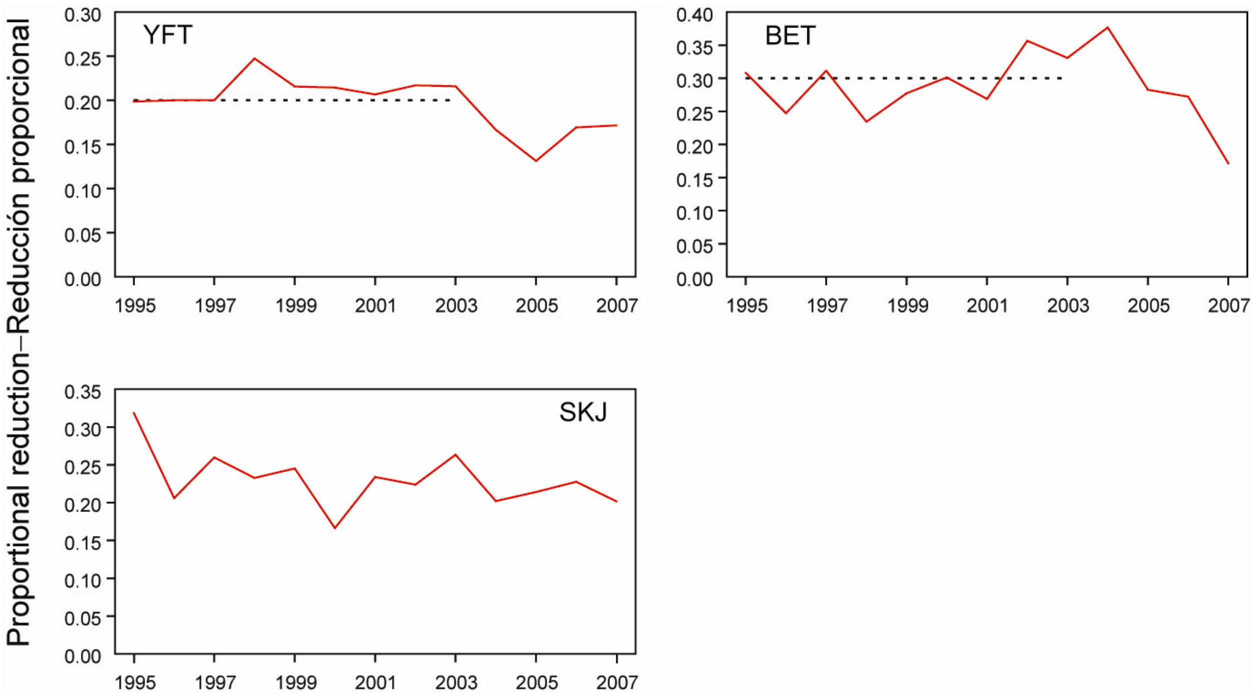


FIGURE 2. Proportional reduction in catch of yellowfin (YFT), bigeye (BET) and skipjack (SKJ) resulting from implementation of the conservation proposal. The dashed lines represent the target reference points for conservation purposes.

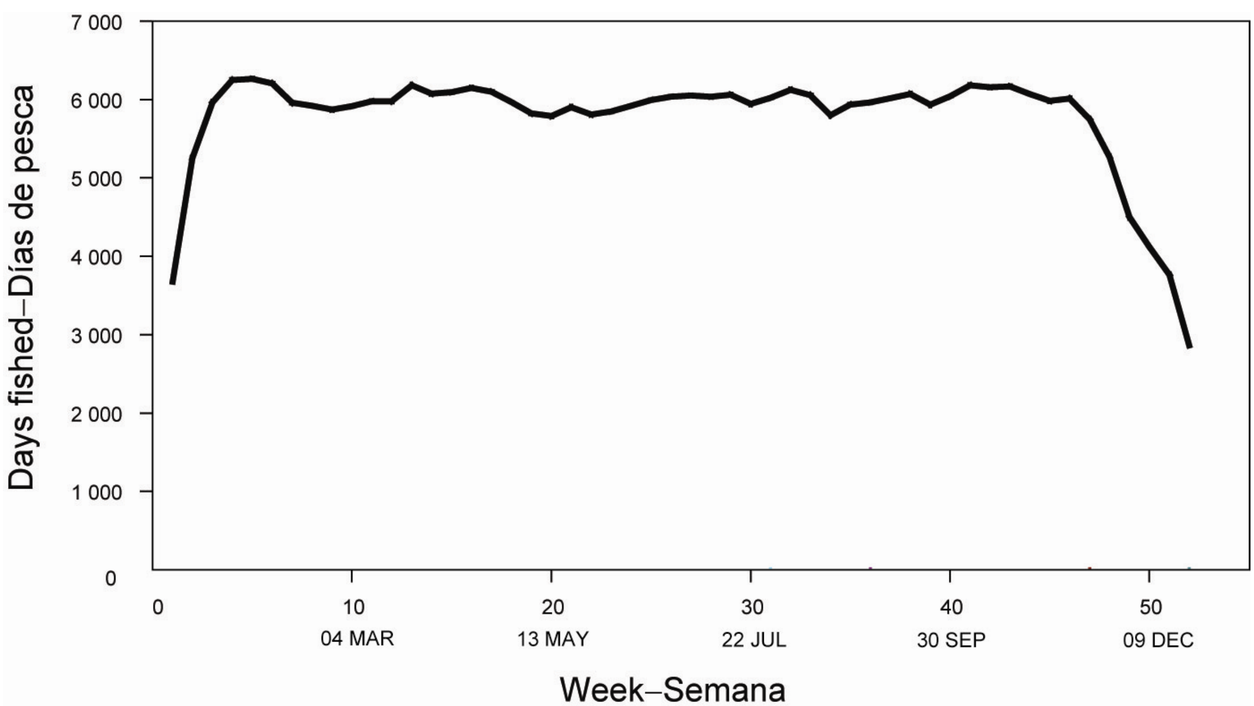


FIGURE 3. Effort, in days fished, in the EPO, summed over the 1995-2003 period. The data used for this figure are not raised to the total effort; therefore, the figure illustrates the trend in effort, not the total effort.

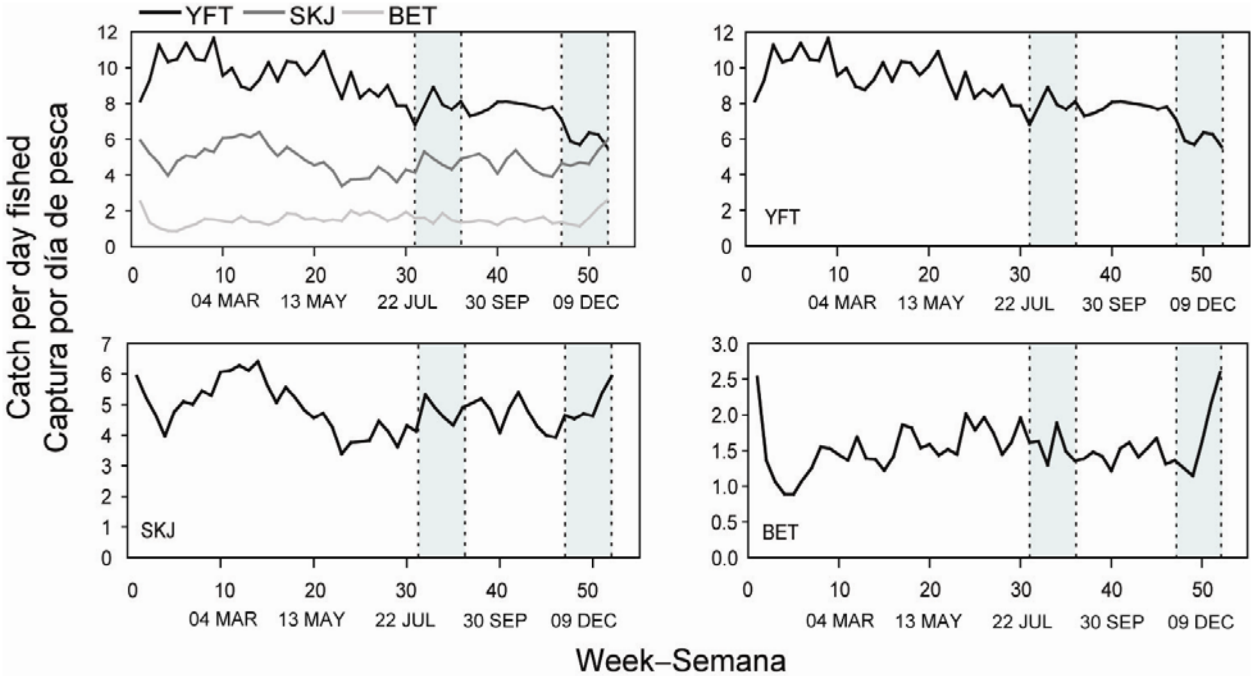


FIGURE 4. Catch per day fished for yellowfin, skipjack, and bigeye in the EPO, calculated using data for 1995-2003. The vertical dashed lines represent the two existing closures.

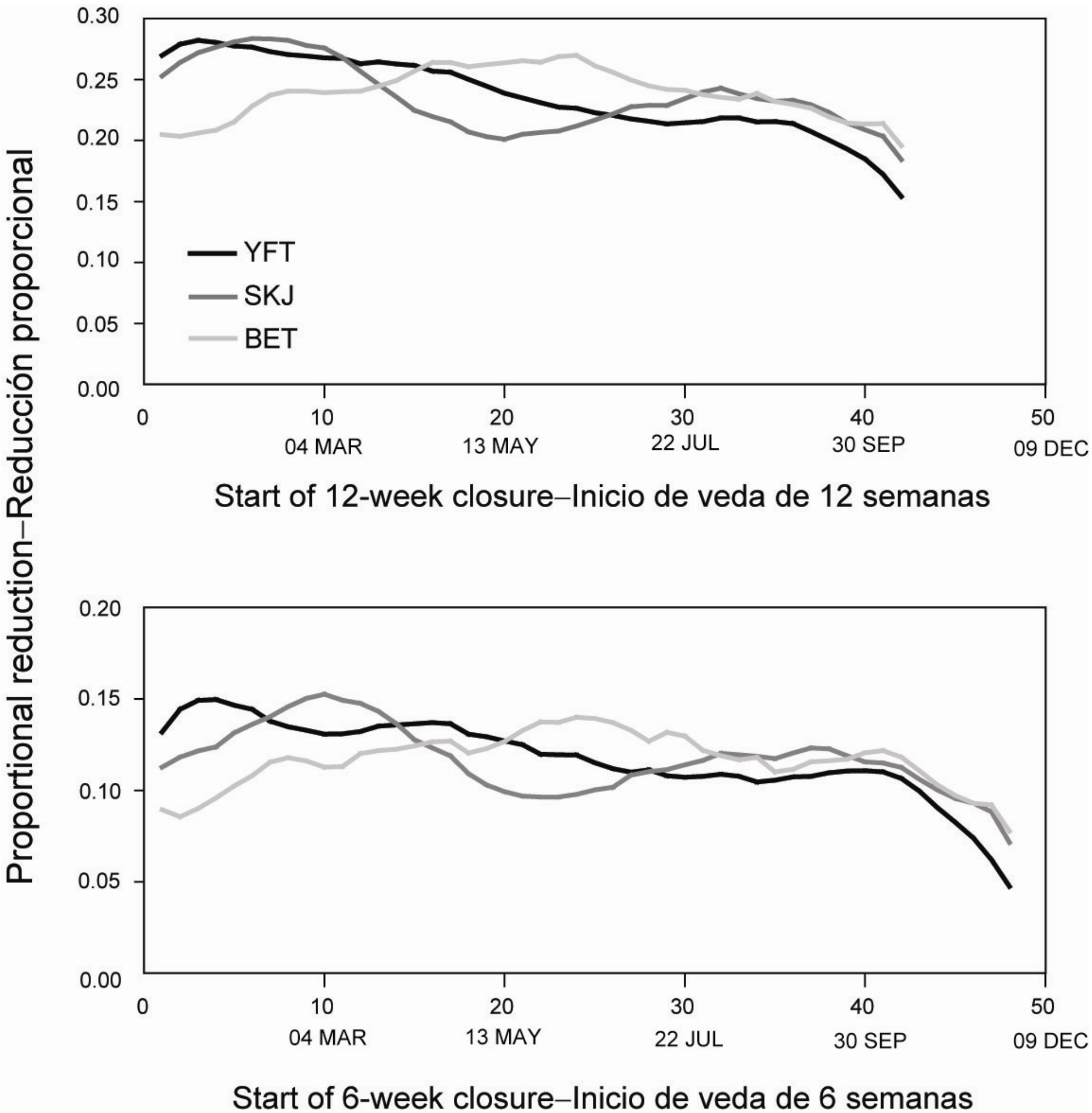


FIGURE 5. Reduction in catch as a proportion of the total catch for 12-week (top) and 6-week (bottom) closures starting at different times of the year. The reductions, based on data from 1995-2003, are calculated independently for each species.

APPENDIX 1

Methods

The closures of the entire EPO are implemented in the analysis by assuming that there will be no purse-seine effort during the closures.

The fishing effort within the offshore closure area (Figure 1) is reallocated to the area outside this area, but south of 10ºN. The restriction to south of 10ºN corresponds roughly to the assumption that those vessels will not switch to dolphin-associated fishing in the north.

The reduced total annual catch in the EPO after implementation of the the proposal is:

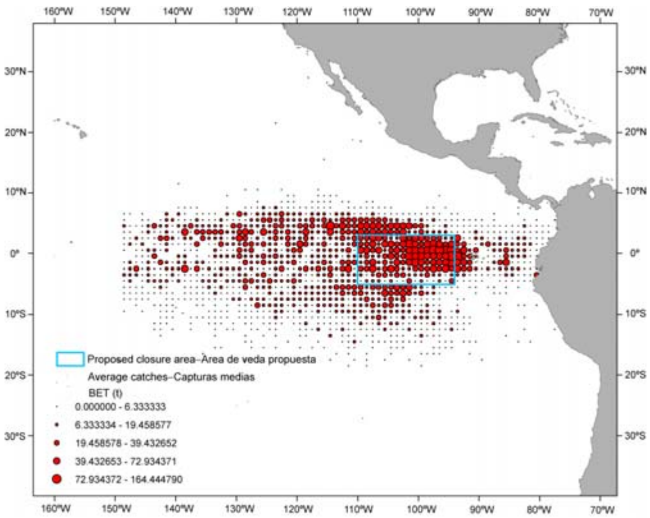
$$C_R = C_T - \sum_{i=1 \text{ to } 3} C_i + CPUE_{outside3} E_3 ,$$

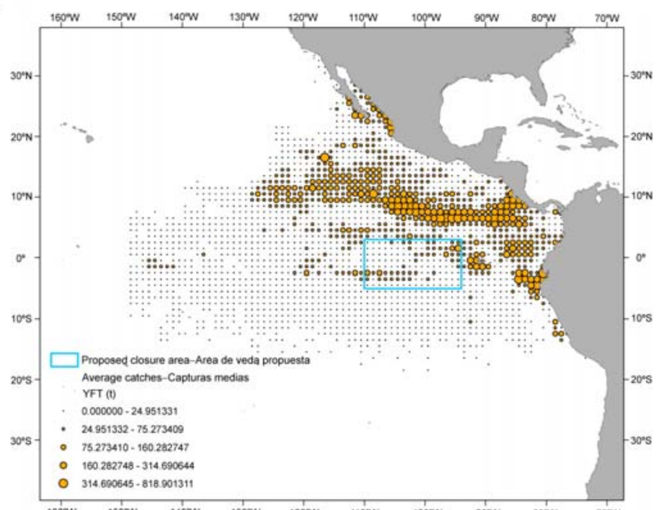
in which:

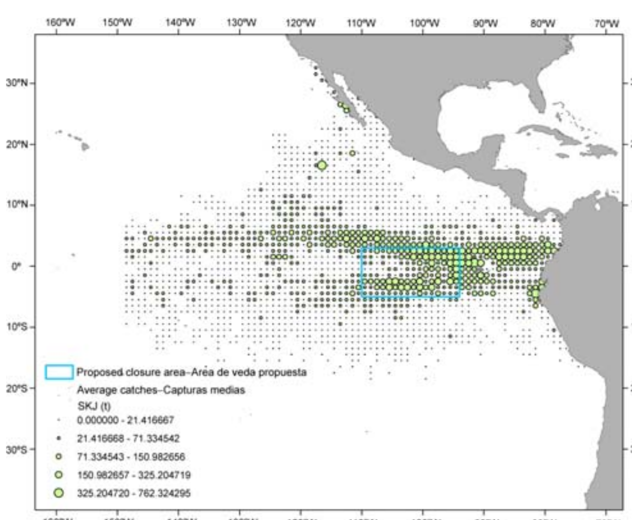
- C_R is the reduced total catch in the EPO after implementation of the proposal;
- C_T is the total catch in the EPO before implementation of the proposal;
- C_I is the catch inside the closed area during closure *i*;
- E_3 is the effort inside the offshore area during the offshore closure;
- $CPUE_{outside3}$ is the catch per unit of effort outside the offshore closure area during the closure period, excluding data from north of 10ºN.

APPENDIX 2.

Distribution of the catches of bigeye, yellowfin and skipjack in the EPO during the offshore closure period (12 September–31 December), 1995-2006.







HIGHLY MIGRATORY SPECIES ADVISORY SUBPANEL
RECOMMENDATIONS TO THE U.S. SECTION OF THE INTER-AMERICAN TROPICAL TUNA COMMISSION (IATTC)

Bigeye and Yellowfin Tuna

Because U.S. west coast fisheries by the smallest purse seine vessels (Class I-V vessels) are a negligible contributor to the total fishing effort on the bigeye and yellowfin tuna stocks, further curtailment of these catches would have no practical effect on overfishing. For consideration of an exemption, the HMSAS recommends that the IATTC scientific staff provide a study of the annual catches of yellowfin tuna by purse seine fleets of all IATTC members that use Class I-V vessels for purposes of determining whether the total catch of such vessels represents a negligible contribution to the total fishing effort on the yellowfin stock.

Striped Marlin

Under Agenda Item J.2.a the HMSAS was provided with some excerpts on the 2006 status of striped marlin from the June 2007 IATTC meeting. In addition, NMFS provided a report on an updated stock status report on striped marlin that was completed in July 2007 that came to some different conclusions about both the composition and status of the stock.

Striped marlin is a very important highly migratory species stock for the recreational fishery in the jurisdiction of the Council. The HMSAS recommends that the Council in its recommendations to the U.S. Section of the Inter-American Tropical Tuna Commission highlight the need for the best possible information on the status of striped marlin.

Conservation of striped marlin stocks is a growing concern among recreational anglers and that concern has manifested itself in an increasing use of a catch and release ethic and fishing practices such as the use of circle hooks to increase survivability of caught striped marlin.

North Pacific Albacore

The HMSAS unanimously passed the following motion concerning current levels of effort in the North Pacific Albacore fishery: The HMSAS requests that the Council ask the U.S. delegation to the IATTC to again request that all members of the IATTC report accurately and expeditiously the status of their nation's efforts to comply with the reporting of current levels of albacore fishing effort as described under the IATTC resolutions.

PFMC
04/11/08

HIGHLY MIGRATORY SPECIES MANAGEMENT TEAM REPORT ON RECOMMENDATIONS TO THE U.S. SECTION OF THE INTER-AMERICAN TROPICAL TUNA COMMISSION (IATTC)

The Highly Migratory Species Management Team (HMSMT) suggests the Council provide recommendations to the IATTC for the following HMS species: yellowfin tuna, striped marlin, and albacore tuna.

At their recent extraordinary meetings, the IATTC failed to institute new management measures for yellowfin and bigeye tuna which are currently experiencing overfishing in the Eastern Pacific Ocean. The IATTC had tabled a proposal for conservation measures based on management goals to reduce the catch of yellowfin and bigeye tuna by 20 percent and 30 percent, respectively. The proposal was developed from conclusions based on the 2007 stock assessments and scientific advice stemming from them. The HMSMT recommends that the Council communicate to the U.S. delegation of the IATTC that it is inadequate to allow the fisheries to continue without conservation measures given the conditions of the stocks. The U.S. west coast fishers permitted under the Council's HMS can do little to curb overfishing given their minimal landings (less than one percent of eastern Pacific ocean [EPO] catch for each stock; 2007 SAFE Report), and the problem can only be solved in the international arena.

Regarding the recent pessimistic assessment of striped marlin in the North Pacific (Interim Scientific Committee [ISC] 2007), the HMSMT believes that the IATTC should reassess the status of striped marlin in the EPO. The latest IATTC Fishery Status Report indicates that the striped marlin population in the EPO is well above maximum sustainable yield and that fishing effort has been declining and should lead to increased abundance; however, a comprehensive stock assessment for striped marlin in the EPO has not been published since 2003. The Council should inform the U.S. delegation to the IATTC that an updated stock assessment is necessary in order to address international management needs. The Council can do little to address conservation concerns for striped marlin for U.S. west coast fishers since commercial landing of striped marlin under a Council HMS permit is already prohibited.

Finally, the U.S is in compliance with the IATTC's resolution on north Pacific albacore conservation by demonstrating no increase in albacore fishing effort. It is not clear that other member nations are similarly in compliance. The Council should ask the U.S. delegation to the IATTC to inquire about compliance of the other member nations given the ISC's updated conservation advice based on the most recent stock assessment (ISC 2007).

PFMC
04/11/08

Agenda Item J.2.c
Supplemental Public Comment
April 2008

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Via Facsimile 503-820-2299

March 26, 2008

RECEIVED
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PFMC

Re: Effort Controls in U.S. Albacore Troll Fishery

Dear Mr. Hansen:

Western Fishboat Owners Association (WFOA) maintains the position that North Pacific albacore has not been declared overfished, and no overfishing is occurring. Therefore, WFOA feels there is no imminent need for effort controls or limited entry on the U.S. albacore troll, baitboat, or recreational fisheries. This is especially true in regards to the recent ISC albacore workshop, where a new model was developed, which may give better indication on the status of North Pacific albacore in the coming years. Also, no declaration of overfishing was made by the working group.

The U.S. albacore fleet shows no potential for expansion at this time and any excess capacity issues could be addressed first by limiting the Canadian effort with the U.S. EEZ if needed.

WFOA also sees no immediate move toward effort control from the IATTC and WCPFC. Until other nations contribute, the U.S. is unwise to pursue unilateral reduction on a static fleet that catches only 15% of the northern albacore.

We do however remain aware of potential latent capacity if market values of albacore increase and it attracts boats into the fishery with very minimal historic landings. However, given present day operating costs, age of fishermen, and age of vessels we do not see that as a serious threat at this time.

WFOA continues to monitor the sentiment of our membership on this issue at our district and annual meetings. WFOA will report any changes in direction to the PFMC. WFOA represents a large segment of the albacore fleet and does have some divergent views within. However, the vast majority of our membership does not support effort controls on the U.S. albacore fleet at this time. If we ever had to support effort reduction, WFOA would want the process and result based on conservation of the resource, and sound science. We would also want it applied to ALL albacore user groups both foreign and domestic. Past history of other limited entry regimes in other fisheries have found that even the best plan and intentions can come out of the amendment process unrecognizable.

Sincerely,

Wayne Heikkila

Wayne Heikkila
Executive Director

EXEMPTED FISHING PERMIT (EFP) FOR LONGLINE FISHING IN THE WEST COAST EXCLUSIVE ECONOMIC ZONE

In April 2007, the Council recommended that National Marine Fisheries Service (NMFS) issue an exempted fishing permit (EFP) allowing a single vessel to target swordfish with shallow-set longline gear in the West Coast Exclusive Economic Zone (EEZ). The purpose of the EFP fishery would be to gather preliminary information to help determine whether longline fishing could be an economically viable alternative to the current drift gillnet fishery with less environmental impact. Longline fishing is currently prohibited in the West Coast EEZ under regulations pursuant to the Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species (HMS FMP). The general purpose of an EFP is to allow fishing that would normally be prohibited under regulations in order to gather information and test new methods. This information gathering supports any future decision to modify management regulations related to the activity. The EFP was not issued in 2007 because procedural requirements, specifically a consistency determination by the California Coastal Commission, could not be completed in time. The applicant has submitted an almost identical proposal for consideration in 2008.

At their March 2008 meeting the Council recommended forwarding this EFP proposal for public review. As approved for public review by the Council, the EFP proposal is identical to what was to occur in 2007 (including terms and conditions recommended by the Council and other changes to the proposal agreed to by the applicant) except that instead of not fishing within 40 nautical miles of the coast, the applicant proposes not fishing within 50 nautical miles of the coast. This change makes the proposal more precautionary. Attachment 1 is a summary of the fishing activity that would be permitted under the EFP, including the terms and conditions placed on the activity.

Attachment 2 is the environmental assessment (EA) completed by NMFS to evaluate the impacts of the EFP proposal as occurring in 2007. Since baseline environmental conditions are not expected to be substantially different in 2008 in comparison to 2007, the EA provides sufficient information to support Council final action on a recommendation to NMFS about issuing the EFP for 2008. Based on this EA, NMFS made a Finding of No Significant Impact (FONSI) for the EFP as proposed for 2007. Attachment 3 is the Biological Opinion (BO) produced as part of the consultation between NMFS's Sustainable Fisheries Division and Protected Resources Division as required by section 7 of the Endangered Species Act. This document evaluates whether the proposed action is likely to jeopardize the continued existence of any ESA-listed species. The BO concluded that leatherback sea turtles are likely to be adversely affected by the proposed action, but the continued existence of leatherback sea turtles is unlikely to be jeopardized by the proposed action. It also concluded that no other ESA-listed species are likely to be adversely affected by the proposed action.

The Council also agreed to a request by the applicant that if the EFP cannot be issued in 2008, then the EFP could be issued in 2009 without the need for the proposal to be returned to the Council again for a recommendation.

Council Action:

Make a final recommendation on whether or not NMFS should issue an EFP to allow one vessel to fish with shallow-set longline gear within the West Coast EEZ in 2008.

Reference Materials:

1. Agenda Item J.3.a, Attachment 1: Summary of the Exempted Fishing Permit Fishing Activity and Terms and Conditions Placed on the Activity.
2. Agenda Item J.3.a, Attachment 2: Environmental Assessment on Issuance of an Exempted Fishing Permit to Fish with Longline Gear in the West Coast Exclusive Economic Zone. (Chapters 1, 2, and 4 excerpted; the full document is available on Web and CD-ROM).
3. Agenda Item J.3.a, Attachment 3: Endangered Species Act Section 7 Consultation Biological Opinion on Issuance of a Shallow-set Longline Exempted Fishing Permit under the Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species. (Conclusions and Incidental Take Statement excerpted; the full is document available on the Web and CD-ROM).

Agenda Order:

a. Agenda Item Overview — Kit Dahl
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. **Council Action:** Adopt Final EFP Recommendations to NMFS

PFMC
03/19/08

Summary of the Exempted Fishing Permit Fishing Activity and Terms and Conditions Placed on the Activity

Description of the Fishing Activity

The exempted fishing permit (EFP) would allow one vessel to explore[1] the commercial viability of fishing with new and innovative longline gear in the EEZ off of Oregon and California during the 2007 fishing season. The purpose of the EFP is to initially assess whether shallow-set longline (SSLL) gear using the latest gear modifications is a cost-effective alternative to potentially reducing bycatch in the California and Oregon swordfish fishery. Currently, no such information exists on how this gear, specifically designed to reduce bycatch, will operate under: 1) different environmental conditions relative to bycatch and, 2) economic conditions relative to current swordfish practices in the proposed action area. Under the terms and conditions of the EFP, the vessel would target swordfish with SSLL gear utilizing circle hooks and mackerel or mackerel-type bait. This combination has proven successful in existing domestic (Atlantic and Hawaii) and foreign (Italy, Brazil, and Uruguay) SSLL fisheries in reducing the post-hooking mortality of sea turtles compared to traditional longline gear, while maintaining a commercially viable catch-per-unit-of-effort for the target species (Watson and Kerstetter 2006; Boggs and Swimmer 2007). Given the success of these fisheries, the applicant wishes to conduct exploratory fishing off the West Coast to determine if he can cost-effectively target swordfish with the new gear while at the same time minimizing interactions with non-target catch, including protected and sensitive species.

To target swordfish, longline gear is set at a shallower depth (<100 m) than for tunas. For this reason it is termed “shallow-set” as opposed to “deep set” when targeting tunas, where the gear is set in the deeper thermocline zone (~300-400 m). Fishing with longline gear is currently prohibited in the West Coast EEZ under the HMS FMP and Federal regulation at 550 CFR 660.712(a). Furthermore, the FMP prohibits targeting swordfish with longline gear (shallow setting) west of 150° W. longitude (see 50 CFR 660.712(b)). Regulations under the Endangered Species Act (ESA) (50 CFR 223.206(d)(9)) prohibit targeting swordfish with longline gear on the high seas east of 150° W. longitude in order to prevent jeopardy to the continued existence of endangered sea turtles.

The geographic context for the proposed action includes the EEZ off the coasts of Oregon and California; although the applicant has stated that a majority of the proposed fishing activity under the EFP would most likely take place within the EEZ waters adjacent to California

The applicant has stated that he may decide to transit outside the EEZ to use the deep-set gear configuration to target tunas during a trip where test fishing under the EFP using the shallow-set gear configuration occurs. Although conducted during the same trip, any such activity would not be part of the EFP (because deep-setting outside the EEZ is currently permitted). However, as a result, gear used to deep-set may be stored aboard the vessel during a trip where shallow set fishing as part of the EFP occurs. The gear would remain stowed until the vessel exits the EEZ and is in waters where deep-setting is permitted. Both fishing under the EFP and any non-EFP fishing outside the EEZ would be subject to 100 percent observer coverage.

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[1] The proposed action is not designed to conduct a formal experimental test to compare bycatch rates of protected species among gear types. To achieve that goal would require, among other things, a larger sample size of sets/vessels spread out over an appropriate spatial/temporal scale, along with control groups fishing with other swordfish gear including drift gillnet and pelagic longline gear of earlier vintage (e.g., J-hooks with squid bait).

Terms and Conditions

1. 100 percent observer coverage, paid for by NMFS
2. All observers shall carry satellite phones provided by NMFS and immediately inform NMFS of any marine mammal, sea turtle, or seabird capture or interaction
3. A single vessel participating
4. Maximum of 14 sets per trip
5. Maximum of four trips between September 1 and December 31, 2008 (up to 56 total sets for the entire duration of the proposed EFP)
6. Fishing is only authorized within the West Coast EEZ and no SSLL gear shall cross this boundary
7. No fishing within the Southern California Bight as defined by the applicant
8. No fishing north of 45° N. latitude

9 No fishing within 50 nmi of the coastline

10. Utilizing shallow-set longline gear configuration:
    - a. 50-100 km mainline
    - b. 18 m floatline
    - c, 24 m branchlines
    - d. 2-8 hooks between floats
    - e. 400-1,200 hooks per set
    - f. Set fishing gear so hooks are at a depth of 40-45 m below the surface

10. Use 18/0 circle hooks with a 10 degree offset to fish for swordfish (as described at 50 CPR 665.33(f))

11. Use mackerel or mackerel-type bait (as described at 50 CPR 665.33(g))

12. Allow the use of light sticks

13. Require use of temperature-depth recorders (TDRs) to estimate fishing depth (The number of TDR units deployed per set and per trip would be determined by NMFS in consultation with the applicant.)

14. Gear may not be set until one hour after local sunset and must be fully deployed before local sunrise

15. , Prohibit the use of a line shooter for setting the gear

16. Require use of a NMFS-approved dehooking device to maximize finfish (e.g., blue shark) bycatch survivability

17. The following catch/take caps apply for the duration of the EFP. Fishing under the EFP ceases immediately (after gear retrieval) if any one of these limits is reached before the overall effort limit described above is reached.
    - a. A catch cap of 12 striped marlin
    - b. A take cap of one short-finned pilot whale (this species is not ESA-listed)
    - c. A take cap of five leatherback turtles, or one leatherback mortality
    - d. A take cap of one short-tailed albatross

Agenda Item J.3.a
Attachment 2
April 2008

ISSUANCE OF AN EXEMPTED FISHING PERMIT TO FISH WITH LONGLINE GEAR IN THE WEST COAST EXCLUSIVE ECONOMIC ZONE

ENVIRONMENTAL ASSESSMENT

PREPARED BY:

DEPARTMENT OF COMMERCE
NATIONAL MARINE FISHERIES SERVICE
SOUTHWEST REGION
LONG BEACH, CALIFORNIA

SOUTHWEST FISHERIES SCIENCE CENTER
LA JOLLA, CALIFORNIA

PACIFIC FISHERY MANAGEMENT COUNCIL
PORTLAND, OREGON

NOVEMBER 2007

Printed: Monday, March 17, 2008 | M:\SSLL EFP EA\Final SSLL_EA_112907.doc

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Cover Sheet
Longline Fishery Exempted Fishing Permit / Regulatory Amendment

Proposed Action:	Issue an exempted fishing permit (EFP) to allow one vessel to conduct exploratory longline fishing in the Exclusive Economic Zone (EEZ) off of Oregon and California, which is currently prohibited, during the 2007 fishing year (April 1 2007-March 31 2008, although fishing would not begin before mid-September 2007). Under terms and conditions of the EFP, the vessel would target swordfish using shallow-set longline gear, which is also currently prohibited pursuant to the HMS FMP and Endangered Species Act (ESA) regulations for the protection of endangered sea turtles.
Type of Statement:	Environmental Assessment (EA)
For Further Information:	
National Marine Fisheries Service, Southwest Region:	Craig Heberer (Craig.Heberer@noaa.gov) Fishery Biologist, Chairman, HMS Management Team Elizabeth Petras (Elizabeth.Petras@noaa.gov) Council Liaison for Protected Resources NMFS F/SWR2 501 Ocean Blvd. Long Beach, CA 90802 Telephone: (562) 980-4000
Pacific Fishery Management Council:	Dr. Kit Dahl (Kit.Dahl@noaa.gov) Staff Officer–Highly Migratory Species PFMC 7700 NE Ambassador Place, Suite 200 Portland, Oregon 97220-1384 Telephone: (503) 820-2280

Abstract

This environmental assessment (EA) evaluates four alternatives. Three of these alternatives were evaluated in a preliminary draft EA used by the Pacific Fishery Management Council (Council) to develop their recommendation to NOAA's National Marine Fisheries Service (NMFS) on issuance of an exempted fishing permit (EFP) to allow a single vessel to use longline gear to target swordfish in the West Coast Exclusive Economic Zone (EEZ). The Council took final action at their April 1–6, 2007, meeting by choosing a preferred alternative which represents their recommendation to NMFS for issuance of the EFP. The alternative of no action is included in this EA, representing the alternative of not issuing the permit. The alternatives were developed in a collaborative and iterative process with the applicant, NMFS, Council staff, and advisory bodies. This EA analyzes the three action alternatives, each of which include various mitigation terms and conditions to reduce potentially adverse impacts to finfish, marine mammals, sea turtles, and seabirds. Alternative 2 includes limits on the total amount of fishing that would be allowed under the EFP (number of trips and sets). Alternative 3 includes all of the terms and conditions identified under alternative 2 and would impose additional mitigation measures. Alternative 4 includes all of the terms and conditions identified under alternative 3 and would further restrict fishing opportunity in the action area off Oregon and California. The principal difference among the three action alternatives is that under alternative 3 the Council would identify incidental catch/take limits (caps) for selected finfish and protected species. If any of these caps were reached the fishery would immediately cease. The Council chose a modification of alternative 3 as their preferred alternative, with the addition of specified caps for species of concern and a prohibition on EFP fishing north of 45° N. latitude and within 30 nautical miles (nmi) of the coastline. As an additional conservation measure, the applicant requested that the boundary be expanded to 40 nmi off the coastline. In this EA the preferred alternative is identified as alternative 4 with the additional conservation measures.

The purpose of the proposed action is to allow the applicant to conduct exploratory fishing off the West Coast to determine if he can effectively target swordfish with the new gear while at the same time minimizing interactions with non-target catch, including protected and sensitive species. The amount of fishing would be constrained by, among other things, EFP-imposed trip and set limits and a variety of mitigation measures to minimize adverse environmental impacts from the activity. Longline fishing with circle hooks and mackerel bait may prove to be a commercially viable means of harvesting swordfish with minimal environmental impact in terms of bycatch of non-target species. According to regulations, a NMFS Regional Administrator may authorize, "for limited testing, public display, data collection, exploratory, health and safety, environmental cleanup, and/or hazard removal purposes, the target or incidental harvest of species managed under an FMP or fishery regulations that would otherwise be prohibited" (50 CFR 600.745(b)). This requires issuance of an EFP, which is the proposed action analyzed in this EA.

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List of Acronyms

AMSY- Average Maximum Sustainable Yield
AVHRR- Advanced Very High Resolution Radiometer
BFAL- Black-Footed Albatross
BO- Biological Opinion
CCS- California Current System
CDFG- California Department of Fish and Game
CFR- Code of Federal Regulations
CITES- Convention on International Trade in Endangered Species
CPFV- Commercial Passenger Fishing Vessels
CPUE- Catch Per Unit of Effort
DGN- Drift Gillnet
DPS- Distinct Population Segments
DSLL- Deep-set Longline
EA- Environmental Assessment
EEZ- Exclusive Economic Zone
EFH- Essential Fish Habitat
EFP- Exempted Fishing Permit
EIS- Environmental Impact Statement
ENP-Eastern North Pacific
ESA- Endangered Species Act
ESU-Evolutionarily Significant Units
FEIS- Final Environmental Impact Statement
FONSI- Finding of No Significant Impact
FMP- Fishery Management Plan
FR-Federal Register
GAM- Generalized Adaptive Model
HMS- Highly Migratory Species
HMS FMP- Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species
HMSAS- Highly Migratory Species Advisory Subpanel
HMSMT- Highly Migratory Species Management Team
IATTC- Inter-American Tropical Tuna Commission
ISC- International Scientific Committee
ITS- Incidental Take Statement
IUCN- World Conservation Union
IUU- Illegal Unreported and Unregulated
IWC- International Whaling Commission
LAAL- Laysan Albatross
LOF- List of Fisheries
MCSST- Multi-Channel Sea Surface Temperature
MMPA- Marine Mammal Protection Act
MSA- Magnuson-Stevens Fishery Conservation and Management Act
NED- Northeast Distant
NEPA- National Environmental Policy Act
NMFS- National Marine Fisheries Service
NOAA- National Oceanic and Atmospheric Administration
OY- Optimum Yield
PacFIN- Pacific Fisheries Information Network

PBR- Potential Biological Removal
PDO- Pacific Decadal Oscillation
Pelagics FMP- Fishery Management Plan for Pelagics Fisheries of the Western Pacific Region
PFMC- Pacific Fishery Management Council
PIFSC- Pacific Islands Fisheries Science Center
POCTRP- Pacific Offshore Cetacean Take Reduction Plan
PRD- Protected Resources Division
RFMO-Regional Fisheries Management Organization
RecFIN- Recreational Fisheries Information Network
SAFE- Stock Assessment and Fishery Evaluation Report
SAFZ- Subarctic Frontal Zone
SAR- Stock Assessment Report
SCB-Southern California Bight
SSLL-Shallow-set Longline
STAL- Short-Tailed Albatross
STFZ- Subtropical Frontal Zone
TDR- Time and Depth Recorder
TRP- Take Reduction Plan
TRT- Take Reduction Team
USFWS- United States Fish and Wildlife Service
WPFMC- Western Pacific Fishery Management Council
ZRMG- Zero Mortality Rate Goal

Glossary

Biological Opinion: the written documentation of a Section 7 consultation.

Incidental take: "take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, or collect individuals from a species listed on the ESA. Incidental take is the non-deliberate take of ESA-listed species, during an otherwise lawful activity (e.g., fishing under a FMP).

Incidental Take Statement: Issued as part of the ESA Section 7 consultation regulations, it is the amount of incidental take anticipated under a proposed action and analyzed in a biological opinion.

Jeopardy: the conclusion of a Section 7 consultation if it is determined that the proposed action would reasonably be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the numbers, reproduction, or distribution of that species.

Mortality or serious injury: a standard used for measuring impacts on marine mammals under the MMPA. Serious injury is defined as an injury likely to result in the mortality of a marine mammal.

Mean annual takes: the estimated number of marine mammals seriously injured or killed each year due to fishery interactions.

Potential Biological Removal: a requirement of the MMPA, it is the estimated number of individuals that can be removed from a marine mammal stock while allowing the stock to maintain or increase its population.

Section 7 consultation: a requirement of all discretionary Federal actions to ensure that the proposed action is not likely to jeopardize ESA-listed endangered or threatened species. Refers to Section 7(a)(2) of the ESA.

1.0 INTRODUCTION

1.1 Organization of the Document

This document provides background information about, and analysis of, a proposal for an exempted fishing permit (EFP) to allow a single longline fishing vessel to conduct exploratory longline fishing targeting swordfish (*Xiphias gladius*) in the EEZ off Oregon and California, which is currently prohibited. Management of the proposed longline fishery would be covered by the *Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species* (HMS FMP), which was developed by the Pacific Fishery Management Council (hereafter, the Council) in collaboration with the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS). The HMS FMP was implemented in 2004 and allows for more comprehensive Federal management of FMP fisheries, supported by decision-making through the Council process. The action must conform to the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the principal legal basis for fishery management within the EEZ, which extends from the outer boundary of State waters at three nautical miles (nmi) to a distance of 200 nmi from shore. In addition to addressing MSA mandates, this document is an environmental assessment (EA), pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended. The purpose of an EA is to disclose and evaluate the effects of the proposed action on the human environment, considered by means of a range of alternatives, and "Briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact" (40 CFR 1508.9). (Section 1.6 provides an initial screening of potentially significant effects to determine the scope of the analysis.) This document contains the analyses required under NEPA. The evaluation of adverse impacts to species listed under the Endangered Species Act (ESA) is consistent with evaluation of the action required by Section 7 of the ESA, which requires consultation with NMFS's Protected Resources Division (PRD) and the United States Fish and Wildlife Service (USFWS) to determine whether the proposed action may jeopardize the continued existence of any federally listed species.

Environmental impact analyses have four essential components: a description of the purpose and need for the proposed action, a set of alternatives that represent different ways of accomplishing the proposed action, a description of the human environment affected by the proposed action, and an evaluation of the expected direct, indirect, and cumulative impacts of the alternatives. (The human environment includes the natural and physical environment and the relationship of people with that environment, as defined at 40 CFR 1508.14). These elements allow the decision maker to look at different approaches to accomplishing a stated goal and understand the likely consequences of each choice or alternative. Based on this structure, the document is organized into six main chapters:

- Chapter 1 describes the purpose and need for the proposed action and considerations that went into the development of this EA.

- Chapter 2 outlines different alternatives that have been considered to address the purpose and need of the proposed action. The Council chose a preferred alternative from among these alternatives, which constitutes a recommendation to NMFS; based on the recommendation, NMFS makes a final determination whether to issue the EFP and what terms and conditions to apply.

- Chapter 3 describes the components of the human environment potentially affected by the proposed action (the "affected environment"). The affected environment may be considered the baseline condition, which would be potentially changed by the proposed action.

- Chapter 4 evaluates the effects of the alternatives on components of the human environment in order to provide the information necessary to determine whether such effects are significant, or potentially significant.

- Chapter 5 details how this action meets 10 National Standards set forth in the MSA (§301(a)).

- Chapter 6 provides information on those laws and Executive Orders, in addition to the MSA and NEPA, that an action must be consistent with, and how this action has satisfied those mandates.

Additional chapters (7-10) list those who contributed to this EA, information on EA distribution, the references cited list, and an appendix with public comments received and NMFS's responses to those comments.

1.2 The Proposed Action

The proposed action is to issue an exempted fishing permit (EFP) to allow one vessel to explore[1] the commercial viability of fishing with new and innovative longline gear in the EEZ off of Oregon and California during the 2007 fishing season. The purpose of the EFP is to initially assess whether shallow-set longline (SSLL) gear using the latest gear modifications is a cost-effective alternative to potentially reducing bycatch in the California and Oregon swordfish fishery. Currently, no such information exists on how this gear, specifically designed to reduce bycatch, will operate under: 1) different environmental conditions relative to bycatch and, 2) economic conditions relative to current swordfish practices in the proposed action area. Under terms and conditions of the EFP, the vessel would target swordfish with SSLL gear utilizing circle hooks and mackerel or mackerel-type bait. This combination has proven successful in existing domestic (Atlantic and Hawaii) and foreign (Italy, Brazil, and Uruguay) SSLL fisheries in reducing the post-hooking mortality of sea turtles compared to traditional longline gear, while maintaining a commercially viable catch-per-unit-of-effort for the target species (Watson and Kerstetter 2006; Boggs and Swimmer 2007). Given the success of these fisheries, the applicant wishes to conduct exploratory fishing off the West Coast to determine if he can cost-effectively target swordfish with the new gear while at the same time minimizing interactions with non-target catch, including protected and sensitive species.

To target swordfish, longline gear is set at a shallower depth (<100 m) than for tunas. For this reason it is termed "shallow set" as opposed to "deep set" when targeting tunas, where the gear is set in the deeper thermocline zone (~300–400 m). Fishing with longline gear is currently prohibited in the West Coast EEZ under the HMS FMP and Federal regulation at 550 CFR 660.712(a). Furthermore, the FMP prohibits targeting swordfish with longline gear (shallow setting) west of 150° W. longitude (see 50 CFR 660.712(b)). Regulations under the Endangered Species Act (ESA) (50 CFR 223.206(d)(9)) prohibit targeting swordfish with longline gear on the high seas east of 150° W. longitude in order to prevent jeopardy to the continued existence of endangered sea turtles.

The geographic context for the proposed action includes the EEZ off the coasts of Oregon and California; although the applicant has stated that a majority of the proposed fishing activity under the EFP would most likely take place within the EEZ waters adjacent to California (section 3.3 discusses those oceanographic factors that may influence the timing and location of fishing).

[1] The proposed action is not designed to conduct a formal experimental test to compare bycatch rates of protected species among gear types. To achieve that goal would require, among other things, a larger sample size of sets/vessels spread out over an appropriate spatial/temporal scale, along with control groups fishing with other swordfish gear including drift gillnet and pelagic longline gear of earlier vintage (e.g. J-hooks with squid bait).

The applicant has stated that he may decide to transit outside the EEZ to use the deep-set gear configuration to target tunas during a trip where test fishing under the EFP using the shallow-set gear configuration occurs. Although conducted during the same trip, any such activity would not be part of the EFP (because deep-setting outside the EEZ is currently permitted) and is not considered part of the proposed action evaluated in this EA. However, as a result, gear used to deep-set may be stored aboard the vessel during a trip where shallow set fishing as part of the EFP occurs. The gear would remain stowed until the vessel exits the EEZ and is in waters where deep-setting is permitted. Both fishing under the EFP and any non-EFP fishing outside the EEZ would be subject to 100 percent observer coverage.

1.3 Purpose of and Need for the Proposed Action

EFPs are requested and issued under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.) and regulations at 50 CFR 600 concerning scientific research activity, exempted fishing, and exempted educational activity. According to regulations, a NMFS Regional Administrator may authorize, "for limited testing, public display, data collection, exploratory, health and safety, environmental cleanup, and/or hazard removal purposes, the target or incidental harvest of species managed under an FMP or fishery regulations that would otherwise be prohibited" (50 CFR 600.745(b)). This requires issuance of an EFP, which is the proposed action analyzed in this EA.

The purpose of the proposed action is to allow the applicant to make an exploratory assessment as to whether using innovative fishing gear and methods in an area where they have not been used before might be commercially viable and merit consideration as an approved method of West Coast commercial fishing in the future. Similar gear has proven effective in achieving a sizable reduction in the rate of marine turtle take and mortality per unit of fishing effort in the Hawaii pelagic longline fishery, without reducing swordfish CPUE (Gilman, *et al*. 2006b). It is currently unknown whether similar results would be obtained if this gear were used in the West Coast EEZ.

The proposed action is needed to gather preliminary data on the possibility of expanding West Coast commercial longline fishing opportunity without jeopardizing endangered sea turtles or other protected species. All longline fishing in the EEZ is currently prohibited pursuant to the HMS FMP, and shallow-set longlining (i.e. swordfish longlining) is also prohibited outside the U.S. West Coast EEZ. If a vessel is registered to a Hawaii Pelagics FMP limited-entry permit, shallow-set and deep-set longline fishing is permitted outside of the U.S. West Coast EEZ. The proposed gear configuration, which would utilize circle hooks and mackerel or mackerel-type bait, has the potential to offer a more conservative alternative to longline fishing with traditional J-hooks and squid bait, or drift gillnet (DGN) fishing for swordfish, possibly resulting in a lower level of protected marine turtle bycatch for a similar level of swordfish catch. In addition, sea turtles captured in the SSLL gear utilizing circle hooks and mackerel or mackerel-type bait have experienced a higher post-release survivorship compared to sea turtles captured in the DGN fishery and in traditional pelagic longline fisheries (Lewison and Crowder 2007; Boggs and Swimmer 2007). The amount of fishing would be strictly regulated by EFP-imposed trip and set limits, and a variety of mitigation measures would be required to minimize adverse environmental impacts from the activity.

The applicant also holds a DGN permit and wishes to begin assessing whether he could use the SSLL fishing gear instead of DGN gear, which is permitted in the West Coast EEZ under a variety of restrictions and is also used to target swordfish. The applicant, rather than NMFS, has assumed the financial risk in order to make this assessment.

A Pacific Leatherback Conservation Area was established off the West Coast to specifically address anticipated leatherback turtle interactions (i.e., "takes" as defined by the ESA) with DGN gear in the fishery. The Conservation Area was required under the biological opinion written for the DGN fishery in

2000 based upon an analysis that estimated anticipated takes and mortalities of leatherbacks. NMFS identified an area know to be utilized by leatherback turtles at certain times of the year and established this particular time/area closure between September 15 to November 15. The closure applies only to the DGN fishery based on information collected by NMFS over several years. Because NMFS has no information on how leatherbacks will interact with the latest SSLL gear innovations in the U.S. West Coast EEZ, the closure only applies to the DGN fishery.

Besides the DGN fishery, harpoons and SSLL are the only other known gears used to harvest swordfish. The U.S. harpoon fishery does not have the potential or capacity to serve as a reliable swordfish harvesting gear in the U.S. West Coast EEZ to meet current demand. Without the ability to cover the U.S. demand, imports from foreign sources, whose fleets are believed to operate under less stringent management and conservation measures, would fill the void thereby exacerbating the regional bycatch problem. The expansion limitations include, among others, a narrow band of favorable waters and time periods for sighting and harpooning swordfish (i.e., basking swordfish in the Southern California Bight), the negative economic constraints based on increased fuel consumption and operational costs for this gear type, and the narrow market niche for this higher-priced product. While not as selective as harpoon gear, NMFS finds that since the agency adopted new bycatch reduction technologies and measures, SSLL gear has become exceedingly more selective. This fact has been substantiated by NMFS's own research as well as the research of others and has been extensively published in peer-reviewed scientific journals (Boggs and Swimmer 2007; Gilman, *et al*. 2006d; Lewison and Crowder 2007).

The terms and conditions imposed on fishing under the EFP are intended to strictly contain the environmental impacts of the activity, principally related to the incidental take of protected species, to a level in compliance with current law and policies. NMFS also has an interest in encouraging the use of conservative gear alternatives to DGN gear if the gear would lead to an overall reduction in non-target bycatch and protected species interactions or "takes" while allowing the continued delivery of fresh, U.S.-caught swordfish to West Coast markets. If the outcome of the EFP suggests the potential for a commercially viable fishery, this could support design and implementation of future studies to better determine if there are benefits from encouraging the use of this longline gear as an alternative to DGN gear.

1.4 Background

Under California law, longline gear is not legally authorized within the EEZ; therefore, landing into California ports longline-caught fish from the EEZ off California is prohibited. With implementation of the HMS FMP in 2004, a prohibition on longline fishing for the entire West Coast EEZ was created in Federal regulations. In 1991, there were three longline vessels that fished beyond the EEZ targeting swordfish and bigeye tuna and unloaded their catch and re-provisioned in California ports. In 1993, a Gulf Coast fish processor set up at Ventura Harbor, California, to provide longline vessels with ice, gear, bait, and fuel, and fish offloading and transportation services (Vojkovich and Barsky 1998). Consequently, longline vessels seeking an alternative to the Gulf of Mexico longline fishery, and precluded from entering the Hawaii fishery due to lack of permits, began arriving in southern California. By 1994, 31 vessels comprised this California-based fishery, fishing beyond the EEZ, and landing swordfish and tunas into California ports. These vessels fished alongside Hawaiian vessels in the area around 135° W. longitude in the months from September through January. Historically, vessels from Hawaii had the option of returning to Hawaii to land their catch or landing their catch on the West Coast.

The Western Pacific Fishery Management Council (WPFMC) developed and implemented the Pelagics FMP in 1987. In response to the rapid influx of East Coast longliners into the Hawaiian-based fishery during the late 1980s, Amendment 4 to the Pelagics FMP extended previous emergency interim rules (56 FR 14866; 56 FR 28116) that were implemented to arrest the rapid growth of the longline fishery. This

1991 amendment established a moratorium on new participants from entering the Hawaiian longline fishery. In 1994, Amendment 7 to this FMP replaced the moratorium with a limited entry program for the Hawaiian longline fishery (59 FR 26979), limiting the fishery to 167 vessels.

By 1995, only six longline vessels made a high seas trip from a California port, although 36 vessels made at least one longline landing containing HMS (Vojkovich and Barsky 1998; table 1–1). The group of vessels that came to California from the Gulf of Mexico in 1993 and 1994 left the California-based fishery. This group of vessels either returned to the Gulf of Mexico fishery, or acquired Hawaiian longline permits in order to have fishery options for the months of February through September, when fishing within range of California ports drops off substantially. Many of the vessels that had participated in the California fishery had discovered productive swordfish fishing grounds in the fall and winter that were further east than the Hawaiian fleet usually operated. As the California fleet migrated to Hawaii, these vessels continued to move east later in the year, and operated out of California ports when these ports became closer than Hawaiian ports. These vessels fished from California until about January, when the pattern of fishing moved to the west, and operating from Hawaii became more convenient. Consequently, beginning in the latter part of 1995, a number of vessels from the Hawaiian fleet began a pattern of fishing operations that moved to California in the fall and winter and then back to Hawaii in the spring and summer.

In August 2000, as the result of the case *Center for Marine Conservation vs. NMFS*, a Federal district court issued an order directing NMFS to complete an Environmental Impact Statement (EIS) to assess the environmental impacts of fishing activities conducted under the Pelagics FMP by April 1, 2001, and ordered restrictions and closures over millions of square miles of the Hawaiian longline fishery's usual fishing grounds. These court-ordered closures effectively eliminated the Hawaii swordfish fishery. As a result, some Hawaiian longline permit holders de-registered their vessels from the permit, and proceeded to fish from California ports, as was their custom during this time of year.

NMFS completed the EIS in March, 2001, and, consistent with a biological opinion (BO) that was issued at the same time, NMFS implemented measures for the protection of endangered and threatened sea turtles. Such measures included a prohibition against targeting swordfish north of the equator by Hawaiian longline vessels, and prohibited longline fishing by Hawaiian longline vessels in waters south of the Hawaiian Islands from 15° N. latitude to the equator, and from 145° W. to 180° W. longitude during the months of April and May. This decision was challenged in a lawsuit filed by the Hawaiian Longline Association. The Court vacated the existing regulations as of April 1, 2004, with the expectation that a new regulatory regime would be implemented by that date. As a result, the WPFMC developed Regulatory Amendment 3, which was subject to a Section 7 consultation and accompanying BO. The amendment requires vessels fishing under the WPFMC's Pelagics FMP and targeting swordfish to use mackerel-type bait and 18/0 size circle hooks, among other bycatch reduction mitigation measures. (This type of hook and bait has been demonstrated to reduce incidental take of sea turtles.) The amendment also set an effort limit of 2,120 sets per year and hard caps on takes of loggerhead and leatherback sea turtles, which if reached, would close the fishery for the year. The regulations became effective April 2, 2004 (69 FR 17329) and substantially increased opportunity in the fishery. At almost the same time, April 7, 2004, (69 FR 18444) the final rule for implementing the HMS FMP was implemented (effective date, May 7, 2004), which included the regulations described above, effectively closing the West Coast high seas longline fishery for swordfish. As seen in table 1–1, the number of high seas longline vessels making HMS landings on the West Coast increased substantially in the years 1997–2004. Some of these increases were likely due to the regulatory changes discussed here.

This history of West Coast longline landings of fish caught outside the EEZ reflects this history of participation. Swordfish landings were generally a negligible share of all West Coast pelagic longline landings of HMS species up until 1991, from which time they steadily increased to a peak in 2000 of

1,885 metric tons (mt), which represented 90 percent of overall West Coast HMS pelagic longline landings of 2,084 mt (see table 1–2). Swordfish landings have declined since that time with significant reductions in 2004 and 2005. (The few vessels fishing with longline gear cannot have their 2005 landings reported since Federal regulations prohibit reporting fishery statistics for three or fewer vessels due to confidentiality reasons). Currently, the EFP applicant is the only active longline participant on the West Coast targeting tuna outside the EEZ. Vessels permitted under the WPFMC's FMP and operating under their management regime may land swordfish on the West Coast.

Other marketable species in the longline catch include opah (*Lampris regius*), mahi mahi (*Coryphaena hippurus*), and escolar (*Lepidocybium flavobrunneum*). Relatively few sharks, in proportion to those caught, have been marketed from the high seas fishery. The major shark bycatch is blue shark, which is discarded for economic reasons because the flesh quickly deteriorates after death. Other incidental catch of concern includes striped marlin, turtles, seabirds, and marine mammals.

Longline fishing gear consists of a main line strung horizontally across up to 100 km of ocean, supported at regular intervals by vertical float lines connected to surface floats. Descending from the main line are branch lines, each ending in a single, baited hook. The main line droops in a curve from one float line to the next and usually bears some 2–25 branch lines between floats. Fishing depth is determined by the length of the floatlines and branchlines, and the amount of sag in the main line between floats (Boggs and Ito 1993). The depth of hooks affects their efficiency at catching different species (Hanamoto 1976, 1987; Suzuki, *et al*. 1977; Boggs 1992). When targeting swordfish, vessels typically deploy 24 to 72 km of 600 to 1,200 pound test monofilament mainline per set. Mainlines are rigged with 22 m branch lines at approximately 61 m intervals and buoyed every 1.6 km. Between 800 and 1,300 hooks are deployed per set. Large squid (*Illex spp*.) are a primary bait species with various colored light sticks used to attract the target species to the bait. The mainline is deployed from 4 to 7 hours and left to drift (unattached) for 7 to 10 hours with radio beacons attached to facilitate gear recovery. Retrieval typically requires seven to 10 hours depending on length of mainline and number of hooks deployed. Fishing occurs primarily during the night when more swordfish are available in surface waters. Generally, longline gear targeting tuna is set in the morning at depths below 100 m, and hauled in the evening. Longline gear targeting swordfish is set at sunset at depths less than 100 m, and hauled at sunrise. A typical longliner carries a crew of six, including the captain, although some of the smaller vessels operate with a four-man crew. Fishing trips last around three weeks. Most vessels do not have built-in refrigeration equipment, limiting their trip length. The fish are iced and sold as "fresh." As discussed in chapter 2, a variety of conditions would be attached to fishing under the EFP in order to minimize take of protected species. As a result, fishing methods would differ somewhat from what is described here.

As previously noted, the use of large circle hooks and mackerel or mackerel-type bait has proven to be successful by increasing the post-hooking survivorship of sea turtles captured and released in domestic and international pelagic longline fisheries. Developments (2006-2007) in scientific research on the use of modified fishing gear to reduce longline bycatch of sea turtles WCPFC-SC3-EB SWG/WP-7 (Boggs and Swimmer 2007). At present, NMFS is encouraging international regional fisheries management organizations to adopt the following measures as means to reduce both sea turtle-fisheries interaction rates as well as injuries caused by fishing gear, thereby increasing survivorship of turtles after their release:

1) Replacing J hooks and tuna hooks with circle hooks reduces the deep ingestion of hooks by sea turtle species that tend to bite baited hooks (e.g. hard shell sea turtles).
2) In fisheries with bycatch of large (45-65 cm carapace length) loggerhead turtles (*Caretta caretta*) or leatherback turtles (*Dermochelys coriacea*), using large sizes of circle hooks (i.e., wider than 4.9 cm minimum width, e.g. size 18/0) can substantially reduce the bycatch of both species. It appears that larger hook size reduces capture rates of turtles that bite baited hooks (hard shell turtles), and

that circle hook shape helps prevent turtles that seldom bite (e.g. leatherbacks) from being snagged and subsequently entangled.

3) In fisheries with bycatch of smaller turtles, using smaller sizes (e.g. size 16/0) of circle hooks can reduce capture rates of sea turtles when the circle hooks replace other hook styles with smaller widths. Circle hooks tend to be much wider than other hook styles with similar length and gape.
4) Using fish for bait instead of squid can reduce bycatch of both leatherback and hard shell sea turtles. Use of fish bait is especially valuable in offsetting the potential loss of swordfish from use of circle hooks.

Longline-caught fish are sold to wholesale fish dealers. Local California fisheries, distant offshore fisheries, and imports from Hawaii, Chile, and Taiwan all influence the ex-vessel price paid to local longline fishermen for swordfish. Swordfish are often graded by size and quality and the price is adjusted accordingly.

Between 1989 and 2005, the U.S. annual demand for swordfish[2] ranged from 10,948 mt to 23,114 mt, averaging 16,556 mt. Imports have recently comprised the majority of annual U.S. demand for swordfish. Imports increased markedly beginning in 1997 with total demand peaking in 1998, when imports accounted for 70 percent of the total (table 3–16). In 2005, U.S. imports of swordfish were 10,187 mt, valued at about $77 million. Singapore, Panama, Canada, and Chile were the dominant suppliers of imports.

Since 1991, Pacific landings (West Coast and Hawaii) have generally accounted for between half and three-quarters of U.S. catch, or 10 to 47 percent of annual demand including imports (table 3–17). During this period, U.S. landings averaged 6,444 mt (about 39 percent of demand) and imports averaged 10,111 mt (61 percent). Landings of swordfish in the United States have shown a general pattern of decline from the early 1990s through the early 2000s, with landings in 2005 of 3,039 mt at only 28 percent of the record landings of 10,851 mt in 1993. In contrast, the share of U.S. swordfish demand supplied by imports increased from 35 percent in 1993 to 77 percent of the total in 2005. Over the entire period from 1989 through 2005, imports increased from rough parity with U.S. landings early in the period to over three times domestic landings in recent years.

1.5 Council Decision-making and the Scoping Process

Scoping is "an early and open process for determining the scope of issues to be addressed and for identifying significant issues related to a proposed action" (40 CFR 1501.7). The scoping process described in NEPA regulations emphasizes public involvement, prioritization of issues so that the impact analysis may focus on potentially significant impacts, and planning the impact analysis. The Council, as much as it is an organization, is a process for coordinating involvement of the public and interested State and Federal agencies in decision making related to Federal fishery management. As such, it serves as an effective scoping mechanism. All Council meetings, and meetings of its various committees, are open to the public and opportunity for oral and written comment on issues brought before these bodies is provided.

An application to grant the EFP was originally submitted to the Council in November 2005 by U.S. West West HMS fishermen Mr. Pete Dupuy. At their March 2006 meeting, the Council gave preliminary approval for further consideration of the application. At a November 2–3, 2006, joint meeting of the Council's HMS Management Team (HMSMT), composed of State and Federal fishery managers, and its HMS Advisory Subpanel (HMSAS), with representation from different fishery sectors and user groups, a range of alternatives for terms and conditions attached to the EFP was discussed and refined. These

[2] Demand is defined for this discussion as the sum of a year's domestic catches and imports.

alternatives were adopted by the Council at their November 12–17, 2006, meeting. The Council chose a preferred alternative at their April 1–6, 2007, meeting in Seattle, Washington, based in part on information contained in this EA. Subsequent to the Council's recommendation at the April meeting, further modifications to the preferred alternative were made based on collaborative input among the applicant, NMFS, Council staff, and advisory bodies to further refine and enhance the conservation measures being proposed. As the modifications were more conservative in nature (e.g., reducing the size of the proposed action area), they were appended to the preferred alternative in lieu of creating a new alternative.

1.6 Determining the Scope of the Analysis

Staff began work on this EA by assessing the alternatives in order to identify likely environmental impacts and narrow the scope of the present analysis to the significant issues to be analyzed in depth and to eliminate from detailed study the issues which are not significant (40 CFR 1501.7). They used 16 factors enumerated in NOAA NEPA guidance (NAO 216-6) §6.01[3], which reproduces the factors defining "significant" listed at 40 CFR 1508.27, and §6.02, specific guidance on fishery management actions, in order to screen for potentially significant impacts and determine the scope of the analysis. The §6.02 criteria are listed first below and generally focus on components of the human environment potentially affected by a fishery management action. The §6.01 criteria are related to the intensity—or severity—of the impact, which were considered in the context of the environmental components listed in §6.02.

These factors can be used to determine whether a finding of no significant impact can be made or whether it is necessary to prepare an EIS to evaluate significant impacts in more detail. This EA provides the information and analysis on which to determine the appropriateness of a Finding of No Significant Impact (FONSI). For each factor listed below a brief discussion follows, indicating in general terms the types of effects that may be reasonably expected, and an assessment of whether the potential effects are of sufficient magnitude or concern to justify analysis in this EA. Impacts evaluated in detail in this EA are summarized in section 4.7.

1-2) Can the proposed action be reasonably expected to jeopardize the sustainability of any target or non-target species that may be affected by the action?

Fishing mortality by the single vessel that would be authorized to fish in 2007 represents a very minor proportion of total fishing mortality on target and non-target finfish species. Swordfish catches by all vessels in the Eastern Pacific Ocean (EPO) during the years 2001-2005 were 13,000–20,000 mt annually (PFMC 2006; IATTC 2006). The U.S. West Coast catch has averaged 1,500 mt over the same period, while according to the EFP application, catches under this EFP would be 7–18 mt (15,000–40,000 lb).[4] Bycatch of non-target species (which is likely to be principally blue sharks) would also constitute a minor component of the larger Pacific-wide catches. The additional catch of target and non-target species that would occur under the EFP would not jeopardize their sustainability. Summary impacts of effects of the proposed alternatives on target and non-target stocks are presented in chapter 4 of the EA.

If fishing under the EFP is conducted it could form the basis for future evaluations, which could occur under conditions of additional EFPs until sufficient information had been gathered by NMFS to determine whether a regulatory change is justified. Any future fishing activities of this nature would be subject to additional rigorous environmental review to evaluate potential effects. Therefore, it is reasonable to

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[3] http://www.corporateservices.noaa.gov/~ames/NAOs/Chap_216/naos_216_6.html#section_6

[4] However, distinct stocks are recognized south and north of the equator in the EPO. Catches north of the equator account for roughly one third of the EPO total.

conclude that granting the EFP for 2007 for a single vessel with explicit effort controls and protected species catch caps, would not have significant effects on target or non-target stocks. In order to inform the public and decision makers on the likely effects of the EFP on finfish, this EA includes an evaluation of such effects.

3) Can the proposed action be reasonably expected to cause substantial damage to the ocean and coastal habitats and/or essential fish habitat (EFH) as defined under the Magnuson-Stevens Act (MSA) and identified in FMPs?

Pelagic longline fishing operations deploy fishing gear in open water between the surface and bottom of the ocean. No fishing would be allowed within 40 nmi of the coast. Environmental safeguards are built into the EFP alternatives to reduce the risk of harm to populations of protected species which migrate across the boundary between coastal and EEZ habitats. For these reasons, it is unlikely that the proposed action would cause substantial damage to shared protected species stocks, habitats or EFH. A detailed assessment of the potential impacts of the three action alternatives on finfish, protected species and seabirds can be found in sections 4.3, 4.4 and 4.5 of this EA.

4) Can the proposed action be reasonably expected to have a substantial adverse impact on public health or safety?

The proposed action involves one fishing vessel fishing in open waters off California and Oregon. There are no public health implications involved. Since substantial adverse impacts on public health or safety are not expected, they are not further evaluated in this EA.

5) Can the proposed action be reasonably expected to adversely affect endangered or threatened species, marine mammals, or critical habitat of these species?

Longline gear is known to incidentally catch and entangle threatened and endangered marine mammals, sea turtles, and seabirds. This EA evaluates impacts to ESA-listed species and their designated critical habitat, and marine mammals, which are protected under the MMPA. A detailed assessment of the potential impacts of the three action alternatives on finfish, protected species and seabirds can be found in sections 4.3, 4.4 and 4.5 of this EA.

6) Can the proposed action be expected to have a substantial impact on biodiversity and ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)?

The proposed action would potentially have a minor adverse effect on biodiversity and ecosystem function through the removal of target, non-target, and protected species. Fish removals under the proposed action would represent a very minor proportion of the biomass of these species and would have a remote likelihood of adversely affecting biodiversity and ecosystem function. Potential removals of protected species are addressed under question five and impacts evaluated in detail in this EA are summarized in section 4.7.

7) Are significant social or economic impacts interrelated with significant natural or physical environmental effects?

Prosecution of the EFP could generate revenue for the applicant over the short term, some of which would have community income impacts in terms of purchase of fuel, supplies and other inputs. A summary of the socioeconomic and environmental impacts of the three action alternatives can be found in section 4.7 of this EA.

8) To what degree are the effects on the quality of the human environment likely to be highly controversial?

The Council and NMFS received a large number of written and oral comments opposing the proposed action. Public opposition stems primarily from the perception that longline gear is indiscriminate and would cause an increase in injury and mortality of protected species, particularly endangered leatherback sea turtles. Most of the controversy centered on two main themes: 1) that removal of any Pacific leatherbacks from the population would drive the species closer to extinction; and 2) that longline gear results in high levels of marine mammal and sea turtle mortality. The majority of comments received did not establish a foundation with supporting scientific documentation and/or citations that would contribute to the analysis in the EA. The authors of the EA used the best available scientific information available in developing the analysis of impacts, including species level impacts, of the proposed action. A limited number of public comments were received that did provide substantive suggestions and data sources that were utilized to improve the analysis in the EA.

9) Can the proposed action be reasonably expected to result in substantial impacts to unique areas, such as historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers or ecologically critical areas?

This activity would occur in the marine environment and has little or no direct effect on the biophysical component of the terrestrial environment. No unique areas would be affected.

10) To what degree are the effects on the human environment likely to be highly uncertain or involve unique or unknown risks?

The risks are neither unique nor unknown; SSLL fishing has previously occurred in the high seas area adjacent to the West Coast EEZ, out of Hawaii, and in the Atlantic, providing detailed and voluminous information on possible catch and bycatch of finfish and take of protected species. Actual catch or take rates within the EEZ may differ from what has been experienced outside the EEZ. Therefore, the risks are to some extent uncertain in terms of their intensity, although mitigation measures (such as limits on fishing effort and caps on protected species takes) would be expected to both reduce impacts and reduce uncertainty about their intensity. In addition, the EFP terms and conditions would include 100 percent observer coverage for the duration of the EFP, thereby quantifying the exact level of bycatch encountered.

11) Is the proposed action related to other actions with individually insignificant, but cumulatively significant impacts?

The EA describes past and present activities that contribute to the kinds of impacts identified for the proposed action (fishing mortality, protected species takes). Reasonably foreseeable future actions are discussed. These are considered together to arrive at the cumulative effects. Section 3.1 discusses this analytical framework.

12) Is the proposed action likely to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural or historical resources?

The proposed action would not affect historic places or result in the loss or destruction of significant scientific, cultural, or historical resources. As noted above, the primary adverse impact of the proposed action would be the removal of target and non-target finfish species and the incidental take of protected species. To the extent these may be construed as scientific or cultural resources, the proposed action is not expected to result in a significant level of loss or destruction.

13) Can the proposed action be reasonably expected to result in the introduction or spread of a non-indigenous species?

The proposed action does not involve the transport of non-indigenous species. The fishing vessel participating in the proposed action is located in a local port and would not increase the risk of introduction through ballast water or hull fouling.

14) Is the proposed action likely to establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration?

The EFP is intended to gather information to preliminarily assess the commercial viability of new and innovative SSLL fishing gear to target swordfish in the West Coast EEZ. This EA only covers an EFP for the 2007 fishing year. If the EFP is conducted and determined successful, it could provide information to form the design and development of future EFP(s), with a larger number of vessels participating as part of an experimental sampling design approach (e.g., control groups, variables catered for) with the purpose of gathering enough information to determine whether a regulatory change is justified. Any future EFP proposals of this nature would be subject to review and recommendation for approval/disapproval by the Pacific Council following guidelines established in the Council's Operating Procedure #20 for HMS EFPs. Any potential future action would be evaluated in an EA or EIS with separate decisions taken on proceeding at each step. For these reasons the action does not establish a precedent for future actions with significant effects nor does it represent a decision in principal about a future consideration.

15) Can the proposed action be reasonably expected to threaten a violation of Federal, State, or local law requirements imposed for the protection of the environment?

Chapter 6 describes potentially applicable cross-cutting mandates and the proposed action would be implemented to comply with these laws and executive orders for the protection of the environment. The proposed action will not threaten a violation of Federal, State, or local law or requirements imposed for the protection of the environment. Per requirements codified at Section 307(c)(3)(a) of the Coastal Zone Management Act, the EFP applicant will be submitting documentation, including this EA, at the California Coastal Commission's November 14-15, 2007, meeting to request a Consistency Certification (15 C.F.R. §D) for the proposed EFP.

16) Can the proposed action be reasonably expected to result in beneficial impacts, not otherwise identified and described above?

The proposed action may result in short-term beneficial impacts for West Coast processors/suppliers in the way of temporarily increased sales (e.g., fish, ice, bait, supplies), for consumers by way of access to higher-quality fresh, U.S. caught product, and for fisheries managers by way of access to pertinent fishery-dependent data that will assist in guiding future management decisions in an existing data-poor fishery.

Table 1–1. Number of vessels with West Coast commercial HMS landings with pelagic longline gear identified on the landing tickets, 1981-2005.

Year	Number of Vessels
1981	27
1982	28
1983	19
1984	14
1985	12
1986	6
1987	8
1988	14
1989	4
1990	5
1991	13
1992	20
1993	12
1994	44
1995	36
1996	29
1997	52
1998	70
1999	53
2000	70
2001	56
2002	36
2003	41
2004	40
2005	9

Source: PacFIN, extracted March 8, 2007. Additional processing info: Only fish tickets where at least 1 lb of any highly migratory species (except striped marlin) was landed for pelagic longline gears were used. Aquaculture fish ticket/fish ticket line information is excluded.

Table 1–2. Commercial landings (round mt) in the West Coast pelagic longline fishery, 1981–2005. (Source: Table 4–13 in the 2006 HMS SAFE).

		Sharks					Tunas								
Year	Sword-fish	Common Thresher	Pelagic Thresher	Bigeye Thresher	Shortfin Mako	Blue	Albacore	Other	Dorado	Ground-fish	Coastal Pelagics	Crab	Salmon	Other	Total
1981	<0.5				19	72	25	1		2	<0.5			1	120
1982	<0.5	1			6	18	42	1	<0.5	<0.5	<0.5			2	70
1983	<0.5	<0.5			1	2	6	3	<0.5	<0.5	<0.5			7	19
1984	12	3		<0.5	2		2	2	3	2	<0.5			4	30
1985	<0.5	1			<0.5	<0.5	<0.5			10				1	12
1986		2			1	<0.5				6	<0.5			4	13
1987		<0.5			3	<0.5	<0.5			43				3	49
1988	<0.5	1			152	1		<0.5		27	<0.5			5	186
1989					5	1				<0.5					5
1990		<0.5			15	4	<0.5	1		<0.5	<0.5			<0.5	20
1991	27	<0.5			23	<0.5	<0.5	2	<0.5	3				18	73
1992	63	2		<0.5	2	<0.5	1	<0.5		21	<0.5			2	91
1993	27	<0.5			1	<0.5	<0.5	5	1	1	1			2	38
1994	722	19		3	20	12	49	56	32	4	<0.5			15	932
1995	271	11		1	7	5	4	58	5	8	2			4	376
1996	346	2			5	<0.5	3	68	9	6	<0.5			5	444
1997	663	4		2	3	<0.5	6	83	1	32	<0.5			2	796
1998	418	3			4	<0.5	9	96	1	9	1			20	561
1999	1,325	5			7		66	161	17	1				4	1,586
2000	1,885	5	<0.5	<0.5	6	<0.5	22	99	41	12		3		11	2,084
2001	1,749	20		1	7	2	22	73	15	7	<0.5			53	1,949
2002	1,320	2			3	41	1	12	<0.5	12	<0.5			2	1,393
2003	1,810	<0.5			3		2	29	1	4				4	1,853
2004	898	1		<0.5	2		2	31	1	13	<0.5			3	951
2005	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

*Not reported due to data confidentiality requirements.
Source: PacFIN, extracted August 3, 2006.
Additional processing info:
Only fish tickets where at least 1 lb of any highly migratory species (except striped marlin) was landed for the pelagic longline fishery were used.
Landings in lbs are converted to round weight in mt by multiplying the landed weights by the conversion factors in each fish ticket line and then dividing by 2204.6.
Aquaculture fish ticket/fish ticket line info is excluded.

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

Four alternatives are evaluated in this EA, including no action. The Council identified a preferred alternative (alternative 4) at their April 1–6, 2007, meeting in Seattle, Washington. The Council's preferred alternative represents a recommendation to NMFS on issuance of the EFP. An additional conservation measure was added to the preferred alternative after the Council's recommendation was sent to NMFS. This measure, which would further restrict the proposed action area, was developed in a collaborative process between the applicant and NMFS, and will provide positive benefits in regards to mitigating the impacts of the alternative.

2.1 Alternative 1 (No Action)

Under alternative 1 the EFP would not be granted and no longline fishing would occur in the West Coast EEZ. All current regulations applicable to longline fishing under the HMS FMP would continue to apply.

2.2 Alternative 2

Under alternative 2 the EFP would be approved with the terms and conditions proposed by the applicant. (See appendix A for the proposal submitted by the applicant.) These terms and conditions are as follows:

1. 100 percent observer coverage, paid for by NMFS
2. All observers shall carry satellite phones provided by NMFS and immediately inform NMFS of any marine mammal, sea turtle, or seabird capture or interaction
3. A single vessel participating
4. Maximum of 14 sets per trip
5. Maximum of four trips between September and December (up to 56 total sets for the entire duration of the proposed EFP)
6. Fishing is only authorized within the West Coast EEZ and no SSLL gear shall cross this boundary
7. No fishing within the Southern California Bight as defined by the applicant. (See definition below.)
8. No fishing within 30 nmi of the coastline (see figure 2–2)
9. Utilizing shallow-set longline gear configuration:
    a. 50–100 km mainline
    b. 18 m floatline
    c. 24 m branchlines
    d. 2–8 hooks between floats
    e. 400–1,200 hooks per set (up to a maximum of 67,200 hooks for the entire duration of the proposed EFP)
    f. Set fishing gear so hooks are at a depth of 40–45 meters below the surface
10. Use 18/0 circle hooks with a 10 degree offset to fish for swordfish (as described at 50 CFR 665.33(f)).
11. Use mackerel or mackerel-type bait (as described at 50 CFR 665.33(g)).
12. Allow the use of light sticks.

2.2.1 Rationale for Terms and Conditions

Under these terms and conditions the EFP would pertain to a single vessel with effort constraints defined in terms of the number of trips and sets allowed. This would allow gathering preliminary information on whether the proposed action is commercially and environmentally viable. With a single vessel participating, NMFS could financially and logistically deploy the necessary observers, which is further simplified by the limit on the number of trips to four. Having an observer on board would allow independent verification of total catch (including bycatch), protected species take and interactions, and area of operation. The prohibition on operating more than 30 nmi from the mainland coastline and outside of the Southern California Bight (SCB, see below) is intended to reduce gear conflicts with other commercial and recreational fishing vessels. The prohibition could also reduce interactions with protected species to the degree they are more prevalent in coastal areas.

Under these terms and conditions the applicant would use the shallow-set gear incorporating large circle hooks and mackerel or mackerel-type bait to target swordfish. This gear configuration has been demonstrated to dramatically increase the post-hooking survivorship of captured sea turtles. The application states that albacore, bigeye, yellowfin, and northern bluefin tunas may be caught in addition to swordfish. The proposed shallow-set gear configuration includes longer branchlines intended to allow any hooked or entangled sea turtles to reach the surface so they will not drown before the gear is retrieved. Light sticks serve as an attractant during night fishing. Regulations for the pelagic longline fishery managed under the WPFMC's Pelagics FMP (50 CFR 665) allow the use of light sticks for targeting swordfish (shallow setting) although they are prohibited when deep-setting (targeting tunas). The limitation on the type of hooks and bait used are consistent with current Federal regulations applicable to vessels fishing under the WPFMC's Pelagics FMP. Although the EFP would exempt the applicant from the gear restrictions at 660 CFR 712(a), the other provisions of that section (b-e), covering sea turtle take mitigation measures, seabird mitigation measures, use of a vessel monitoring system if required by NMFS, and requirement for the skipper to attend a protected species workshop if so requested, would apply.

Subsequent to Council adoption of the range of alternatives, several changes were made to the description of this alternative in addition to providing the definition of the SCB, below. In general, these changes clarify that the applicant may only use shallow set gear, targeting swordfish. First, the applicant originally proposed a range of 2–25 hooks between floats. The number was narrowed to 2–8 hooks after additional consultation with members of the HMSMT. Second, the applicant had proposed using smaller circle hooks (16/0) with no offset to fish for tunas but subsequently decided against this option. Finally the specification that the gear would be set at 40–45 m was added.

2.2.2 Southern California Bight

The SCB is a region including waters off the coastal areas and the Channel Islands south of Point Conception. The coastline is indented, trending to the southeast providing shelter from northwest winds that prevail during summer months. Circulation patterns and bathymetric complexity contribute to high marine biodiversity within the region. Because of its proximity to major metropolitan areas it also attracts heavy recreational use. Under the EFP terms and conditions fishing would not be allowed in this region. However, this requires delineation of a boundary line that is relatively easy to enforce. The applicant proposes a boundary line that is similar to one described in the 2003 HMS FMP FEIS (PFMC 2003) under Pelagic Longline Fishery Management Measures Alternative 4 (see page 8–31). The description in the FMP is as follows: "Prohibit fishing with longline gear north of Point Conception within 25 nmi of shore and, south of Point Conception, east of a line from Point Conception to the western tip of San Miguel Island, to the northwest tip of San Nicholas Island to the intersection of 118°00'00" W. longitude with the southern boundary of the U.S. EEZ". The applicant proposed that the intersection with the EEZ boundary be at 118°45'00" W. longitude and that longline fishing would not occur within 30 nmi of the mainland shore. Two other adjustments have been made to the proposed line. First, the intersection of the 30 nmi buffer from the mainland and the line defining the SCB was moved west of a line drawn from Point Conception through the western tip of San Miguel Island so that this intersection occurs at the boundary of the Channel Island National Marine Sanctuary (i.e., Sanctuary waters would be excluded from the fishing area). Second, instead of setting the boundary at the western tip of San Nicholas Island, this waypoint is set at the three nmi State waters boundary off of the island. Figure 2–1 shows the boundary line in combination with the 30 nmi mainland buffer. The coordinates for this boundary line are as follows:

33°57'21" N., 120°31'44" W. – Intersection with 30 nmi mainland buffer
33°47'24" N., 120°19'48" W. – Intersection with 40 nmi mainland buffer
33°15'00" N., 119°40'00" W. – State waters boundary off western tip of San Nicholas Island
31°06'08" N., 118°45'00" W. – Intersection with southern EEZ boundary

Figure 2–2 shows a coastwide perspective of the combined 30 nmi offshore limit and SCB boundary line.

2.3 Alternative 3

Under alternative 3 the EFP would be approved with all the terms and conditions listed above under alternative 2, but the following *additional* terms and conditions would also be imposed:

1. Require use of time and depth recorders (TDR) to estimate fishing depth (The number of TDR units deployed per set and per trip would be determined by NMFS in consultation with the applicant.)
2. Gear may not be set until one hour after local sunset and must be fully deployed before local sunrise[5]
3. Prohibit the use of a line shooter for setting the gear
4. Require use of a NMFS-approved dehooking device to maximize finfish (e.g., blue shark) bycatch survivability
5. Establish protected species take caps for marine mammals, sea turtles, seabirds, and prohibited species, such as striped marlin, that may be exposed to and adversely affected by this action

2.3.1 Rationale for Additional Terms and Conditions

These additional terms and conditions are intended to further minimize potential takes of protected species and bycatch of other species of concern. Deployment of TDRs would provide more detailed information on fishing depth and provide additional data related to catch rates and gear interactions with protected species.

The requirement to set the gear at night and is intended to reduce accidental hooking and/or entanglement of seabirds. Seabirds typically get hooked when the line is being deployed. The birds dive for the baited hooks, get hooked, and are dragged underwater and drown. Because seabirds are less active at night, the night setting requirement reduces these interactions.

Sharks are a major component of longline bycatch, especially blue sharks. If handled properly, a large proportion of these animals can be released alive when the gear is retrieved. Use of a NMFS-approved dehooking device would increase bycatch survival.

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[5] This measure is based on a condition in the USFWS biological opinion for the HMS FMP with regard to the short-tailed albatross and brown pelican (USFWS 2004), which are endangered species. The way it was originally written when the alternatives were adopted for public review (gear must be completely retrieved by sunrise) was incorrect and would not be feasible for a typical longline set (i.e., it is not possible to set and retrieve the gear in the amount of time between sunset and sunrise). For this reason the measure has been corrected to accurately reflect the condition in the biological opinion. This condition is also consistent with regulations applicable to vessels permitted under the WPFMC's Pelagics FMP, 50 CFR 665.35(a)(4) (Pelagic longline seabird mitigation measures): *Shallow-setting requirement*. In addition to the requirements set forth in paragraphs (a)(1) and (a)(2) of this section, owners and operators of vessels engaged in shallow-setting that do not side-set must begin the deployment of longline gear at least 1 hour after local sunset and complete the deployment no later than local sunrise, using only the minimum vessel lights to conform with navigation rules and best safety practices.

Species take caps would establish a limit on protected species takes or bycatch of other animals of concern. If any cap were reached fishing operations would cease pending retrieval of remaining gear in the water at which time fishing under the EFP would be terminated. NMFS would contact all relevant enforcement staff, including NOAA enforcement, the U.S. Coast Guard, and California Department of Fish and Game enforcement, to notify them of the termination of the fishing operations authorized under the EFP. Although recommended cap levels are not presented under this alternative, chapter 4 presents information that the Council used to determine the species and take levels for caps when making their recommendation (choosing the preferred alternative). The caps identified by the Council are analyzed as part of the preferred alternative in this final EA, which supports NMFS's final decision on whether to issue the EFP. Based on an exposure analysis, the following marine mammals are most likely to be affected by the EFP: California sea lion, northern elephant seal, short-beaked common dolphin, Risso's dolphin, and northern right whale dolphin. Other marine mammal species that in the past the Council has identified as of concern are: short-finned pilot whale, sperm whale, humpback whale, fin whale, gray whale, and minke whale. Of sea turtle species the leatherback is the only one for which a cap is likely appropriate, based on population status and the possibility of a take. For striped marlin, California laws and policies have identified this as a recreational-only species (commercial landings are prohibited), a policy which was reinforced under the establishment of the HMS FMP. The Council may wish to propose an incidental catch limit for this species to address concerns raised by the recreational fishing community.

In considering caps it is very important to distinguish between take or catch (some type of encounter with the fishing gear) and actual mortality because mortality rates can be significantly lower than 100 percent, depending on the species and type of encounter (lightly entangled versus a deeply ingested hook for example). A cap based on takes is easier to monitor and enforce, but in arriving at a value for the cap the difference between a take and actual mortality should be considered. For example, if the intent is limit mortality to only one animal for a given species, but the mortality rate is 25 percent, a take cap of four animals could limit mortality to the desired level. Any such computation could be complicated as multiple mortality rates can be assigned depending on the type of encounter. For example, in the biological opinion for the Hawaii SSLL fishery (NMFS 2004) four different mortality rates for sea turtles are referenced for a variety of encounter conditions (including entanglement with the turtle subsequently disentangled, various hook ingestion and subsequent release scenarios, and drowning of the turtle by the gear). For species listed under the ESA the caps are set consistent with the Incidental Take Statement (ITS) in the BO accompanying this action.

As originally adopted, this alternative had two additional conditions: (1) Prohibit the use of small circle hooks; allow only 18/0 circle hooks with a 10 degree offset to fish for swordfish (as described at 50 CFR 660.33(f)), and (2) Require 4–6 hooks between floats. However, with the modifications to alternative 2 discussed above, these conditions are redundant because they are included in alternative 2, and all those conditions are applicable under alternative 3. (The limitation on the number of hooks between the floats is effectively identical to the requirement of 2–8 hooks under alternative 2.) Therefore, those two conditions are not repeated under this alternative.

2.4 Alternative 4

This alternative is essentially equivalent to alternative 3 with the addition of specific caps for certain species of concern and restrictions on the area of operation. It includes all of the terms and conditions under alternative 3 (and thus also under alternative 2). The additional features under the preferred alternative are:

- A catch cap of 12 striped marlin

- A take cap of one short-finned pilot whale (this species is not ESA-listed)
- A take cap of five leatherback turtles , or one leatherback mortality
- A cap of one short-tailed albatross
- No fishing north of 45° N. latitude
- No fishing within 40 nmi of the coastline

The terms and conditions in alternative 2 and alternative 3 that are included in alternative 4 are:

1. 100 percent observer coverage, paid for by NMFS
2. All observers shall carry satellite phones provided by NMFS and immediately inform NMFS of any marine mammal, sea turtle, or seabird capture or interaction
3. A single vessel participating
4. Maximum of 14 sets per trip
5. Maximum of four trips between September and December (up to 56 total sets for the entire duration of the proposed EFP)
6. Fishing is only authorized within the West Coast EEZ and no SSLL gear shall cross this boundary
7. No fishing within the Southern California Bight as defined by the applicant
8. Utilizing shallow-set longline gear configuration:
    a. 50–100 km mainline
    b. 18 m floatline
    c. 24 m branchlines
    d. 2–8 hooks between floats
    e. 400–1,200 hooks per set
    f. Set fishing gear so hooks are at a depth of 40–45 m below the surface
9. Use 18/0 circle hooks with a 10 degree offset to fish for swordfish (as described at 50 CFR 665.33(f))
10. Use mackerel or mackerel-type bait (as described at 50 CFR 665.33(g))
11. Allow the use of light sticks
12. Require use of TDRs to estimate fishing depth (The number of TDR units deployed per set and per trip would be determined by NMFS in consultation with the applicant.)
13. Gear may not be set until one hour after local sunset and must be fully deployed before local sunrise
14. Prohibit the use of a line shooter for setting the gear
15. Require use of a NMFS-approved dehooking device to maximize finfish (e.g., blue shark) bycatch survivability

2.4.1 Rationale for Additional Terms and Conditions

The cap of 12 striped marlin was chosen by the Council based on a range of 7–12 fish recommended by the HMSAS. The upper bound of this range (12) was derived by taking five percent of the average annual catch of 248 striped marlin for the period 1997–2006. These catch estimates were summarized from private logbooks submitted by members of the three major billfish clubs active in the southern California area and from California commercial passenger fishing vessel (CPFV) logbook data. Given the lack of reliable private boat catch estimates for billfish from the existing State recreational sampling program, the billfish club and CPFV data sets provide the best available approximation of catch for striped marlin. These data sets are further discussed in section 4.3.3. The lower bound of this range (7) is an estimate submitted by members of the HMSAS in consultation with the applicant based upon anticipated areas to be fished and potential encounter rates.

The Council recommended a cap of one short-finned pilot whale, due largely to concerns about the stock's population status reflected in its low PBR. Short-finned pilot whales are not ESA-listed but are subject to the MMPA. Under the MMPA an estimate is made of potential biological removal (PBR), a level of removals the population can sustain, and maintain or reach its optimal sustainable population. The analysis in this EA (which in draft form was used to choose the preferred alternative) includes both an exposure analysis for marine mammals and a listing of marine mammal species with low PBR values. The analysis within this EA indicates that the take of a short-finned pilot whale is very unlikely in fishing operations under the proposed EFP. Nonetheless, given the stock's low PBR value of 1.2 and current estimated annual average serious injury or mortality from West Coast fisheries at one animal, the Council took a precautionary approach by capping the take of this species. Similarly, the exposure analysis indicates that, although remote, there is some chance that humpback and sperm whales may be encountered in the EFP fishery. However, because of their larger size, the likelihood of entanglement in the gear that would lead to serious injury or mortality is lower than other species of concern. Incidental takes of leatherback sea turtles are anticipated, although takes of loggerhead sea turtles are considered not likely to occur. Thus, based on the ITS prepared as part of the biological opinion, there would be a take cap of five leatherback turtles, or one leatherback mortality, for the proposed action.

The Council decided that for ESA-listed species the take caps should be based on the ITSs that are part of the biological opinion prepared in the ESA Section 7 consultation process. The ITS is an estimate of the number of ESA-listed individuals that are expected to be taken as a result of the proposed action. The consultation process is both an assessment of whether such take would jeopardize the continued existence of these species and an exemption from the take prohibitions in Section 9 and Section 4 of the ESA. NMFS Protected Resources Division has consulted with the Sustainable Fisheries Division for ESA-listed marine species that may be affected by the action.

The USFWS is the responsible agency for ESA-listed seabirds. On June 8, 2007, NMFS SWR Sustainable Fisheries Division initiated informal consultation with USFWS on the effects of the proposed action on short-tailed albatross (*Phoebastria albatris*) and brown pelican (*Pelecanus occidentalis*). USFWS has made a determination that a formal consultation and preparation of a biological opinion is not necessary. The USFWS concurs with NMFS's determination that the proposed EFP is not likely to adversely affect ESA-listed seabird species. As a precautionary measure, there would be a cap of one short-tailed albatross for the proposed action.

The prohibition of fishing under this EFP north of 45° N. latitude stems from concerns raised by the Washington Department of Fish and Wildlife representative on the Council. Data from an experimental DGN fishery off of Washington in the late 1980s showed a high incidental take of leatherback sea turtles. Leatherbacks may be attracted to favorable conditions produced by the Columbia River plume, which enhances biological productivity.

The prohibition of fishing within 40 nmi of the coastline was recommended for inclusion by the applicant as he desires to conduct his fishing operations completely outside the boundaries of any federally-designated National Marine Sanctuary. The prohibition of fishing within 30 nmi of the coastline that is contained in alternative 2 would have allowed a very minor fraction of Sanctuary waters to be included in the proposed action area.

2.5 Alternatives Eliminated from Detailed Study

Given the limited scope of the action (one vessel) no other alternatives were considered. The action alternatives are considered to contain a reasonable range of mitigation measures.

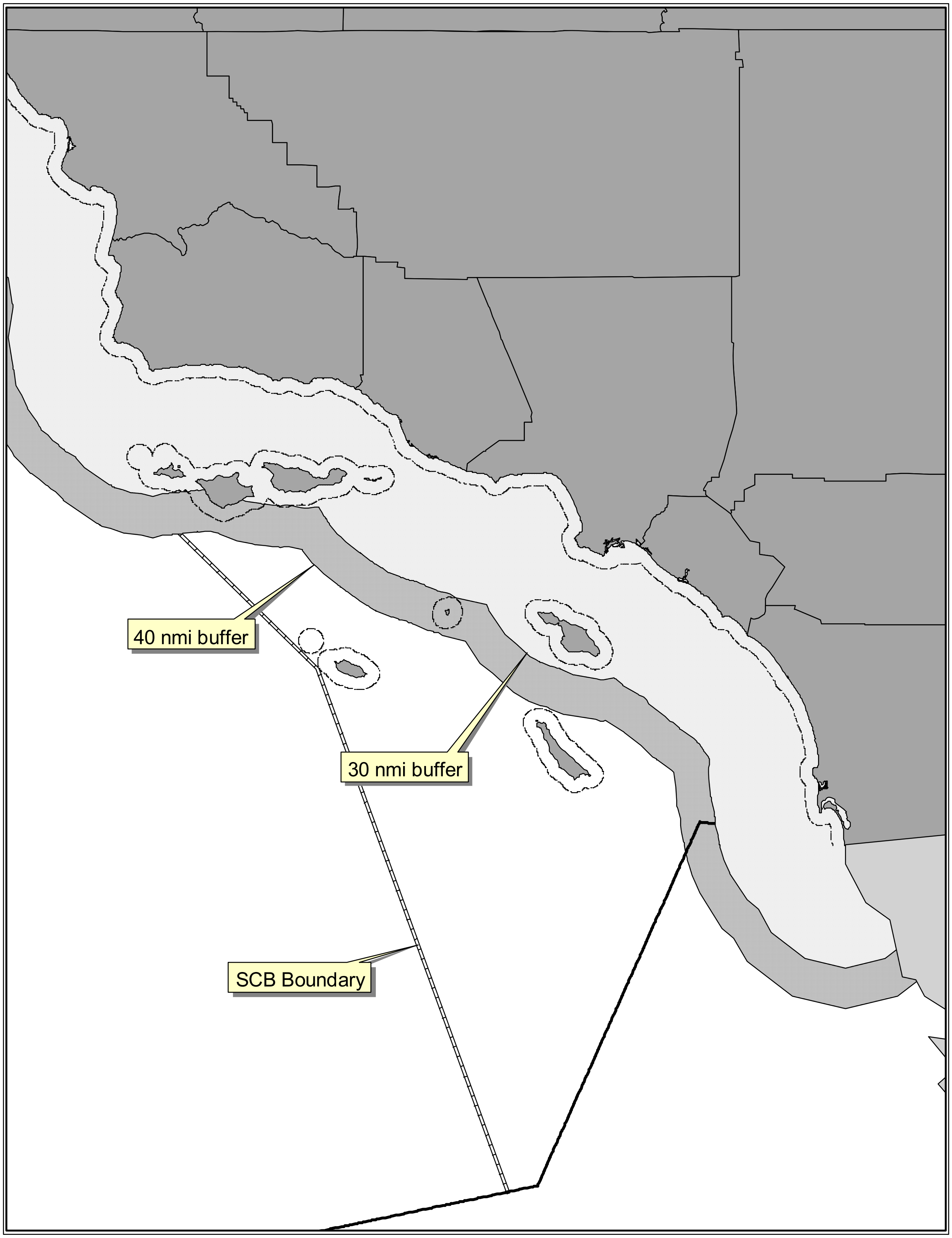

Figure 2–1. Boundary line for the Southern California Bight. The originally proposed coastwide 30 nmi buffer zone and subsequent 40 nmi recommended by the applicant are also shown.

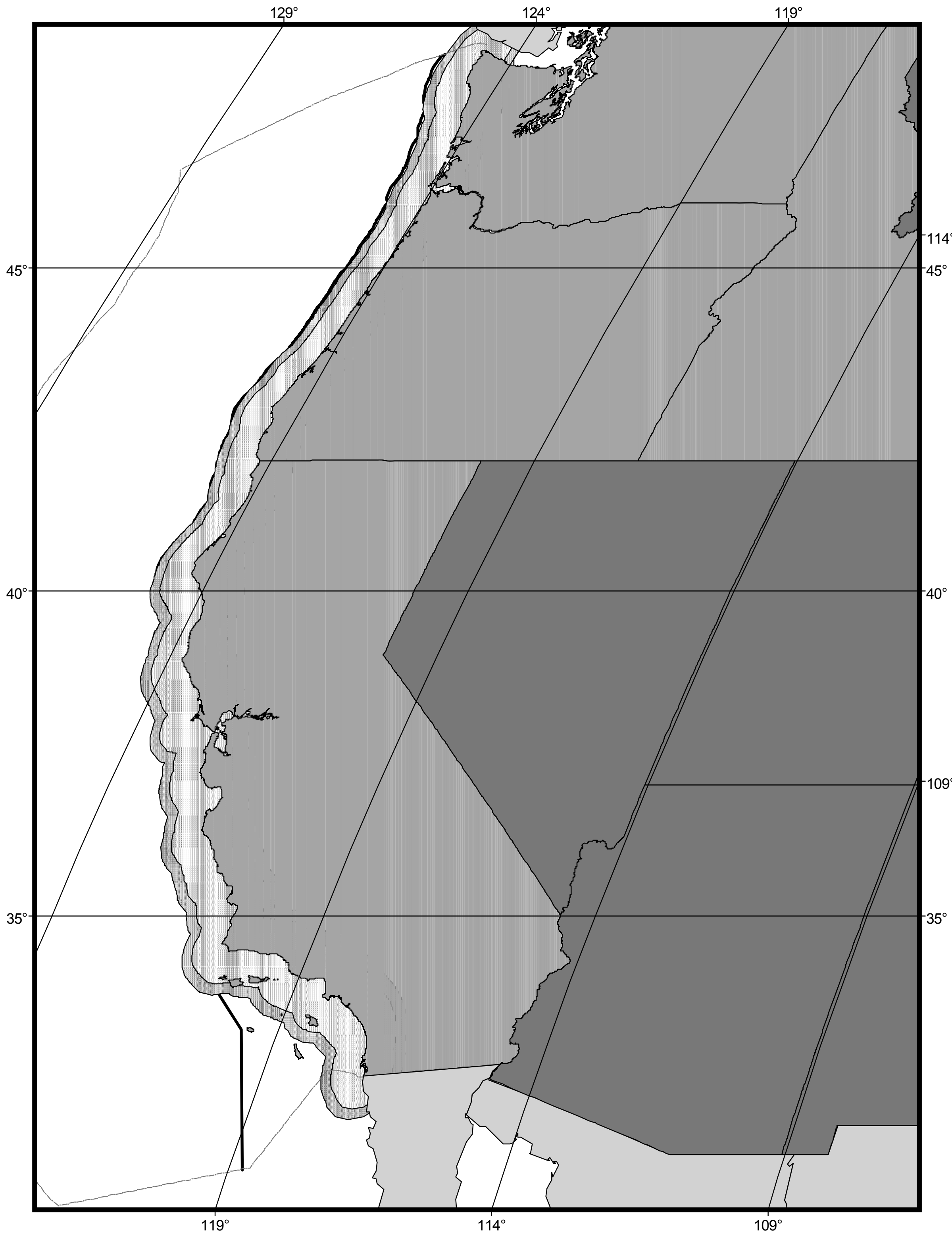

Figure 2–2. Coastwide view of originally proposed 30 nmi buffer zone and applicant proposed 40 nmi buffer zone. The Southern California Bight boundary is also shown (see figure 2–1 for detail)

3.0 AFFECTED ENVIRONMENT

3.1 Introduction

3.1.1 Analytical Framework

This chapter and chapter 4 comprise the analytical portion of the EA. Basic guidance on what to analyze and how to analyze it is provided by Council on Environmental Quality (CEQ) regulations at 40 CFR Parts 1500–1508. This analysis considers the effect of the alternatives on different parts of the human environment, which in shorthand we refer to as *environmental components*. Section 1.6 presents a preliminary screening of possible effects, taking into account potential environmental components, such as target and nontarget fish, habitat, etc. Based on that preliminary screening, three environmental components have been identified for further evaluation and discussion in these chapters: target and non-target finfish; protected species, with particular attention given to certain marine mammal, sea turtle, and seabird species; and the socioeconomic environment, which includes the EFP applicant and suppliers who may gain income from the sale of inputs (bait, fuel, fishing gear, etc.) to the applicant in the course of EFP fishing operations. The analysis can be visualized as a matrix consisting of the alternatives and the environmental components. Each cell in the matrix represents a possible effect that will be evaluated using some form of measurement, a *metric*. As shorthand we will use the term metric to refer to two related elements: the *type* of effect (e.g., change in temperature) and the *unit of measurement* for gauging the effect (e.g., degrees Fahrenheit). More often than not, metrics are more of a conceptual device because we are not able to precisely measure the effect. First, data that may be used to characterize the effect are often limited or unavailable. Second, because the action will occur in the future, there is a need to either project or infer effects based on what has occurred in the past. Third, effects may be part of a larger chain of causation that includes intermediate factors or the influence of other activities. For example, the EFP would affect certain stocks of fish through fishing mortality—catching and harvesting a certain number of fish that interact with the fishing gear. Longline fishing that has occurred in the past—and in this case other areas, since longline fishing is prohibited in the EEZ—can be used to make some inference about the likely amount of fish of a given species that will be caught by fishing under the EFP. Fishing mortality in this case is the metric, but there is some uncertainty about the precise number of fish that will be caught. Furthermore, by itself fishing mortality says little about the effect of the action; it is necessary to consider it in the context of the status of the stock and other sources of fishing mortality contributing to the removal of fish from the stock. For all these reasons, the impact assessment is presented in descriptive form.

CEQ regulations at 40 CFR§1508.25 identify three types of impacts that must be considered in an environmental impact statement (and by extension, an EA): direct, indirect, and cumulative effects. Direct and indirect effects are causally related to the proposed action: they are either directly related to the action (occurring at the same time and place) or are indirect in that there is some intermediate cause-and-effect between the proposed action and the actual effect being evaluated in the analysis (occurring at a distance in time and/or place). The regulations (40 CFR §1508.7) also define a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such actions." Although the regulations and guidance identify cumulative effects as a separate, third class of impacts, all effects can be viewed as cumulative to the extent they are part of some causal chain that results in an ultimate effect on an environmental component. Using this concept of cumulative effects, this EA frames the analysis in terms of an additive model. To arrive at the final, cumulative effect on an environmental component, the effects in a causal chain are traced out and measured qualitatively or quantitatively, in terms of the metrics that have been identified in this EA. The components in this additive model begin with (1) the baseline condition of the environmental component, to the degree it can be distinguished, and identifies (2) past and (3) other present actions and their effect on baseline conditions; (4) the effect of the proposed action (considered separately for each of the alternatives), (5) reasonably foreseeable future actions, and (6) any mitigation proposed separately from the alternatives are then added to the baseline to arrive at the cumulative effect. This is then compared to a threshold, if one exists in Federal, State, or local law (1508.27(b)(10)); or in land use plans, policies or controls for the area (1502.16(c)); or can be defined in terms of an inconsistency with such laws, policies or plans (1506.2(d)). If no such threshold can be identified, then the alternatives are evaluated comparatively to identify which one has the least effect, in terms of the metric concerned. (Although this is an additive model, it should be noted that component effects can be "subtractive" to the degree that they are in fact mitigative; conceptually this can be likened to adding a negative number.)

This additive model is applied within the framework of the EA by describing in chapter 3 actions other than those of the proposed action (alternatives) and their effects; this serves as the description of the "affected environment." The affected environment is thus a summary of current conditions, which results from the interaction between past and present actions and underlying natural phenomena, and is described in terms of the same metrics used in chapter 4. In addition, chapter 3 discusses those factors likely to alter the condition of evaluated environmental components in the future—reasonably foreseeable future actions—in terms of the metrics. This projects the affected environment, or environmental baseline, forward in time by considering the interaction of these foreseeable actions with the natural phenomena. This is also a description of the overall, or cumulative, impact of the no action alternative, which in chapter 4 can be used comparatively to describe how the alternatives would alter future baseline conditions (recognizing that the proposed action and alternatives are also future actions.) Chapter 4 evaluates the impacts of the alternatives. This includes a description of how these alternatives affect the evaluated environmental components, in terms of the metrics, and a summation of these effects in combination with a projected environmental baseline (or conditions under no action); this represents the cumulative impact assessment.

No mitigation measures are proposed separately from any mitigative effect of the alternatives. Therefore, the effect of mitigation measures is not considered further in this EA when evaluating impacts.

3.1.2 Data Sources

The primary data sources utilized in this EA include NMFS Fisheries Observer records, State and Federal HMS Fishing Logbook records, catch-and-effort estimates for HMS species tallied in the Recreational Fisheries Information Network (RecFIN), and commercial landings estimates tallied in the Pacific Fisheries Information Network (PacFIN). A brief description is provided below for each of these data sets.

3.1.2.1 Hawaii and California-based Shallow-set Longline Fisheries Observer Records

Catch-and-effort estimates utilized in this EA for target, non-target, and prohibited finfish species are based in part on NMFS Observer Program records compiled for the SSLL fishery that has operated since 1994 out of Hawaii (February 1994–December 2001, April 2004-April 2006) and for a limited time out of California (October 2001–February 2004). The objectives of the NMFS Observer Program are to record, among other things, information on protected species and bycatch interactions that are not typically nor accurately reported in the fishing logbooks. The area of fishing operations for the Hawaii-based boats occurred between 16.9° N. and 44.7° N. latitude and 127.3° W. to 179.7° E. longitude. The area of fishing operations for the California-based boats occurred between 28° N. and 43° N. latitude and 165° W. to 135° W. longitude.

Prior to April, 2004, the Hawaii- and California-based SSLL fisheries utilized traditional J-hooks and squid bait that were at the time the industry standard for targeting swordfish with longline gear. From April 2004 to the present, the SSLL fishery has been operating mainly out of Hawaii utilizing large circle hooks and mackerel or mackerel-type bait, which have proven to increase the post-release survivorship for selected bycatch species, including sea turtles and sharks. The post-2004 Hawaii SSLL circle-hook data set is utilized as a proxy in the analysis of the EFP alternatives in regards to finfish impacts given the similar gear and operational characteristics.

California/Oregon Swordfish/Thresher Shark Observer Records[6]

NMFS Southwest Region has operated an at-sea observer program in the DGN fishery since July 1990 to the present, while CDFG has operated a DGN observer program from 1980–1990. The objectives of the NMFS Observer Program are to record, among other things, information on protected species and bycatch interactions that are not typically nor accurately reported in the fishing logbooks. Information regarding DGN fishery interactions with non-target and prohibited species were drawn from Observer Program records for the years 1997–2005, with comparative breakouts for the time series 2001–04 (baseline), and 1997–2005 (reflective of current DGN gear modification regulations in effect). Observer coverage of the DGN fleet targets 20 percent of the annual sets made in the fishery, with close to 100 percent of the net retrieval monitored on observed trips for, among other things, species identification and enumeration. Since 1990, approximately 7,200 DGN sets have been monitored by at-sea observers generating a database containing more than 28,000 records.

Pacific Fisheries Information Network[7]

Total landings of longline harvested target species and commercially-valuable non-target species were obtained from the Pacific Fisheries Information Network database (PacFIN). The PacFIN central database includes fish-ticket and vessel registration data provided by the Oregon and California State fishery agencies. The data sources supply species-composition and catch-by-area proportions developed from port sampling and logbook data systems.

Recreational Fisheries Information Network[8]

Established in 1992, the Recreational Fishery Information Network (RecFIN) is designed to integrate State and Federal marine recreational fishery sampling efforts into a single database to provide important biological, social, and economic data for Pacific coast recreational fishery biologists, managers and anglers.

State and Federal HMS Daily Fishing Logbooks

State HMS logbooks were utilized for DGN, harpoon, and charter recreational fishing vessels. Federal HMS logbooks were utilized for surface hook-and-line (albacore troll and baitboat), purse seine and pelagic longline. The State HMS logbooks have been deemed acceptable by NMFS in meeting the reporting and record-keeping requirements codified in the HMS FMP implementing regulations. Therefore, separate (duplicate) Federal logbooks are not required. The NMFS Southwest Fishery Science Center staff in La Jolla, California, handles the data entry and database management for the HMS logbooks.

[6] http://swr.nmfs.noaa.gov/psd/codgftac.htm
[7] http://www.psmfc.org/pacfin/
[8] http://www.recfin.org/recfin.html

3.2 Climate and Biophysical Factors Contributing to Baseline Effects

3.2.1 West Coast Oceanography

The West Coast of North America from the Straight of Juan De Fuca to the tip of Baja California is part of an eastern boundary current complex known as the California Current System (Hickey 1988). The U.S. West Coast EEZ encompasses one of the major coastal upwelling areas of the world, where waters provide a nutrient-rich environment and high densities of forage for HMS species, especially from the Columbia River Plume south to the SCB. During summer months northerly winds set up Ekman transport of surface waters offshore causing colder, nutrient rich waters to upwell in nearshore areas, enhancing primary production as nutrients become available in the photic zone. The region is influenced by various currents and water masses, the shifting nature of which affects the occurrence and distribution of HMS at particular times of the year and from year to year. Large-scale currents within this region include the surface-flowing California Current and the Inshore Countercurrent (Davidson Current), and the subsurface California Undercurrent (figure 3–1). The region includes two major river plumes (Columbia River and San Francisco Bay), several smaller estuaries, numerous submarine canyons, and the complex borderland of the SCB with its offshore islands, undersea ridges and deep basins.

Physical oceanographic features of the environment change seasonally and also during periods of large-scale, oceanic regime shifts such as El Niño (see below). The California Current represents an extension of the North Pacific Gyre, which splits upon reaching the North American continental margin at approximately Vancouver Island, forming a northern limb, the Alaska Current, and a southern limb, the California Current. The California Current generally flows southward year round, with strongest flows in spring and summer. Inshore, these flows may be reversed by the seasonal appearance in fall and winter of the subsurface poleward-flowing Inshore Countercurrent. The California Undercurrent primarily intensifies in late spring and summer as a narrow ribbon of high-speed flow which presses northward at depth against the continental slope, generally beneath the equator-ward flowing upper layers (Lynn and Simpson 1987). Coastal upwelling of cold, salty and nutrient-rich water to the surface occurs primarily in spring and summer in California and into early fall off Oregon, driven by prevailing seasonal winds. Upwelling is often most intense near such promontories as Cape Mendocino and Point Conception. During El Niño events, flow in the California Current is anomalously weak, the California Undercurrent is anomalously strong, and the water in the upper 500 m of the water column is anomalously warm (Chelton and Davis 1982).

The SCB differs dramatically from the regions to the north and south. The shelves in this area are generally very narrow (<10 km) and the sea bed offshore is cut by a number of deep (>500m) basins (figure 3–2). The ocean is generally warmer and more protected here than areas to the north, especially inshore of a line roughly drawn from San Miguel Island to San Clemente Island. From Point Conception northward to off Cape Flattery, Washington, the coastline is relatively unprotected from the force of the sea and prevailing northwest winds. In contrast to the SCB, rugged waters and sea state conditions are common north of Point Conception.

3.2.2 Oceanic Fronts

The occurrence and behavior of pelagic species is strongly influenced by the thermal structure of the open ocean environment. Although swordfish, the principal target species in this EFP, occur widely in the Pacific, and tolerate a wide range of water temperature (5-27 degrees C), they concentrate at oceanic fronts. These fronts are areas of steeper temperature and salinity gradient. In the North Pacific two major frontal regions important to swordfish fisheries occur, the subarctic frontal zone (SAFZ) occurring between 40° N. and 43° N. latitude and the subtropical frontal zone (STFZ) occurring between 27° N. and 33° N. latitude. The STFZ occurs variously as a temperature front from late fall to summer and all year as a salinity front (Bigelow, *et al*. 1999). Within these zones, fronts develop, persist, and shift seasonally in complex patterns (Seki, *et al*. 2002). Seki, *et al*. (2002) identified two prominent semi-permanent fronts within the STFZ, the Subtropical Front (STF) located between 32° N. and 34° N. latitude and the South Subtropical Front (SSTF) located between 28° N. and 30° N. latitude. The STF is identifiable by the 17 degrees C sea surface temperature (SST) isotherm and 34.8 isohaline (line of equal salinity) while the SSTF can be identified by the 20 degrees C isotherm and 35.0 isohaline and 24.8 isopycnal (line of equal density) (Seki, *et al*. 2002). Fronts also affect vertical structure as the thermocline and stability layer shoals to the upper euphotic zone on the cold side of the STF. This structure has an important effect on primary production. Production may be further enhanced by meander-induced upwelling at the front. Enhanced primary production affects system productivity; forage species are concentrated along fronts and account for the concentration of large pelagic species along these fronts. Bigelow, *et al*. (1999) used a Generalized Additive Model (GAM) to examine the relation between fishery performance (swordfish and blue shark CPUE) in the Hawaii longline fishery and spatial, temporal, and oceanographic factors, including indicators of these fronts. Spatial distribution of effort in the Hawaii fishery shows a concentration in the STFZ north of Hawaii and to a lesser extent the SAFZ. Although basic spatio-temporal factors (latitude, time, longitude) were most important in explaining CPUE variance, front indicators (SST and SST frontal energy, a calculation of the change in SST by distance) were intermediate. GAM outputs showed swordfish CPUE was highest in 15 degrees C water and decreased at higher temperatures. Increasing SST frontal energy had a positive effect on swordfish CPUE. Formation of fronts will also be affected by major current systems and near the continental margin by bathymetry. Atlantic longline fisheries concentrate on a shelf-break front where CPUE is higher (Podestá, *et al*. 1993). On the West Coast, the California Current and coastal upwelling affect the formation of fronts.

Figures 3–2 to 3–5 are monthly composite SST plots for September-December 2004 from the NOAA CoastWatch high resolution (1.1 km/pixel) Advanced Very High Resolution Radiometer (AVHRR) data sets for the southern California region (Region L)[9]. The data were processed using the CoastWatch Data Analysis Tool to constrain color steps to 1 degree C increments between 10 and 20 degrees C. Figures 3–6 to 3–9 are low resolution (5 km/pixel) AVHRR plots for the West Coast region (Region Z)[10] processed in the same way. The intent is to give a general idea of seasonal temperature regimes that may occur during the prosecution of the EFP. The literature discussed above suggests that temperatures in the range of 15 to 18 degrees C would indicate areas of swordfish abundance. On the plots this temperature range is indicated by the green-yellow-orange shades. The West Coast plots also show the 200 m and 2,000 m isobaths, which indicate the shelf break and slope. This may be another area of frontal activity.

Etnoyer, *et al*. (2004) identify areas of persistent pelagic habitat by analyzing AVHRR and Miami Multi-channel Sea Surface Temperature (MCSST) data with edge detection algorithms to identify temperature gradients indicative of fronts. Using time series data they also estimated the persistence of such fronts. They identified an area they call the Baja California Frontal System, located off the West Coast of Mexico, as exhibiting the highest concentration of persistent fronts. Other important areas include the North Pacific Transition Zone (the area between the SAFZ and STFZ) north and west of Hawaii, and the Channel Islands pelagic region off of southern California.

Frontal zones are also important to protected species that may be vulnerable to the longline EFP. Polovina, *et al*. (2000) compared the tracks of nine loggerhead turtles equipped with satellite transmitters and satellite derived information on SST (MCSST), chlorophyll (Sea-viewing Wide Field-of-view sensor, SeaWiFS), and geostrophic currents computed from satellite altimetry data (TOPEX/Poseidon). The turtles were initially taken in the Hawaii longline fishery in the STF north of Hawaii. Two groups of turtles could be discriminated, one associated with the 17 degrees C isotherm and the second with the 20

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[9] http://coastwatch.pfel.noaa.gov/sst_comp_high.html
[10] http://coastwatch.pfel.noaa.gov/sst_comp_low.html

degrees C isotherm. These are the STF and SSTF identified by Seki, *et al*. (2002) and discussed above. Etnoyer, *et al*. (2004) link areas of high frontal activity (Baja California Frontal System, Channel Islands) to large pelagics, such as blue whales. They cite satellite telemetry data from four blue whales to show individual whale movements overlapped frontal features or the whales maintained positions between frontal features in the Baja California Frontal System.

Although the large open ocean frontal zones discussed above do not extend to the West Coast, localized frontal systems are set up within the California Current System in response to coastal upwelling and interaction with coastal geometry (Castelao, *et al*. 2006). Fronts develop close to the coast in the spring, particularly south of Cape Blanco, and increase over the summer, extending farther offshore. Etnoyer, *et al*. (2004) show areas where persistent fronts occur along much of the West Coast. Limited data indicate concentrations of leatherback sea turtles associated with the freshwater plume generated by the Columbia River (discussed in section 3.4). The Columbia River plume has regional effects by causing intense mixing that contributes nutrients to surface layers and consequent primary production (Orton and Jay 2005). Leatherback sea turtles may be attracted to the region as prey species are either attracted to or entrained in the plume front.

3.2.3 Climate Variability

Two meso-scale climate phenomena likely affect frontal activity and the distribution of swordfish, other target and non-target finfish, and protected species that may be caught in the longline EFP. The first is El Niño-Southern Oscillation (ENSO), which is characterized by a relaxation of the Indonesian Low and subsequent weakening or reversal of westerly trade winds, causing warm surface waters in the Western Pacific to shift eastward. Although the effects can be global, especially during an intense event, off the West Coast an El Niño event brings warm waters and a weakening of coastal upwelling. Tropical species, such as tuna and billfish are found farther north; for example striped marlin were recorded off the Oregon coast during the strong 1997-99 El Niño event (Field and Ralston 2005). A related condition is termed La Niña and results in inverse conditions (i.e., intensified Indonesian Low, strengthened westerly trade winds, pooling of warm water in the Western Pacific, and relatively cooler water in the Eastern Tropical Pacific and California Current System). Etnoyer, *et al*. (2004) found the Eastern North Pacific was less active in terms of front concentration and persistence during El Niño and relatively more active during La Niña. The current prediction (September 24, 2007) from the National Weather Service Climate Prediction Center[11] indicates mild La Niña conditions are expected to develop over the next few months and continue into early 2008.

Longer period cycles, which are partially identified by an index termed the Pacific Decadal Oscillation (PDO), also have important ecological effects in the California Current System (CCS). Regime shifts indicated by the PDO have a periodicity operating at both a 15-25 and 50–70 year intervals (Schwing 2005). The PDO indicates shifts between warm and cool phases. The warm phase is characterized by warmer temperatures in the Northeast Pacific (including the West Coast) and cooler-than-average sea surface temperatures and lower-than-average sea level air pressure in the Central North Pacific; opposite conditions prevail during cool phases. Rapid phase shifts occurred in 1925, 1947, 1977, and 1989. A regime change has been detected as occurring in 1998. The 1977 shift, from a cool to warm phase in the CCS, produced less productive ocean conditions off the West Coast and more favorable conditions around Alaska. Hare, *et al*. (1999) documented the inverse relationship between salmon production in Alaska and the Pacific Northwest and related this to PDO-influenced ocean conditions. Researchers have identified similar relationships between meso-scale climate regimes and the productivity of other fish populations (see Francis, *et al*. 1998 for a review). However, both the 1989 and 1998 shifts have different characteristics from previous shifts. The 1989 shift did not bring cooler water and enhanced upwelling to

[11] http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.html

the West Coast. This has apparently resulted in a further decline in the productivity of some fish populations in the Eastern North Pacific (McFarlane, *et al*. 2000). The 1998 shift resulted in dramatic cooling of West Coast waters, but the characteristics of this phase are obscured by the short time series since onset, and the development of El Niños in 1998-99 and 2002-03. The cooling trend was interrupted or may have ended in 2003 (Schwing 2005).

Because the effects are similar, "in-phase" ENSO events (e.g., an El Niño during a PDO warm phase) can result in intensified conditions. However, aside from these phase effects, regime conditions identified by the PDO index, although of much longer duration than ENSO events, are milder. It is also important to note that—while the fundamental causes of PDO are not fully understood—they are known to be different from those driving ENSO events. And while ENSO has its primary effect on the tropical Pacific, with secondary effects in colder regions, the opposite is true of PDO; its primary effects occur in the Eastern North Pacific.

The ecosystem effects of PDO conditions are pervasive. Climate conditions directly affect primary production (phytoplankton abundance), but ecosystem linkages ensure these changes influence the abundance of higher trophic level organisms, including fish populations targeted by fishers (Francis, *et al*. 1998; MacCall 2005).

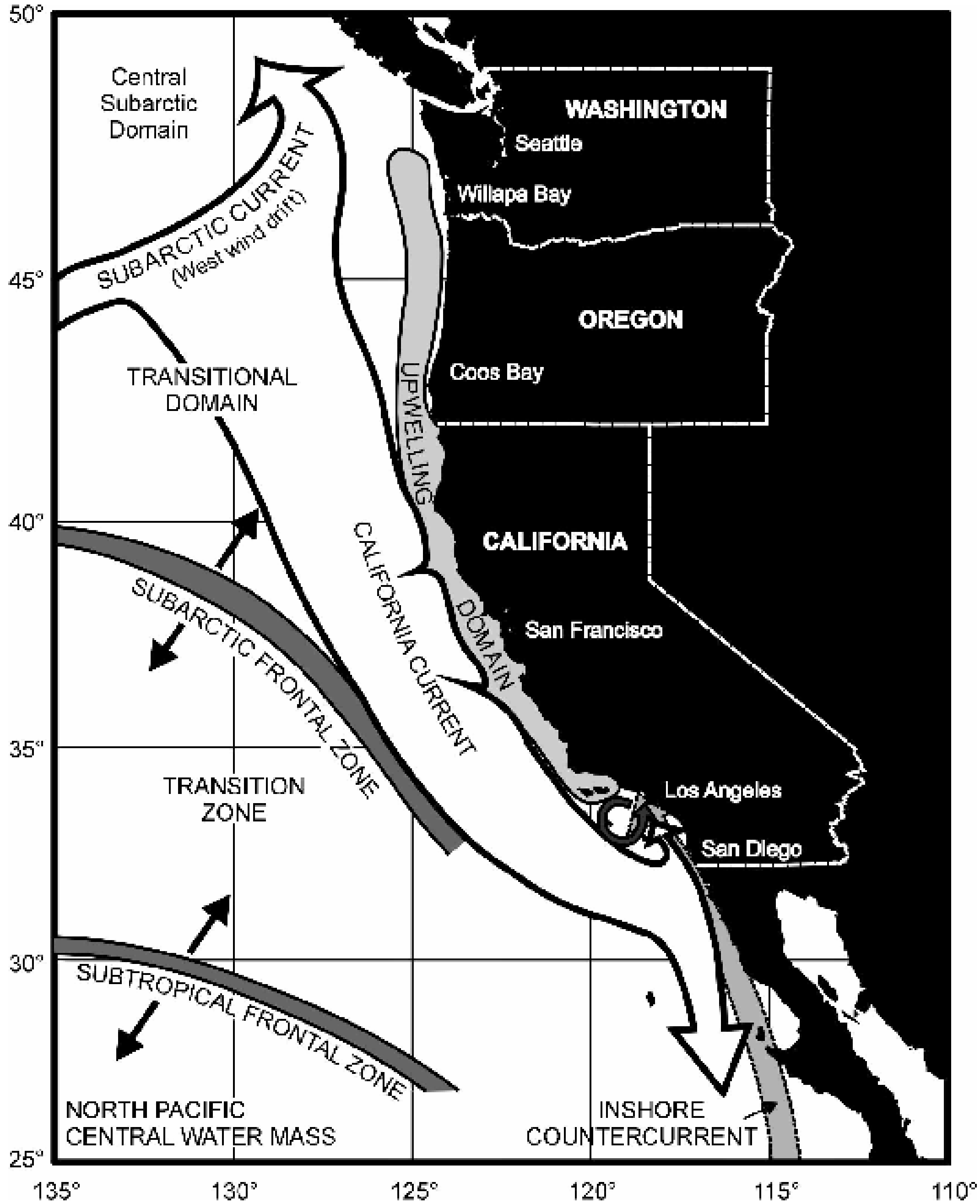

Figure 3–1. Major current and water mass systems that influence essential fish habitat of highly migratory management unit species in the U.S. West Coast EEZ.

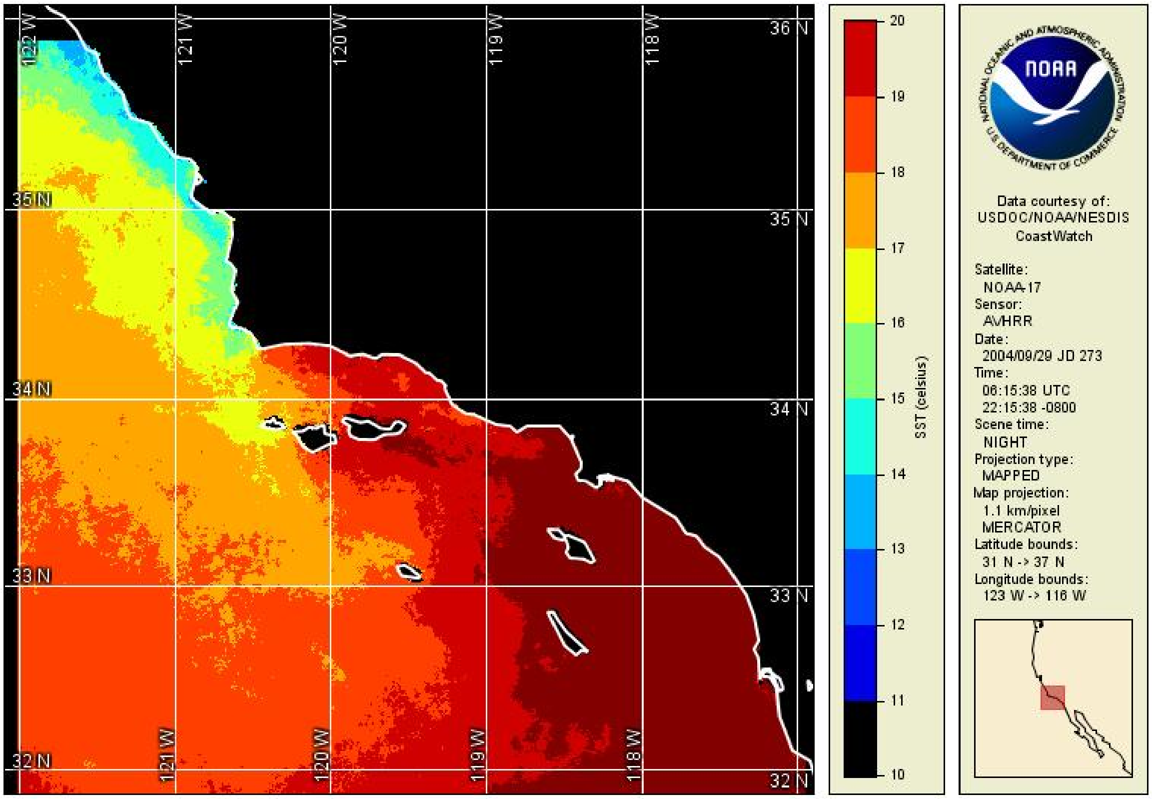

Figure 3–2. Monthly SST composite, southern California region, September 2004.

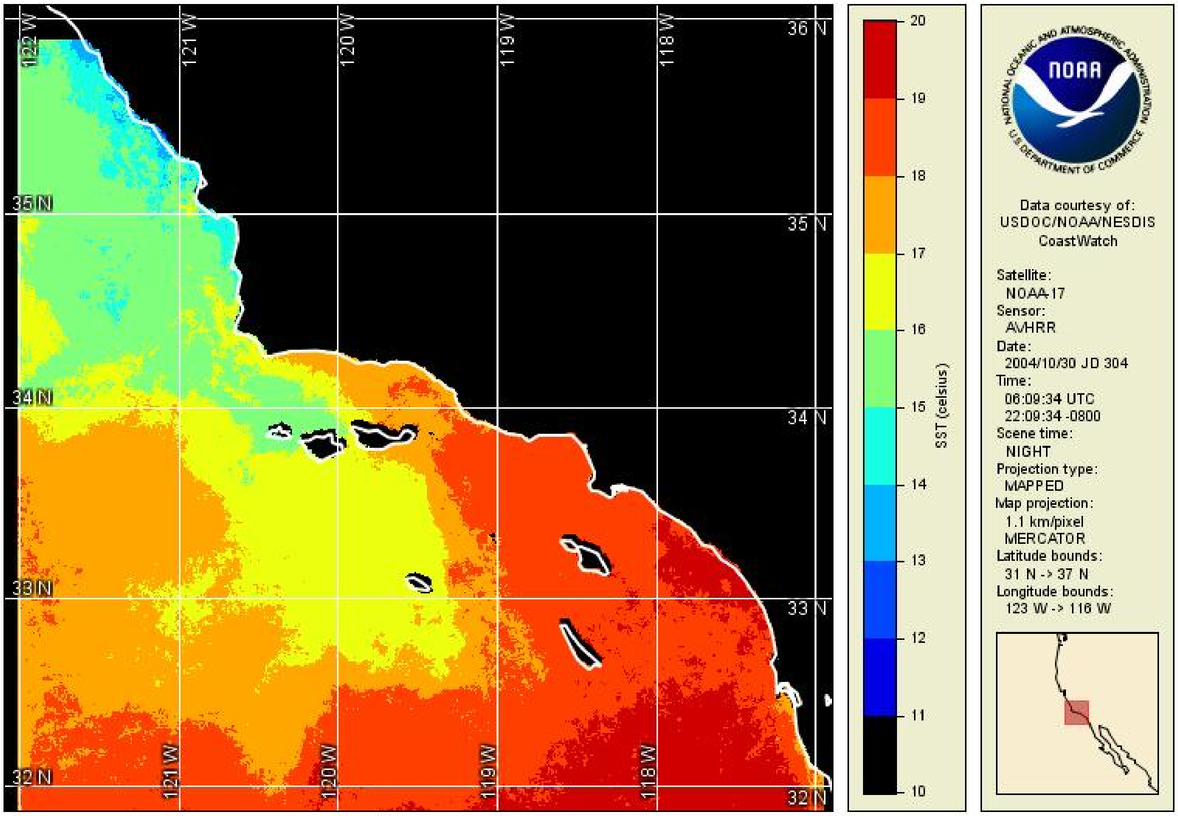

Figure 3–3. Monthly SST composite, southern California region October 2004.

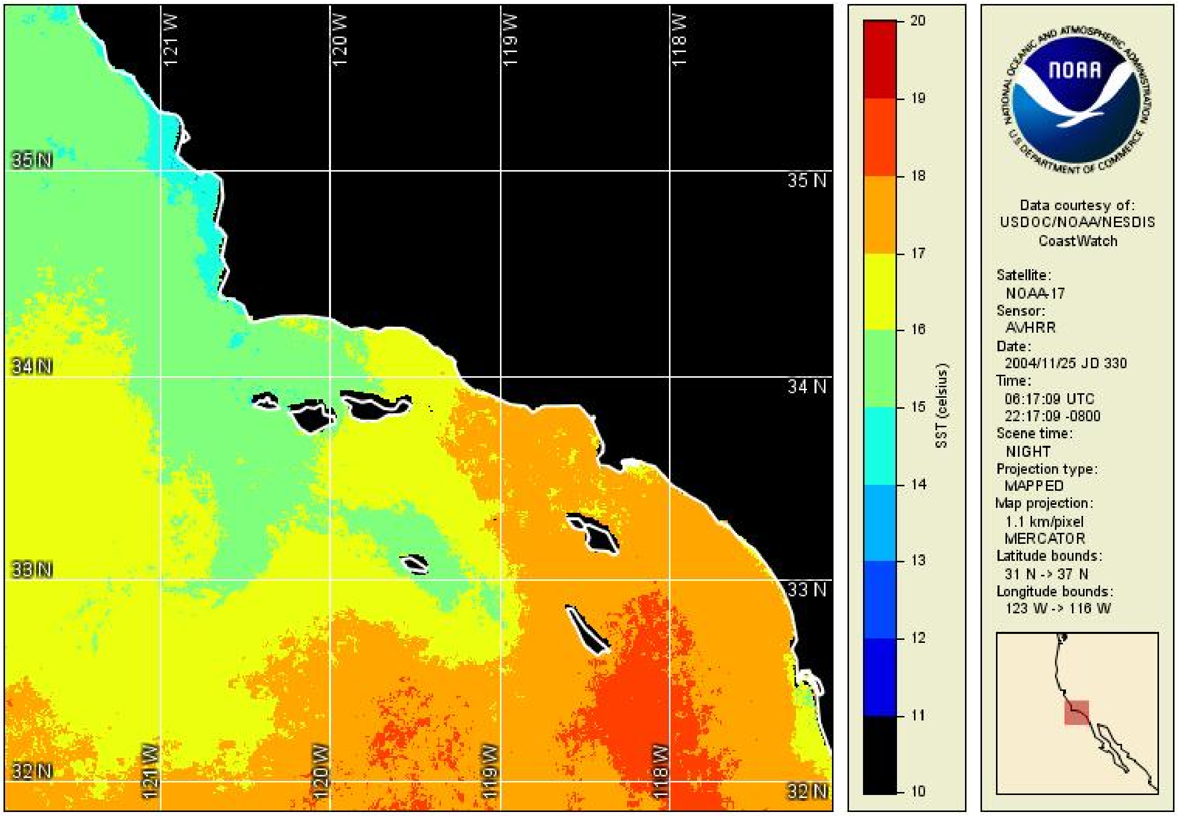

Figure 3–4. Monthly SST composite, southern California region November 2004.

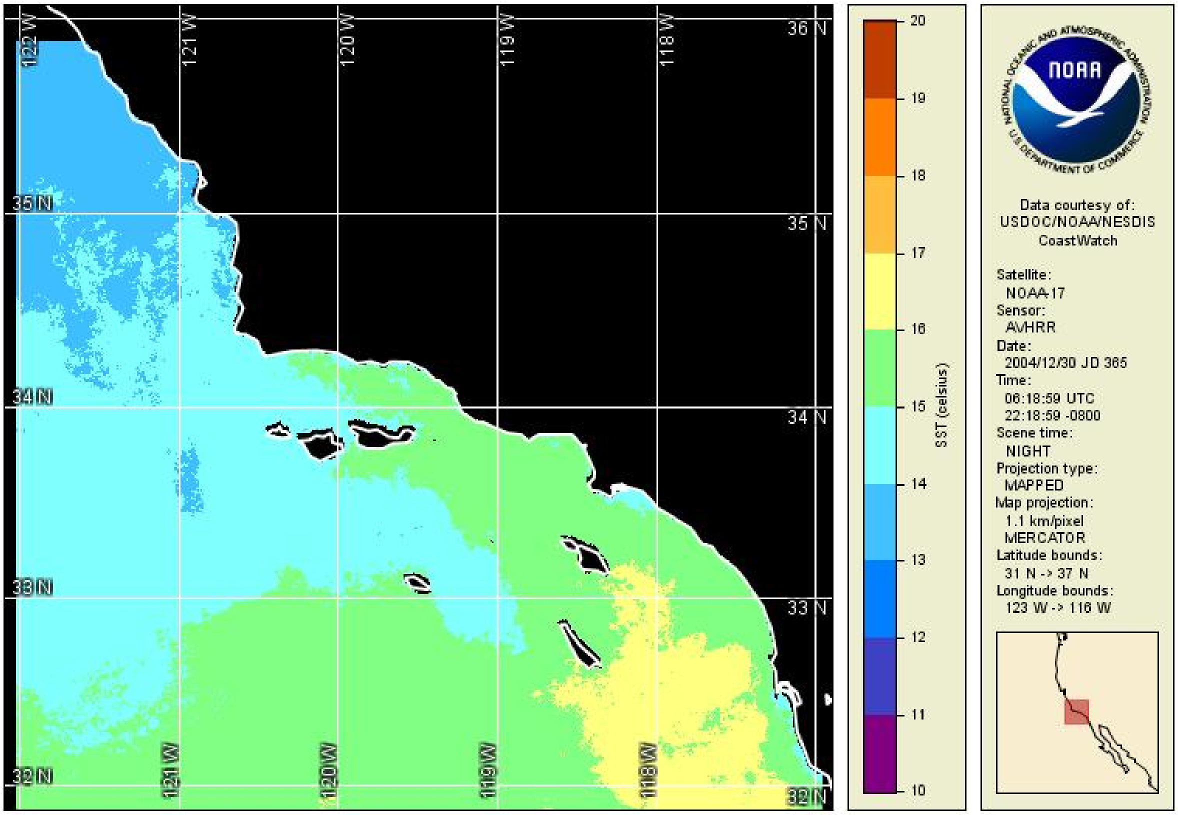

Figure 3–5. Monthly SST composite, southern California region December 2004.

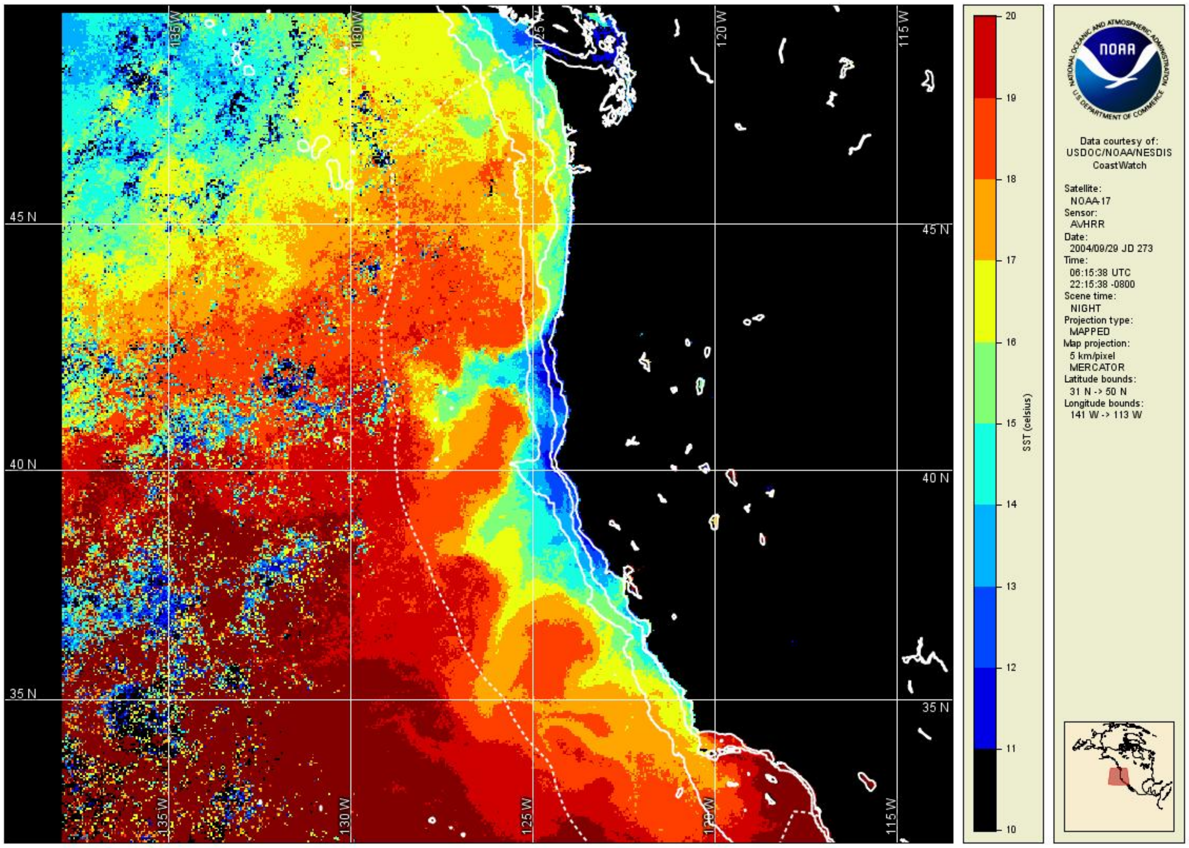

Figure 3–6. Monthly SST composite, West Coast region September 2004.

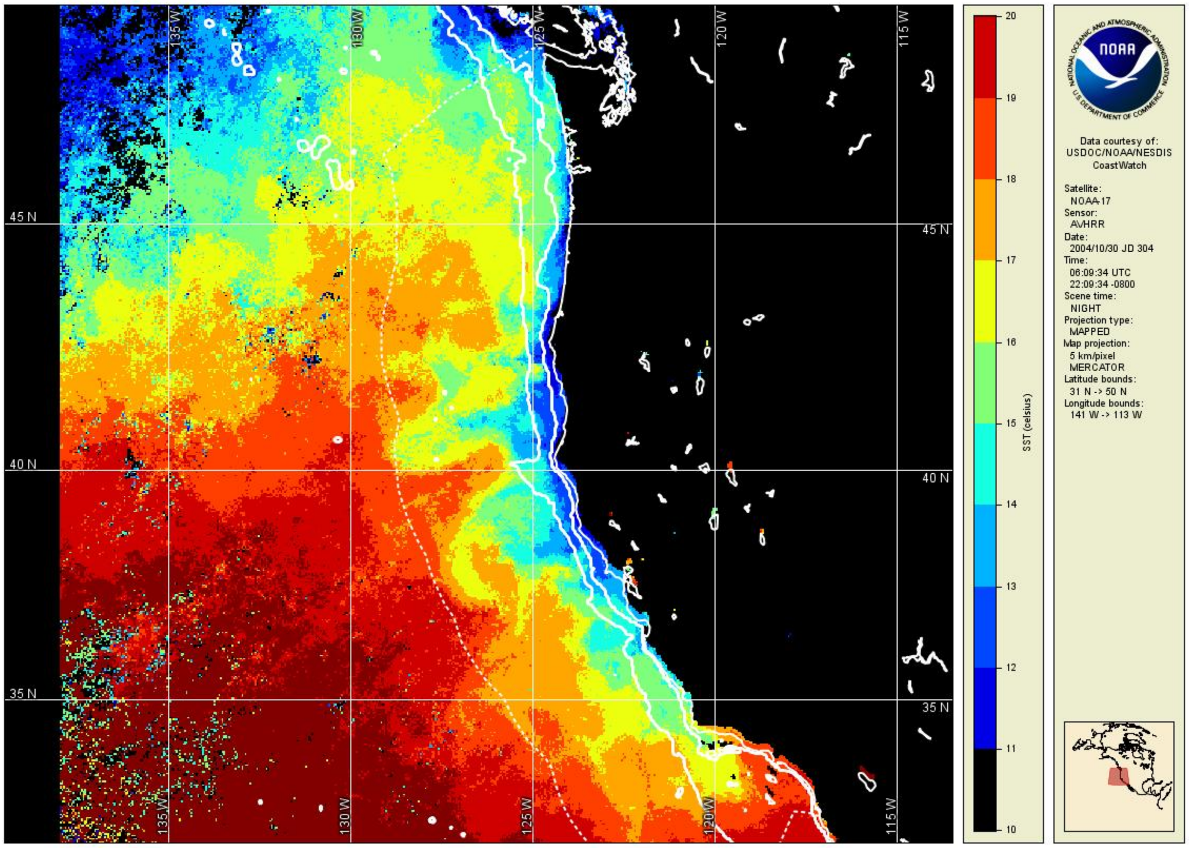

Figure 3–7. Monthly SST composite, West Coast region October 2004.

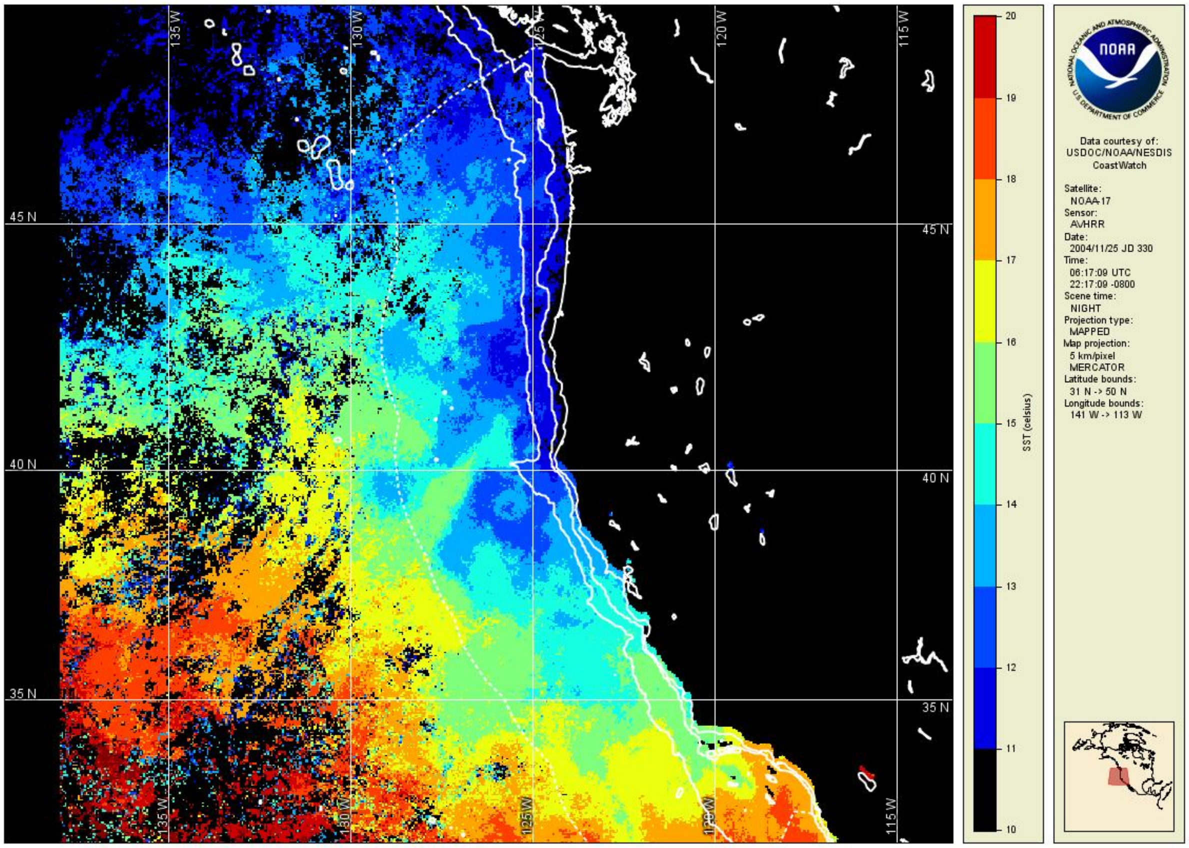

Figure 3–8. Monthly SST composite, West Coast region November 2004.

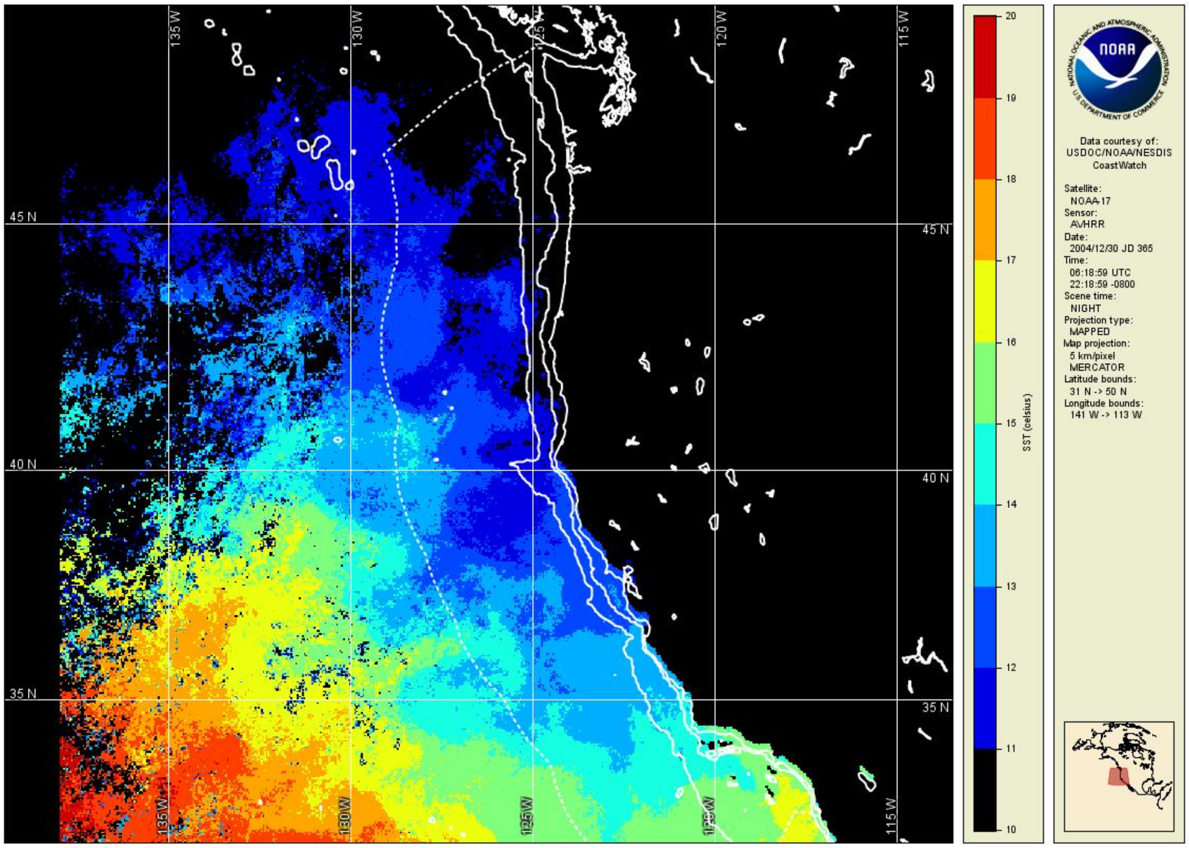

Figure 3–9. Monthly SST composite, West Coast region December 2004.

3.3 Finfish

This section describes the baseline conditions of the finfish species likely to be caught in the longline EFP that is the subject of this EA. The baseline conditions include the range of fisheries contributing mortality of the stocks, review fishery catches on a stock basis, and summarize what is currently known about stock status.

3.3.1 Baseline Description of Past, Present, or Future Fisheries in the Proposed Action Area

The target species for the proposed action, the broadbill swordfish, as well as several of the major non-target finfish species such as blue and shortfin mako sharks, are included as HMS management unit species (table 3–1) under the HMS FMP (PFMC 2003, Ch. 3 Pg.4). The HMS FMP further designates a complex of fish species as "prohibited species", meaning that they cannot be retained, or can be retained only under specified conditions, by persons fishing for management unit species (PFMC 2003, Ch.3-Pg.6). These FMP categories are used to organize the discussion of the current condition of finfish stocks that may be affected by the longline EFP.

The review of fisheries below has two purposes. First, the review provides a summary of actions contributing to cumulative effects of the proposed action. Second, because pelagic longline fishing has never been permitted within the EEZ waters adjacent to California, there are no longline fishery dependent records to draw upon to estimate the effects of the proposed action. For that reason, catch rates in similar fisheries in adjacent areas such as the Hawaii-based shallow-set swordfish longline fishery or, in the case of the California/Oregon Swordfish/Thresher Shark DGN fishery, a different gear type targeting swordfish within the action area, are reviewed to help inform the analysis of the effects of the alternatives in chapter 4. The HMS FMP provides a detailed description of the baseline environment for all HMS fisheries and the reader is referred to that document for further insight (PFMC 2003).

There are numerous foreign fisheries that operate throughout the Pacific Ocean using, among other gears, pelagic longline, pole-and-line, purse seine, gillnet, and troll gears. By comparison, U.S. West Coast-based fisheries generally harvest a small fraction of the total Pan-Pacific harvest of HMS. The U.S. North Pacific albacore troll fleet is one of two significant U.S. fisheries in this regard landing an estimated annual average of 13 percent of the total harvest of North Pacific albacore for the period 2001-2005 with Japanese fleets landing an estimated annual average of 66 percent (Childers and Aalbers 2006).

The combined U.S. swordfish fishery is the other fishery of significance landing approximately 13 percent of the North Pacific-wide swordfish landings based on the latest tables produced by the ISC (ISC 2007). The DGN fishery lands roughly 13 percent of the U.S. swordfish catch based on Pacific Fishery Information Network (PacFIN) records for the same time period (PFMC 2006).

Major Pacific fishing areas for swordfish include the waters off Japan, the North Pacific Transition Zone north of Hawaii, the West Coast of the United States, Mexico, Ecuador, Peru, Chile, and off Australia and New Zealand. Much of the Pacific catch is taken incidentally in longline fisheries targeting tunas. Japan, Taiwan, and the United States account for about 70 percent of current reported production, with Mexico, Ecuador, and Chile providing the remainder. In the Eastern Pacific, swordfish are primarily harvested using longlines, drift nets, and hand-held harpoons (PFMC 2006).

The HMS FMP requires that all commercial and recreational charter fishing vessel operators maintain and submit to NMFS logbook records of catch and effort statistics, including bycatch. These measures, together with existing data collection and reporting requirements (e.g., observer records), are intended to provide a comprehensive standardized bycatch reporting system. However, HMS logbook bycatch records suffer from under-reporting and non-reporting biases, a common shortcoming in regards to accuracy of bycatch estimates from most fishery logbook programs. When available, estimates of bycatch reported in HMS logbooks are presented, but the limitations of the data should be kept in mind.

Commercial pelagic longline fishing has never been permitted within the California EEZ and as such there are no longline fishery dependent records to draw upon for describing the potential baseline condition within the proposed action area (U.S. West Coast EEZ off California and Oregon).[12] The State of Oregon approved and offered permits for a pelagic longline fishery beginning in 1995, and up until the time of the HMS FMP implemented longline prohibition in 2004, no participants have applied for the permit (Schmitt 2007). There is, however, an existing U.S. domestic pelagic SSLL fishery based in Hawaii that will allow some comparisons to be drawn for the proposed action. The suite of potential species and magnitude of interactions will differ to some degree, given the more temperate and coastal areas that will be targeted under the proposed action.

Description of past and present longline fisheries taking place outside the U.S. West Coast EEZ are presented followed by a description of pertinent non-longline fisheries that interact and harvest HMS species. Given the lack of longline fishing history inside the EEZ, the U.S. domestic DGN fishery operating primarily off the coast of California provides the closest approximation to the spatial and temporal scope for the proposed EFP action area. Observer records from the DGN fishery provide some indication of the potential suite of target, non-target, and prohibited finfish species that may interact with the SSLL longline gear. Given the similarity in gear and techniques, the California- and Hawaii-based SSLL fishery provides the best, albeit tenuous approximation given the disparate fishing areas, of the potential CPUE for the target, non-target, and prohibited finfish species that may be taken under the proposed action. Observer records from the California-Hawaii SSLL fishery are used to compute CPUE estimates as a proxy for the expected take under the proposed action.

Table 3–1 HMS FMP management unit species.

Common Name	Scientific Name
Striped marlin	*Tetrapturus audax*
Swordfish	*Xiphias gladius*
Common thresher shark	*Alopias vulpinus*
Pelagic thresher shark	*A. pelagicus*
Bigeye thresher shark	*A. superciliosus*
Shortfin mako shark	*Isurus oxyrinchus*
Blue shark	*Prionace glauca*
North Pacific albacore	*Thunnus alalunga*
Yellowfin tuna	*T. albacares*
Bigeye tuna	*T. obesus*
Skipjack tuna	*Katsuwonus pelamis*
Northern bluefin tuna	*T. orientalis*
Dorado	*Coryphaena hippurus*

[12] A limited experimental shark longline fishery was conducted within the EEZ off the coast of California during the period 1988-1991 (see section 3.3.1.1, p.26). The experiment did not lead to commercial-scale fishing and was abandoned.

3.3.1.1 Longline Fisheries

Southern California Experimental Drift Longline Fishery for Sharks, 1988–1991

A small-scale experimental drift longline fishery for sharks, ranging from 6–10 vessels per year, was conducted in 1988–1991 within the EEZ off the coast of California. The target species for this fishery were shortfin mako and blue sharks with gear consisting of heavy gauge steel leaders and short steel cable mainlines (~5 miles in length), to maximize retention. Target fishing depth was estimated to be 10–20 m with daytime soak times averaging about five hours. The catch records from this experimental fishery indicate a low rate of interaction with non-target species, which would be somewhat expected given the heavy gear and probable avoidance by visually perceptive pelagic predators such as marlins and tunas. Due to concerns with the incidental take of striped marlin, approximately 19 percent of all fishing operations were monitored by California Department of Fish and Game (CDFG) observers (O'Brien and Sunada 1994) and no striped marlin were observed taken. Landings data based on CDFG landing receipts for the target sharks are presented in table 3–2.

Table 3–2 Shortfin mako shark and blue shark landings (pounds) for the experimental drift longline fishery for sharks, 1988–1991.

	1988 (10 vessels with 609,026 hook effort)	1989 (10 vessels with 377,382 hook effort)	1990 (6 vessels with 461,524 hook effort)	1991 (8 vessels with 157,720 hook effort)
Shortfin mako shark	269,604	177,928	174,215	110,513
Blue shark	2,462	10,818	42,818	0
Total	**272,066**	**188,746**	**217,033**	**110,513**

The observed catch was similar among years with blue sharks comprising 62 percent of the total catch, shortfin mako sharks 29 percent, and pelagic stingrays nearly 9 percent. Observers noted that 52 percent and 88 percent of the blue sharks released in 1988 and 1989 were in good condition and likely to survive. The marked survival increase was attributed to the use of long-handled hook removal pliers beginning in 1989. Five sea lions were caught and released alive (no condition status noted).

Table 3–3. Number and percentage of total catch for species captured during the experimental drift longline fishery for sharks, 1988 and 1989.

Species	**1988**		**1989**	
	No.	**%**	**No.**	**%**
Blue shark	1,900	62.1	1,320	62.0
Shortfin mako shark	883	28.9	610	28.7
Pelagic stingray	265	8.7	194	9.1
Ocean sunfish	1	---	2	0.1
California sea lion	3	0.1	2	0.1
Hammerhead shark	2	0.1	0	0
Finescale triggerfish	1	---	0	0
Giant Sea bass	1	---	0	0
Pacific mackerel	2	0.1	0	0

California-based Deep-set Tuna Longline Fishery, 2005–Present

A single West Coast-based pelagic longline vessel has been operating out of southern California ports for the past several years. This vessel primarily targets tuna using deep-set longline (DSLL) gear with a percentage of swordfish and other HMS taken incidentally. At the present time, any longline fishing by West Coast-based vessels must take place on the high seas outside of the U.S. EEZ. A significant increase in participation for this fishery is not expected. Even if participation were to increase, the maximum number of vessels fishing would be small given, among other things, the high operational costs for fishing outside the EEZ coupled with potential protected species interactions and the need for a high rate of observer coverage. NMFS SWR observer records, based on six observed trips and 73 sets of effort, demonstrate that tuna catches made up 94 percent by number of the total catch with swordfish comprising 0.2 percent and thresher shark 0.3 percent.

California- and Hawaii-based Shallow-set Longline Swordfish Fishery, 1994–Present

The target species of the Hawaii-based SSLL fishery are the broadbill swordfish and tunas (*Thunnus spp*.). A host of other marine species with market value are captured incidentally in this fishery. The NMFS Pacific Islands Fisheries Science Center (PIFSC) provides logbook summaries for all longline vessels, including shallow-set and deep-set vessels landing products in Hawaii.[13] For the time period of January 2005 through December 2005, a total of 124 longline vessels landed HMS, based on logbook records submitted to the PIFSC. These vessels completed 1,549 trips with 18,191 recorded sets. A total of 24,350 swordfish were harvested of which 21,665 were kept. The thresher shark catch, which is predominantly made up of bigeye thresher, totaled 3,611 sharks of which only 382 were recorded as kept.

Observer catch estimates for target, non-target, and prohibited finfish species are presented below and are based in part on observer records compiled for the SSLL fishery that has operated since 1994 out of Hawaii (February 1994–December 2001, April 2004–April 2006) and for a limited time out of California (October 2001–February 2004). The area of fishing operations for the Hawaii-based boats occurred between 16.9° N. and 44.7° N. latitude and 127.3° W. to 179.7° E. longitude. The area of fishing operations for the California-based boats occurred between 28° N. and 43° N. latitude and 165° W. to 135° W. longitude.

[13] Data source: http://www.pifsc.noaa.gov/fmsd/reports/hlreports/2005.pdf

Table 3–4. Total observed catch (numbers) and catch-per-unit-effort (numbers/ 1,000 hooks of effort) for California- and Hawaii-based shallow-set longline fishery (NMFS SWR Observer Program unpublished data; NMFS PIRO Observer Program unpublished data).

	Total Observed Catch for CA-based SSLL	CPUE (No. per 1,000 hooks)	Total Observed Catch for HI-based SSLL	CPUE (No. per 1,000 hooks)
Swordfish	7,512	21.530	56,995	16.651
Albacore tuna	460	1.318	11,108	3.245
Bigeye tuna	223	0.639	6,085	1.778
Yellowfin tuna	18	0.052	1,575	0.460
Pacific Bluefin tuna	11	0.032	60	0.018
Skipjack tuna	10	0.029	249	0.073
Unid. tunas and mackerels	5	0.014	107	0.031
Blue shark	5,575	15.978	53,947	15.761
Shortfin mako shark	249	0.714	2,313	0.676
Unid mako sharks	33	0.095	123	0.036
Bigeye thresher shark	8	0.023	116	0.034
Pelagic thresher shark	0	0.000	6	0.002
Unid thresher sharks	0	0.000	23	0.007
Oceanic White-tip shark	0	0.000	559	0.163
Unid sharks	998	2.860	471	0.138
Striped marlin	12	0.034	2,747	0.803
Blue Marlin	4	0.011	633	0.185
Black Marlin	1	0.003	7	0.002
Shortbill spearfish	0	0.000	435	0.127
Unid billfishes	12	0.034	66	0.019
Pelagic stingray	125	0.358	2,259	0.660
Remora	21	0.060	4,397	1.285
Longnose Lancetfish	235	0.674	4,509	1.317
Snake mackerel	29	0.083	1,632	0.477
Escolar	194	0.556	4,472	1.307
Dorado	65	0.186	18,793	5.490
Oilfish	86	0.246	935	0.273
Wahoo	7	0.020	412	0.120
Sickle Pomfret	0	0.000	365	0.107
Pacific Pomfret	30	0.086	58	0.017
Common Mola	51	0.146	157	0.046
Opah	36	0.103	232	0.068
Unid. fish	34	0.097	288	0.084

For the period February 1994 to January 2004, the SSLL fishery utilized pelagic longline gear consisting of, among other things, size 9/0 J-hooks with a mixture of squid, mackerel, and other bait types. For the period January 2004 to the present, new regulatory measures were put in place as bycatch mitigation measures (69 FR 17329) and the SSLL fishery utilized gear consisting of, among other things, large 18/0 circle hooks and mackerel-type bait. These gear differences should be kept in mind when considering the interaction and catch rate estimates presented for the species that may be taken in the proposed action.

Table 3–5. Total observed catch and CPUE for SSLL vessels using circle hooks and mackerel bait (after February, 2004) and those vessels using non-circle hooks and mixed baits (prior to February, 2004) (NMFS SWR Observer Program unpublished data; NMFS PIRO Observer Program unpublished data).

	Total Observed Catch for circle hook SSLL trips	Circle hook CPUE (No. per 1,000 hooks)	Total Observed Catch for non-circle hook SSLL trips	Non-circle hook CPUE (No. per 1,000 hooks)
Swordfish	36,595	17.156	20,167	15.637
Albacore	2,255	1.057	8,651	6.708
Bigeye tuna	3,342	1.567	2,741	2.125
Yellowfin tuna	348	0.163	1,227	0.951
Pacific Bluefin tuna	1	0.000	59	0.046
Skipjack tuna	140	0.066	107	0.083
Tunas and mackerels	32	0.015	75	0.058
Blue shark	26,965	12.641	26,532	20.572
Shortfin mako shark	1,867	0.875	399	0.309
Unid mako shark	115	0.054	7	0.005
Unid shark		0.000	705	0.547
Bigeye thresher shark	52	0.024	64	0.050
Pelagic thresher shark	3	0.001	3	0.002
Unid thresher shark	12	0.006	10	0.008
Oceanic whitetip shark	352	0.165	207	0.160
Striped marlin	1,810	0.849	936	0.726
Blue marlin	389	0.182	244	0.189
Black marlin	1	0.000	8	0.006
Shortbill spearfish	245	0.115	190	0.147
Unid billfishes	38	0.018	28	0.022
Pelagic stingray	202	0.095	2,035	1.578
Remora	920	0.431	3,474	2.694
Longnose lancetfish	2,702	1.267	1,786	1.385
Snake mackerel	685	0.321	946	0.733
Unid. fish	49	0.023	3	0.002
Escolar	3,539	1.659	913	0.708
Dorado	7,467	3.501	11,319	8.776
Oilfish	488	0.229	443	0.343
Wahoo	159	0.075	253	0.196
Sickle pomfret	285	0.134	76	0.059
Pacific pomfret	0	0.000	58	0.045
Common Mola	21	0.010	134	0.104
Opah	176	0.083	51	0.040

Distant Water Foreign Longline Fisheries

Currently, Japan, Korea, Taiwan, and to a lesser extent China, operate large, specialized, industrial longline fisheries for catching tunas and billfish, including swordfish throughout the Pacific Ocean. The HMS FMP/FEIS (PFMC 2003) provides an in-depth description of the areas fished and gear specifications for these fisheries. Catch and effort data for these fisheries, including logbook and some limited observer data, is maintained by the Regional Fisheries Management Organizations (RFMO) operating in the Pacific Ocean, the IATTC[14] and the Western and Central Pacific Fisheries Commission[15]. The majority of the catch and effort from these fisheries is significantly displaced from the proposed action area for the EFP and for the most part quantifiable bycatch information is not available for review.

3.3.1.2 Non-longline Fisheries

California/Oregon Swordfish/Thresher Shark DGN Fishery

Detailed descriptions of the DGN fishery can be found in the HMS FMP (PFMC 2003, Ch. 2 Pg. 13–Ch. 2 Pg.17), in the Environmental Assessment for the Implementation of the Reasonable and Prudent Alternative on the Issuance of the Marine Mammal Permit under Section 101(a)(5)(e) of the MMPA for the California/Oregon DGN, and in the Biological Opinion on the Authorization to Take Listed Marine Mammals Incidental to Commercial Fishing Operations.[16]

Currently, the DGN fishery is one of six West Coast HMS fisheries managed by the Pacific Council through the HMS FMP, with many of the existing State regulations and laws pertaining to the fishery adopted into the FMP. In 2005, 42 DGN vessels landed 182 mt of swordfish and 155 mt of common thresher shark (table 3.6). Historically, the California DGN fleet has operated within EEZ waters adjacent to the State to about 150 nmi offshore, ranging from the United States–Mexico border in the south to as far north as the Columbia River during El Niño years.

Since 2001, an annual August 15–November 15 time/area closure (Drift Gillnet Pacific Leatherback Conservation Area) has been applied to the DGN fishery. This seasonal closure extends from the waters off of Monterey, California, to the mid-Oregon coast and westward beyond the Exclusive Economic Zone (EEZ) to 129° W. longitude (figure 3–10). NMFS established the Drift Gillnet Pacific Leatherback Conservation Area because of the projected incidental take of leatherback sea turtles (*Dermochelys coriacea*), listed as endangered under the ESA. As a result of the closure, the majority of the current DGN fishing effort is concentrated in the Southern California Bight (figure 2–1).

There are three general fishing areas, which are segregated by latitude and occupy areas of similar bottom depths, targeted by the DGN fishery along the California coast. The southern area is centered off San Diego and is characterized by relatively shallow water in depths of less than 1,000 fathoms. This area is within the SCB and fairly close to the coast. The central area off of San Francisco is in deep waters in depths of 1,500–2,000 fathoms, with the northern area off the California/Oregon border in moderate depths of 1,600 fathoms. Fishing activity is highly dependent on seasonal oceanographic conditions that create temperature fronts that concentrate feed for swordfish. Because of the seasonal migratory pattern of swordfish and seasonal fishing restrictions, about 90 percent of the fishing effort occurs August 15 to December 31.

[14] www.iattc.org
[15] www.wcpfc.int
[16] http://swr.nmfs.noaa.gov/psd/codgftac.htm

Figure 3–10. The Drift Gillnet Pacific Leatherback Conservation Area closed to DGN vessels, August 15 to November 15.

The DGN fishery typically begins in late May and continues through the end of January, although 90 percent of the fishing effort typically occurs from mid-August to the end of December. Effort in the fishery is initially concentrated in the southern portion of the fishing grounds, expanding to its full range by October before retreating back to the south because of the dissipation of oceanographic water temperature breaks caused by storm systems moving down from the north. However, the majority of fishing effort is concentrated south of Point Conception due to the leatherback time/area closure. Some limited effort does take place to the south and west of the closure, in international waters off of Mexico and the U.S. EEZs, and north of the closure (figure 3–10).

The highest catch of target swordfish occurs 15–150 km off the California coast. Fishing effort within 15 km of the coast or near the Channel Islands usually targets pelagic sharks. In higher latitudes, swordfish catch and effort tend to be further offshore based on logbook and observer data. There are various time and area restrictions in place that limit the geographic extent of the fishery in addition to the leatherback time/area closure. These include State and Federal marine sanctuary boundaries and near-shore coastal zone restrictions. The near-shore restrictions address catches of species of concern, such as thresher sharks and gray whales, and mitigate recreational fishing industry concerns of excessive marlin bycatch in the DGN fishery.

The California DGN fishery is closed within 200 nmi of the coastline from February 1–April 30, inclusive, and DGNs are not permitted to take swordfish and shark within 75 nmi of the California coastline from May 1–August 14 between the westerly extension of Oregon-California boundary and the western extension of the United States–Mexico boundary. From August 15–January 31, swordfish can be taken within 75 nmi, pursuant to area restrictions specified in the CDFG Code and respective of any Federal protected species closures in place.

Table 3–6. Annual number of vessels, limited entry permits, and landings (round mt) for swordfish and common thresher shark in the DGN fishery (source: PFMC 2006).

Year	Vessels (number)	Permits (number)	Swordfish Landings (mt)	Common Thresher Shark Landings (mt)
1981	118	-	270	917
1982	166	-	208	650
1983	193	-	242	421
1984	214	226	286	915
1985	228	229	197	1,095
1986	204	251	78	451
1987	185	218	6	393
1988	154	207	1	393
1989	144	189	-	460
1990	134	183	-	335
1991	114	165	51	569
1992	119	149	60	285
1993	123	117	162	245
1994	138	162	760	272
1995	117	185	682	207
1996	111	167	708	241
1997	108	120	655	249
1998	98	148	847	281
1999	84	136	585	152
2000	78	127	631	155
2001	69	114	351	273
2002	50	106	298	216
2003	43	99	198	241
2004	40	96	175	66
2005	42	90	182	155

Table 3–7. Catch rates (animals-per-100 sets) for the target and major non-target species observed in the DGN fishery (north and south of Point Conception).

Data source: NMFS SWR observer records 1990–2005[17].

	Catch in numbers per 100 sets			
	All Years[a] North PC	All Years South PC	2001-2004[b] North PC	2001-2004 South PC
Bonito, Pacific	0.45	16.9	0	34.2
Fish, Unidentified	7.2	5.2	0	1
Hake, Pacific	7.9	0.69	1	0.3
Louvar	14.2	7	41.8	12.8
Mackerel, Bullet	1.8	66.1	0	4.5
Mackerel, Pacific	59.6	82.7	23.5	47.5
Marlin, Blue	0.04	1.1	0	1
Marlin, Striped	0.59	8.2	0	5.9
Mola, Common	453.8	664.3	878.6	745.6
Opah	36.7	64.9	30.6	61.8
Pomfret Pacific	15.2	1	39.8	1.4
Remora	2.5	0.9	0	0.8
Shark, Bigeye Thresher	7.1	6.1	0	6
Shark, Blue	461.4	176.6	312.2	129.5
Shark, Common Thresher	53.1	84.5	63.8	73.6
Shark, Pelagic Thresher	0	1.8	0	0
Shark, Shortfin Mako	42.6	121	18.4	149.6
Stingray, Pelagic	1.5	6.3	0	6.5
Swordfish	292	142.5	298.9	156
Tuna, Albacore	487.6	49.5	1,189.8	60.4
Tuna, Bigeye	0.3	0.3	0	0
Tuna, Bluefin	83.7	29.2	235.7	26.8
Tuna, Skipjack	121.8	122	27.6	149.4
Tuna, Yellowfin	1.2	10	0	19.4
Yellowtail	0.04	1.6	0	2.3

[a] For all years (1990-2005), the observed sets south of Point Conception equal 4,344 and north of Point Conception equal 2,862.
[b] For the time series 2001-2004, the observed sets south of Pt. Conception equal 1,121 and north of Pt. Conception equal 98.

[17] http://swr.nmfs.noaa.gov/psd/codgftac.htm

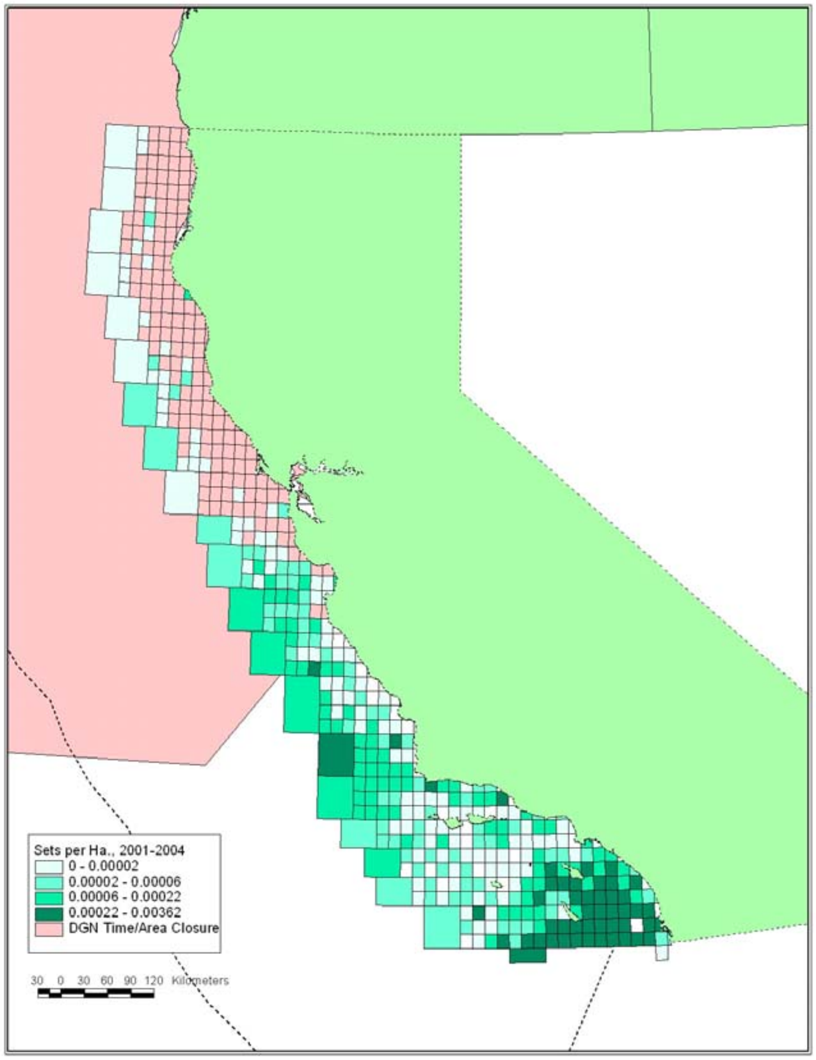

Figure 3–11. Spatial distribution of average annual DGN fishing effort (sets) for the years 2001–2004.

Source: CDFG fishing logbooks standardized by fishing blocks (sets/hectare). NOTE: The logbook data presented in this figure show only California fishing location information; however, there was some limited fishing effort north of California in Oregon and Washington during this time period (~7 percent of total sets).

West Coast harpoon fishery

The California harpoon fishery dates back to the early 1900s. The harpoon fishery used to account for the bulk of swordfish landings into California but was supplanted by the DGN fishery in the 1980s. Participation in the harpoon fishery peaked in 1978 with 309 vessels landing over 11,000 mt before being largely displaced by the more efficient DGN fishery (Leet, *et al*. 2001). Since that time, the harpoon fleet has declined substantially with 24 vessels landing 74 mt of swordfish in 2005. Fishing effort is concentrated in the coastal waters off San Diego and Orange Counties with peak landings in August (PFMC 2006). This fishery is highly dependent on suitable environmental conditions to be able to locate and harpoon swordfish on the surface, and participation is not expected to change. Given the selective gear used in this fishery, bycatch is practically non-existent.

However, the Pacific Fisheries Information Network (PacFIN) landing records for harpoon-permitted vessels are confounded by gear code conflicts, as many harpoon vessels carry DGN gear as part of a multiple fishery operation. The assumption is that an unknown percentage of landings may be inaccurate due to the gear code bias (Coan 2006). Harpoon landing and logbook records were analyzed for the time period 1969–1993 (Coan, *et al*. 1998). Noting the recognized shortcomings in logbook data estimates (e.g., reporting biases and gear code conflicts), a small amount of "other sharks" are reported as taken in the harpoon fishery, including mako sharks. In addition to the 74 mt of swordfish, PacFIN landings for harpoon gear in 2005 reported no thresher shark landed and a very small amount of mako shark landed (1,278 lb).

West Coast HMS recreational fisheries

Recreational anglers in California take many of the same HMS species that are caught in the SSLL and DGN fisheries. Fishing occurs in the EEZ waters of the United States as well as Mexico aboard commercial passenger fishing vessels (CPFV) and private boats. Fishery statistics are compiled by the Recreational Fisheries Information Network (RecFIN) and from CPFV logbooks required by State regulations and/or per HMS FMP regulations. Some limited observer data exists for HMS bycatch on recreational charter boat trips but the sample size is very small and was unavailable for review at the time of this assessment.

West Coast HMS CPFV fleet

Recreational anglers in California harvest swordfish primarily from private fishing boats with the occasional catch on CPFVs. In 2004, approximately two swordfish were caught and kept by recreational fishermen on board CPFVs fishing in the U.S. EEZ, whereas in 2005 there was no catch reported for swordfish.[18]

With the exception of sharks, most HMS and non-target finfish are caught by anglers fishing from CPFVs based in southern California and fishing primarily in the Mexican EEZ. In 2005, CPFV anglers fishing in Mexican waters landed 82,603 albacore, 4,949 bluefin, and 3,496 skipjack tuna based on CPFV logbook records. A total of 40 mako sharks and 14 unidentified marlin were also landed. In 2005, CPFV anglers fishing in the U.S. EEZ off California landed 15,625 albacore, 722 bluefin, and 2,212 skipjack tuna based on CPFV logbook records. A total of 121 mako sharks, 26 blue sharks, and four striped marlin were also landed.

West Coast HMS private boat fleet

For recreational anglers fishing in the U.S. EEZ, Title 14 of the CDFG Code limits the take of a number of HMS: thresher, mako, and blue sharks,o00 and swordfish - two per day; marlin – one per day. For other HMS, there are either no limits or there is an overall bag limit of 20 fish of mixed species with no more than 10 fish of any one specie. Anglers may possess more than the limit depending on the length of the fishing trip. Fishing occurs in the EEZ waters of the United States, primarily off the southern California coast, as well as in Mexico. A typical fishing season for HMS begins in the spring and continues to late fall depending on the oceanographic conditions present in a given year. Private anglers are not required to keep a daily fishing log on their vessels so catch estimates are based on California Recreational Fisheries Survey interviews of anglers returning to port. Generally, it is recognized that catch and effort estimates for the private anglers are underestimated due to the lack of sampler access to private marinas where many private vessels are berthed.

[18] Data source: California Commercial Fisheries Information System, CPFV logbook data.

Catch estimates for private boats are for vessels fishing exclusively in the U.S. EEZ. Many private vessels fish in the EEZ of Mexico but the number and catch by these vessels is unknown. In 2005, private boat anglers fishing in the U.S. EEZ off California landed approximately 5,000 albacore, 85 bluefin, and four skipjack tuna.[19] According to RecFIN estimates, a total of 14,000 mako sharks and 15 blue sharks were caught with over 50 percent of the mako sharks released alive. In 2004, recreational anglers fishing from private boats in the U.S. EEZ caught approximately 4,000 thresher sharks, while in 2005 the catch dropped to 216.

The average private boat recreational catch of common thresher for the period 2001–2004 is approximately 2,500 sharks (PFMC 2006). The average weight for thresher shark captured in the recreational fishery was estimated to be 68 kg (Sepulveda 2006). Therefore, the estimated take of thresher shark by the recreational fishery would equal approximately 170 mt (2,500 sharks x 68 kg/shark). A growing catch-and-release ethic has been practiced amongst private boat anglers and an unknown number of sharks are released alive back to the water. Estimates of post-release mortality are not known and additional research and monitoring efforts are needed.

The average recreational catch (numbers) of shortfin mako shark for the period 2001–04 is approximately 4,250 sharks (PFMC 2006). Of this total, it is estimated that roughly half were released alive with an unknown survival rate. For the purposes of this EA, a conservative catch-and-release mortality estimate of 20 percent was applied to derive a total estimated take in the recreational fishery. For the time period 2001 to 2004, an average of 2,125 mako sharks per year were released alive (RecFIN data, PFMC 2006). Applying a 20 percent mortality factor to those mako sharks released results in an estimated take equal to 425 animals. The average weight for mako shark captured in the recreational fishery during the 2001 to 2004 time period was estimated to be approximately 20 kgs (Sepulveda 2006). The estimated tonnage of mako shark taken by the California recreational fishery will therefore be reported as the sum of the landed tonnage (2,125 animals x 20 kgs. = 42.5 mt) and the estimate of mortality in the released catch (425 animals x 20 kgs. = 8.5 mt) for a total of 51 mt.

Blue sharks are targeted by private boat anglers using light tackle and captured incidentally by private anglers fishing for other HMS sharks. Most of the recreational shark trips are based out of southern California and catch small blue sharks that average ~7 pounds. Since blue shark meat quickly ammoniates when killed, most if not all are caught and released with high survivorship assumed (Sepulveda 2006).

California small mesh set net fishery

The small mesh set net fishery utilizes monofilament gillnets designed to capture halibut and Pacific angel shark. Incidental catches include thresher and mako shark and a host of benthic marine organisms. Vessels used in the fishery are generally 25–40 ft in length, which is suited for inshore coastal operations. Fishing effort is concentrated off Santa Barbara and Ventura counties and around the northern Channel Islands, especially Santa Cruz and Santa Rosa Islands. A decline in landings occurred in 1991 when a voter initiative was passed banning the use of gill and trammel nets within three miles of the southern California mainland coast and within one mile around the Channel Islands. Many gillnetters switched to other fisheries and a few dropped out entirely or retired (Leet, *et al*. 2001). In 1990, a total of 144 vessels landed angel shark and by 1994, the number was reduced 50 percent to 72 vessels. These boats landed 23,000 pounds, a decline of 91 percent from the catch in 1990. For the period 2001–2004, an average of 76 vessels participated in the fishery averaging 4,782 days of combined effort. Logbook records indicate

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[19] RecFIN estimates of fewer than 1,000 fish are reported as less than 1,000 in the HMS SAFE documents due to the extrapolation uncertainty with the estimates (e.g., high percent error).

that 3,343 thresher shark (836/year) and 13 swordfish (3.3/year) were caught. Logbook records show 2 basking sharks and 16 great white sharks were captured.

Logbook records of non-target catch for that time period are presented below in table 3–8.

Table 3–8. Small mesh set gillnet logbook records for non-target finfish catch, 2001–2005.

Species	Total No. Reported	Avg. Reported/Year
Mako shark	1,520	304
Blue shark	12 (2003 data only)	
Unid. shark	542	108
Albacore tuna	99 (98 in 2001, 1 in 2002)	
Bluefin tuna	35	9
Pacific mackerel	1,058	353
Unid. Mackerel	3,997	799
Louvar	9	3
Opah	20	4.5
Pomfret	4 (2001 data only)	
Common mola	2 (2003 data only)	

During the 2005-2006 fishing season, NMFS observers monitored 4 set gillnet trips totaling 12 sets of effort. The catch of non-target HMS species included 10 common thresher sharks (all kept), 24 pacific mackerel (all discarded dead), 1 yellowtail (kept), and 1 bonito (kept).

California small mesh DGN fishery

This fishery primarily targets white seabass, California barracuda, and yellowtail. Incidental catches include thresher, mako and blue sharks, and albacore, bluefin, and skipjack tuna. Except for a few directed tuna trips, which are now banned under the HMS FMP regulations, thresher and mako sharks make-up the majority of the incidental catch.

With the implementation of the HMS FMP, the small mesh DGN and set gillnet fleets are not permitted to land swordfish as they did prior to the FMP. They are, however, permitted to land other HMS, with the restriction of 10 fish per landing of each non-swordfish HMS, including thresher and mako sharks.

United States tuna purse seine fishery

There are two components to this fishery sector: large vessels (> 400 short tons (st)[20] carrying capacity) and small vessels (equal to or less than 400 st carrying capacity). The large vessels usually fish outside U.S. waters and deliver their catch to foreign ports or transship to processors outside the mainland United States. The fleet of large vessels based on the West Coast and fishing in the Eastern Pacific has been greatly reduced over the past 20+ years with a single U.S. flagged vessel participating in the EPO fishery in 2005 (Routt 2007). This vessel did not fish in the U.S. EEZ and bycatch data were not available for review.

The small vessel tuna purse seine fleet, based primarily in southern California ports, is a multi-fishery fleet reliant primarily on coastal pelagic species (sardines, mackerel, and squid) and shifts to tuna when they are seasonally available. There are approximately 61 small purse seiners with limited entry permits under the Pacific Council's Coastal Pelagic Species (CPS) FMP.[21] The coastal pelagic species fishery is

[20] The IATTC uses short tons in its stock status reports. 1 short ton is equal to 0.9072 metric ton.
[21] http://www.pcouncil.org/cps/cpsback.html

under a limited entry program when operating south of 39º N. latitude pursuant to the Council's CPS FMP. Alternatively, vessels could enter the purse seine fishery to target tunas as there is currently no limited entry program for purse seine vessels operating under the HMS FMP. A few vessels also may be able to arrange to catch bluefin for transfer to Mexican vessels for "grow out" facilities that have been established off Baja California. The ability of this market to handle large quantities is unknown. Thus significant growth in the U.S. purse seine fishery is not expected and declines seem more likely.

The landings of HMS in the small vessel tuna purse seine fishery have been declining for many years, and the recent closure of the last cannery that processed whole fish in California suggests that this trend will continue. Large effort shifts into the purse seine fishery for HMS are not anticipated. A total of 10 HMS permitted tuna purse seine vessels operated in 2005 landing 283 mt of yellowfin tuna, 522 mt of skipjack tuna, and 201 mt of bluefin tuna to southern California ports (PFMC 2006). Logbook data for this fishery have not been collected nor analyzed prior to the implementation of the HMS FMP; therefore, bycatch records from this reporting source are non-existent.

A CPS observer pilot program was instituted by NMFS in July 2004 for the small vessel purse seine fleet (catch consists of CPS and tuna species). The objective of the pilot program is to gather preliminary bycatch data and to derive an estimate of an appropriate future percent coverage, if warranted, for these fisheries. Prior to this pilot, anecdotal accounts indicate bycatch levels in both fisheries were relatively low. For the period July 2004–January 2006, NMFS observers monitored 9 tuna purse seine targeted trips providing 15 sets of observed effort. A total of four blue sharks (one released alive, three discarded dead), and one common mola (released alive), were noted as catch of major non-target finfish species. For the period July 2004–January 2006, a total of 107 CPS trips carried NMFS observers with 228 sets of effort monitored. A total of two blue sharks (released alive), one common mola (released alive), three unidentified sharks (one released alive; two discarded dead), and one unidentified thresher shark (released alive) were noted for bycatch species that are also taken by the DGN fishery.

HMS albacore troll and baitboat fleet

U.S. troll and baitboat vessels have fished for albacore in the North Pacific since the early 1900s using artificial lures with barbless hooks. A total of approximately 64,000 mt of albacore were harvested throughout the North Pacific in 2005, which is below the average annual catch of approximately 75,000 mt since 1952 (Childers and Aalbers 2006). Japanese fisheries have traditionally caught the greatest amount of albacore within the North Pacific and account for approximately 73 percent of the total albacore landed by all fisheries since 1952. During the same period, the U.S. albacore fisheries have annually caught approximately 21 percent of the total North Pacific albacore catch. An estimated 652 U.S. troll vessels fished in the 2005 North Pacific albacore fishery logging 25,252 days of fishing effort and landing 9,122 mt of albacore.

In recent years, the North Pacific albacore troll season started as early as mid-April in areas northwest of Midway Atoll. In July and August, fishing effort expands to the east, towards the West Coast of North America (160° W. longitude to 120° W. longitude), extending from southern California to Vancouver Island (32° N. latitude to 55° N. latitude). Fishing can continue into November if weather permits and sufficient amounts of albacore remain available to troll gear.

The HMS FMP requires all U.S. fishing vessels targeting albacore in the Pacific to submit copies of their daily fishing logbook to NMFS at the conclusion of each trip. Review of albacore troll logbook records for the time period 2001–05, reveals minor amounts of HMS non-target species reported with 126 non-target catch records (table 3–9) in comparison to an average yearly landing of target albacore of 1,711,805 fish. Most of the skipjack and other more tropical HMS species were caught by the offshore vessels while in transit from Samoa or Hawaii to the North Pacific fishing grounds (Aalbers 2006). The logbook reporting rate was 39 percent for the years 2001–04 (i.e., prior to the implementation of the HMS FMP mandatory reporting requirement).

Table 3–9. Non-target finfish catch reported in albacore troll logbooks for the period 2001-2005.

Species	# Reported	# Kept	# Released
Bluefin tuna	26	21	5
Blue Shark	21	0	21
Mako Shark	10	4	6
White Shark	1	0	1
Skipjack tuna	1,421	555	866
Bigeye tuna	6	6	0
Swordfish	2	2	0
Pomfret	9	9	0

NMFS recently instituted an albacore troll pilot observer program for the West Coast and for the period January 2005–May 2006, 7 trips and 69 days of fishing effort were observed by on-board government fisheries observers. The catch of major non-target finfish included 2 blue shark (one released alive, one unknown), 1 dorado (kept), 3 skipjack (all kept), and 18 unknown fish (most likely target albacore known as "poppers," which are fish that hit the jigs and are hooked but "pop off" prior to being landed).

Trawl and pot fisheries and other non-HMS fisheries

The HMS FMP final rule authorizes incidental commercial landings of HMS, within limits, for non-HMS gear such as bottom longline, trawl, pot gear, small mesh DGN, set/trammel gillnets, and others.

For bottom longline (set line) fishery, landings are restricted to 3 HMS sharks, or 20 percent of total landings by weight of HMS sharks, whichever is greater. For trawl, pot gear, and other non-HMS gear, a maximum of one percent of total weight per landing for all HMS shark species combined is allowed (i.e., blue shark, shortfin mako sharks, and bigeye, pelagic, and common thresher sharks) or two HMS sharks, whichever is greater.

The amount of HMS bycatch is assumed to be negligible in ocean salmon and groundfish fisheries based on anecdotal accounts and a cursory review of available observer records by target trip type. There have been some mixed landings of HMS and groundfish by commercial trawl vessels as well as HMS in commercial salmon troll fisheries, but evidence indicates these were probably mixed target trips. There is also evidence that most significant landings of HMS in the salmon troll fishery are also mixed target trips. These seem to occur when albacore are close in and available to the salmon troll fleet. There have also been accounts of recreational salmon fishermen incidentally catching albacore, but these are rare events (DeVore 2006).

Illegal, unreported, and unregulated (IUU) fishing fleets

Despite the ban on large-scale high-seas driftnet fishing in the North Pacific imposed beginning in the early 1990s, fishing effort by IUU foreign fishing vessels continues to occur in the high seas throughout the Pacific Ocean. Anecdotal evidence, including photographs submitted by U.S. fishermen showing albacore tuna with net scars, demonstrate that albacore and possibly other HMS species are probably interacting with net gear deployed by IUU vessels. For most of these fishing fleets, little or no data exist regarding fishing effort or catch of marine species, including HMS. Without such information, it is impossible to assess the impacts of these fisheries on the major bycatch species included in this EA.

As part of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (Public Law 109-479), which was signed in January 2007, the Moratorium Protect Act (Public Law 104-43) was amended to require actions by the United States to strengthen international fishery management organizations and address IUU fishing and bycatch of protected living marine resources. NMFS published an Advanced Notice of proposed rulemaking on June 11, 2007 (72 FR 32052) to announce development of certification procedures to address IUU fishing activities.

3.3.1.3 Fluctuations in the Ocean Environment

Large-scale environmental fluctuations are characteristic of all oceanic ecosystems and have significant affects on the distribution, movement, and habitat of all HMS-related species. Significant sources of inter-annual physical and biological variation are El Niño and La Niña events in the Pacific. Regime shifts (e.g., in the North Pacific) have also been identified as having impacts on both the physical and biological systems, with concurrent impact on the distribution of oceanic species. There is no evidence to suggest that populations of Eastern Pacific HMS are immune to these shifts. In fact, emerging evidence suggests that these environmental and climatological perturbations may have greater influence on the relative abundance of HMS (especially tuna) and related species (PFMC 2003).

While changes in the ocean environment affect HMS, implementation of the EFP is not expected to create a resource conservation concern for the major finfish target and non-target species projected to be taken as part of the EFP. The condition of the stocks and the major finfish bycatch species will be monitored continuously, and necessary actions will be taken to promote conservation and management through the Council and NMFS oversight.

3.3.1.4 Current and Future Regulatory Regimes

There are a variety of evolving national and international legal instruments in force for the conservation and management of HMS. To a great extent these regulatory regimes are representative of species-directed fishery management policies which, more recently, are being questioned as effective at preventing undesirable changes in the marine ecosystem structure and function. General principles for oceanic ecosystem management tend to be theoretical at this juncture. The extent to which they can be implemented is unclear. Regardless, members of the IATTC and the newly established Western and Central Pacific Fisheries Commission are involved in implementation of a new international conservation arrangement for HMS in the Pacific. These arrangements will be intended to conserve the targeted species (mainly tuna) and related species, but if they fail, there could be adverse impacts on U.S. West Coast fisheries. At this point, there are no apparent conflicts between international management measures and the domestic measures proposed in this SSLL EFP.

The States of Washington, Oregon, and California have managed HMS fisheries in the past, continue to do so at the present time, and it is expected that these States will play a role in management of these fisheries in the future. NMFS anticipates that most of these regulations will continue to remain in effect and will be consistent with the goals and objectives of the EFP. In some cases, the FMP defers to the States' management programs, for example in the setting of recreational bag limits, licensing, and reporting provisions. California has the most extensive set of HMS regulations on the West Coast due to the diversity of HMS fisheries based there.

The Western Pacific and North Pacific Fishery Management Councils have a management responsibility for U.S. HMS fisheries in other areas of the Pacific. Actions by these councils would impact HMS stocks and fisheries on the West Coast. There is a need to ensure coordination among the councils to achieve comprehensive management of HMS.

3.3.2 *Current Stock Status of Target and Non-target Species*

The HMS FMP (PFMC 2003, Ch.3, p.13) provides an overview of stock status for HMS management unit species up to the 2002 fishing season. The 2005 HMS Stock Assessment and Fishery Evaluation Report (SAFE) provides an updated status of the HMS management unit species, including target swordfish (PFMC 2006, Ch. 5, p.103). Given the highly migratory nature of many of the HMS FMP management unit species, effective management can only be achieved with coordinated cooperation in the international arena. HMS stock assessments are periodically carried out by scientists from Pacific-based regional fisheries management organizations such as the IATTC and by the International Scientific Committee (ISC) for Tuna and Tuna-like Species in the North Pacific.

Stock status refers to the condition or health of the species (or stock) in the management unit. Status is usually determined by estimating the abundance (or biomass, or yield) of the stock throughout its range and comparing the estimate of abundance with an adopted acceptable level of abundance (reference point). The HMS FMP (PFMC 2003, Pg. ES-5), as required by the MSA, establishes a level of biomass (or proxy) below which a stock is defined as being in an "overfished" condition, and a level of fishing mortality above which "overfishing" is occurring. If overfishing is occurring, fishing levels must be reduced. Stocks that are overfished must be rebuilt to certain biomass levels within a certain time period. As required by the MSA, HMS stocks are to be managed to achieve optimum yield (OY). The HMS FMP (PFMC 2003, Ch. 3, pp. 9-32) provides a detailed description of overfishing criteria and default control rules.

3.3.2.1 Target Species: Swordfish (Xiphias gladius)

Swordfish occur throughout the Pacific Ocean between about 50° N. latitude and 50° S. latitude. They are caught mostly by the longline fisheries of Far East and Western Hemisphere nations. Lesser amounts are caught by gillnet and harpoon fisheries, and infrequently by recreational fishermen. The stock structure of swordfish is not well known in the Pacific. There are indications that there is only a limited exchange of swordfish between the EPO and the Central and Western Pacific Ocean. Hinton and Maunder (2003) concluded that there are northern and southern stocks of swordfish in the EPO, with the boundary between the stock distributions occurring at 5° S. latitude, and there may at times be some mixing of stocks from the Central Pacific with the northeastern stock. The northeastern stock appears to be centered off California and Baja California, Mexico, recognizing that there may be movement of a Western North Pacific stock of swordfish into the EPO at various times.

The lack of contrast in the standardized catch and effort series in the northern and southern regions of the EPO suggests that the fisheries that have been taking swordfish in these regions have not been of a magnitude sufficient to cause significant responses in the populations. In addition, catches in the region have been fairly stable since 1989, averaging about 3,700 mt in the northern region and 8,400 mt in the southern region annually. Based on these considerations, it appears that swordfish are not overfished in the northern and southern regions of the EPO (Hinton, *et al*. 2004). Swordfish stocks have not been declared overfished or undergoing overfishing, nor are there currently quotas or harvest guidelines in place under the HMS FMP.

Recent ISC analyses of swordfish stocks in the North Pacific (north of 10° N. latitude and west of 130° W. longitude), based on CPUE indices from Japanese longline vessels, show declining trends (ISC 2004). These trends are mainly driven by declines in the northwest portion of the study area (north of 10° N. latitude and west of 170° E. longitude) and their proximate cause is not known at present (e.g., changes in stock abundance, environmental variability, and/or fishing practices).

3.3.2.2 Current Stock Status for Major Non-Target Species Catch

Overview

For the purposes of this EA, non-target catch includes incidental catch retained for personal use and/or sale, and catch that is discarded, whether it is dead or alive. These discards, also referred to as bycatch, include both economic discards (e.g., blue sharks) and/or regulatory discards (e.g., protected species). Although the MSA defines terms such as bycatch, discards, and incidental take for practical use, the definitions for these terms are not standardized. For the purpose of this EA, NMFS will use the umbrella term "non-target catch" to avoid confusion.

The stewardship responsibilities of NMFS to lead and coordinate the nation's collaborative effort to monitor and reduce the bycatch of living marine resources are identified in the MSA, ESA, MMPA, Migratory Bird Treaty Act, and in international agreements. As part of its efforts to meet these responsibilities, NMFS reports on the scope and complexity of bycatch in the United States and approaches to addressing bycatch problems. In early 2003, NMFS developed a National Bycatch Strategy to monitor and mitigate bycatch within the Nation's fisheries. As part of this strategy, a National Working Group on Bycatch was appointed to formulate procedures for monitoring bycatch; in particular, it provides information that could be used to develop standardized bycatch reporting methodologies (NMFS 2004a).

Major versus Minor Non-Target Finfish Species

For the purposes of this EA, the assessment of catch rates and impacts are reported and analyzed for those species that were captured in quantities greater than 0.05 animals per 1,000 hooks observed and/or likely to be encountered in the proposed action area (i.e., some of the tropical species like oceanic whitetip sharks, lancet fish, snake mackerels, blue and black marlins, and wahoo are not included). Species referred to as major non-target species include, among others, blue, mako, and thresher sharks, escolar, pelagic stingrays, dorado (mahi-mahi), striped marlin, pomfrets, remoras, and tunas (tables 3–4 and 3–5). The species captured in quantities less than 0.05 animals per 1,000 hooks observed did not, for the most part, involve species for which there are pressing resource conservation concerns, given their infrequent capture in the SSLL fishery. These are referred to as minor non-target species. This tabulation is based on SSLL fishery observer records from 1994–2006, which include the baseline period under review here. Several minor non-target finfish are included for review under the major non-target category due to their status as HMS management unit species or their likelihood of being captured in the proposed action area based on DGN observer records (e.g. striped marlin, common thresher shark, common mola and dorado).

Status of Major Non-target Tunas

Five commercially important tuna species (albacore, yellowfin, bigeye, skipjack, and bluefin tuna) are taken as non-target tuna catch in the SSLL fishery operating outside of the U.S. EEZ. With the exception of albacore, the tropical tunas are not considered a major non-target catch but are reviewed here given their economic importance and relevance to domestic and international fisheries and resource management.

<u>North Pacific albacore (*Thunnus alalunga*) (ISC 2007)</u>

Stock status of North Pacific albacore is reviewed at one- to two-year intervals by ISC Albacore Working Group (formerly the North Pacific Albacore Workshop) with participating members from the United States, Mexico, Canada, Japan, and Taiwan. The latest assessment was finalized by the working group in July 2007. Spawning stock biomass (SSB) estimates for the period 1966-2006 show fluctuations around an estimated time series average of roughly 100,000 mt. The assessment demonstrates a recent increase in SSB from 73,500 mt in 2002 to 153,300 mt in 2006 with a projected further increase to 165,800 mt in 2007. The recent increases are likely due to strong year classes in 2001 and 2003. Despite the high SSB estimates relative to the time series average, fishing mortality rates are high relative to most commonly used reference points. The population is being fished at roughly $F_{17\%}$ (i.e. at a rate resulting in a reduction of the spawning potential ratio to 17 percent of the maximum spawning potential ratio in the absence of fishing). If fishing continues at the current level, and all else being equal, then SSB is projected to decline to an equilibrium level of 92,000 mt by 2015. Considering the high fishing mortality rates, and the fact that total catch has been in decline since 2002, the ISC recommended that all nations practice precautionary-based fishing practices.

Since the mid-1970s, the U.S. component of the overall pan-Pacific Ocean catch is estimated at roughly 15 percent. Albacore troll boats account for nearly all the West Coast catch. Currently there are no quotas or harvest guidelines established for North Pacific albacore catch under the HMS FMP.

Pacific bluefin (*Thunnus orientalis*) (ISC 2006a)

Stock status of Pacific bluefin is reviewed at one to two year intervals by the Bluefin Working Group of the ISC. The latest assessment was conducted in January 2006, but the results were not sufficient to determine stock status without high uncertainty. Nevertheless, results from the multiple models provided some common conclusions: (1) biomass has local peaks in the late 1970s and late 1990s, with a decline after the second peak; (2) recruitment in recent decades has varied considerably, and the 2001 year class appears to be strong; and (3) there is no evidence of recruitment failure in recent years (ISC 2006a). The latest assessment, consistent with the 2004 assessment, demonstrates that current fishing mortality rates likely exceed F_{max}. Noting the uncertainty in the assessments, the ISC Plenary recommended that bluefin tuna fishing mortality not be increased above recent levels as a precautionary measure.

North Pacific bluefin probably constitute a single North Pacific-wide stock with trans-Pacific migratory patterns. Most of the Pacific-wide catch occurs in the Western Pacific. The U.S. West Coast catch is taken primarily by purse-seiners operating off southern California and Baja California, Mexico, mainly between spring and fall and within 100 mi of shore. In the Eastern Pacific, bluefin taken are nearly always immature (ages 1–2) (PFMC 2003, appendix A). Catch by U.S. West Coast fisheries constitutes 2–3 percent of the Pacific-wide catch.

Skipjack *(Katsuwonus pelamis)* (Maunder and Harley 2004)

Stock status of skipjack tuna in the Eastern Pacific is assessed every 1–2 years if deemed necessary by the IATTC. The latest assessment was conducted in 2004. The assessment was considered preliminary because of uncertainties about stock structure, the vulnerabilities of all age classes, and how well fishery catch/effort data tracks abundance. The analysis indicated that a group of relatively strong cohorts entered the fishery in 2002–2003 (but not as strong as those of 1998) and that these cohorts increased the biomass and catches during 2003. There is an indication that more recent recruitments are average, which may lead to lower biomass and catches. Unfortunately, it was not possible to estimate the status of the stock relative to average maximum sustainable yield (AMSY), a commonly used reference point for management, because of uncertainties in estimates of natural mortality and growth.

In 2006, a full assessment was not conducted; however, an analysis of skipjack CPUE was performed which was consistent with the previous assessment (Maunder and Hoyle 2006). Thus, the IATTC concluded that there was not a conservation concern for skipjack in the Eastern Pacific and did not recommend that management was necessary.

Skipjack tuna are taken throughout the Pacific, primarily by purse-seiners, but also by baitboat fishers. In the Eastern Pacific, there are two major fisheries, one off Central and South America, and one off North America in the waters off Baja California, Mexico, the Revillagigedos Islands, and near Clipperton Island. The U.S. West Coast catch constitutes less than one percent of the total Eastern Pacific catch.

Yellowfin (*Thunnus albacares*) (Maunder 2007)

Stock status of yellowfin tuna in the Eastern Pacific is assessed every 1–2 years by the IATTC. The latest assessment was conducted in 2007 and is based on the assumption that there is a single stock of yellowfin tuna in the EPO, although it is likely that there is a continuous stock throughout the Pacific Ocean. Based in part on the most recent stock assessment results, NMFS has determined that EPO and WCPO yellowfin tuna stocks are subject to overfishing. Fishing is concentrated in the east and west, making separate consideration of the EPO stock relevant for management purposes.

The 2007 base case assessment, which does not include a stock-recruitment relationship, indicates that the spawning stock size has been in decline during 2002-2006 from a high point in 2001 to about the level corresponding to the AMSY. The recent fishing mortality rate (F), an average of F for 2004-2005, is near to that corresponding AMSY. Recent catches are significantly below AMSY.

In general, the recruitment of yellowfin tuna in the Eastern Pacific has experienced two, or possibly three recruitment regimes: a period of low recruitment during 1975-1982; a period of high recruitment during 1983-2001; and now a period of intermediate or low recruitment during 2000-2006. Based on the latest assessment, under the recent lower productivity regime, the spawning biomass ratio is estimated to be below AMSY and effort levels above those which would support AMSY.

Based in part on the previous IATTC yellowfin assessment, NMFS determined that the yellowfin tuna stock in the Eastern Pacific is subject to overfishing. The PFMC is working with the IATTC to end yellowfin tuna overfishing in the EPO. Catch of yellowfin tuna by U.S. West Coast fisheries constitutes less than one percent of the Eastern Pacific-wide catch.

Bigeye (*T. obesus*) (Aires-da-Silva and Maunder, 2007)

Stock status of bigeye tuna in the Eastern Pacific is assessed every 1–2 years by the IATTC. The latest assessment was conducted in 2007 and is based on the assumption that there is a single stock of bigeye tuna in the EPO.

The results of the base-case stock assessment, which assumes no stock-recruitment relationship, demonstrate a continuing trend seen in the previous assessments: the biomass of 3 quarter-plus age fish was at a peak level of 614,898 mt in 1986, and has been in decline to a recent low level of 278,962 mt. Current biomass is below that corresponding to AMSY. There was a brief interruption in the biomass decline by above-average recruitment in 2001 and 2002. Recent catches are estimated to have been at about the AMSY level. Under current fishing mortality levels and patterns of age-specific selectivity, the level of fishing effort (F) corresponding to the AMSY is about 83 percent of the current (2004-2006) level of effort.

The floating object fishery that began in 1993 catches small fish below the critical size; however, the AMSY of bigeye in the EPO could be maximized if the age-specific selectivity pattern of the fishery were similar to that for the longline fishery, which catches larger individuals. The two most recent estimates indicate that the bigeye stock in the EPO is overfished (Spawning biomass, $S < S_{AMSY}$) and that overfishing is taking place ($F>F_{AMSY}$). Based in part on the previous IATTC bigeye tuna stock assessment, NMFS determined that the bigeye tuna stocks are subject to overfishing. The PFMC is working with the IATTC to end bigeye tuna overfishing in the EPO. Catch of bigeye tuna by U.S. West Coast fisheries constitutes less than one percent of the Eastern Pacific-wide catch.

Status of Major Non-Target Sharks

As with the rationale presented for delineating between major and minor non-target tuna catch, a similar approach is applied here for the shark species taken in the SSLL fishery. The focus of the analysis will be on the major non-target shark species, namely blue sharks and shortfin mako sharks. For all sharks in the management unit, the HMS FMP establishes that OY be set at 75 percent of MSY, because these species have low productivities and are vulnerable to overfishing. Status of the common thresher shark will be included in this section even though this species is considered a minor non-target species; stocks of the common thresher shark and shortfin mako shark are being managed using precautionary harvest guidelines under the HMS FMP. Basic population dynamic parameters for these shark species are poorly known, and they are considered vulnerable given their life history characteristics (slow growth, late maturing, and low fecundity). A harvest guideline is a numerical harvest level that is a general objective and is not a quota. A quota is a specified numerical harvest objective, the attainment of which triggers the closure of the fishery or fisheries for that species. If a harvest guideline is reached, NMFS initiates review of the species' status according to provisions in the HMS FMP and in consideration of the Council recommendations. Annual estimates for catch levels of common thresher shark and shortfin mako shark have been at about the level of the harvest guidelines for the time period 2001–2005.

Blue shark *(Prionace glauca)* (Kleiber, *et al*. 2001)

Blue sharks are found world-wide in temperate and tropical pelagic waters, but have been known to frequent inshore areas around oceanic islands and locations where the continental shelf is narrow. In the Eastern Pacific, blue sharks range from the Gulf of Alaska down to Chile, migrating to higher latitudes during the summer, and lower latitudes during the winter.

Within the U.S. West Coast EEZ, blue sharks are entangled in pelagic DGN gear, but rarely taken by other commercial HMS gears. On the high-seas, blue sharks have been caught with longline gear in the Hawaii-based SSLL fishery and the California-based SSLL fishery prior to its closure. In addition, blue sharks are caught in the deeper-set tuna longline fisheries. Most commercially-caught blue sharks are considered undesirable bycatch, since the meat quickly ammoniates, reducing marketability. As with several other shark species, the fins of blue sharks are sold to Asian markets for use in shark-fin soup. However, since implementation of the U.S. Shark Finning Prohibition Act which prohibits landing shark fins without accompanying carcasses, blue sharks are rarely landed or marketed when taken in U.S. commercial fisheries. Recreationally, blue sharks are considered a sport fish and larger individuals provide a challenge for fishermen using light tackle. Because most of the recreational shark trips are based out of southern California, and the average size of blue sharks taken is small (7 lb), blue sharks are often caught and released in this fishery. The blue shark is currently listed as "near threatened" by The World Conservation Union (IUCN).

For the North Pacific blue shark population, a range of examples of what might be considered "plausible" Maximum Sustainable Yield (MSY) were calculated in 2001 (Kleiber, *et al*. 2001). The data on which the analysis was based consisted of catch, effort, and size composition data collected during the period 1971–1998 from commercial fisheries operating in the North Pacific west of 130° W. longitude; primarily the Japan- and Hawaii-based pelagic longline fisheries, which catch significant numbers of blue sharks. The results indicated that the blue shark stock, under the fishing regime present at that time in the North Pacific, appeared to be in no danger of collapse. An updated analysis covering the same spatial area and which included data through 2003 was recently completed and produced results similar to the previous assessment, namely that blue sharks in the North Pacific are neither suffering overfishing nor approaching an overfished state (Sibert, *et al*. 2006).

Shortfin mako shark *(Isurus oxyrinchus)* (PFMC 2003)

The shortfin mako shark occurs throughout the tropical and temperate Pacific, but is not managed internationally. The mako is widely distributed in pelagic waters, and the population fished off the West Coast is likely part of a stock that extends considerably to the south and west. Although makos are most frequently found above the mixed layer, they have been recorded down to depths of 740 m. Tagging and fishery catch data show makos prefer water temperatures between 17–20 degrees C, and it has been hypothesized that this species migrates seasonally from the coast of California along the Baja peninsula following favorable seasonal water conditions (Cailliet and Bedford 1983). This movement pattern has been supported by tag and release studies. West Coast commercial fisheries take mainly juveniles, with an average dressed weight of 34 lb (Leet, *et al*. 2001). Shortfin mako constitutes an important incidental catch whose market quality and ex-vessel value make it an important component of the landed catch of the DGN fishery (Cailliet and Bedford 1983; Holts and Sosa-Nishizaki 1998).

Shortfin mako is an important component of California's ocean recreational fishery. The majority are caught by anglers fishing with rod-and-reel gear from private vessels in the Southern California Bight from June through October, with a peak in August. Historically, makos have been esteemed as a prized game fish along the east coast of the United States. During the early 1980s, they increased in prominence as a popular game fish on the U.S. West Coast as well, with annual West Coast catches peaking in 1987 at 22,000 fish. Since 2001, annual catch estimates have ranged from 2,000–6,000 fish, with a percentage of sharks successfully released by southern California fishermen favoring catch-and-release versus harvest (Sepulveda 2006).

Because basic population dynamic parameters for this species of shark are unknown, it is being managed under the HMS FMP with a precautionary harvest guideline of 150 mt. Catch statistics from the CA/OR DGN fishery suggest that the shortfin mako was not overexploited through the 1990s; however, CPUE rates indicated a possible overall decrease (PFMC 2003). Clear effects of exploitation have not been shown, and it is tentatively assumed that overfishing of the local stock is not occurring. The IUCN currently lists the shortfin mako as "Near Threatened" due to a lack of evidence that population levels have been sufficiently depleted.

Common thresher shark (*Alopias vulpinus*)

The common thresher shark is a pelagic species inhabiting both coastal and oceanic waters throughout the tropical and temperate Pacific. Most West Coast commercial landings of common thresher are presently taken in the DGN fishery, but some are also caught by set nets and the small-mesh drift nets. Adults are predominantly taken in the DGN fishery, while the inshore net fisheries land predominantly juveniles. Although temporal and regional closures have resulted in the take of fewer adults than in previous years, the common thresher remains an important component of the DGN fishery. Common thresher populations off Baja California are thought to be of the same population as those fished off the U.S. West Coast (Hanan, *et al*. 1993). Common thresher sharks are not commonly taken in the shallow set longline fisheries outside the U.S. EEZ; however, they have occasionally been caught during fishery independent longline surveys and in a small scale longline fishery for mako sharks which operated within the U.S. EEZ from 1988-91 (O'Brien and Sunada 1994), demonstrating that they are vulnerable to longline gear.

Common thresher sharks are harvested in California's recreational fishery, but are a relatively minor component of the overall total catch. Private boaters catch thresher sharks as they migrate from Baja California, Mexico, to Oregon and Washington in the spring and early summer months. From 1982–

2004, private boaters caught on average 2,000 fish annually. Since 2001, annual RecFIN catch estimates have ranged from 2,000–4,000 fish; however, some uncertainty exists with these catch estimates due to a low number of sampler contacts with fishers.

Thresher sharks are often hooked on the upper lobe of the caudal fin, which is used to stun prey. Catch-and-release mortality is assumed higher for sharks hooked and fought in this fashion (Sepulveda 2006). The estimates of fishing mortality on recreational landings for the common thresher shark in California are considered underestimated and additional monitoring is needed. Similarly, little is known about the take of common thresher sharks in fisheries off Mexico because shark landings are not routinely reported by species, and the pelagic thresher shark is also common off Mexico.

The thresher shark is considered a “data deficient” species by IUCN worldwide. However, because of population depletion by the U.S. West Coast DGN fishery in the 1980s, the California population is considered “near-threatened” (Goldman 2005).

With State-imposed time and area restrictions in place for the DGN fishery since 1990, the population appears to be in recovery; however, because this stock is also harvested by the adjacent Mexican fishery, total annual landings are not well understood for this species. A regional harvest guideline of 340 mt is in place under the HMS FMP. Average annual commercial catch levels for the common thresher shark during the time period 2001–2005 averaged 254 mt.

Status of Major Non-Target Billfish

Striped marlin (*Tetrapturus audax*)

Stock status of striped marlin in the Eastern Pacific has been assessed regularly by the IATTC. The latest EPO assessment was conducted in 2003. The Marlin Working Group of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) also recently conducted an assessment of the North Pacific striped marlin population status (ISC 2006b). The stock structure of striped marlin in the Pacific Ocean is not well known. An analysis of trends in catches per unit of effort in several sub areas suggest that the fish in the EPO constitute a single stock thus that is an assumption of the IATTC assessments.

Striped marlin are found throughout the Pacific Ocean between about 45° N. and 45° S. latitude. They are caught mostly by the longline fisheries of the Far East and Western Hemisphere nations. Lesser amounts are caught by recreational, gillnet, and other fisheries. The HMS FMP prohibits commercial take of striped marlin, however there is a small seasonal recreational fishery for striped marlin in the Southern California Bight in the late summer months. Similarly, in Mexico, commercial take of striped marlin is prohibited within 50 nmi of the coast to provide opportunities for recreational anglers.

For the EPO assessment, standardized catch rates were obtained from a general linear model and from a statistical habitat-based standardization method. Analyses of stock status were made using two production models, taking into account the time period when billfish were targeted by longline fishing in the EPO, that were considered the most plausible. A Pella-Tomlinson model yielded estimates of the AMSY in the range of 3,700–4,100 short tons (st)[22] with a current biomass being about 47 percent of the unfished biomass. The current biomass is estimated to be greater than the biomass that would produce the AMSY. An analysis, using the Deriso-Schnute delay-difference model, yielded estimates of AMSY in the range of 8,700–9,200 st, with the current biomass greater than that needed to produce the AMSY, and about 70 percent of the size of the unexploited biomass.

[22] The IATTC uses short tons in its stock status reports. 1 short ton is equal to 0.9072 metric ton.

The catches and standardized fishing effort for striped marlin decreased in the EPO from 1990–1991 through 1998, and this decline has continued, with the annual catches during 2000–2003 between about 2,000–2,100 st, well below estimated AMSY. This may result in a continued increase in the biomass of the stock in the EPO.

The status of a hypothesized stock of striped marlin spanning the North Pacific was conducted by the ISC in 2007. The status is difficult to determine due to a range of uncertainties in the fishery data as well as biological uncertainties (e.g. maturity schedule, growth rates, stock structure, etc.). Nonetheless, the results of the two models demonstrate that biomass has declined to levels that are 6 to 16 percent of their level in 1952. In addition, landings and indices of abundance have declined markedly, and recruitment has been steadily declining with no evidence that strong year-classes have or are about to enter the fishery. There appears to be inconsistency in the indices developed for the Western Pacific and the Eastern Pacific, and it was recommended that future modeling efforts include spatial segregation. The ISC Plenary recognized that current levels of fishing effort across the North Pacific are not likely to be sustainable, and recommended that fishing effort not be increased above current levels. Catch of striped marlin by U.S. West Coast fisheries constitutes about one percent of the Eastern Pacific-wide catch.

Status of Major Non-target Finfish

Dorado (*Coryphaena hippurus*)

Dorado are predominantly a warm water tropical species that are seasonally abundant in the SCB most likely from populations reproducing off Baja California, Mexico. Catch estimates from international fisheries are poorly documented due in part to the artisanal fishing nature of this fishery, and due to the lack of bycatch monitoring programs. West Coast fishermen access the northern range of the species; there are no HMS FMP harvest guidelines recommended at this time (PFMC 2003). The total landings for all of the West Coast commercial fisheries in 2003 and 2004 were 6 and 1 round mt, respectively. This species is more important in the recreational fishery with an average of 912 fish caught annually along the Pacific coast (PFMC 2006).

Dorado are fast-growing and highly productive species with a short life span of 2–4 years and the ability to rebound relatively quickly from exploitation. Females mature at 4–7 months and spawning can occur all year long in the tropics. The high adult mortality rates may limit the resiliency of this species (PFMC 2003). Dorado from the Eastern Pacific Ocean feed during both day and night, and dominant prey species vary by location (Olson and Galvan-Magana 2002).

Pelagic stingray (*Pteroplatytrygon (Dasyatis) violacea*)

The pelagic stingray is found worldwide in latitudes spanning tropical to temperate waters. This species is small, reaching a maximum size of 80 cm (disc width), and sexual maturity occurs at an average 37.5 cm in males and an average of 50 cm in females. There is evidence suggesting that the Eastern Pacific population migrates to the warmer waters off Central America during the winter. Females give birth in the warmer waters before migrating to higher coastal latitudes such as along the Southern California Bight. This species is commonly found within the top 100 m in deep, blue water zones and are often caught as bycatch in longline and DGN fisheries targeting HMS (Mollet 2002).

Escolar (*Lepidocybium flavobrunneum*)

The black escolar occurs throughout the world's oceans and are distributed between 40º N. and 40º S. latitude. Biological information is lacking for the Pacific populations. Daily catch and fishing effort data was used to determine escolar population structure for the Southwestern Atlantic Ocean (SAO). In the SAO, black escolar are taken as incidental catch when longlining for tuna and swordfish. It was found that the intra-annual catch patterns for the black escolar were similar to those of the target species. This suggests that escolar have similar trophic and reproductive behavior as tuna and swordfish. Highly productive oceanic fronts that are developed in winter and spring attract pelagic species that feed on squid and anchovy. Catches are lower in the summer when presumably escolar are migrating to lower latitudes to reproduce (Milessi and Defeo 2002). In California, escolar were the third most frequently caught species in the pelagic longline fishery with 132 total fish, along with 504 swordfish, and 459 blue sharks in 2001-2002. Catches of escolar declined slightly throughout 2002–2004 (PFMC 2006).

Common mola (*Mola mola*)

Common mola, also known as ocean sunfish, are a seasonally common inhabitant of southern Californian waters. Presently, very little is known about the habitat preferences or behavior of ocean sunfish, but prevailing thought is that molas associate with frontal and stratified water masses rather than in cooler, mixed water (Cartamil and Lowe 2004; Sims and Southall 2002). Key aspects of their biology are largely unknown, such as annual movements and the mode and location of breeding. With respect to mola migrations into the SCB, peak abundance occurs off of Catalina Island in late September and early October, coinciding with peak water temperatures (Cartamil 2006).

Research in the Atlantic suggests that the larger part of their lives may be spent in deep water, although they are thought to undertake seasonal inshore migrations (Fraser-Bruner 1951; Lee 1986). This is especially important in some regions, like the Mediterranean, where molas can constitute 70–95 percent by number of driftnet catches (Silvani, *et al*. 1999). Mola catches in the DGN fishery for the years 2001–2004 make up 30 and 44 percent of the total catches by number, north and south of Point Conception, respectively. There is scant information available on the population dynamics of this species.

Pacific pomfret *(Brama japonica)*

The Pacific pomfret is an oceanic species distributed from southern California to the Gulf of Alaska, Aleutian Islands, and to the Pacific Coast of Japan. The southern limit to their distribution appears to be about 20° N. latitude where surface water temperatures exceed 70 degrees F. They are pelagic and found in near-surface waters to depths of 50 fathoms. Distribution (north-south as well as vertical) seems to be strongly controlled by temperature; they are usually found in water temperatures between 50–66 degrees F (McCrae 1994). Squid, fish and crustaceans are the most common food items. Sharks and some species of whales may be the major predators of Pacific pomfret. Maximum size is about 62 cm with most fish caught in the 30–50 cm length range and estimated to be 4–6 years old. Large fish are generally found farther north than smaller fish that stay in the more southerly waters during the summer and do not migrate north. Pomfret have been a large component of the bycatch in the Asian DGN fisheries for flying squid, and gillnet and purse-seine fisheries for salmon in Alaska. The estimated catch of Pacific pomfret in the squid fisheries in 1990 and 1991 was 1,329 million and 82 million fish, respectively (McCrae 1994). There is no recreational fishery for pomfret.

3.3.3 Status of Prohibited Species

Any HMS stocks managed under the HMS FMP for which quotas have been achieved and the fishery closed are deemed prohibited species. In addition, table 3–10 lists the prohibited non-HMS finfish species designated under the HMS FMP. In general, prohibited species must be released immediately if caught, unless other provisions for their disposition are established, including for scientific study.

Table 3–10. HMS FMP Prohibited Species.

Common Name	Scientific Name
Great white shark	*Carcharodon carcharias*
Basking shark	*Cetorhinus maximus*
Megamouth shark	*Megachasma pelagio*
Pacific halibut	*Hippoglossus stenolepis*
Pink salmon	*Onchorhynchus gorbuscha*
Chinook salmon	*O. tshawytscha*
Chum salmon	*O. keta*
Sockeye salmon	*O. nerka*
Coho salmon	*O. kisutch*

3.3.3.1 Salmon

The chinook (king) and coho (silver) salmon are the major salmon species taken mainly with troll gear in California, Oregon, and Washington fisheries. Sockeye, chum, and steelhead are rarely caught in these fisheries. Distribution of the prohibited salmon species range from Japan to the Bering Sea and south to San Diego, California; although, most occur north of Santa Cruz, California. In recent years, because of the critically low population sizes of some salmon stocks and threats to their continued existence, certain stocks in California and Oregon have been listed as endangered or threatened species under the ESA. There have been no recorded interactions of listed or non-listed salmon stocks with the SSLL fishery or the DGN fishery. The proposed action should also not have any interactions.

3.3.3.2 Great White Shark

The great white shark is an oceanic and coastal inhabitant ranging in the Eastern Pacific from the Gulf of Alaska to the Gulf of California, although it appears to prefer temperate waters (Eschmeyer, *et al*. 1983). As a large, true apex predator, this species is relatively rare. This shark commonly patrols small coastal archipelagos inhabited by pinnipeds (seal, sea lions, and walruses); offshore reefs, banks, and shoals; and rocky headlands where deepwater lies close to shore. Its low productivity and accessibility in certain localized areas make it especially vulnerable. Overall population estimates for this species are unknown and even regional and localized estimates are questionable.

Adult great whites sighted off northern California most likely originate from southern California. The northward migration may be triggered by a shift in dietary preference toward seals and sea lions as the sharks grow large (Klimley 1994). Large males and females tend to be captured along the northern coast, while juveniles as well as large females are generally found to the south. This species has been prohibited by the State of California since 1995; it may not be taken except for scientific and educational purposes under permit. The HMS FMP adopts the State measures across the board. At present, the great white shark is listed as “vulnerable” by the IUCN throughout its range, and is now protected in some regions.

In 2004, the Convention on International Trade in Endangered Species (CITES) placed this shark on its Appendix II list, which demands tighter regulations and requires a series of permits that will control the trade in great white shark products.

There have been three recorded interactions with the DGN fishery: one in December 1996, and two in September 1997 . Two were retained as incidental catch and one was discarded dead. There has been one recorded interaction of a great white shark in the Hawaii-based SSLL fishery based on observer records.

The animal was captured on February 10, 1997 and was retained for sale. The proposed SSLL EFP may potentially have a higher degree of interaction with great white sharks given the larger number of animals that have been observed in the proposed action area. As a prohibited species under the HMS FMP, any great white shark captured during the EFP will need to be immediately released.

3.3.3.3 Basking Shark

The basking shark is a coastal pelagic species inhabiting the Eastern Pacific from the Gulf of Alaska to the Gulf of California. The basking shark is typically seen swimming slowly at the surface, mouth agape in open water near shore. This species is known to enter bays and estuaries as well as venturing offshore. Basking sharks are often seen traveling in pairs and in larger schools of up to 100 or more. Basking sharks are highly migratory. Sightings of groups of individuals of the same size and sex suggest that there is pronounced sexual and population segregation in migrating basking sharks.

In the past, basking sharks were hunted worldwide for their oil, meat, fins, and vitamin-rich livers. Today, most fishing has ceased except in China and Japan. The fins are sold as the base ingredient for shark fin soup. A small fishery took place off Monterey Bay during the period from 1924 to the 1950s for fish meal and liver oil; it is still taken as bycatch in the area. Basking sharks occur in greatest numbers during the autumn and winter months off California, but may shift to northern latitudes in spring and summer along the coasts of Washington and British Columbia. The harvest of this species has not been allowed by California since 2000, and the HMS FMP adopted the same State measures. It is thought to be the least productive of shark species. The basking shark is also currently categorized as “vulnerable” throughout its range and “endangered” in the Northeast Atlantic Ocean and North Pacific Ocean regions by the IUCN. There have been two recorded captures of basking shark in the DGN fishery (December 1993, May 2002); one was released alive and one was released assumed dead. There has been one recorded interaction of a basking shark in the Hawaii-based SSLL fishery based on observer records. The shark was captured December 3, 2003, and was discarded dead.

3.3.3.4 Megamouth Shark

The megamouth shark is a very unique animal that lives in the upper part of the water column in open ocean areas. There have been only a few sightings of megamouth, including a specimen that was tagged and followed for two days, allowing insight into its habitat preference and behavior. The shark remained at a depth of 15 m during the night, then dove to 150 m at dawn and returned to shallow waters at dusk. The megamouth is presumed to be a vertical migrator on a diel cycle, spending the daytime in deep waters and ascending to midwater depths at night. This vertical migration may be a response to the movements of the small animals on which it feeds. The krill that make up part of megamouth’s diet are known to migrate from deep waters to the surface.

The HMS FMP provides protection as a prohibited species because of extreme rarity and uniqueness. Due to the lack of information concerning distribution and population status, the megamouth is considered “data deficient” by the IUCN.

Incidentally-caught specimens that would not survive if released are made available to recognized scientific and educational organizations for research or display purposes. Four specimens of this rare species have been taken in the DGN fishery; all but one was released alive (November 1984, October 1990, October 1999, and October 2001). (A review of world-wide megamouth captures, including the four DGN interactions, can be found at Florida Museum of Natural History 2006)[23]. There have been no recorded interactions of megamouth sharks in the SSLL fishery based on observer records.

[23] http://www.flmnh.ufl.edu/fish/Sharks/Megamouth/mega.htm.

3.3.3.5 Pacific Halibut

Pacific halibut occur from the Sea of Japan to the Bering Sea and south to Santa Rosa Island, southern California. Pacific halibut is an important commercial and sport species in the Pacific Northwest, and fished commercially by longline, set gillnet and recreational hook-and-line fisheries. There have been no recorded interactions of Pacific halibut in the SSLL fishery.

3.4 Protected Species

The West Coast EEZ nearly encompasses the California Current and as described above hosts a wide array of species including marine mammals, sea turtles, threatened and endangered fish species, and seabirds. These animals are protected under the MMPA (all marine mammals), the ESA (if listed as threatened or endangered), and the MBTA (within three nautical miles of the coast). This section will address affects on marine mammals and sea turtles. Seabirds are addressed in section 3.5. As described above in section 3.3.3.1, no ESA-listed salmon species are expected to be affected by the proposed action. Similarly, no listed species of steelhead, white abalone or green sturgeon are likely to be affected. A full description of all marine mammal species likely to occur in the proposed action area can be found in the U.S. Pacific Marine Mammal Stock Assessments (SARs): 2006 (Carretta, *et al*. 2007) and the Alaska Marine Mammal SARs: 2006 (Angliss and Outlaw 2007). A comprehensive review of the status of leatherback sea turtles can be found in the Biological Opinion for the DGN EFP (NMFS 2006c) and a review of all sea turtles in the area can be found in the HMS FMP Biological Opinion (NMFS 2004c).

This section provides information about the current environmental baseline for protected species in two ways. First, an exposure analysis is presented, utilizing historical data from the DGN fishery and observer data from longline fisheries in various parts of the United States, along with information on the biology and distribution of the various species within the proposed action area. Because there has been no longline fishery within the West Coast EEZ and therefore no direct data from which to project likely impacts on protected species, the exposure analysis serves to screen for those protected species most likely to be affected by the proposed action. Second, other past, present and reasonably foreseeable actions are reviewed in order to provide information about the cumulative effects of the proposed action; these cumulative effects are considered in the summary evaluation in section 4.4.

3.4.1 Marine Mammals

All marine mammals that may be found in the action area are listed below. A description of all marine mammals that may be found within the proposed action area can be found in the Pacific SARs (Carretta, *et al*. 2007); the Alaska SARs (Angliss and Outlaw 2006); and the draft Environmental Assessment prepared for the 2006 DGN EFP (NMFS and PFMC 2006). All marine mammals are protected under the MMPA and managed under that statute on a stock basis.

Cetaceans
Dall's porpoise (*Phocoenoides dalli*) – CA/OR/WA stock
Harbor porpoise (*Phocoena phocoena*) - Morro Bay stock, Monterey Bay stock, San Francisco-Russian River stock, northern CA/southern OR stock, OR/WA stock.
Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) – CA/OR/WA stock, northern and southern stocks
Risso's dolphin (*Grampus griseus*) – CA/OR/WA stock
Bottlenose dolphin offshore stock (*Tursiops truncatus*) – CA/OR/WA stock
Short-beaked (*Delphinus delphis*) – CA/OR/WA stock
Long-beaked common dolphins (*Delphinus capensis*) – CA stock

Northern right whale dolphin (*Lissodelphis borealis*) – CA/OR/WA stock
Striped dolphin (*Stenella coeruleoalba*) – CA/OR/WA stock
Short-finned pilot whale (*Globicephala macrorhynchus*) – CA/OR/WA stock
Sperm whale (*Physeter macrocephalus*) – CA/OR/WA stock
Dwarf sperm whale (*Kogia sima*) - CA/OR/WA stock
Pygmy sperm whale (*Kogia breviceps*) - CA/OR/WA stock
Killer whale (*Orcinus orca*) – Eastern North Pacific offshore stock, Eastern North Pacific southern resident stock
Mesoplodont beaked whales (*Mesoplodon* spp.) - CA/OR/WA stock

Hubbs' beaked whales
Gingko-toothed whale
Stejneger's beaked whales
Blainville's beaked whales
Pygmy beaked whale or lesser beaked whale
Perrin's beaked whale
Due to the difficulties involved with identifying different species, as well as the rarity of these species, the SAR for these species designated all Mesoplodont beaked whales as one stock in the EEZ waters off the coasts of CA/OR/WA

Cuvier's beaked whale (*Ziphius cavirostris*) - CA/OR/WA stock
Baird's beaked whale (*Berardius bairdii*) – CA/OR/WA stock
Blue whale (*Balaenoptera musculus)* – Eastern North Pacific stock
Fin whale (*Balaenoptera physalus*) - CA/OR/WA stock
Gray whale (*Eschrichtius robustus*) - Eastern North Pacific
Humpback whale (*Megaptera novaeangliae*) - Eastern North Pacific stock
Minke whale (*Balaenoptera acutorostrata*) - CA/OR/WA stock
Northern right whale (*Eubalaena glacialis*) - North Pacific
Sei whale (*Balaenoptera borealis)* - Eastern North Pacific stock

Pinnipeds
Steller sea lions (*Eumetopias jubatus)* – Eastern U.S. stock
California sea lion (*Zalophus californianus*) – U.S. stock
Guadalupe fur seal (*Arctocephalus townsendi*) – Only one extant population
Harbor seal (*Phoca vitulina richardsi*) – CA stock, OR and WA stock
Northern elephant seal (*Mirounga angustirostris*) – CA breeding stock
Northern fur seal: (*Callorhinus ursinus*) – San Miguel Island stock

Some marine mammals within the area are also listed under the ESA (table 3–11). ESA-listed marine mammals under NMFS's jurisdiction are listed below. Under the ESA, marine mammals are generally listed based upon the global population, not by stocks (as under the MMPA), although some distinct population segments (DPS) are listed (e.g., the Eastern North Pacific (ENP) resident killer whale DPS).

Table 3–11. Threatened or endangered under the ESA, under NMFS's jurisdiction, and occurring in the waters off California, Oregon, and Washington.

Marine Mammals	Status
Blue whale *(Balaenoptera musculus)*	Endangered
Fin whale *(Balaenoptera physalus)*	Endangered
Humpback whale (*Megaptera novaeangliae*)	Endangered
Sei whale (*Balaenoptera borealis*)	Endangered
Sperm whale (*Physeter macrocephalus*)	Endangered
Steller sea lion - eastern distinct population segment (DPS) (*Eumetopias jubatus*)	Threatened
Killer whales - southern resident DPS (*Orcinus orca*)	Endangered
Northern Right Whale (*Eubalaena glacialis*)	Endangered
Guadalupe fur seal (*Arctocephalus townsendi*)	Threatened

3.4.1.1 Marine Mammal Species Most Likely to be Affected by the Action

In order to determine which species are most likely to be affected by the proposed EFP fishery the following data were reviewed: observer records from the DGN fishery; the California-based SSLL and DSLL fisheries (both prosecuted outside the EEZ, thus outside the action area); the Hawaii SSLL and DSLL fisheries; and other U.S. longline fisheries for which observer information was available and applicable to this analysis. The Hawaii SSLL fishery is the only fishery that currently utilizes gear (e.g., circle hooks and mackerel bait) similar to the proposed action (Atlantic longliners use circle hooks with mackerel or squid bait). In addition, patterns of distribution and abundance of various species within the proposed action area were reviewed. When considered together, these data provide the basis of an exposure analysis to determine which marine mammals are most likely to be exposed to the longline fishery and affected by its prosecution as proposed in the alternatives.

As previously described, there has not been a longline fishery in the West Coast EEZ, so there are no records from such a fishery to assist in predicting the effect of the proposed action on marine mammals. However, within the proposed time and area, a DGN fishery has occurred and observer records dating back to 1990 are available. These records were reviewed as a first step in understanding marine mammal exposure to the proposed fishery. In both the historic DGN and proposed longline fishery, gear is set at night and allowed to soak overnight and both gears are fished to target primarily swordfish. The two fisheries overlap temporally, with most DGN activity occurring from September 1 through December 31, the same time period as the proposed longline EFP fishery.

There are, however, two key differences between the two fisheries that should be considered. First, fishing under the preferred alternative for the longline EFP would occur at least 40 nmi offshore of the West Coast in waters north of Point Conception and west of the SCB south of Point Conception and includes the EEZ off California and Oregon south of 45º N. latitude (under the preferred alternative). It should be noted that this area does not precisely match the area of historic DGN effort, some of which occurred within 40 nmi of shore (see Carretta, *et al*. 2005 for a map of the distribution of DGN effort from 1996 to 2002). Second, the DGN observer records likely do not reflect likely takes in the proposed longline EFP, since the nature of the interactions with marine mammals are different, as described in the following paragraphs.

Gillnet gear has been identified as a major source of anthropogenic mortality for marine mammals species globally (Perrin, *et al*. 1994). The cause of entanglements in gillnets is usually attributed to marine mammals being unable to detect the net and becoming entangled. This is supported by the substantial decline of marine mammal entanglements in the DGN fishery during field testing of pingers (Barlow and Cameron 2003) and following the implementation of the Pacific Offshore Cetacean Take Reduction Plan

(POCTRP) (NMFS SWR Observer Program unpublished data) which includes a requirement that acoustic pingers be attached to DGN nets (62 FR 51805). By contrast, marine mammal takes in longlines are generally attributed to odontocetes (toothed whales) either feeding on the bait, or fish caught on the hooks, a behavior referred to as depredation; less frequently, marine mammals are entangled in longline gear (Gilman, *et al*. 2006a). Entanglements of large baleen whales have been recorded in the Hawaii-based SSLL fishery although they are not common (Forney 2004). A direct comparison of gillnet and longline marine mammal CPUEs could not be made for this EA as no comparable fishery records could be found of gillnets and longline occurring in the same area, time, and target species. Although a review of the observer records from California, Hawaii, and the Atlantic suggest that marine mammal entanglements of most species are generally quite low in longline fisheries.

Table 3–12. Marine mammals observed taken in the DGN fishery.

Species	Number observed taken
Beaked Whale, Baird's	1
Beaked Whale, Cuviers	21
Beaked Whale, Hubbs'	5
Beaked Whale, Mesoplodont	2
Beaked Whale, Stejneger's	1
Beaked Whale, Unidentified	3
Dolphin, Bottlenose	3
Dolphin, Long-Beaked Common	14
Dolphin, Northern Right Whale	65
Dolphin, Pacific White-sided	28
Dolphin, Risso's	33
Dolphin, Short-Beaked Common	327
Dolphin, Striped	1
Dolphin, Unidentified Common	21
Porpoise Dall's	22
Sea Lion, California	153
Sea Lion, Steller	2
Seal, Northern Elephant	112
Whale, Fin	1
Whale, Gray	3
Whale, Humpback	3
Whale, Killer	1
Whale, Minke	3
Whale, Pygmy Sperm	2
Whale, Short-finned Pilot	12
Whale, Sperm	8

While the DGN and SSLL gears likely have different CPUEs and may result in different probabilities of marine mammal takes, the DGN data present a useful starting point from which to identify species that may be exposed to longline gear fished under the proposed EFP. Table 3–12 provides the number of marine mammals observed taken in 7,221 sets from 1990-2005 (NMFS SWR Observer Program unpublished data). Species in italics are also listed under the ESA.

In the EFP proposal received by the Council, the applicant suggested utilizing CPUEs developed from the DGN records and applying that rate to 56 sets (assuming that effort could be standardized and that one set of a DGN gear would equal one set of a SSLL gear). While this approach must be viewed with caution due to the differences between the DGN fishery and the proposed longline fishery, it does suggest a low probability that most marine mammal species will be taken in the longline EFP fishery. As can be seen in table 3–12, takes of some species are very rare (e.g., one fin whale observed taken in 16 years).

Quantifying likelihoods of takes based upon such rare events is difficult and may not allow for reasonable projections of future takes, particularly in instances where so little is known about the nature of the interaction and the cause for entanglements. For this reason and the difficulty in using the DGN fishery as a proxy for likely takes under the longline EFP, a review of the biology and known distribution of various marine mammals was conducted along with a review of other SSLL fisheries to provide a more qualitative probability of exposure and effects to marine mammal species.

ESA-listed Marine Mammals

Several species of ESA-listed large baleen whales (blue, fin, and humpback whales), spend the summer and fall feeding in waters off California within the EEZ which places them in the area of the proposed action. Feeding aggregations have been observed in the summer and fall in central California and the waters around the Channel Islands (Carretta, *et al*. 2007). A number of listed whales migrate through the action area in the fall (including humpbacks that spend their summers feeding off Oregon, Washington, and British Columbia, Canada). One ESA-listed baleen whale, the sei whale, is not expected to be affected by the action as this species has rarely been observed in the West Coast EEZ and has not been observed incidentally taken in the DGN fishery that operated within the proposed action area of the SSLL EFP. For the species that utilize the action area for feeding and as a migratory corridor, exposure to and entanglement in longline gear is possible. Because there is no direct information on interactions between ESA-listed whales and a longline fishery within the EEZ, other sources of information were used to evaluate the likelihood of interaction with these species.

The first source of information is the historical DGN fishery observer records. As noted in table 3–12 , over the course of 16 years and 20 percent observer coverage, very few ESA-listed baleen whales were observed entangled in DGN gear; three humpbacks, one fin, and no blue whales were observed entangled in DGN gear, suggesting that interactions between fishing gear and these whales are rare. For humpback and fin whales, utilizing the applicant's method of using the CPUEs developed for the DGN fishery and applying them to the potential SSLL EFP effort yield projected incidental take rates much lower than one (two and three orders of magnitude less than one) suggesting an extremely low likelihood of interactions. Also, all observed takes of humpback and fin whales occurred within the SCB, which is not a part of the proposed action area. When considering the DGN observer data it must be remembered that it is possible that these large species (up to 100 foot long blue whales) may have interacted with gear, but were able to "burst" through the gear before becoming entangled. In order to further consider the assumption that the likelihood of interaction with ESA-listed baleen whales is low, observer data from the California-based SSLL outside the EEZ were reviewed and indicated that none of these species were observed taken during that fishery. This data may not directly reflect the likelihood of interactions with these listed species, since they do not include the nearshore migratory corridors or summer feeding areas utilized during the summer and fall by listed whales.

In order to assess the likelihood of interactions within a similar environment (i.e., baleen whale feeding area and migratory corridor), information from the Atlantic HMS observer program was reviewed. In twelve years of observing the Atlantic HMS fishery (at approximately five percent annually) there are no records of entanglements between ESA-listed whales commonly found in the area (e.g., sei, blue, humpback, fin) and the commercial pelagic longline fishery along the Atlantic coast (NMFS 2004d). There was one account of an unidentified large whale entangled in gear during the Northeast Distant (NED) experiments testing modified longline gear (circle hooks) and methods. While the animal could not be positively identified, it was likely a listed species based upon the known distribution of whale species in the NED. The animal was released unharmed without any trailing gear (NMFS 2004d). In the Hawaii SSLL fishery, only one humpback whale has been observed entangled in gear (in 2006) during 2,631 observed sets (2,150,681 hooks) since 2004 (NMFS PIRO Observer Program unpublished data). The whale entangled in 2006 was released alive, although final assessment of its condition (i.e., seriously injured or not) has not been made (Yates 2007). In the SSLL fishery from 1994-2002, there were no observed takes of ESA-listed baleen whales (Forney 2004). However, one incidental take of a humpback did occur in 2006 in the Hawaii-based SSLL fishery.

In order to attempt to quantify likely effects of the proposed SSLL EFP on ESA-listed whales, CPUEs for three ESA-listed marine mammal species that have been observed taken in the DGN fishery were calculated (no blue whales have been observed taken, so the CPUE is zero). The CPUEs were applied to the anticipated number of sets, 56, and estimated whale takes were extremely low. The incidental take of large whales is quite rare in SSLL gear; therefore there is limited utility in applying CPUE rates to the proposed action, since takes may be too rare to make this a meaningful way of predicting take. Nonetheless, a CPUE per 100 sets in the Hawaii SSLL was calculated simply to demonstrate the low level of takes (see table 3-13). If these rates are applied to the anticipated 56 sets in the proposed action, the resulting takes are considered nil.

In an attempt to identify a proxy fishery that may reflect habitat utilization similar to that utilized by marine mammals on the West Coast, observer data from the Atlantic HMS fishery and stock abundance was reviewed. No take of ESA-listed marine mammals has been observed nor is it anticipated in the Atlantic-based SSLL fishery. Some of the areas fished overlap feeding areas and migratory corridors for ESA- listed marine mammal species, similar to the conditions in the West Coast EEZ, thus this may serve as a better ecological proxy for the anticipated takes in the proposed fishery then the Hawaii SSLL fishery or the DGN fishery, suggesting that the likelihood of takes is quite low.

Based upon the rarity of observed interaction between DGN gear and large baleen whales and the rarity of entanglements in SSLL fisheries in Hawaii and the Atlantic it is not likely that the fishing that would occur under the EFP would affect ESA-listed baleen whales, blue, fin, or humpback whales (table 3-13).

Table 3-13. Observed takes in SSLL fisheries and minimum population estimates for ESA-listed stocks that may be affected by SSLL EFP.

Species	Take in HI SSLL	Takes per 100 sets	N(min) (HI stock)	Observed takes in Atlantic-based SSLL	N(min) (Atlantic stock)	N(min) (US West Coast stock)
Humpbacks	1	.0005	1,234	0	647	1,396
Fin	0	0	174	0	2,362	3,454
Sperm	2	.0713	7,082	0	3,539	2,265
Blue	0	0	308	0	unknown	1,384

Based upon the rarity of observed interaction between DGN gear and large baleen whales and the rarity of entanglements in SSLL fisheries in Hawaii and the Atlantic it is not likely that the fishing that would occur under the EFP would affect ESA-listed baleen whales, blue, fin, or humpback whales.

Sperm whales are listed as endangered and are found throughout the California Current off the U.S. West Coast, reaching peak abundances off of California from April to mid-June and the end of August through mid-November (Rice 1974) demonstrating seasonal movements but not a clear migration like most large baleen whales. There have been eight observed takes of sperm whales in the 16 years of DGN fishery observer program. Most of the takes occurred within two relatively limited area around 36° N. latitude and 122° W. longitude (south and west of Monterey Canyon) to around 32° N. latitude and 120° W. longitude (southwest of the Channel Islands and near Cortes Bank). As above, utilizing a CPUE from the DGN fishery and applying it to the anticipated 56 sets results in an extremely low projected rate of take, suggesting that the likelihood of sperm whales interacting with longline gear operating in similar spatial and temporal distributions as the historic DGN is extremely low. Sperm whales are more abundant in waters around Hawaii than the West Coast EEZ therefore a review of the Hawaii-based SSLL was done. There have been no observed entanglements in the SSLL fishery as it has been operating since 2004 and only one observed take between 1994–2002 and the animal was not seriously injured (Forney 2004). One sperm whale was observed taken in an experimental fishery outside the Hawaii EEZ, but an assessment of its condition (i.e., seriously injured or not) could not be made (Carretta, *et al*. 2007).

The Atlantic SSLL was reviewed as a possible proxy for the SSLL EFP fishery since SSLL effort and sperm whale feeding areas overlap temporally and spatially in the Atlantic, similar to the proposed action area. Interestingly, although both the Atlantic SSLL fishery and sperm whales utilize the same regions, 100, 200 and 1000 meter isobaths, sperm whales have not been observed taken in the fishery, despite high levels of effort. There were over one million SSLL hooks set in the regions of sperm whale feeding, primarily the Mid-Atlantic Bight (MAB) and Northeast Coastal (NEC) (Fairchild-Walsh and Garrison 2007).

To complete our review of sperm whale takes in other fisheries, we reviewed observer data from the California-based SSLL adjacent to the West Coast EEZ and there were no reports of interactions.

The rarity of observed sperm whale takes in the historical DGN fishery, the Atlantic and Hawaii SSLL fisheries, and California-based SSLL fishery suggests that entanglements are rare events and at the level of effort in the proposed action, entanglements are considered very unlikely.

Sperm whales have been observed interacting with longline fisheries in Alaska, feeding on sablefish that have been caught on bottom longlines (Angliss and Outlaw 2007). One animal was observed with trailing gear attached from a longline fishery in 2000 and was determined to be seriously injured due to the amount of gear attached to the animal. No other serious injuries were recorded during this time, 1999–2003 (Angliss and Outlaw 2007). Sperm whales feed primarily on large and medium-sized squids, although the list of documented food items is fairly long and diverse. Prey items include other cephalopods, such as octopuses, and medium- and large-sized demersal fish, such as rays, sharks, and many teleosts (Berzin 1972; Clarke 1977, 1980; Rice 1989). The diet of large males in some areas, especially in high northern latitudes, is dominated by fish (Rice 1989), which may explain the depredation events (removing fish off hooks) observed in the Alaska longline fisheries. All observed depredation events were done by males (Hill, *et al*. 1999).

It is not impossible that sperm whales may begin a pattern of depredation on longlines within the proposed action area, although this is considered unlikely to occur in 2007. The causes for sperm whales and other odontocetes depredation on longline gear are not known but the animals are likely to become familiar with the sounds of the fishery (e.g., boat engines and gear hydraulics) and associate the sounds with feeding opportunities (Gilman, *et al*. 2006). There is also evidence that the same individual whales will feed on longlines (Hill, *et al*. 1999) suggesting that this is a learned and specialized behavior. It is considered unlikely that sperm whale depredation will develop in the SSLL conducted under the SSLL EFP since this does appear to be a specialized and learned behavior that is likely developed over time and exposure to the fishery. The relatively low level of effort is unlikely to cause a change in sperm whale behavior. Also, the fishery will occur within a very large geographical area and sperm whales are believed to use passive acoustics to locate longline vessels. The distances at which the vessels can be heard by sperm whales is not known although sperm whales have been observed not reacting to longline vessel sounds over 10 miles away (NMFS 2006). If the SSLL fishery were to expand, additional analysis of potential of depredation may be necessary, but as described in Hill, *et al*. (1999) and Angliss and Outlaw (2006), high levels of depredation on the sablefish bottom longline fishery was not correlated with high levels of serious injury or mortality. In Hill, *et al*. (1999), no serious injuries or mortalities were observed; in the 2000 through 2004 fishing seasons, the estimated mean annual serious injuries or mortalities is 0.45.

Due to the overlap of sperm whale distribution and the proposed action, it is not impossible that sperm whales may be affected by the proposed action, but given our review of other SSLL, the relative abundances of these stocks, and the relatively low level of effort anticipated in the proposed action, it is considered very unlikely that sperm whales would be affected by the action, either by entangling in lines while depredating or getting snagged on line or hooks while moving through an area.

It is not impossible that ESA-listed whales may become entangled in the SSLL gear. As described above, observed takes in this gear are extremely rare. Relying upon the DGN observer data to reflect the likelihood of species presence in the action area and likelihood of interactions, blue and sei whales have not been observed taken in the DGN fishery and only one fin whale has been observed taken, within the SCB which is not part of the action area. Humpback whales have been observed incidentally taken in the DGN fishery, although at low numbers, and there has been only one observed incidental take in the Hawaii-based SSLL fishery (the minimum population sizes of these two stocks is comparable). As noted above, sperm whales are known to interact with longline gear, although observed serious injuries or mortalities are extremely rare. In the Hawaii-based SSLL, there have been only two observed interactions, one animal was not seriously injured, the condition of the other was not assessed. In the Gulf of Alaska sablefish longline fishery, the estimated mean annual mortality is 0.45 sperm whales (Angliss and Outlaw 2006). Both the Hawaii-based SSLL and Alaska sablefish longline fisheries had substantially more annual effort than is proposed in the SSLL EFP fishery. Based upon the relatively low level of effort in the EFP, the comparisons to other SSLL fisheries, and the relative abundance of ESA-listed whales within the action area it is not considered likely that any ESA-listed whales will be impacted by the action.

Steller sea lions may be exposed to the longline fishery although this is considered unlikely. Incidents of observed entanglements in DGN are extremely rare, only two observed entanglements in 16 years of observations. Because Steller sea lions are found only along the West Coast, observer records from fisheries in Alaska were reviewed to further assess likelihood of entanglements of Steller sea lions. Longline fisheries are much more widespread, with much higher levels of effort, in the waters off Alaska, where the endangered stock of western Steller sea lions are found. In the Alaska fisheries, one Steller sea lion has been observed incidentally taken and killed in the Alaska sablefish longline fishery, which results in an estimated annual mortality of 1.37 (Angliss and Outlaw 2006). Steller sea lion rookeries are located at Año Nuevo and South Farallon Island, both of which are inshore of the proposed action area and therefore there is not expected to be a direct or indirect effect of the fishery on the rookeries. Also, activity in the rookeries (i.e., pupping, nursing, and breeding) occurs from January through May; thus there is no temporal overlap between rookery activities and the proposed action, although it is not impossible that animals moving to rookeries may interact with the proposed fishery. Based upon the rarity of interactions between Steller sea lions and DGN gear, and observer records from Alaska, and the timing and location of breeding in California waters, Steller sea lions are not expected to be affected by the proposed action.

One stock of killer whales is listed as endangered, the ENP southern residents. These animals have been observed feeding primarily on salmon and are thought to be fish eaters (as opposed to transients that prey primarily on marine mammals and other non-fish species). The ENP southern residents have been observed five times in central California, generally near Monterey Bay from December through February (NMFS 2006e). There have been no sightings of this population in the action area during the months of September through December, although during this time sightings of this stock within inland waters of Washington State are common. In Alaska, killer whales have been observed predating on longline fisheries in the Bering Sea and Gulf of Alaska (Sigler, *et al*. 2003). Recent genetics studies indicate that resident killer whales are predators on longlines targeting cod and flatfish (which may be part of their normal diet), while transient whales are predators on fisheries targeting pollock (usually trawls) (Angliss and Outlaw 2006). The most recent data indicates one observed mortality of a resident killer whale in the cod longline fishery in 2003 (Angliss and Outlaw 2006). In the historic DGN fishery, there was one observed take of a transient killer whale. Swordfish, the target species of the proposed fishery, are unlikely to be a prey species for the endangered killer whale population since they feed primarily on salmon (NMFS 2006b). Due to the rarity of this population in the area, rare occurrence of killer whale takes in the DGN observer records, and the low likelihood that this population would depredate swordfish or tuna, the likelihood of interaction in the proposed EFP fishery is very low to nonexistent.

Northern right whales and Guadalupe fur seals may be in the proposed action area, but it would be very unlikely, based upon observer records from the DGN fishery (no recorded entanglements for either of these species) and also aerial and ship-based surveys conducted throughout the area (Carretta, *et al*. 2007). Therefore, it is not anticipated that the proposed action would affect either of these ESA-listed species.

Non-ESA-listed Marine Mammals

Only three gray whales have been observed taken in the DGN fishery. Unlike some of the other large whale species, large aggregations of feeding gray whales are not likely to occur within the primary action area of the proposed action (i.e., off the California coast). The majority of the gray whale stock moves into the waters off Oregon, Washington, British Columbia, Canada, and especially Alaska to feed throughout the summer. The timing of the proposed action coincides with the annual migration of gray whales from northern waters to the waters Baja California, Mexico throughout the fall. When migrating, gray whales will generally stay relatively close to shore and are therefore not likely to be within the proposed action area. Based upon the available information it is very unlikely that gray whales would be affected by the proposed action.

As noted above, one population of killer whales is listed as endangered; however, another population, the ENP transients, may be found in the action area. Based upon the extremely low observed level of takes in the DGN fishery (one in 16 years) it is very unlikely that the longline fishery would entangle a transient killer whale. Also transients off the U.S. West Coast are thought to feed primarily on marine mammals and are unlikely to depredate bait or target species, swordfish, off a longline, further limiting the likelihood of exposure.

Short-finned pilot whale is a species of concern in terms of bycatch within West Coast fisheries since the stock's PBR is very low—1.2—and at this time the five year average annual mortality is one (estimated annual mortality is calculated for the most recent five year period for which information is available to be consistent with recent survey data, less than eight years old, and used to estimate a stock's population). The annual mortality of one is based upon one observed short-finned pilot whale caught and killed in a DGN fishery in 2003 which was observed at approximately 20 percent (NMFS observer program). The stock found in the proposed action area is the California/Oregon/Washington stock of short-finned pilot whales which has a wide range that extends into the waters off Baja California, Mexico. Short-finned pilot whales are a tropical and warm water species and their range appears to be primarily restricted to the waters south of Point Conception during normal or cold water ocean conditions (Forney 2006). Although once commonly seen off southern California, surveys conducted since the strong 1982–1983 El Niño suggest that their abundance within the West Coast EEZ has declined since the 1980's (Carretta, *et al*. 2007). The current minimum population estimate for this stock is 149 (Carretta, *et al*. 2007). The abundance of short-finned pilot whales in the West Coast EEZ appears to be variable and related to oceanographic conditions (e.g., El Niño or periods of unusually warm water off the coast) (Forney 1997). During warm water or El Niño periods, short-finned pilot whales appear to more commonly move north of Point Conception. Short-finned pilot whales are known to be capable of diving to deep depths presumably in search of squid, their primary prey. It is not known precisely how warmer water conditions may affect their offshore distribution or where in the water column they feed. The target SST identified by the applicant is 15–18 degrees C (60–65 degrees F), which is generally colder than the preferred temperatures of short-finned pilot whales, which may limit the likelihood of exposure to the gear. However, in 1993 the NMFS Southwest Science Center's (SWFSC) ship survey recorded the highest number of pilot whales ever recorded in one survey and all were found in waters 15–18 degrees C (Forney 2007). 1993 was part of a prolonged period of unusually warm water in the West Coast EEZ, which is likely to have contributed to the distribution of this stock.

Short-finned pilot whales have been observed taken in the DGN fishery. Only one short-finned pilot whale has been observed taken and killed in the DGN fishery since the implementation of the Cetacean Offshore Take Reduction Plan (TRP); the take occurred south of Point Conception in 2003. Prior to that, from 1990 through September 1997, 11 short-finned pilot whales had been observed taken and killed in the DGN fishery, all north of Point Conception. Eight of the short-finned pilot whales were observed taken in 1993, with multiple animals (two and four) taken in single hauls. Observed takes also occurred in 1992 and 1997, with single animals taken in each net. The years 1992, 1993, and 1997 were all identified as El Niño years or part of a prolonged warm-water period (from 1991 to 1993) (Pacific Marine Environmental Laboratory 2006).

Short-finned pilot whales have been observed taken in the Atlantic pelagic longline fishery and NMFS recently completed a draft take reduction plan for the long-finned and short-finned pilot whale, and Risso's dolphins. The nature of the interactions in the Atlantic is unclear; fishermen suggest that depredation on swordfish and tuna is occurring, although squid (the bait commonly used in longlines in the Atlantic) is a more typical prey item (NMFS 2006a). Squid bait would not be used in the proposed SSLL EFP fishery.

Short-finned pilot whales have been observed taken in the Hawaii-based SSLL fishery: one take in 1996 (line wrapped around the caudle peduncle—the animal was dead when retrieved) and one take in 2000 (the animal was seriously injured after being hooked in the mouth or ingesting a hook) (Forney 2004). These two observed takes occurred during an observer program operating from 1994-2002 in which 1,308 shallow longline sets targeting swordfish were observed. The level of take may be related to the abundance of short-finned pilot whales in the water around Hawaii; the current minimum population estimate in that region is 5,986. Since implementation of gear changes in the SSLL fishery in Hawaii, no short-finned pilot whales have been observed taken. The reason for this is unknown, although one of the constraints on the re-opened SSLL fishery was that squid could not longer be used as bait. Squid is a primary prey for short-finned pilot whales, so switching bait may have had an effect on depredation. However, there has been no comprehensive review of the fishery to analyze marine mammal bycatch and changes to bycatch levels since the fishery was re-opened in 2004.

Short-finned pilot whales have been observed taken in the Atlantic pelagic longline fishery and NMFS recently completed a draft take reduction plan for the long-finned and short-finned pilot whale, and Risso's dolphins (NMFS 2006a). As with short-finned pilot whales in the waters around Hawaii, the rate of interactions in the Atlantic may be related to the relative abundance of population interacting with longline gear and the overlap of fishing effort and whale distribution. A population estimate for the short-finned pilot whale is not possible due to difficulties in distinguishing short-finned from long-finned pilot whales during surveys, although the total minimum population for *Globicephala spp*. is 24,866 and the 2005 estimated annual serious injury or mortality is 211.5 (Waring, *et al*. 2007). There is substantial over-lap in the areas utilized by short-finned pilot whales and the SSLL fishery, particularly in the Mid-Atlantic Bight and Northeast Coast. Both whales and fishers utilize the 200 and 1000 fathom isobaths for feeding and fishing. There is a sizable amount of fishing effort in these two areas, as noted above over one million hooks are set annually. The nature of the interactions is not completely understood; fisherman report that pilot whales feed on caught tuna and swordfish, although in this area of the Atlantic, squid dominates the diet of pilot whales, so it would be reasonable to believe that the bait is being depredated upon (NMFS 2006) In the Atlantic-based SSLL fishery, squid bait is allowed, however only mackerel bait may be used in the EFP fishery which may further reduce likelihoods of interactions.

The level of short-finned pilot whale serious injury and mortality is a source of concern in the Atlantic SSLL fishery, but the fishery likely does not reflect what will likely occur in the proposed action for a number of reasons. One reason is the relative abundance of the stocks in the two areas, the current minimum population estimate is 149 in the West Coast EEZ (Carretta, *et al*. 2007) and over 24,000 in the Atlantic (Waring, *et al*. 2007), so there are many fewer animals in the proposed action area and so less likelihood of interactions. Also, in the Atlantic, pilot whale foraging areas are along the continental shelf, which is the same area where much of the pelagic longline effort occurs (Waring, *et al*. 2007). The foraging areas of short-finned pilot whales within the proposed action is not well known, but does not appear to overlap spatially with pilot whale feeding areas to the extent of overlap in the Atlantic. Finally, in the Atlantic fishery, squid bait is commonly used and squid is a primary prey choice for pilot whales in the Atlantic and the Pacific (Leatherwood and Reeves 1983). Squid bait will not be allowed in the proposed action, thus it is not reasonable to compare these two fisheries in terms of probabilities of depredation and interactions.

Based upon the low abundance of short-finned pilot whales in the U.S. West Coast EEZ, their occurrence in water generally warmer than those targeted by the applicant, the current climate prediction that for late 2007 of ENSO neutral or La Niña condition, and the rarity of entanglements on Hawaii longlines (where the stock is much more abundant) and the use of mackerel bait, rather than squid bait (squid is a prey species of the short-finned pilot whale) it is considered unlikely that short-fined pilot whales would be affected by the proposed action.

Species of beaked whales have been observed taken in the historical DGN fishery and could possibly be taken in the proposed longline fishery. Mesoplodont beaked whales consist of six species, Blainville, Hubb's, Perrin's, lesser beaked, ginko toothed and Stejneger's. Due to difficulties in distinguishing these individual species, the six species are managed as one stock, the California/Oregon/Washington mesoplodont beaked whales. From the 16 years of observer data from the DGN fishery, five Hubbs, one Stejneger's, and two unidentified mesoplodonts have all been observed entangled in the DGN fishing gear at low numbers, for a total of eight interactions with individual animals from this stock. The Cuvier's beaked whales have been observed taken at a higher rate, 21 individuals over 16 years. Cuvier's beaked whales are the most widely distributed of all of the beaked whales and like other beaked whales, are generally found in deep offshore, tropical-to-cool temperate waters of the world. They are the most commonly observed beaked whale species within the West Coast EEZ. They seem to prefer slope waters with a steep depth gradient. Their preferred prey appears to be squid and deep-water fishes (Leatherwood and Reeves 1983). The reason for the high level of takes in the DGN fishery is not known; although all of the takes occurred from 1992 to 1995, there have been no observed takes since 1995. There have been no reports of beaked whales interacting with the California-based SSLL fishery outside the EEZ and beaked whales have not observed taken in the Hawaii-based SSLL fishery (although one Blainville beaked whale was observed killed in the deep-set tuna fishery (Forney 2004). Based upon the lack of observed recent interactions between the DGN fishery and beaked whales, lacked of observed takes in the Hawaii-based SSLL fishery and the tendency of beaked whales to forage and travel at depths greater than the proposed SSLL gear, it is unlikely that mesoplodont beaked whales would be affected by the proposed action. However, it is possible that Cuvier beaked whales may interact with the SSLL, based upon their abundance, distribution, and history of interactions with the DGN fishery. Takes in the DGN are as follows: 1992 (6), 1993 (3), 1994 (6), 1995 (6). Records of Cuvier's beaked whales being taken in other SSLL fisheries could not be found, therefore an estimation of take based upon a proxy fishery could not be made, however, based upon the low observed levels of takes, the number of Cuvier's beaked whales that may be taken in the proposed action is expected to be low.

For other marine mammal species, the level of observed takes in the DGN fishery was used to estimate the species most likely to occur in the same area and time as the proposed action. If the CPUEs developed from the DGN records are used and applied to 56 sets (assuming that effort could be standardized and that one set of a DGN would equal one set of a SSLL), the resulting rates of takes suggest that most marine mammal species are unlikely to be taken in the longline EFP fishery. Using this quantitative approach, a very low number of Risso's dolphins, short-beaked common dolphins, northern elephant seals, and California sea lions may be taken, due to their abundance in the area (the minimum population estimates for these three stocks are 305,694, 60,547, and 138,881 animals respectively) (Carretta, *et al*. 2007). Risso's dolphins and northern right whale dolphins may also be taken at low levels. Risso's dolphins have been observed taken at low levels in the SSLL fishery in Hawaii and there was one observed take in the California-based SSLL fishery (NMFS SWR Observer Program unpublished data; NMFS PIRO Observer Program unpublished data). Five California sea lions were observed taken in the 1988-1989 experimental drift longline fishery for shark off California (see table 3–3), although the condition of the animals (alive, injured, killed) was not recorded. A short-beaked common dolphin was observed taken in the Hawaii-based SSLL fishery between 1994 and 2002, although it was not seriously injured (Forney 2004). A very low number of northern right whale dolphins and northern elephant seals may be taken based upon take rates in the DGN fishery, although there is no record of these species being taken in California-based longline fisheries operating outside the EEZ in the past. Surveys indicate that some species, particularly California sea lions, have a more coastal distribution, so exposure to the SSLL fishing gear 40 nmi offshore is unlikely. Similarly, northern right whale dolphins have more often been observed within 40 nmi of offshore or within the SCB, than within the proposed action area in the fall, which may minimize the likelihood of exposure. Risso's dolphins, short-beaked common dolphins, and Cuvier's beaked whales are exhibiting a wide distribution across the west coast EEZ. Both Risso's dolphins and Cuvier's beaked whales are deep-divers and seem to prey largely on squid, which may limit their likelihood of feeding on mackerel bait set at relatively shallow depths (40 to 45 meters). Short-beaked common dolphins may be the most likely to be exposed to SSLL gear, due in part to their tendency to feed at night (Leatherwood and Reeves 1983) and their wide distribution throughout the proposed action area.

The analysis provided within this section has been based largely upon observer data from the DGN fishery that has primarily occurred in the waters off California but with low levels of effort off of Oregon and Washington. The preferred alternative limits fishing to south of 45° N. latitude (central Oregon), however this was not a condition of the original alternatives. The following provides a brief analysis of possible impacts if fishing had been allowed in the waters off Washington State. In Washington, DGN gear has been banned since 1990. Observer information from an experimental thresher shark DGN fishery within the EEZ off of Washington State was reviewed to provide some insight, albeit limited, into the possible effects of a longline fishery within those waters (WDF&W 1988; WDF&W 1989). As with the swordfish DGN data, application of CPUEs from a gillnet fishery to a longline fishery is problematic. However, what was most striking about the data from Washington was the estimated marine mammal CPUEs, which were generally an order of magnitude larger than the swordfish DGN CPUEs. (A discussion on sea turtle CPUEs in the Washington experimental fishery is provided in section 3.4.2.1.) In addition, species not observed taken in the swordfish DGN fishery, were observed taken in the Washington State fishery, including harbor porpoise and harbor seals. If SSLL sets are made in the waters off Washington, anticipated effects on marine mammals may be different than those presented in this analysis. As noted above, the preferred alternative limits the SSLL EFP to south of the 45° N. latitude, so the waters off of northern Oregon and off of Washington State will not be fished under the proposed SSLL EFP. Thus the analysis done based upon the historic DGN observer data is applicable to the preferred alternative.

The following provides a very brief review of the marine mammals considered most likely to be affected by the proposed action.

Short-beaked common dolphin (*Delphinus delphis*) – CA/OR/WA stock

Short-beaked common dolphins are the most abundant cetacean off California, with abundance varying both seasonally and between years. They are distinguished in color from the long-beaked common dolphin by having a white abdominal area with a darker eye patch that is continuous with a dark stripe that extends forward and joins the blackness of the lips. Their preferred prey is small schooling fish and they often hunt at night in the deep scattering layer of vertically migrating prey (Reeves, *et al*. 2002). In more temperate waters of the higher latitudes, these dolphins tend to calf in the late spring and early summer and gestation lasts approximately 10–11 months, with a 10-month lactation period (Reeves, *et al*. 2002). Surveys show wide distribution from the coast out to at least 300 nmi from shore. The best abundance estimates for the short-beaked stock is 449,846 (Coefficient of Variance (CV) =0.25) animals, with a minimum population estimate of 365,617 animals and an estimated PBR of 3,656 animals per year. The estimated mean annual take (serious injury and mortality) for short-beaked common dolphins in U.S. commercial fisheries is 93 (CV=0.23) animals, based on information from 1997–2001. This stock is not classified as strategic under the MMPA (Carretta, *et al*. 2007).

California sea lion (*Zalophus californianus*) – U.S. Stock

California sea lions are perhaps the most familiar pinnipeds in the North Pacific Ocean. Adult females and juveniles are slender-bodied, whereas adult males are robust at the shoulder, chest, and neck, and slender at the hind end. The snout is long, straight, and narrow. They have broad foreflippers with hair on the upper surface and short hindflippers with short claws. Adult males have a pronounced forehead and are mostly dark brown to black, with areas of light tan on their face. Females and juveniles are lighter in color than males (Reeves, *et al*. 2002). California sea lions have a diverse diet, feeding on northern anchovy, market squid, sardines, Pacific and jack mackerel, and rockfish (Reeves, *et al*. 2002). Population estimates are made from pup counts and the proportion of pups in the population, since not all age classes of sea lions are ashore at the same time. California sea lions breed at the Channel Islands, off southern California, at islands along the Northern Pacific coast of Baja California, and on the east coast of Baja California in the middle and southern Gulf of California (Reeves *et al*. 1992). After the breeding season, large numbers, particularly males, migrate north along the Pacific coast. The U.S. stock of California sea lions population ranges between the United States/Mexico border and extends northward into Canada. The population abundance estimate for this stock is between 237,000–244,000 animals, with a minimum population estimate of 138,881. The PBR for this stock is calculated to be 8,333 animals per year. Estimated mean annual take in commercial fisheries is 1,476 animals, based on data from 1997–2001. Takes have been documented during those years in the CA/OR DGN fishery, the California set gillnet fishery for halibut and angel shark, the CA/OR/WA groundfish trawl fishery, the WA/OR salmon net pen fishery, and the salmon pen fishery operating out of British Colombia. Other threats to this stock include shooting, entrainment in power plants, marine debris, and boat collisions. The stock is not classified as strategic under the MMPA (Carretta, *et al*. 2007).

Risso's dolphin (*Grampus griseus*) – California/Oregon/Washington Stock

Risso's dolphins are found world-wide in tropical and warm-temperate waters. From seasonal distribution patterns seen from aerial and boat surveys, it is thought that Risso's dolphins move northward into Oregon and Washington during the late spring and summer, while they are found generally off California during the cold water months (Carretta, *et al*. 2007). They have a distinctive, beakless head shape and body that is noticeably more robust in the front half than in the back, a blunt snout, and prominent appendages, with long pointed flippers and a tall, slender, and falcate dorsal fin. Adults have extensive linear scarring concentrated on the back and sides, which makes many adults appear almost completely white except for the dark dorsal fin and flippers (Leatherwood, *et al*. 1983; Reeves, *et al*. 2002). Risso's dolphins travel in groups of on average 25 individuals and feed most often on squid, primarily at night (Reeves, *et al*. 2002). Risso's dolphins in CA/OR/WA waters are considered one stock in the SARs. The best estimate of population abundance for this stock is 16,066 (CV=0.28), with a minimum population estimate of 12,748 animals. PBR for this stock is estimated to be 115 animals per year. The mean annual serious injury and mortality in commercial fisheries for this stock is estimated to be 3.6 (CV=0.63) animals, based on data from 1997–2001. This stock is not classified as a strategic stock under the MMPA (Carretta, *et al*. 2007).

Northern right-whale dolphin (*Lissodelphis borealis*) - California/Oregon/Washington Stock

Northern right-whale dolphins are generally seen in shelf and slope, cool temperate waters, ranging on the West Coast of North America from the Gulf of Alaska and the State of Washington, south to Baja California (Reeves, *et al*. 2002), depending on prey availability. They are distinguished by their slim, graceful body and the absence of a dorsal fin or any trace of a dorsal ridge. They are primarily black, but with a striking white lanceolate pattern of varying extent on the ventral surface. The melon slopes gently forward into a small distinct beak (Leatherwood, *et al*. 1983). They travel in schools of several hundred to thousands of animals and often associate with Pacific white-sided dolphins. Primary prey species include small fish, including lanternfish and squid. Peak calving occurs in the summer months, and the gestation period is a little over a year, with a calving interval of at least two years (Reeves *et al*. 2002). The SARs designated northern right-whale dolphin found in the waters of California/Oregon/Washington as one stock. The estimated population abundance for this stock is 20,362 (CV=0.26) animals, with a minimum population estimate of 16,417 animals. Based on this minimum population, the estimated PBR is 164 animals per year. The mean annual serious injury and mortality of northern right whale dolphins in U.S. commercial fisheries is estimated to be 23 animals, based on data from 1997–2001. This is not classified as a strategic stock under the MMPA (Carretta, *et al*. 2007).

Northern elephant seal (*Mirounga angustirostris*) –California Breeding Stock

The northern elephant seal is the largest phocid in the Northern Hemisphere. They have a robust torso that tapers to narrow hips with short foreflippers, with slightly longer outer digits and long broad claws. Males begin to develop an elongated fleshy nose (proboscis) at about puberty, which they inflate during the winter breeding season to resonate sound when threatening other males. Adult males can be about three to four times the mass of adult females. Adult females and juveniles are mostly lighter to chocolate brown, whereas males are uniformly dark brown except for their chest, which are heavily calloused and scarred and thus appear white and light brown (Reeves, *et al*. 2002; Reeves, *et al*. 1992). The California breeding population of northern elephant seals is considered one stock in the SARs, separate from the breeding population in Baja California, Mexico. Generally, northern elephant seals breed and pup from December to March. Males then forage further north in Alaskan waters, while females forage off Oregon and Washington waters, typically south of 45º N. latitude. Adults return to land to molt between March and August, with males beginning their molt later than females. Northern elephant seals eat mesopelagic fish and squid, though some may forage on the sea bottom and continental shelf for skates, rays, sharks, and rockfish (Reeves, *et al*. 2002). The best estimate of population abundance for the California breeding stock is 101,000 from 2001, with a minimum population estimate of 60,547 animals. PBR for this stock is calculated to be 2,513 animals per year. Threats to this stock include mortality and injury in fishing gear (greater than 86 mean annual takes per year, based on data from 1996–2000). Takes have been documented in the California/Oregon DGN fishery, the California set gillnet fishery for halibut and angel shark, and the California/Oregon/Washington groundfish trawl fishery. Other threats include boat collisions, collisions with automobiles, shootings, and entanglement in marine debris. The stock is not classified as a strategic stock under the MMPA (Carretta, *et al*. 2007).

Cuvier's beaked whale (*Ziphius cavirostris*)

Cuvier's beaked whales are the most widely distributed of all of the beaked whales and are found in deep offshore, tropical to cool temperate waters of the world. They seem to prefer continental slope waters with a steep depth gradient. They are rotund in shape with a steep melon and a short, thick beak. Adult males have a white head, while the lighter head coloration in females is less pronounced. Mature animals can reach up to 23 ft in length, with females larger than males. They usually travel alone or in small groups and feed mainly on squid on or near the ocean floor. Little is known of the reproduction of this species (Reeves, *et al*. 2002). The SARs designated the Cuvier's beaked whales in the EEZ waters off CA/OR/WA as one stock. Sightings of Cuvier's beaked whale off the U.S. West Coast have been infrequent, although they are the most commonly encountered beaked whale off the West Coast. Seasonal trends are not apparent from stranding records. Based on the best available data, the best population estimate for this stock of Cuvier's beaked whale is 1,884 (CV=0.68) animals, with a minimum population estimate of 1,121 animals. The estimated PBR for this stock is 11 animals per year, and the average annual estimated take (serious injury and mortality) in the U.S. commercial fisheries is zero animals. As with other beaked whales, anthropogenic noise may also threaten the Cuvier's beaked whale, particularly mid-frequency active sonars, although the extent of this threat is unknown. Since the estimated annual average incidental mortality of this stock of Cuvier's beaked whale does not exceed its PBR level, it is not classified as a strategic stock under the MMPA (Carretta, *et al*. 2007).

3.4.1.2 Other Actions Contributing to the Baseline Condition of Marine Mammals

Most of the marine mammal stocks identified as most likely to interact with the longline EFP fishery range along the West Coast of the contiguous United States and Baja California, Mexico. The following text provides an overview of cumulative effects in primarily U.S. waters on marine mammals that may, although are unlikely, to interact with the longline EFP fishery. As described above, a number of ESA-listed marine mammals may be in the area of the proposed longline EFP fishery, these are: blue, sei, fin, humpback, northern right, and southern resident killer, and sperm whales; Guadalupe fur seals; Steller sea lions. Based upon the low level of effort (sets and hooks) under the proposed longline EFP, interactions are very unlikely to occur and authorization of take of these ESA-listed species under Section 101(a)(5)(E) of the MMPA is not necessary. A very low number of short-beaked common dolphins, northern elephant seals, California sea lions, Risso's dolphins, and northern right whale dolphins may be taken during longline operations carried out under the EFP. The following is a general description of cumulative effects for marine mammal species found within the U.S. West Coast EEZ.

All marine mammals in the North Pacific are vulnerable to a variety of threats detailed in the following section.

Fishery interactions with marine mammals are regulated under the MMPA. The following fisheries have been classified as either a Category I or II fishery in the MMPA 2007 List of Fisheries (72 FR 14466 March 28, 2007) based on the level of serious injury or mortality of marine mammals that occurs incidental to the fishery.

- Category I fisheries: CA angel shark/halibut and other species set gillnet (>3.5 inch mesh); CA/OR thresher shark/swordfish DGN (≥14 inch mesh)
- Category II fisheries: CA yellowtail, barracuda, white seabass and tuna DGN fishery (mesh size >3.5 inches and <14 inches); CA anchovy, mackerel, tuna purse seine; CA squid purse seine; CA pelagic longline (this includes the DSLL fishery).

All of these fisheries have had some level of interaction with marine mammals, either documented from ongoing observer programs or historic observer data. A more thorough description of the fisheries and impacts on marine mammal stocks can be found in the most recently published U.S. Pacific Marine Mammal Stock Assessment Report: 2005 (Carretta, *et al*. 2007) and the Alaska Marine Mammal Stock Assessment, 2005 (Angliss and Outlaw 2006).

Marine mammals may also be affected by a variety of past and current anthropogenic and non-anthropogenic threats. Historically, the primary anthropogenic effects have been from direct harvest of marine mammals. All large marine mammal species, baleen whales and some odontocetes, have been captured in whaling operations. In the past, commercial whaling occurred at higher levels than at the present time, although some species continue to be subject to directed hunting, including fin whales, sperm whales, gray whales, minke whales, and beaked whales (although not necessarily the stocks exposed to the DGN fishery). Commercial whaling is closely monitored by the International Whaling Commission to ensure sustainable level of harvest, although illegal whaling is known to occur and recently pressure has been put on the IWC to relax the 20 year whaling moratorium.

Threats to marine mammals include entanglement in discarded fishing gear, ship strikes, lethal removal by fisheries (gunshots), exposure to toxins (including PCBs, DDT, and heavy metals), pollution, loss of habitat or prey, and underwater sound. These effects are difficult to quantify, but may be reflected in stock trends.

Within the proposed action area, a number of fisheries have been observed and incidents of marine mammal takes have been recorded. These include the California angel shark/halibut and other species set gillnet (>3.5 inch mesh); California/Oregon thresher shark/swordfish DGN (14 inch mesh); the California yellowtail, barracuda, white seabass DGN fishery (mesh size >3.5 inches and <14 inches); California anchovy, mackerel, tuna purse seine; California squid purse seine. Some of the marine mammal species that may be affected by the proposed action have limited distribution (primarily the waters off California, Oregon, and Washington), although some are distributed throughout the waters off Mexico and others are highly migratory (particularly baleen whales) and thus their range extends as far as Alaska to the north and Central America to the south. For the most part, fishery effects outside U.S. waters are largely unknown. See the Pacific SARs (Carretta, *et al*. 2007); Alaska SARs (Angliss and Outlaw 2007); and the draft Negligible Impacts Determination (NMFS 2006d) for more information on threats to marine mammals.

3.4.2 Sea Turtles

Four species of marine turtles may be found in the area of the proposed action, they are listed along with their status in table 3–14.

Table 3–14. Sea turtles within the proposed action area

Sea turtles	Status
Leatherback turtle (*Dermochelys coriacea*)	Endangered
Loggerhead turtle (*Caretta caretta*)	Threatened
Olive ridley (*Lepidochelys olivacea*)	Endangered/threatened
Green turtle (*Chelonia mydas*)	Endangered/Threatened

3.4.2.1 Species of Sea Turtles Most Likely to be Affected by the Proposed Action

All four sea turtle species within the proposed action area have been observed taken in the DGN fishery and in longline fisheries throughout the Pacific, although leatherbacks and loggerheads are most commonly caught in SSLL gear (NMFS Hawaii observer program; NMFS observer program; Watson, *et al*. 2005). Based upon observer records, leatherback sea turtles were the most commonly observed sea turtle entangled and killed in the DGN fishery and the CPUE of leatherbacks was substantially higher north of Point Conception than south of the point (Carretta, *et al*. 2005). This is likely due to the oceanographic differences between the two areas. Loggerheads are the second most commonly observed sea turtle species taken in the DGN fishery with all takes occurring south of Point Conception, usually within the SCB, and all but one during declared El Niño years. Table 3–15 provides the number of observed takes of sea turtles in the DGN fishery between 1990 and 2005 with 20 percent observer coverage.

Table 3–15. Number of observed takes of sea turtles in the DGN fishery, 1990-2005.

Species	Number Taken
Turtle, Green/Black	1
Turtle, Leatherback	23
Turtle, Loggerhead	15*
Turtle, Olive Ridley	1

*All but one of the takes occurred during El Niño years and none occurred within the proposed action area.

Leatherback Sea Turtles

Of all the sea turtle species within the action area, the leatherbacks are the most likely to be affected by the proposed action. As noted above, there is a much higher leatherback CPUE north of Point Conception than south and this is consistent with the biology and emerging information about the distribution and foraging patterns of Pacific leatherbacks. Aerial surveys conducted during the late summer and fall months reveal that leatherbacks forage off central California, generally at the end of the summer, when upwelling relaxes and sea surface temperatures increase. Leatherbacks were most often spotted off Point Reyes, south of Point Arena, in the Gulf of the Farallon, and in Monterey Bay. These areas are upwelling "shadows," regions where larval fish, crabs, and jellyfish are retained in the upper water column during relaxation of upwelling. Researchers estimated an average of 170 leatherbacks (95 percent CI = 130–222) were present between the coast and roughly the 50 fathom isobath off California. Abundance over the study period, 1990–2003, was variable between years, ranging from an estimated 20 leatherbacks in 1995 to 366 leatherbacks in 1990 (Benson, *et al*. 2007).

Initially, genetic analyses of stranded leatherbacks found along the West Coast determined that the turtles had originated from Western Pacific nesting beaches. Furthermore, genetic analysis of samples from leatherback turtles taken off California and Oregon by the DGN fishery and in the Northern Pacific, taken by the California-based longline fishery, revealed that all originated from Western Pacific nesting beaches (i.e., Indonesia/Solomon Islands/Malaysia; Dutton 2003).

In the last five years, researchers have documented movements of leatherback turtles between nesting beaches in the Western Pacific and the U.S. West Coast. Observations of tracked leatherbacks captured and tagged off the West Coast have revealed an important migratory corridor from central California, to the south of the Hawaiian Islands, leading to Western Pacific nesting beaches. Researchers have also begun to track female leatherbacks tagged on Western Pacific nesting beaches, both from Jamursba-Medi and War-mon, Papua, Indonesia, and from the Morobe coast of Papua New Guinea. Most of the females that have been tagged in Jamursba-Medi, Papua, which primarily nest during the late spring and summer, have been tracked heading on an easterly pathway, towards the West Coast or heading north toward foraging areas off the Philippines and Japan. In addition, one female that was captured in central California in 2005 still had a tracking device that had been attached to her on Jamursba-Medi, confirming this trans-Pacific migration (Dutton 2005). Research and tagging of leatherbacks is part of ongoing work by the SWFSC.

For a full description of the status of leatherback sea turtles and all sea turtle species that may be found in the proposed action area, see the draft EA written for the DGN EFP (NMFS and PFMC 2006), the 2006 biological opinion written for the DGN EFP (NMFS 2006c), or the biological opinion written for this SSLL EFP (NMFS 2007). The following is a very brief review of the basic status of leatherbacks in the Pacific.

Based on published estimates of nesting female abundance, leatherback populations are declining at all major Pacific basin nesting beaches, particularly in the last two decades (NMFS and USFWS 1998; Spotila, *et al*. 1996; Spotila, *et al*. 2000). Declines in nesting populations have been documented through systematic beach counts or surveys in Malaysia (Rantau Abang, Terengganu), Mexico, and Costa Rica. In other leatherback nesting areas, such as Papua New Guinea, Indonesia, and the Solomon Islands, there have been no systematic consistent nesting surveys, so it is difficult to assess the status and trends of leatherback turtles at these beaches. In all areas where leatherback nesting has been documented, however, current nesting populations are reported by scientists, government officials, and local observers to be well below abundance levels of several decades ago. The collapse of these nesting populations was most likely precipitated by a tremendous overharvest of eggs coupled with incidental mortality from fishing (Eckert 1997; Sarti, *et al*. 1996).

In both the Eastern Pacific and Western Pacific, leatherbacks are threatened by poaching of eggs, killing of nesting females, human encroachment on nesting beaches, incidental capture in fishing gear, beach erosion, and egg predation by animals. In May 2004, researchers, managers, and tribal community members with extensive knowledge of local leatherback nesting beach populations and activities in Papua (Indonesia), Papua New Guinea, the Solomon Islands, and Vanuatu assembled in Honolulu, Hawaii, to identify nesting beach sites, and share abundance information based on monitoring and research, as well as anecdotal reports. Dutton, *et al*. *(*2007) estimate that there are between 2,700 and 4,500 breeding females in the Western Pacific population. Information on trends in abundance is not available, making it difficult to assess the health of the population.

Based upon the level of take in the historic DGN fishery and the known distribution of leatherbacks within the proposed action area, it is likely that leatherbacks will be affected by the proposed SSLL EFP. Determining the number of individual leatherback taken and associated mortalities is difficult because there has not been a SSLL fishery in the proposed action area, so there are no observer records from fisheries that can be utilized to make projections. During internal review of the draft EA, a more comprehensive review of other SSLL fisheries was undertaken to characterize the level of anticipated takes in the proposed action. As was done for other species, the DGN observer records were reviewed to indicate presence of the species in the proposed action area. As described previously, comparing one set of DGN gear to one set of SSLL gear is not considered reasonable given the differences in the gear and the lack of evidence to support the assumption that the gear types are comparable. If the sets were comparable, then applying the CPUEs for leatherbacks to anticipated SSLL effort would yield an anticipated take of less than one leatherback. This approach was not considered the best available.

The Hawaii-based SSLL, which re-opened in April 2004 was considered as a possible proxy. CPUEs of leatherbacks in this fishery were highly variable over the past three years, ranging from 0.0027 to 0.013 turtles captured per 1,000 hooks, reflective of the dynamic nature of interactions between sea turtles and fishing gear. Using CPUEs from Hawaii may not be appropriate to the West Coast EEZ given the differences in leatherback behavior in the two areas (the waters off Hawaii have been identified as migratory and perhaps feeding areas, whereas the West Coast EEZ has been identified as a foraging area for Western Pacific leatherbacks). However, if the leatherback CPUE used in the 2004 biological opinion for the Hawaii pelagics FMP (NMFS 2004c) is applied to the level of effort proposed in the SSLL EFP, the anticipated rate of take is extremely low, approximately one leatherback. As with the DGN fishery, this estimate of take likely does not accurately reflect the area and likely interactions.

Recent work from the East Coast suggests that leatherbacks of the northeast coast of the United States and southeast coast of Canada utilize shelf and slope waters during the summer as foraging areas. Two areas in particular, the Northeast Coast (NEC) and Mid-Atlantic Bight (MAB), may most closely resemble some of the foraging areas on the U.S. West Coast, particularly central California. Leatherbacks were satellite tagged (n=38) between 1999 and 2003 off Nova Scotia, Canada within the NEC. Tracks from the tags indicate that leatherbacks travel extensively in the shelf and slope waters (James, *et al*. 2005). On the water observations of "prey handling" at the surface of the water and dive patterns suggest that the NEC and MAB are high use foraging areas for Western Atlantic leatherbacks (James and Herman 2001). Recent work by the SWFSC and their colleagues indicate that the U.S. West Coast in some areas is utilized by leatherbacks in a similar manner as in the Atlantic, that is, leatherbacks migrate into the area seasonally to forage on abundant gelatinous plankton and jellyfish, the primary prey of leatherbacks in these areas. If it is assumed that the range of leatherback CPUEs, per area and per quarter, in the Atlantic-based SSLL fishery reflects the range of CPUEs that may be observed in the SSLL EFP and apply these to the anticipated maximum number of hooks (67,200), the resulting range of anticipated takes is zero to ten leatherbacks. Alternatively, if we calculate a simple CPUE based upon total number of observer leatherback takes over the total number of observed hooks for the two years and two areas and apply this to the anticipated maximum 67,200 hooks in the SSLL EFP, the estimated total take would be four leatherbacks.

Similar to other SSLL fisheries that were considered as possible proxies for the SSLL EFP, there are a number of problems with using the Atlantic bycatch data and applying it to the Pacific. One of the key problems is the differences in scale in terms of leatherback populations and fishing effort. Satellite tracking work done by James, *et al*. (2005) indicates that leatherbacks moving into the NEC and MAB foraging areas are from Western Atlantic nesting beaches. The most recent population estimate for adult females from these populations, not including nesting beaches in Africa, is 10,000 to 31,000 (TEWG 2007). In 2005, the logbook reported level of effort in the third and fourth quarters in the MAB and NEC was 945,700 hooks; in 2006 the effort was 1,158,100 hooks. The most recent population estimate of the entire Western Pacific leatherback adult females is 2,700 to 4,500 (Dutton, *et al*. 2007). Of these adult females, satellite tracks suggest that females from a specific region, Jamursba-Medi, Papua, Indonesia, travel across the Pacific and forage in the West Coast EEZ (Benson, *et al*. 2007), whereas females from other nesting beaches forage in other parts of the Pacific and along the coasts of Asian countries. Thus the number of leatherbacks likely to be exposed to the SSLL in the CA/OR waters is likely a sub-set of the entire Western Pacific population. As noted previously, the total number of hooks anticipated to be set in the SSLL EFP is 67,200 (compared to around one million set in the Atlantic-based SSLL fishery in just two regions in six months).

Finally, observer data from the SSLL outside the West Coast EEZ was examined, along with estimated CPUEs developed by the SWFSC for the Council in 2003. In order to best approximate the areas likely to be fished under the SSLL EFP, data from east of 130° W. longitude was reviewed. This area is closest to the West Coast EEZ and included sets made by California- (2001–03) and Hawaii- (1997–2001) based vessels. Utilizing the CPUE developed for the SSLL fisheries operating in this area and applying it to the anticipated hooks in the SSLL EFP yields an anticipated take of four leatherbacks. However, the SWFSC's report also calculated anticipated takes if gear and bait modifications similar to those tested in the NED experiments were applied to the SSLL fishery CPUEs. Assuming an approximately 65 percent decline in leatherbacks takes, yields an anticipated take in the SSLL EFP of three turtles (with a range of two to four). If most fishing effort in the SSLL EFP occurs between 33° N. and 38° N. latitude and offshore, then this estimate may be the most reasonable approximation on what may occur in the SSLL

EFP. However, there is insufficient refinement on the proposed area that will be fished to determine how closely it will follow the historical SSLL effort off the West Coast EEZ. Reviewing these records and using them to calculate a range of anticipated takes in the SSLL EFP does again suggest that the levels of take are likely to be quite low, if records from a nearby area can be reliably used to project takes.

Based upon a review of relevant other SSLL fisheries and the known distributions and abundance on leatherbacks exposed to these fisheries, it is reasonable to assume that rates of take in the SSLL EFP may be higher than rates of take in the Hawaii-based SSLL, but lower than the Atlantic-based SSLL fishery. The historic SSLL just off the West Coast EEZ may serve as the best approximation of likely takes, although the rate may slightly underestimate the anticipated takes within the proposed action area, as leatherbacks may be more densely aggregated in the EEZ as they move out of nearshore feeding areas. It is not known which areas of the EEZ, beyond the neritic zone, are utilized by leatherbacks. The limited tracks from satellite tagged leatherbacks suggest that the animals move southwest as they leave one known feeding area in the central California, which may place them south of the area traditionally fished by the West Coast-based SSLL fishery. It is therefore estimated that approximately five leatherbacks may be taken in the SSLL EFP. This is slightly higher than the high range of takes estimated using the observed leatherback CPUE of the SSLL east of 130º W. longitude and consistent with the rate estimated using the Atlantic-based SSLL fishery data for 2006 (which is a more complete data set than the 2005 data). This number may over-estimate the actual amount of leatherback take observed, but is the best estimate that could be made with the available information. As described previously, take rates of sea turtles in fisheries is highly variable among years, seasons, and areas, thus any projection of takes based upon observer data from the past is difficult to make with accuracy. In light of this, a conservative approach was taken in the development of the anticipated take in the SSLL EFP in which there is no observer data and there has been no historic fishery.

In order to estimate likely mortality associated with the incidental take of five leatherbacks, observer records from other SSLL fisheries were again reviewed. In the Hawaii-based and Atlantic-based fisheries, there were 0 percent and less than 1 percent immediate mortality rates, respectively. Based upon these rates, it is very unlikely that any leatherbacks taken in the SSLL EFP will be killed immediately. However, post-hooking mortality is a concern and the NMFS post-hooking mortality matrix (Ryder, *et al*. 2006) was used in this assessment. The Hawaii-based SSLL fishery records did not provide sufficient detail to estimate post-hooking mortalities with the matrix. All leatherbacks were recorded as "lightly hooked" but there was no detail on whether these animals were hooked externally (e.g., flipper, shoulder, or shell) or hooked in the mouth or jaw. Also, the precise amount of gear left on the animal was not recorded. Without these types of information, only a broad assessment of likely post-hooking mortalities can be made.

In previous biological opinions, post-hooking mortality estimates have been done based upon estimates from the NED experiment. In the experiment, with high levels of observer coverage, the leatherback post-hooking mortality rate was estimated to be 15 percent. This is due in part to the nature of the hookings (externally hooked) and removal of trailing gear. It is reasonable to assume that a similar situation will occur in the SSLL EFP; therefore, anticipated post-hooking mortality associated with the five takes is one leatherback.

Any estimate of leatherback takes must be considered with caution, particularly given the high inter-annual variability of take. The reasons for the variability and possible correlations between turtle distribution and oceanographic conditions are a topic of on-going studies by NMFS. A recently published paper described the positive relationship between years with positive Northern Oscillation Index (NOI) and higher abundance within the neritic zone off California, north of Point Conception (Benson, *et al*. 2007). A similar pattern could not be found between NOI conditions and leatherback takes in the DGN fishery, but work in this area will continue.

Based upon the distribution of leatherbacks within the proposed action area, the observed takes in the DGN fishery, and rates of observed takes in the Hawaii-based SSLL and Atlantic-based SSLL fishery, it is possible that a small number of leatherbacks may be taken as a result of fishing under the SSLL EFP. Based upon the differences in the leatherback populations and distribution in the two regions and differences in fishing effort, it is likely that the level of take in the EFP is a number between the two estimates from the Hawaii- and Atlantic-based SSLL fishery. The final ITS developed for this action is five leatherbacks, of which a post-hooking mortality rate of 15 percent, or one leatherback, is anticipated.

As explained above in section 3.4.1.1, the exposure analysis provided here has relied primarily upon observer records from the DGN fishery operating primarily off the coast of California, with limited effort off the coast of Oregon and a ban on DGN gear in waters off of Washington State. Records from the experimental thresher shark DGN fishery in the EEZ off Washington were examined for rates of impacts on sea turtles. While no sea turtles were observed in 1986 and 1987, the first two years of the experiment, with very low levels of observer coverage (less than 6 percent per year), logbook entries from the fishery indicate one leatherback taken in 1986. Perhaps most striking is the level of observed leatherback takes was in 1988: 13 leatherbacks taken in 68 observed sets, yielding a CPUE of 191.2 leatherbacks per 1,000 sets (the estimated leatherback CPUE, north of Point Conception, is 7.7 turtles per 1,000 sets). The reason for the high CPUE cannot be explained with the limited data available at the time of this writing, but high densities of leatherbacks are suspected to exist around the Columbia River plume (between Washington and Oregon). As described in section 3.2.1.1 for marine mammals, if SSLL sets are made in the waters off Washington, anticipated effects on sea turtles, particularly leatherbacks, may be different than those presented in this analysis. The preferred alternative restricts fishing to south of 45° N. latitude.

Loggerhead Sea Turtles

In order to determine whether or not loggerhead sea turtles may be affected by the proposed action, observer records were reviewed along with an extensive review of the literature on loggerhead distribution within the North Pacific. Loggerhead sea turtles have not been observed incidentally taken in the DGN fishery north of Point Conception. All but one observed takes of loggerheads occurred during years in which an El Niño had been declared and all but two occurred with the SCB, as described in the proposed action, there will be no SSLL fishing in the SCB under this EFP. The observed takes in the DGN fishery are likely related to oceanographic conditions and its effects on the distribution of loggerheads. The waters off Baja California, Mexico, have been identified as a key feeding area for juvenile and sub-adult loggerheads that feed on their primary prey, red crab, which are found in high concentrations in coastal warm waters off Baja. Observer records from the DGN fishery strongly suggest that juvenile loggerheads only move into the waters off California during El Niño years and are generally found within the SCB, where SSLL fishing will not occur under the proposed action. However, to better understand the distribution of loggerheads throughout the Pacific and particularly differences in the likelihood of exposure in the proposed SSLL fishery and the Hawaii-based SSLL fishery, a review of the recent literature was done.

Recently, satellite tracking of loggerheads has provided insights into their behavior and distribution in the Pacific. Loggerheads exhibit shallow dive patterns with more than 90 percent of their dives within the top 40 meters of water (Polovina, *et al*. 2004), which is similar to the hook depth range of the proposed fishing gear (hook depths of 40–45 meters below the water's surface). Genetic analysis of loggerheads that may be exposed to the longline gear indicate that they are likely to be from nesting beaches in Japan (95 percent) and Australia (five percent) and forage off Baja California (Bowen, *et al*. 1995) and the Central North Pacific. Satellite tracking of loggerheads indicates that loggerheads occupy a wide range of SST from 15–25 degrees C while in the Central North Pacific, although tracks of turtles within narrowly defined temperature bounds were also observed (Polovina, *et al*. 2004). The published temperature range is within the stated preferred water temperature for fishing under the proposed action. However, based upon recent satellite tracking and ongoing studies it does not appear that the waters of the West Coast EEZ are utilized by loggerheads. Satellite tracking indicates that loggerheads tagged and released from North Pacific fisheries and from Japan travel in the North Pacific Transition Zone (NPTZ) and the Kuroshio Extension Current perhaps spending years as juveniles feeding in these large Pacific currents (Polovina, *et al*. 2004, 2006). Satellite tracks of juvenile loggerheads in the NPTZ end at approximately 130° W. longitude (Polovina, *et al*. 2004), which is the eastern boundary of the Subarctic and Subtopical gyre in which the NPTZ is found. This area is east of the proposed action area and on the western edge of the California Current. It has been speculated that when the gyre meets the south-moving California Current, objects in the gyre, including juvenile loggerheads, are moved into the waters off Baja (Nichols, *et al*. 2000). After spending years in the nearshore environment feeding, loggerheads head back across the Pacific to nesting beaches in Japan and Australia. Limited satellite tracking of loggerheads tagged in Baja indicate a due east movement that suggests that they may be utilizing the subtropical front at 25–30° N. latitude (Nichols, *et al*. 2000).

Due to a lack of satellite tags of loggerheads east of 130° W. longitude, a review of observer records from the California-based SSLL fishery outside the EEZ and stranding records were reviewed for indications of loggerheads in the proposed action area. The California-based SSLL was observed for three years and loggerhead takes observed, with high concentrations between 140–150° W. longitude. Data from the Hawaii-based SSLL fishery, observed from 1997–2001, were also reviewed. The total record of observed SSLL sets in the California-based and Hawaii-based SSLL fisheries is 586 sets. In this data set, there were no observed takes at or east of 130° W. longitude (NMFS observer program). To further assess the likelihood of interactions between the proposed SSLL and loggerheads, observer records were reviewed for loggerhead strandings. The majority of strandings occurred in counties bordering the SCB (i.e., Los Angeles, Orange, and San Diego counties). Less than five strandings were recorded north of the SCB. This is consistent with oceanographic differences between the two areas, with warmer waters to the south of Point Conception and colder waters to the north. The available data suggests that while loggerheads may be occasionally found in waters north of Point Conception and outside the SCB, it is considered quite rare based upon fishery observer records, stranding records observer records, along with the preferred temperature range identified for the species. Taken together this information strongly suggests that loggerheads are unlikely to be found in the proposed action area and are unlikely to be affected by the proposed action.

Green Sea Turtles and Olive Ridley Sea Turtles

There has been only one observed take of a green turtle and one observed take of an olive ridley in the DGN fishery since 1990. Generally, both green and olive ridley sea turtles are found in warm waters, greater than 18 degrees C, which is warmer than the targeted SST identified by the applicant. Further, the only observed takes of these species both occurred in southern California during a period of a warm water intrusion from Baja California, Mexico, that is believed to have brought individual sea turtles into the SCB. Take of these two sea turtles species in fisheries in the West Coast EEZ is extremely low, particularly in the areas of the proposed action, outside the SCB, where SSTs are generally lower than the preferred temperatures for green and olive ridley sea turtles. It is unlikely that green or olive ridley sea turtles would be affected by the proposed action.

3.4.2.2 Other Actions Contributing to the Baseline Condition of Sea Turtles

Anthropogenic and non-anthropogenic effects on leatherback sea turtles include poaching of eggs, killing of females at nesting beaches, human encroachment on nesting beaches, incidental capture in fishing gear, beach erosion and microclimate-related impacts at nesting sites (e.g., loss of trees due to deforestation near nesting sites on beaches can cause sub-optimal incubation conditions for eggs in nests), egg predation by animals, and low hatchling production (Tapilatu and Tiwari 2007). In the case of leatherbacks, a number of actions have occurred in recent years to provide better protection of females at nesting beaches, protect eggs and hatchlings from poaching, and limit direct take of leatherbacks as food. Many of these efforts, particularly in the Western Pacific, have occurred over the past five to fifteen years (WPFMC 2006). The NMFS Southwest Regional Office funds several sea turtle conservation projects each year, depending on the available funding. In 2007, the office provided funds to: (1) War Mon Smolbag Theatre for monitoring and protecting leatherback nesting beaches in Vanuatu; (2) ProPeninsula for outreach and education efforts and proactive work in the establishment of a loggerhead refuge area in Baja California, Mexico; (3) Aquatic Adventures for support towards experiments to reduce sea turtle bycatch in gillnets and longlines; and (4) Earth Resource Foundation for support towards outreach in southern California to reduce the introduction of plastic into the marine environment. The effects of these actions may not yet be observed in the population, since leatherback and all sea turtle populations are tracked by counting nesting females and the age at sexual maturity averages 13 to 14 years old (Zug, *et al*. 2002). (Recent work in the Atlantic by Avens and Goshe (2007) suggest that leatherbacks may not reach sexual maturity until they are at least 20 years old, although there has been no comparable recent analysis in the Pacific, so the estimated age to 13 to 14 years old is considered appropriate for Pacific leatherbacks). Given the late age of sexual maturity and nesting, effects of past actions may take longer to detect in nesting female populations.

Fishery Effects

Leatherback sea turtles are subject to take in U.S.-based fisheries and international fisheries. The following U.S. fisheries are known to take leatherbacks: the Hawaii longline fishery (shallow- and deep-set); the Hawaii handline, troll, pole and line fishery; and the West Coast DGN fishery. For each of these fisheries, Section 7 consultations have been conducted and the cumulative anticipated takes under the current incidental take statements is 33 takes annually, of which there are projected to be 10 mortalities annually. In the Hawaii-based SSLL fishery, which has 100 percent observer coverage, a turtle cap is imposed upon the fishery; if 16 leatherbacks are incidentally taken, of which two are expected to result in mortalities, the fishery must close. On March 20th, 2006, the Hawaii-based SSLL fishery was closed after reaching the loggerhead sea turtle cap of 17 takes. Only one leatherback sea turtle was observed taken before the fishery closed. For all other fisheries, if the take of leatherbacks or other sea turtles in the fishery exceeds the incidental take statement, re-initiation of consultation is required and if necessary emergency rules can be implemented to close the fishery to protect ESA-listed species.

A U.S. West Coast-based DSLL fishery has recently developed that may take leatherback, loggerhead, green, and olive ridley sea turtles. In an initiation package developed to begin Section 7 consultation on this component of the HMS FMP, it was estimated that up to six vessels may participate in this fishery, setting approximately 800,000 hooks per year. This level of effort results in an estimated take of one leatherback in three years, one loggerhead in three years, and annually one green turtle and three olive ridley sea turtles. NMFS has conducted a Section 7 consultation on this action and determined that the estimated levels of take will not result in jeopardy to these species.

Very few international fisheries have observer programs; therefore, takes of sea turtles in most fisheries is unknown. It is difficult to quantify effects since so little is known about the leatherback takes, including which populations, Eastern Pacific or Western Pacific, these takes may be affecting. A complete review of fisheries that are known to take, or may take, leatherback sea turtles is provided in the 2004 NMFS biological opinion on the HMS FMP (NMFS 2004c). The Japanese tuna longline fishery and the coastal setnet and gillnet fisheries in Taiwan are known to incidentally take a low number of leatherbacks; they are cumulatively estimated to take less than 30 animals annually. The Eastern Tropical Pacific purse seine tuna fishery has a requirement of 100 percent observer coverage on large vessels, which make up 66 percent of the fleet. Observer records indicate that only one leatherback was observed taken in this fishery (Kondel 2006).

One of the biggest fishery impacts on Pacific sea turtles is from various tuna longline fisheries (Kaplan 2006). It is difficult to quantify the impacts on leatherbacks of the foreign tuna longline fleet in the Central and Western Pacific. Observer levels are very low, less than one percent, and there are no observers in Japanese, Korean, or Australian distant water fisheries (NMFS 2004c). From these low observer rates, it has been estimated that 2,182 sea turtles are taken, and 500–600 turtles killed, annually in the various tuna longline fisheries in the Central and Western Pacific (NMFS 2004c). The species taken, in order of highest to lowest occurrence, are: olive ridley, green, leatherback, loggerhead, and hawksbill (NMFS 2004c).

Non-fishery Effects

As described above, a number of non-fishery anthropogenic actions may affect leatherbacks: poaching of eggs; killing of females at nesting beaches; human encroachment on nesting beaches; incidental capture in fishing gear; beach erosion and microclimate-related impacts at nesting sites (e.g., loss of trees due to deforestation and sub-optimal incubation conditions for eggs in nests); egg predation by animals; and low hatchling production. There are also natural phenomena that may affect leatherbacks that are detailed in the following paragraphs.

The affects of climate on sea turtles are just beginning to be studied and are largely speculative. Nonetheless, long-term changes in climate could have a profound effect on leatherbacks and other sea turtles. Changes in temperature (rising air temperatures) may affect nesting success; very high temperatures while eggs are incubating in the sand may kill the offspring. The sex of turtles is temperature dependent; eggs incubated at higher temperatures produce more females while eggs incubated at lower temperatures result in more males. Increased air temperatures may result in a bias of the sex ratio of offspring, which over the long-term could lead to reduced fecundity (insufficient males to fertilize eggs). Thus, while the number of nesting females may be stable or increasing, the eggs may not be viable or the hatchling output may not produce a balanced sex ratio necessary for future successful reproduction.

The climate may also affect turtle nesting habitat. Long-term climate change (e.g., rising average temperatures) will likely result in rising sea levels due to loss of glaciers and snow caps coupled with thermal expansion of warming ocean water which may lead to the loss of usable beach habitat (Baker, *et al*. 2006). Similarly, short-term climate variability may cause an increase in storm or tidal activity that can inundate nesting sites, causing loss of habitat. Studies suggest that leatherbacks do not have the same high level of nesting site fidelity as hard shelled turtles, so they may be able to better adapt to the loss of habitat by seeking out new nesting areas.

Oceanographic changes due to climate may also affect leatherback sea turtle prey availability, migration, and nesting. Leatherbacks that may be exposed to the SSLL EFP are believed to travel across the Pacific for large concentrations of prey, particularly jellyfish. Short-term variability in climate such as the El Niño Southern Oscillation (ENSO) may limit prey due to a reduction in upwellings brought by warm surface waters and limited or no wind (Peterson, *et al*. 2006; Benson, *et al*. 2006). Over the longer term, climate models suggest a number of possible changes in oceanographic conditions, including the slowing down of the thermohaline circulation, higher precipitation storms, rising sea surface temperatures, and rising sea levels (IPPC 2001). Also, as temperature patterns change in oceans, current foraging habitats may shift (McMahon and Hays 2006). It is believed that leatherbacks migrate along ocean currents and it is possible that currents may change along with other oceanographic features (USFWS 2005). There is already evidence to suggest that some sea turtles' re-migration periods are being affected by variations in SSTs (Chaloupka 2001; Solow, *et al*. 2002).

Additional studies will be necessary to determine how climate may be affecting leatherbacks and the entire marine eco-system in the Pacific and elsewhere. The possible effects are included here to provide a very brief review of possible effects and areas of necessary additional study in the field.

Finally, the effects of the December 2004 tsunami have been reported in a report by the signatory States to the Indian Ocean and Southeast Asia Marine Turtle Memorandum of Understanding (IOSEA). The report's assessment of effects on leatherbacks in the region is briefly summarized here. The tsunami hit the northern coast of Indonesia, the country with perhaps the largest nesting populations of leatherbacks. However, the area hit was not a major nesting area. Low nesting densities have been observed in Sumatra, but nesting does not occur in December. The tsunami did not hit the area where leatherbacks in Malaysia nest. A number of research and conservation centers in Thailand were lost (including the loss of two young volunteers). A small number of leatherbacks nest in the winter along the Indian Ocean in Thailand. Eggs from nests laid before and after the tsunami likely did not survive. Reports in the media shortly after the tsunami suggest that in the long-term there may be some benefits to sea turtles, as previously developed beaches have returned to conditions closer to pristine. New building regulations may prevent the development of these beaches, thus adding to usable nesting habitat, but at this point such suggestions are speculative. Research is planned by conservation groups in Thailand to assess the longer-term effects of the tsunami on nesting and foraging of sea turtles in the area. In India, all leatherback nests laid were likely lost to the tsunami (which occurred during the nesting season). Some of the most important nesting sites have been severely damaged, although new nest sites may develop due to the creation of new beaches. The longer-term effects of the tsunami are at this point speculative, but loss of nesting habitat is a clear concern, along with loss of beach vegetation (vegetation helps prevent beach erosion and provide shade to nest sites). The effects of the tsunami on foraging habitats in all areas are not known, although loss of seagrass, mangroves, and coral reefs have been reported. Fortunately, the major leatherback nesting areas were not affected by the tsunami. Perhaps the greatest loss is within the research and conservation community, which lost not only members, but also facilities, data, and animals. Most organizations are currently trying to re-build their operations.

3.4.3 Other ESA-listed Species

There are other ESA-listed marine animals in the West Coast EEZ. With respect to marine finfish that may occur in the pelagic environment where the proposed action will occur, these are various runs, or evolutionarily significant units (ESUs), of salmon and steelhead. As discussed in section 3.3.3.1, the likelihood that any salmon would be taken by SSLL gear is extremely remote. All other ESA-listed species that may be affected by the proposed action have been described in the preceding sections or in section 3.5.

3.5 Seabirds

Due to the nature of pelagic longline operations and the fishing area under consideration for the proposed action, the only seabirds potentially impacted by this proposed fishery are the black-footed albatross (*Phoebastria nigripes*), the laysan albatross (*P. immutabilis*) and the short-tailed albatross (*P. albatrus*). The brown pelican (*Pelecanus occidentalis*) and cassin's auklet (*Ptychoramphus aleuticus*) also occur in the proposed action area, but are not likely to be adversely affected, as these species are not known to interact with pelagic longline fishing gear and nighttime setting will reduce the chance these species will interact with the gear.

3.5.1 Fishing-related Sources of Mortality

3.5.1.1 Pelagic Longline Fishing in the United States

U.S.-based pelagic longline swordfish and tuna fisheries in the vicinity of the Hawaiian Islands have the potential to affect albatrosses. NMFS observer records from 1994–2000 (based on four percent observer coverage) estimate an average take of 1,380 black-footed albatross and 1,163 laysan Albatross per year. No takes of short-tailed albatross in any U.S.-based pelagic longline fishery have been reported. The Hawaii-based swordfish longline fishery was closed by court order in 2001 due to concerns over incidental catch of sea turtles. Seabird incidental catch decreased significantly with the fishery closure. The swordfish fishery based in Hawaii was reopened on a limited basis in 2004, with requirements to conduct sets beginning no earlier than one hour after local sunset and ending deployment no later than one hour before local sunrise, use large 18/0 circle hooks, and carry 100 percent observer coverage. In addition, all swordfish-target sets are to use thawed and blue-dyed bait. Observers have documented 10 black-footed albatross and 71 laysan albatross captured in this fishery since it reopened in 2004, with 2,133,096 hooks observed.

The Hawaii-based tuna, or deep-set pelagic longline fishing vessels, are not required to use any seabird deterrents when fishing south of 23° N. latitude, generally south of the southernmost short-tailed albatross observations in Hawaii. When fishing north of 23° N. latitude, these vessels are required to use a line-setting machine, minimum 45 gram weights on branch lines, thawed and blue-dyed bait, and strategic offal discharge.

3.5.1.2 Trawl Fishing in the United States

U.S.-based trawl fisheries also have the potential to affect albatrosses. In some trawl fisheries, sonar equipment mounted on the trawl net transmits sonar data to the vessel via a “third wire” or “net sonde” cable. Seabirds attracted to offal and discards from trawl vessels may either strike the hard-to-see cable while in flight, or get caught and tangled in the cable while they sit on the water. USFWS is currently investigating the possibility of seabird collisions with U.S.-based trawl fishing gear, both with third wires and with warp cables (the larger diameter, more visible cables running to the trawl doors).

3.5.2 Non-fishing-related Sources of Mortality

USFWS lists current non-fishing threats to short-tailed albatross as: catastrophic events at breeding colonies, climate change and oceanic regime shift, contaminants, air strikes, disease/parasitism, predation and other natural factors, invasive species, and other human activities (USFWS 2005). Black-footed albatross and laysan albatross experience many of the same threats as the short-tailed albatross.

3.5.3 Current Status of Seabird Populations

Three species of albatross are known to occur within the region with short-tailed albatross listed as endangered. The black-footed albatross is the most abundant albatross off the West Coast of Canada and the United States, ranging throughout the North Pacific between 20° N. and 58° N. latitude, but more eastern in its at-sea distribution than the laysan albatross (Cousins and Cooper 2000). The estimated number of black-footed albatross worldwide is approximately 290,000, of which 58,000 pairs (116,000 birds) bred in 2001–02 (USFWS 2005). The conservation status for black-footed albatross under the World Conservation Union (IUCN) criteria for threatened species is “Vulnerable,” due to an observed 20 percent or more population decrease over three generations (~45 years). While the laysan albatross is less common in the West Coast EEZ, it is the most abundant albatross Pacific-wide with an estimated 2,200,000 individuals (USFWS 2005), with centers of concentration in the Central and Western Pacific

(Cousins and Cooper 2000). Numbers of breeding laysan albatross have declined over the last five years in the two largest colonies of this species (USFWS 2005). IUCN status for the laysan albatross is "Lower Risk-Least Concern". Both the black-footed albatross and laysan albatross nest principally in the Hawaiian Islands, mate for life, and lay only one egg in a single season. The black-footed albatross occurs off the West Coast primarily from spring through fall but can be found year round; breeding birds begin returning to the Hawaiian Island chain in October. During egg-laying, incubation, and early chick feeding, which lasts from December through March, these birds are generally more concentrated near the breeding islands, although some may still travel considerable distances. The laysan albatross also occurs uncommonly off the West Coast year round, primarily in summer during the non-breeding season.

The short-tailed albatross has rarely been sighted off the West Coast of the United States or off Mexico in recent history, and has not been observed to interact with any West Coast HMS fishery. It is nonetheless highly endangered, has historically occupied West Coast EEZ waters, and will likely return to its former range as its population recovers (and may have already begun to do so). Of the 23 sightings of this species off the West Coast since 1947, 74 percent have been made in the last two decades (1983–2000) with 88 percent occurring from August–January (Roberson 2000). This temperate and subarctic species breeds only on the Western Pacific islands of Torishima and Minami-Kojima in Japan. The most recent estimate of its population includes 1,712 individuals on Toroshima and 340 individuals from Minami-Kojima (USFWS 2005). In summer (i.e., the nonbreeding season), individuals appear to disperse widely throughout the historical range of the North Pacific, with observed concentrations in the northern Gulf of Alaska, Aleutian Islands, and Bering Sea. Individuals have been recorded as far south as the Baja Peninsula and south to about 20° N. latitude off the Pacific coast of Mexico (USFWS 2000). Its current distribution may also be complicated by identification problems. For the untrained observer, even though the short-tailed albatross is the largest albatross and has an extremely large pink bill, during its various plumage stages it can be confused with black-footed albatross and laysan albatross (Mitchell and Tristram 1997). The short-tailed albatross is currently listed as Endangered throughout its range under the ESA, including U.S. waters (65 FR 46643, July 31, 2000).

3.6 Socioeconomic Environment

3.6.1 West Coast HMS Commercial Fisheries for Swordfish and Shark

Since there is currently no longline fishery within the West Coast EEZ, the discussion in this section focuses on other closely-related fisheries which target swordfish and either take place in the West Coast EEZ or land in West Coast ports. Where it is relevant, additional discussion is included on the Hawaii pelagic longline fishery for swordfish.

The socio-economic characteristics of the West Coast HMS commercial fisheries for swordfish and shark are described in sections 2.2.4–2.2.5 of the HMS FMP and section 2.0 of the September 2006 HMS Stock Assessment and Fisheries Evaluation (SAFE) report which was prepared by NMFS. Historical measures of economic performance for these fisheries are provided in section 4.1 of the 2006 HMS SAFE. Relevant portions of these descriptions are incorporated below as background on the socio-economic environment in which the EFP would operate.

Swordfish and shark are currently harvested commercially within the U.S. EEZ by two principle gear types, DGN and harpoon. In addition, swordfish are occasionally caught by anglers in the private recreational and CPFV fleets. A California-based high seas longline fishery (with effort outside the U.S. EEZ), which is allowed to land its catch in California ports, developed in the 1990s. Longline fishing effort is prohibited within the West Coast EEZ; the proposed EFP would provide an exemption to this prohibition to allow the sole applicant the opportunity to fish a limited number of sets within the West Coast EEZ.

California's commercial swordfish industry transformed from primarily a harpoon fishery to a DGN fishery in the late 1970s, and landings soared to a historical high of 286 mt by 1984. Initial development of the DGN fishery in the late 1970s was founded on catches of common thresher shark. The thresher shark fishery rapidly expanded, peaking at more than 900 mt in 1981. After 1981, swordfish became the primary target species for the fleet, because it commands a higher price-per-pound than thresher shark, resulting in a decline in reported thresher shark landings to lows of the late 1980s and early 1990s. However, common thresher is still a target species of the DGN fishery and is commonly landed with swordfish. Since 1990, annual landings and ex-vessel revenue for thresher shark have averaged 169 mt and $500,179, respectively. The number of DGN vessels landing swordfish declined from 228 in 1985 to 43 in 2004. Since 1984, annual landings and ex-vessel revenues have been declining in general, averaging 354 mt and $2.5 million, respectively.

A key question which this EFP would help address is whether longline fishing subject to gear restrictions and continuous monitoring represents an economically and environmentally superior alternative to either DGN or harpoon gear for fishing within the West Coast EEZ. The Hawaii pelagic longline fishery achieved roughly an 89 percent reduction in marine turtle bycatch per unit of longline fishing effort when use of circle hooks became mandatory in 2004 (Gilman, *et al*. 2006b). A reduction in marine turtle bycatch at a given level of fishing effort implies the potential for some combination of increased fishing effort (and target species catch) along with a reduction in marine turtle bycatch, provided target species catch per unit of effort is not adversely impacted by the gear modification.

3.6.2 United States Swordfish Demand

It is informative to consider recent changes in the share of U.S. swordfish demand that is provided by U.S. landings versus imports. Besides providing insight to the health of the U.S. commercial swordfish fishery, such statistics also shed light on changes in the amount of U.S. demand which is met by foreign landings of swordfish. Since protected marine sea turtles are migratory species, an increase in foreign swordfish landings to meet U.S. import demand could potentially have implications for the global level of marine turtle bycatch. It is also important to note that U.S. regulators cannot generally monitor nor control bycatch in foreign fleets.

U.S. annual swordfish demand is comprised of that year's U.S. landings plus imports. Annual demand reached a record high in 1998 due mainly to increased imports (table 3–16). Between 1989 and 2005, U.S. annual swordfish demand ranged from between 10,948 metric tons (mt) and 23,114 mt, averaging 16,556 mt. During this period, U.S. landings averaged 6,444 mt (about 39 percent of demand) and imports, 10,111 mt (61 percent). US landings of swordfish showed a general pattern of decline from the early 1990s through the early 2000s, with landings in 2005 of 3,039 mt at only 28 percent of the record landings of 10,851 recorded in 1993.

The share of U.S. swordfish demand supplied by landings into Hawaii and the States of Washington, Oregon, and California are 10-47 percent of total U.S. supply during 1989-2005 (table 3–16), with a lower share of the total since 2000 than before. Between 24–73 percent of U.S. swordfish landings are supplied by Pacific landings during the same period.

The share of US swordfish demand supplied by imports increased from 35 percent in 1993 to 77 percent of the total in 2005. In 2005, U.S. imports of swordfish were 10,187 mt, valued at about $77 million. Singapore, Panama, Canada, and Chile were the dominant suppliers of imports. Over the entire period from 1989 through 2005, imports increased from rough parity with U.S. landings to over three times domestic landings.

Table 3–16. U.S. annual swordfish demand, 1989-2005.

Year	U.S. Landings	Imports	Demand	Share of Demand (%) U.S. Landings	Imports
		(metric tons)-		U.S. Landings	Imports
1989	6,801	6,813	13,614	50%	50%
1990	6,993	7,476	14,469	48%	52%
1991	8,583	7,171	15,754	54%	46%
1992	9,647	6,883	16,530	58%	42%
1993	10,851	5,838	16,689	65%	35%
1994	7,404	4,379	11,783	63%	37%
1995	6,267	4,681	10,948	57%	43%
1996	6,100	5,140	11,240	54%	46%
1997	6,499	15,598	22,097	29%	71%
1998	6,832	16,282	23,114	30%	70%
1999	7,454	13,843	21,297	35%	65%
2000	8,004	14,314	22,318	36%	64%
2001	4,266	13,698	17,964	24%	76%
2002	3,930	15,712	19,642	20%	80%
2003	4,142	13,150	17,292	24%	76%
2004	2,742	10,726	13,468	20%	80%
2005	3,039	10,187	13,226	23%	77%
2006	N/A	10,334	N/A	N/A	N/A
Average(1989-2005)	6,444	10,111	16,556	39%	61%

Sources: U.S. Department of Commerce. 2007. U.S. Foreign Trade . U.S. Department of Commerce. 2007 Commercial fishery landings.

Table 3–17. Pacific swordfish landings, 1989-2005 (metric tons).

Year	Total U.S. Supply (1)	Pacific landings (2)	Pacific Share (%) of U.S. Supply (2)/(1)	Pacific Share (%) (2)/ U.S. Landings
1989	13,614	1,642	12%	24%
1990	14,468	2,831	20%	40%
1991	15,727	4,980	32%	58%
1992	16,529	6,482	39%	67%
1993	16,689	7,887	47%	73%
1994	11,783	5,065	43%	68%
1995	10,948	3,827	35%	61%
1996	11,239	3,854	34%	63%
1997	22,097	4,333	20%	67%
1998	23,114	4,653	20%	68%
1999	21,297	5,127	24%	69%
2000	22,318	5,611	25%	70%
2001	17,963	2,503	14%	59%
2002	19,641	2,035	10%	52%
2003	17,292	2,282	13%	55%
2004	13,468	1,422	11%	52%
2005	13,226	1,860	14%	61%

Sources: U.S. Department of Commerce. 2007. U.S. Foreign Trade . U.S. Department of Commerce. 2007 Commercial fishery Landings.

3.6.3 West Coast Ports Involved in HMS Fishing

Communities which would primarily benefit from any increase in commercial catch due to EFP effort would include ports along the California coast from Eureka to San Diego. Any increase in longline revenues would create an economic impact through the local economies.

Only one fisherman, the EFP applicant, would be directly impacted by the EFP, as the sole EFP participant. This fisherman has invested a great deal of time, money, and lost value of alternative employment opportunity in acquiring the human capital (fishing skills) and gear (boats, nets, etc.) whose value may only be realized through the opportunity to fish.

A key benefit of catch from the EFP would be to provide a local supply of fresh fish to area buyers and processors. Area restaurants would benefit from having a reliable local supply of fresh swordfish. The availability of fresh locally caught fish would be of particular value since the alternative is to rely on fresh swordfish imported from fisheries with potentially higher levels of protected species bycatch due to less stringent environmental regulation than U.S. EEZ fisheries (Dutton and Squires 2007).

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 Estimating Change in Efforts under the Alternatives

The impact analysis in this EA is based on estimates of the change in effort from a baseline level, or the no action alternative, that would occur under each of the action alternatives. As referenced in the description of the baseline condition in chapter 3, the quantitative estimation of potential impacts for the proposed action on target and non-target finfish can utilize in a proxy fashion observer records from two existing HMS fisheries. These fisheries are the Hawaii-based SSLL fishery for trips using circle hooks and mackerel-type bait and the California-based DGN fishery. These estimates are not ideal in the comparative sense given that the SSLL fishery, although employing almost identical gear as the proposed action, is prohibited from the coastal, more temperate waters of the proposed action; and the DGN fishery, although it overlaps to some degree the proposed action area and season, employs a non-comparable gear type. For this EA, it was deemed a better fit to utilize the Hawaii-based SSLL observer records for those trips that took place after January 2004, coinciding with the implementation of, among other measures, the mandatory use of circle hooks and mackerel bait. These trips and records match the gear and operational methods the proposed action will employ but may not fish a comparable species list and distribution based on oceanography differences between the tropical and temperate coastal habitats fished.

The applicant is unable at this time to define the exact number of hooks per set that he will deploy for a given trip or how many sets will occur, up to the maximum of 14 per trip. A range of effort estimates were drawn up based on a low estimate of 400 hooks deployed per set, a moderate or average estimate of 1,000 hooks per set, and a high estimate of 1,200 hooks per set. The moderate figure is based on the applicant's estimate of an average number of hooks that he can efficiently fish per set once he reaches full production fishing and other operational mitigating factors are catered to. The first trip and sets will most likely be expended in an exploratory fashion, given the applicants inexperience with the gear type fishing in the proposed action area. As a result, the hooks per set may start out near the low end of the range and gradually increase towards the stated average once proficiency sets in.

The impact estimates will assume all four trips will be conducted with the maximum of 14 sets per trip carried out (i.e., most liberal interpretation of potential impacts). The three EFP action alternatives include, among other mitigation measures, a set limit and catch quotas to reduce the potential take for protected species such as striped marlin. The alternatives include area constraints as well but these constraints may or may not constrict effort for the proposed action given the limited scope and window of opportunity.

4.2 Direct and Indirect Impacts of Alternative 1 (No Action)

Alternative 1, the no action alternative, represents the state of the environment if the EFP was not issued and the fishery did not occur. Chapter 3 describes the baseline environment, including past, present, and reasonably foreseeable future actions contributing to cumulative effects. The resources in question, finfish, marine mammals, sea turtles, and seabirds would continue to be affected by those other activities. Thus, chapter 3 provides a description of the effects under the no action alternative.

4.3 Direct and Indirect Impacts of Alternatives 2, 3, and 4 on Finfish

Impacts to target, non-target, and prohibited finfish species are principally reflected in increased catches of these species, which are a function of the estimates of change in effort discussed in section 4.1.

Evaluation of the consequences of the alternatives includes the entire affected environment, as described in chapter 3 of this document.

4.3.1 Evaluation Criteria

In order to evaluate the potential impact of the alternatives on the resources in question, a set of criteria were developed to help determine whether any of the alternatives are likely to result in significant adverse impacts to finfish. For the target, non-target, and prohibited species finfish interactions under the various alternatives, the following criteria are used:

- Would the alternative likely result in catch levels that would create an “overfished” or “overfishing” condition for any of the HMS FMP management unit species?

- Would the alternative likely result in catch levels that would exceed any of the management objectives of the HMS FMP?

- Would the alternative likely result in catch levels that would contribute to a substantially elevated conservation concern for prohibited species under the HMS FMP?

- Would the alternative provide sufficient monitoring to ensure that management objectives of the HMS FMP are being adhered to and that needed data elements are collected for future management decisions?

For each criterion above, the effects are measured in terms of estimated effort in number of hooks (as discussed in section 4.1) for the alternatives, and the corresponding catch based on the CPUE estimates from the Hawaii-based SSLL fishery observer data for trips utilizing circle hooks and mackerel-type bait outside the EEZ. These trips reflect the mandatory management measures instituted per the court order that re-opened the fishery and reflect the current state of affairs in the fishery today. Table 4–1 provides effort estimates in number of sets associated with the action alternatives.

4.3.2 Direct and Indirect Impacts of Alternative 2

Impacts to target, non-target, and prohibited finfish species under alternative 2 are principally reflected in increased catches of these species, which are a function of the estimates of change in effort discussed in section 4.1. Evaluation of the consequences of the alternatives includes the entire affected environment, as described in chapter 3 of this document.

Projected catches of target, non-target, and prohibited finfish species are presented in table 4–1 utilizing the Hawaii-based SSLL observer records as a proxy for trips utilizing circle hooks and mackerel-type bait outside the EEZ. As mentioned previously, it is uncertain if the proposed EFP catches will be similar to the catch rates observed in the Hawaii-based SSLL fishery given the disparate areas fished and the dissimilar oceanographic features between the more coastal, temperate California Current System and the more tropical off-shore waters near Hawaii.

Catch estimates are provided for the low (400 hooks) and high (1,200 hooks) effort estimates that the applicant supplied in the EFP application. These estimates are then multiplied across the maximum number of sets per trip (14) and total trips (4) to come up with projected maximum catch in numbers of animals. An additional column, providing catch estimates for 1,000 hooks per set, is included based on the applicant’s best guess of probable average hooks-per-set of effort once he gains experience in the fishing method and area.

The estimated impacts are addressed in the summary evaluations (section 4.3.4) for the major non-target tunas, sharks, and finfish that cover the HMS FMP objectives, among other things, of maintaining sustainable fisheries and managing fishing mortality levels based on established control rules and thresholds outlined in the HMS FMP (PFMC 2003).

Using the highest potential effort scenario (67,200 hooks), coupled with the observed CPUE estimates presented in table 4.1, the proposed action would harvest in order of magnitude an estimated 1,153 target swordfish, 850 blue sharks, 235 dorado, 105 bigeye tuna, 59 shortfin mako sharks, and 57 striped marlin. The impacts for bigeye tuna and shortfin mako sharks are discussed in the summary evaluation section (4.3.3) for these species. U.S. longline bigeye tuna catches in the Pacific are subject to an annual quota of 500 mt. The catch of bigeye tuna under this EFP would be monitored for accounting and compliance with the annual quota and would therefore be a part of conservation measures established by the IATTC and implemented by NMFS. The impacts for striped marlin are discussed under alternative 3 (4.3.2) for establishing take caps but as previously mentioned the estimated catch is very minor and unlikely to have an adverse impact on the population status. In addition, fishing would terminate under the EFP if a total of 12 striped marlin were captured thereby capping the potential harvest and population impact at a negligible amount.

The estimated harvest of swordfish represents a very minor fraction of the annual catches in the EPO. The lack of contrast in the standardized catch and effort series in the northern and southern regions of the EPO suggests that the fisheries that have been taking swordfish in these regions have not been of a magnitude sufficient to cause significant responses in the populations. In addition, catches in the region have been fairly stable since 1989, averaging about 3,700 mt in the northern region and 8,400 mt in the southern region annually. Based on these considerations, it appears that swordfish are not overfished in the northern and southern regions of the EPO (Hinton *et al*. 2004). Swordfish stocks have not been declared overfished or undergoing overfishing nor are there currently quotas or harvest guidelines in place under the HMS FMP.

There are high catch rates of blue shark in HMS fisheries targeting swordfish, including the West Coast DGN fishery and SSLL fisheries prosecuted by Hawaii-based and (in the past) California-based vessels. The use of circle hooks and other mitigation measures, as would be required under the EFP, does not appear to reduce blue shark catch rates but does appear to increase survivorship. Hawaii SSLL observer records for trips utilizing circle hooks, mackerel-type bait, and de-hooking pliers (162 trips, June-March, 2006), indicate that approximately 95 percent of captured blue sharks were released alive. Available information about the stock indicates that the North Pacific stock is not over-exploited. However, the blue shark is listed as "near threatened" world-wide by the IUCN and California CPFV skippers operating in the SCB report fewer observations of blue sharks than in previous years. This observation is supported to some degree by NMFS Shark Abundance Survey data for the years 1994-2006 (Kohin 2007). Estimated blue shark mortality under the EFP, however, would represent a small incremental increase in overall fishing mortality. The required use of a NMFS-approved shark de-hooking device as part of the mandatory EFP terms and conditions would further serve to enhance the survival of released blue sharks.

Table 4–1 Projected EFP catch (numbers of fish) using Hawaii-based SSLL observer records for trips utilizing circle hooks and mackerel-type bait outside the EEZ.[24]

Species	Projected EFP catch (no.) for trips utilizing circle hooks (h) and mackerel-type bait			
	CPUE	22,400 h	56,000 h	67,200 h
	(catch/1000 h)	400 h X 14 sets X 4 trips	1000 h X 14 sets X 4 trips	1200 h X 14 sets X 4 trips
Swordfish	17.16	384.3	960.7	1,152.9
Albacore	1.06	23.7	59.2	71.0
Bigeye tuna	1.57	35.1	87.7	105.3
Yellowfin tuna	0.16	3.7	9.1	11.0
Pacific Bluefin	0.00	0.0	0.0	0.0
Skipjack tuna	0.07	1.5	3.7	4.4
Tunas and mackerels	0.02	0.3	0.8	1.0
Blue shark	12.64	283.2	707.9	849.5
Shortfin mako shark	0.88	19.6	49.0	58.8
Unid mako sharks	0.05	1.2	3.0	3.6
Unid sharks	0.00	0.0	0.0	0.0
Bigeye thresher shark	0.02	0.5	1.4	1.6
Pelagic thresher shark	0.00	0.0	0.1	0.1
Unid thresher sharks	0.01	0.1	0.3	0.4
Striped marlin	0.85	19.0	47.5	57.0
Blue Marlin	0.18	4.1	10.2	12.3
Black Marlin	0.00	0.0	0.0	0.0
Shortbill spearfish	0.11	2.6	6.4	7.7
Unid billfishes	0.02	0.4	1.0	1.2
Pelagic stingray	0.09	2.1	5.3	6.4
Remora	0.43	9.7	24.2	29.0
Longnose Lancetfish	1.27	28.4	70.9	85.1
Snake mackerel	0.32	7.2	18.0	21.6
Unid. fish	0.02	0.5	1.3	1.5
Escolar	1.66	37.2	92.9	111.5
Dorado	3.50	78.4	196.0	235.2
Oilfish	0.23	5.1	12.8	15.4
Wahoo	0.07	1.7	4.2	5.0
Sickle Pomfret	0.13	3.0	7.5	9.0
Pacific Pomfret	0.00	0.0	0.0	0.0
Common Mola	0.01	0.2	0.6	0.7
Opah	0.08	1.8	4.6	5.5

4.3.3 Direct and Indirect Impacts of Alternatives 3

The impacts to finfish as a part of alternative 3 were previously analyzed under alternative 2 and will not be repeated here with the exception of a discussion on the impacts of establishing a catch cap for striped marlin. The option of establishing caps for selected species is discussed in chapter 2. The striped marlin

[24] Based on 161 trips and 2,133,096 hooks of observed effort.

stock in the EPO is considered currently healthy as outlined in section 3.3.2.2. However, recent ISC analyses report that the striped marlin stock biomass North Pacific-wide has declined to levels that are 6 to 16 percent of the level in 1952 and that fishing mortality should not be increased. Projected catch of striped marlin, utilizing the Hawaii-based SSLL observer records for circle hook trips as a proxy, is estimated to be 19 animals at 22,400 hooks of effort, 48 animals at 56,000 hooks of effort, and 57 animals at 67,200 hooks of effort (table 4–1). Given that striped marlin distribution and abundance increases in the more tropical waters targeted by the Hawaii-based SSLL fishery, the actual catch of striped marlin under the proposed action should be less in the more temperate, inshore habitat that will be fished in the proposed action area. An option for establishing a catch cap would be to utilize the Southern California Billfish Club catch records for recreationally caught striped marlin (see table 4–2) and select a percentage of the annual catch to be reserved as a cap that would address any concerns raised by the recreational fishing community. The catches reported in this database for the most part reflect marlin captured in the SCB, which will be a closed area under the terms and conditions of the proposed action, so direct comparisons are not possible. Given that the rationale for imposing a catch cap may be more aligned with resource user conflicts versus resource conservation concerns, establishing a specific striped marlin time/area closure is another viable option that may achieve the desired results. The peak striped marlin catches in the SCB occur in September, coinciding with a series of major recreational billfish tournaments.

Table 4–2. Striped marlin catches from the U.S. Exclusive Economic waters adjacent to the State of California recorded by major billfishing clubs and Commercial Passenger Fishing Vessels logbook data, 1976–2006.

Year	Balboa Angling Club[1]	Avalon Tuna Club[2]	San Diego Marlin Club[3]	CPFV[4]	Annual Total (number)
1976	212	53	210	7	482
1977	386	52	276	12	726
1978	169	32	505	7	713
1979	279	53	344	26	702
1980	147	24	525	58	754
1981	332	77	902	67	1,378
1982	232	51	564	33	880
1983	416	121	312	65	914
1984	502	77	155	287	1,021
1985	393	79	285	71	828
1986	173	27	196	43	439
1987	311	48	204	168	731
1988	268	17	263	134	682
1989	158	37	343	40	578
1990	293	18	150	108	569
1991	105	23	142	12	282
1992	27	49	64	25	165
1993	104	20	103	30	257
1994	152	30	174	42	398
1995	90	16	132	39	277
1996	172	10	232	21	435
1997	219	62	352	24	657
1998	147	95	149	17	408
1999	70	23	86	3	182
2000	78	29	67	3	177
2001	61	24	67	0	152
2002	23	12	12	3	50
2003	7	20	55	4	86
2004	5	26	117	4	152
2005	78	12	138	18	246
2006	176	31	161	13	381

[1]Data Source: Cathcart 2007.
[2]Data Source: Seibert 2006.
[3]Data Source: www.themarlinclub.com/Weighins/overtheyears.htm. The 2006 data are preliminary.
[4]Data Source: CDFG CFIS CPFV logbook data; 2006 preliminary.

4.3.4 Direct and Indirect Impacts of Alternative 4

The impacts to finfish as a part of alternative 4 were analyzed under alternatives 2 and 3 and will not be repeated here with the exception of the establishment of a catch cap of 12 striped marlin. If the striped marlin cap is reached the EFP will be terminated. The potentially premature termination of the EFP would have a negative economic impact on the EFP holder. The Pacific Council's recommendation for an EFP cap of 12 striped marlin was not set utilizing population-based, scientific criteria. The cap was qualitatively derived based on, among other things, competition between resource user groups (e.g., sport fishing impacts).

Alternative 4 stipulates no EFP fishing north of 45° N. latitude. This would further constrain the area of operation and equate to a reduction in the potential bycatch interactions. The EFP applicant, however, has stated that he did not intend to fish that far north.

Alternative 4 stipulates no fishing within 40 nmi of the coastline. This would further constrain the area of operation and equate to a potential reduction in bycatch interactions. Restricting the proposed action area could negatively impact the target species CPUE, but data demonstrating the available abundance and distribution of swordfish within the 10 nmi strip of water in question (i.e., between 30 nmi and 40 nmi off the coastline) are not available. Since the applicant requested the change to further restrict the proposed action area from 30 nmi out to 40 nmi, the potential negative impacts of such a request have been deemed acceptable in the overall fishing strategy being pursued.

4.3.5 Summary Evaluation

The evaluation criteria identified in section 4.3.1 are used below to summarize the overall impacts of the alternatives on finfish. The impact summary of alternatives 2, 3, and 4 are the same except for the marlin cap and de-hooker requirement under alternative 4

4.3.5.1 Risk of Overfishing

Target Species

Based on the status summary for the most recent EPO swordfish stock assessments presented in chapter 3, coupled with the relatively small increase in total effort and catch on a regional basis, the increase in swordfish catch anticipated under the proposed alternatives would most likely not trigger either an overfished or an overfishing condition. This assessment could change as more information and updated stock assessment work becomes available. This includes elucidation on the two-stock determination for the EPO Pacific swordfish stocks referenced in chapter 3, as well as incorporation of improved catch and effort data from regional large-scale commercial fisheries operating outside the United States. The combined U.S. swordfish fishery lands approximately 13 percent of the North Pacific-wide swordfish landings based on the latest tables produced by the ISC (ISC 2007). The DGN fishery lands roughly 13 percent of the U.S. swordfish catch based on Pacific Fishery Information Network (PacFIN) records for the same time period (PFMC 2006). For the alternatives proposed, the fairly small incremental increases in SSLL swordfish fishing effort would constitute a very minor fraction of the composite regional catch and effort targeting swordfish.

Non-target Tunas

Based on the most recent stock assessments, coupled with the relatively small increase in total effort and catch on a regional basis, the increase in major non-target tuna catch under the action alternatives would not trigger either an overfished or an overfishing condition with the exception noted for bigeye and yellowfin tuna. The Pacific Council and NMFS are undergoing action as required by the MSA to reduce fishing mortality below an identified threshold (the default being F_{MSY}) for these two species. Because these stocks have a wide distribution and the majority of catches are made outside of U.S. waters by vessels from other nations, management measures intended to end overfishing will be implemented through the RFMO framework (see section 4.3.5.2).

In the case of the North Pacific albacore tuna stock, RFMO regional resource conservation resolutions have been passed requiring member nations, including those identified in this document that fish for North Pacific albacore, to cap the effort of their fishing fleets targeting albacore. The United States as a member nation and party to these resolutions, is developing a plan of action to meet this obligation. That plan is in the early stages at this point.

Non-target Sharks

Based on the available stock status and summary information presented in chapter 3 of this EA, coupled with the relatively small increase in total effort and catch on a regional basis, the increase in major non-target shark catch under the proposed alternatives would not trigger either an overfished or an overfishing condition.

Other Non-target Finfish

None of the major non-target finfish species taken in the SSLL fishery, such as pelagic stingrays and common molas, are regularly monitored for stock status. Very little is known about their population dynamics, but there does not seem to be a resource conservation concern at this time. These factors would suggest that the major non-target finfish catch under the action alternatives would not trigger either an overfished or an overfishing condition.

4.3.5.2 Failure to Meet HMS FMP Management Objectives

Target Species

The HMS FMP management objectives for swordfish are, among others, those embodied in the goal of the MSA, namely to ensure the long term sustainability of fisheries and fish stocks by halting or preventing overfishing and by rebuilding overfished stocks. A detailed description of the control rules for these HMS FMP management unit species and objectives are presented in the 2003 HMS FMP/FEIS (PFMC 2003, Ch 3) and will not be repeated here.

Non-target Tunas

The HMS FMP management objectives for albacore, yellowfin, bigeye, bluefin, and skipjack tuna stocks are, among others, those embodied in the goal of the MSA, namely to ensure the long term sustainability of fisheries and fish stocks by halting or preventing overfishing and by rebuilding overfished stocks. Based on stock status and summary information presented in section 3.3.2, the alternatives proposed would not at this point conflict with any HMS FMP management objectives taking into account the domestic and international processes under way to address the overfishing conditions that exist for bigeye and yellowfin tuna. RFMO conservation measures have been put in place to reduce the catch and effort for bigeye and yellowfin tuna and they include, among other things, an annual catch quota of 500 mt for the U.S. domestic longline fishery and seasonal closures for the purse seine fishery, including U.S. vessels that target tuna.

Non-target Sharks

Common Thresher Sharks

A harvest guideline of 340 mt has been established under the HMS FMP for common thresher shark catch. Utilizing the SSLL observer records as a proxy (table 4–1), the anticipated catch of common thresher shark under the proposed action is negligible. The catch of all thresher sharks using the highest estimated effort of 62,700 hooks, is equal to two sharks. However, common thresher sharks may be more available within the U.S. West Coast EEZ than on the high-seas where the Hawaii-based SSLL fishery operates.

Based on the catch estimates projected for the action alternatives, the HMS FMP harvest guideline of 340 mt would not be exceeded by the estimated catch of common thresher shark under the most liberal effort scenario. If, however, the estimated private boat recreational catch of thresher shark is factored into the equation, the overall harvest guideline could be exceeded for the proposed alternatives under consideration. These private boat catch estimates, however, must be used with caution due to the high variances and potentially biased catch estimates (PFMC 2006, p.20).

Shortfin Mako Sharks

A harvest guideline of 150 mt has been established under the HMS FMP for shortfin mako shark catch. Utilizing the SSLL observer records as a proxy (table 4–1), the anticipated catch of shortfin mako shark under the highest effort scenario for the proposed action (67,200) is estimated to equal 59 animals. The average round whole weight for shortfin mako sharks caught within the action area, derived from length-weight conversion formula (Kohler, *et al*. 1996), and utilizing at-sea observer measurements for makos captured in the DGN fishery is estimated to be approximately 37 kgs. Multiplying the average weight of 37 kg by 59 mako sharks gives an estimated catch of approximately 2.2 mt.

The average DGN catch of shortfin mako shark for the period 2001–2005 is approximately 35.2 mt (PFMC 2006). Summing the estimated catch under the proposed action results in a total catch estimate of 37.4 mt. This does not exceed the HMS FMP harvest guideline of 150 mt. As noted in regards to the common thresher and blue sharks estimates, private recreational boat catch is not well documented but could contribute a significant component of the overall shortfin mako catch. These private boat catch estimates, however, must be used with caution due to the high variances and potentially biased catch estimates (PFMC 2006, p.20).

Other Non-target Finfish

There are no HMS FMP management objectives, outside of the aforementioned MSY control rules for HMS management unit species, for the major non-target finfish that may be captured under the proposed action.

4.3.5.3 Elevated Conservation Concern for HMS FMP Prohibited Species

Given the low interaction rates and catch probabilities, coupled with the single vessel and maximum set effort limitation under the proposed action, the impacts on prohibited species are not likely to substantially elevate conservation concerns for the species in question.

4.3.5.4 Sufficient Monitoring

The EFP monitoring protocol requires 100 percent observer coverage for all trips and observer protocols require monitoring the entire set and haul-back sequences. Each observer would also be provided a satellite phone by NMFS to ensure adequate communication with NMFS while at sea. As such, there would be more than an adequate amount of monitoring in place to ensure that HMS FMP management objectives are adhered to for the proposed action.

4.4 Direct and Indirect Impacts of Alternatives 2, 3 and 4 on Protected Species

4.4.1 Evaluation Criteria

In order to compare the alternatives, the following questions were developed by which to judge the effects of each alternative:

1. Would the anticipated level of marine mammal take under the alternative result in average annual mortalities equal to or greater than a stock's Potential Biological Removal (PBR)?

2. Would the anticipated level of marine mammal take under the alternative result in average annual mortalities equal to or greater than 10 percent of a stock's PBR?

3. Would the anticipated level of sea turtle take under the alternative result in mortalities that would exceed the existing incidental take statement (ITS) for the HMS FMP?

4. Would the anticipated level of sea turtle mortality under the alternative have a measurable impact on the population?

Given the limited data available, the evaluation of the alternatives is necessarily qualitative and based upon the best available information at this time.

In section 3.4, an exposure analysis was conducted to determine which protected species (marine mammals and/or ESA-listed species) have the highest risk of exposure, and effects on protected species under the proposed action. In this exercise, the alternatives were not differentiated as the three action alternatives reviewed by the Council are very similar in terms of protected species impacts. The only difference is that alternative 3 includes caps on various marine mammal and sea turtle species to be established by the ESA Section 7 consultation and alternative 4 contains species caps on striped marlin, short-finned pilot whale, and leatherback sea turtles. In addition, alternative 4 prohibits fishing under the proposed EFP north of 45° N. and within 40 nmi of shore (other alternatives prohibited fishing within 30 nmi). As described in section 3.4, it is difficult to project the species that may be affected by the proposed action due in large part to a lack of direct information from a longline fishery within the proposed action area, the West Coast EEZ. Based upon the available information it is believed that small numbers of a few marine mammal species may be taken during the proposed action; these include: California sea lions, northern elephant seals, short-beaked common dolphins, Risso's dolphins, northern right whale dolphins, and Cuvier's beaked whales. In addition, it is likely that leatherback sea turtles may be taken in the fishery, although it is considered unlikely that other sea turtle species will be taken.

In order to assess what may happen to animals that encounter the SSLL gear, observer records from other longline fisheries were reviewed. In the California SSLL fishery, outside the EEZ, three marine mammals have been observed entangled in gear (two Risso's dolphins and one unidentified dolphin), and one was killed. In the Hawaii-based SSLL fishery since 2004, all of the marine mammals were recorded as injured and one killed. It must be noted that the format of the information does not provide a means of recording an uninjured animal released unharmed and analysis on serious injuries has not yet been conducted. In the Hawaii-based SSLL fishery targeting swordfish prior to 2004, there were 16 observed entanglements of marine mammals. The species observed taken were Risso's dolphin, short-finned pilot whale, sperm whale, spinner dolphin, bottlenose dolphin, and short-beaked common dolphin. Ten of the 16 takes were considered serious injuries, 1 was a mortality (at time of entanglement) and 5 of the entanglements were not serious injuries (Forney 2004), thus over two-thirds of the entanglements resulted in serious injuries or mortalities. In the Atlantic, the mortality/serious injury rates varied among marine mammal species, but were on average around 50 percent (NMFS 2006a). This rate of serious injury/mortality may serve as the best estimate available for this analysis. The rate of immediate sea turtle mortalities in the Hawaii-based SSLL is zero (Gilman, *et al*. 2006c) and less than 1 percent in the Atlantic-based SSLL fishery (Fairfield-Walsh and Garrison 2007). The post-hooking mortalities have been standardized by NMFS and are described below.

4.4.2 Direct and Indirect Impacts of Alternative 2

It is not possible to quantify the number of marine mammals of each species that may be affected by the proposed EFP, as described in previous sections. However, based upon marine mammal take rates in other SSLL fisheries and the biology, abundance, and distribution of the species, the number of individuals taken is likely to be quite low, likely in the range of one to ten depending on the species and their responses to the gear. As described in section 3.4.1.1, toothed whales and some dolphins may depredate on bait or hooked fish but not become hooked or entangled in the gear. If some marine mammal species begin a pattern of depredation, the likelihood of entanglements may increase, although in some longline fisheries, much of the catch may be consumed in water by marine mammals often with very low levels of actual entanglements or hookings (Gilman, *et al*. 2006a). Large whales may also become entangled in the gear. Based upon observed rates in other SSLL fisheries, it is estimated that approximately 50 percent of marine mammals takes (entanglements or hookings) in the proposed fishery would result in a serious injury/mortality.

To evaluate the effects of alternative 2 on marine mammals, the current average annual mortalities/serious injuries and related PBRs were examined for those species considered most likely to interact with the proposed fishery. As shown in table 4–3, none of the species that have been identified as most likely to be taken in the fishery are from stocks with low PBRs. The species considered most likely to be affected by the proposed action were estimated based upon the relative abundance of the species, records of take in the DGN fishery (similar to the proposed fishery spatially and temporally), observed takes in other SSLL fisheries, and the behavior and distribution of the stocks.

Table 4–3. The PBRs and most recent annual serious injury/mortalities estimates for marine mammal stocks considered most likely to be affected by the proposed action (Carretta, *et al.* 2007)

Species/stock	PBR	Average annual mortality/serious injury
California sea lion	8,333	1,562
Northern elephant seal	2,513	≥88
Short-beaked common dolphin	3,656	93
Risso's dolphin	115	3.6
Northern right whale dolphin	164	23
Cuvier's beaked whales	11	0

As shown in table 4–3, none of the six stocks are being taken in fisheries at a level of average annual mortality/serious injury close to its PBR. However, two of the six marine mammal stocks, CA/OR/WA northern right whale dolphins and California sea lions, have average annual mortalities that are greater than 10 percent of their PBR. Ten percent of PBR has been defined in policy by NMFS as the zero mortality rate goal (ZMRG), which is the goal of each U.S. fishery under the MMPA. If mortalities of northern right whale dolphins or California sea lions occur during fishing under this alternative, any mortalities or serious injuries would move these stocks further from the MMPA goal of ZMRG. However, as described in section 3.4.1, it is possible that neither California sea lions or northern right whale dolphins will encounter the SSLL gear based upon the lack of observations of these species in the offshore areas of the west coast EEZ (they are more often observed within 40 nmi of shore). Also, as previously discussed, most interactions between small cetaceans and longline gear involve depredation, or feeding on the bait or catch on the longline hooks. Neither mackerel or swordfish are identified as a preferred prey for northern right whale dolphins, so it may be unlikely that depredation by this species would develop.

Given the paucity of information available for the exposure analysis and the dynamic nature of the marine environment, it is not impossible that takes of other marine mammal species may occur during the proposed SSLL EFP fishery. Table 4–4 lists the marine mammal stocks that may be exposed to the fishery which have very low PBRs along with the current average annual mortality estimates.

Table 4–4. Marine mammal stocks with low PBRs that could be affected by the proposed action (Carretta, *et al*. 2007).

Species/stock	PBR	Average annual mortality/Serious injury
Short-finned pilot whale	1.2	1
Sperm whale	1.8	1
Humpback whale	2.3	≥1.6

Takes of these three whale species within the proposed action area are quite rare based upon NMFS observer program data from the DGN fishery (see table 3–12 for years 1990-2005; for 2006 and thus far in 2007, there have been no takes of short-finned pilot, humpback or sperm whales). Short-finned pilot and sperm whales have been observed killed and seriously injured in the DGN fishery, with some incidents of multiple animals taken during one set; humpback whales have been observed entangled in DGN gear but have been released alive and not seriously injured (NMFS SWR observer program unpublished data). In the Hawaii-based SSLL, two short-finned pilot whales have been seriously injured or killed in the SSLL fishery prior to 2004. Two sperm whales have been observed taken in the Hawaii-based SSLL; one sperm whale was observed entangled in gear but was not seriously injured, that is, the animal was able to free itself without trailing gear (Forney 2004). The other was taken during an experimental SSLL fishery in 2002, but an assessment of the severity of its injuries could not be made (Carretta, *et al*. 2007). There is one account of a humpback whale being taken in the Hawaii-based SSLL (February 2006) although no assessment of its condition was made. There are three accounts of longline interactions with humpback whales in Hawaii in the deep-set tuna longline fishery. All have been provisionally determined to have been not seriously injured, although a final assessment has yet to be published (Forney 2006; Forney 2004). If, during the course of fishing under the EFP, a marine mammal is hooked or entangled, removing all gear would be one step the applicant could take to ensure that the animal is not considered seriously injured. Generally, if trailing gear is left on a marine mammal the interaction is considered a serious injury (Angliss and DeMaster 1998).

The uncertainty over possible takes in the EFP fishery make it possible that short-finned pilot whales, sperm whales, or humpback whales could be taken at a level that could cause the average annual mortality/serious injury to exceed or approach the stock's PBR. Based upon the best available information, it is not expected that these species would be taken by the proposed EFP fishery, although the likelihood of short-finned pilot whales interacting with the SSLL gear may be higher during an El Niño year or during a period of warm water, as described in section 3.4.

Regarding the second question, if mortalities or serious injuries of California sea lions, or northern right whale dolphins occur, the take would exceed 10 percent of PBR for those stocks, however, takes of these two species is considered quite unlikely.

The likelihood of take of most sea turtle species under the proposed action is quite low. Based upon observer records from the DGN fishery, other SSLL fisheries, and the biology and distribution of the species, a small number of leatherbacks may be exposed to and affected by the proposed action. To evaluate the likelihood of leatherback mortalities, a review of Hawaii observer records since the implementation of mitigation measures in 2004 was reviewed and is provided in table 4–5.

Table 4–5. Changes in sea turtle hookings observed in Hawaii-based SSLL fishery, before and after implementation of bycatch mitigation measures in 2004.

Turtles observed taken	Deeply hooked	Ingested hook	Lightly hooked	Entangled
Before regulations				
Leatherback (n=31)	0	10%	84%	6%
Hardshelled (n=180) Loggerhead (n=163)	60%	0	38%	2%
After regulations				
Leatherback (n=10)	0	0	100%	0
Loggerheads (n=27)	0	22%	63%	15%

As shown in the table, changes in the hook type (18/0 circle hooks with a 10 degree offset and mackerel bait) resulted in substantial changes in the way the animals were hooked. While the reason for the change in hookings is still under investigation, the results are encouraging, particularly for hardshelled turtles (i.e., loggerhead, olive ridley, green, and hawksbill sea turtles). See Gilman, *et al*. (2006d) for a review of longline gear experiments being conducted around the world.

Observer records from the Hawaii-based SSLL after regulations indicate that all leatherbacks hooked (n=10), were alive and lightly hooked. All species of sea turtles taken in the Hawaii-based SSLL fishery following the 2004 regulations were alive when brought to the vessel (i.e., no immediate mortalities from drowning on SSLL gear) (Gilman, *et a*l. 2006c). Leatherbacks lightly hooked with all gear removed have a post-hooking mortality rate ranging from 10 to 15 percent. If the hook is not removed and gear is left on the leatherback, post-hooking mortality rates range from 15 to 40 percent (Ryder, *et al*. 2006). In the Hawaii-based SSLL fishery 30 percent of leatherbacks were released without any gear attached, and 70 percent were released with gear attached (Gilman, *et al*. 2006c). In the Hawaii-based SSLL fishery, 17 loggerheads were lightly hooked and six were deeply hooked. Of these 23, 19 were released without any gear (post-hooking mortality rate of 5 to 10 percent) and 4 were released with gear still attached (Gilman, *et al*. 2006c) (post-hooking mortality rates of 10 to 30 percent; Ryder, *et al*. 2006; figure 4-6). There is insufficient detail in the records from the Hawaii-based SSLL to link the observed takes to the post-hooking mortality matrix. Therefore, a larger data set with greater detail, the NED experiments on modified gear, was considered for estimating mortality rates.

In the NED experiment, with 100 percent observer coverage, most leatherbacks had most, if not all gear removed and most were externally hooked (i.e., hooked in the shoulder, flipper, or shell), which reduces the likelihood of post-hooking mortalities, compared to swallowed hooks (Fairfield-Walsh and Garrison 2007; Watson, *et al*. 2005). Interestingly, approximately one third of the leatherbacks incidentally taken in the Atlantic-based SSLL fishery were entangled, while none of the leatherbacks observed in the Hawaii-based SSLL fishery were recorded as entangled. This may simply be related to the differences in sample sizes, observed takes in the Hawaii-based SSLL fishery over three years is 10; observed takes in the Atlantic were 103 (NMFS 2004). If it is assumed that the larger sample size better reflects the nature of the interactions between leatherbacks and SSLL gear, then the calculated leatherback post-hooking mortality rate is estimated to be 15 percent (NMFS 2004). The low rate of post-hooking mortality is likely due in part to the nature of the hookings (externally hooked) and removal of trailing gear. It is reasonable to assume that a similar situation will occur in the SSLL EFP if proper sea turtle mitigation measures are applied; therefore, anticipated post-hooking mortality associated with the five takes is one leatherback.

Table 4–6. Post-hooking mortality rates of hardshell and leatherback sea turtles in longline gear.

Nature of interaction	Released with hook and line ≥ half the length of the carapace	Release with hook and line < half the length of the carapace	Release with all gear removed
Hooked externally with or without entanglement	20 (30)	10 (15)	5 (10)
Hooked in lower jaw with or without entanglement	30 (40)	20 (30)	10 (15)
Hooked in cervical esophagus, glottis, jaw joint, soft palate, or adnexa with or without entanglement	45 (55)	35 (45)	25 (35)
Hooked in esophagus at or below level of the heart with or without entanglement	60 (70)	50 (60)	n/a
Entanglement only	50 (60)	50 (60)	1 (2)
Comatose/resuscitated	n/a	n/a	60 (70)

Note: Hard shelled rates are outside of parenthesis. Leatherback rates are in parenthesis.

It must be stressed that as incidental takes are difficult to correlate with any particular variable or change in the SSLL fishery gear in Hawaii (Gilman, *et al*. 2006c) it is highly unlikely, but not impossible, that other species may be hooked and/or higher numbers of animals may be hooked, entangled, or killed as a result of this fishery. For example, 77 percent (202 of 264) of all turtles observed captured in the Hawaii-based SSLL fishery (4,261 sets observed) were caught alone, with the remaining 23 percent caught in clusters of two or more turtles caught in a single set (Gilman, *et al*. 2006c), thus it is possible that one set of SSLL gear could result in the take of multiple turtles. The weight of available evidence supports the exposure analysis and estimated low levels of impact on turtle species, but given that there is no direct data on this fishery, the actual effects may differ from those presented here.

Table 4–7. Incidental take statement for sea turtles for the HMS FMP

Species	Entanglement	Mortality	Conditions
Leatherback	3	2	All years
Loggerhead	5	2	During El Niño years
Green	4	1	SST in fishing area similar to Nov 1999
Olive Ridley	4	1	SST in fishing area similar to Nov 1999

Turning to the question of whether anticipated takes of sea turtles are likely to result in mortalities higher than the current HMS FMP ITS (table 4-7), the current ITS for leatherbacks is three turtles likely to be taken annually with two mortalities in the HMS fishery (i.e., in the existing DGN fishery). If the patterns of encounters observed in the Hawaii-based and Atlantic-based SSLL fisheries are applicable to the SSLL EFP, then few leatherbacks would be expected to be caught and of those, none are expected to be immediately killed. Only a small percentage of hooked turtles would be likely to die, post hooking, as a result of injuries. It is conservatively estimated that up to five leatherbacks may be taken in the SSLL

EFP. If not more than two or three leatherbacks were entangled or lightly hooked and all gear removed, then the probability of a mortality would be very low. However, if more leatherbacks are taken, as could occur without a take cap, the likelihood of mortalities increases. Due to the uncertainties surrounding the probability of leatherback takes, it cannot be stated that total mortalities from this proposed fishery will reach or exceed the existing ITS. Without a limit on the amount of take, it is also difficult to determine what the number of mortalities may be and how this may affect the Western Pacific leatherback population.

The indirect effects of this alternative on marine mammals and sea turtles are likely to be quite minor. The gear configuration (long branchlines and limited hooks between each float) makes it likely that hooked marine mammals and sea turtles will be able to swim to the surface. The long-term effects of animals being hooked and released from fishing gear are not well known, but it is generally believed that animals released with all gear removed and no other injuries, do not suffer from debilitating long-term effects (Angliss and DeMaster 1998; Ryder, *et al*. 2006). It is likely that any animals incidentally taken during this proposed fishery will have all gear removed before being released.

4.4.3 Direct and Indirect Impacts of Alternative 3

The substantive difference between the three action alternatives is that under alternative 3 take caps could be imposed on the EFP to limit the take or mortality of selected species. At their April 2007 meeting, the Council used information provided in this section to develop caps on protected species. The analysis of those caps is provided in section 4.4.4 on the preferred alternative. Because this section was utilized by the Council during their decision making and development of their preferred alternative, it remains in this EA.

4.4.3.1 Take Caps for Marine Mammals

This alternative's impact on marine mammals is essentially the same as the impacts described under alternative 2, although this alternative would include caps, which could provide greater certainty in terms of impacts on protected species. Table 4–8 provides a list of marine mammal species with low PBRs that may be affected by the proposed action and species that have been identified by the Council in past actions as species of concern.

Table 4–8. Marine mammals with low PBR values and/or Council species of concern.

Species/stock	Average annual serious injury/mortality*	PBR
Short-finned pilot whale	1	1.2
Sperm whale	1	1.8
Humpback	≥1.6	2.3
Fin	1.4	15
Gray	7.4	442
Minke	0	5.9

*See Carretta, *et al.* (2007) and Angliss and Outlaw (2006) for more details; ESA-listed species are in italics.

As noted in the exposure analysis in section 3.4.1, humpback whales and sperm whales have been observed entangled in longline gear in areas other than the proposed action area (e.g., all of the observed humpback whale interactions occurred in the SCB, outside the proposed action area). Utilizing CPUEs from the Hawaii-based SSLL fishery, and applying these to the level of effort defined in this action, suggests that the likelihood of take of either of these species is very low. Although given the rarity of these events, quantitative analysis must be viewed with caution due to the very limited data to estimate future takes having a high level of uncertainty associated with the predictions. A review of the Atlantic-based SSLL observer records indicates that no takes of ESA-listed marine mammals (other than in the NED experiment) have been observed or anticipated in the fishery (NMFS 2004d). Given these two fisheries as examples of the probability of interactions with the SSLL gear and what is known of the proposed action, it is considered unlikely that these two ESA-listed species will be encountered during the SSLL EFP fishery.

As shown in table 4–8, two marine mammal stocks have annual average serious injury/mortalities close to their PBRs: humpbacks and short-finned pilot whales. In order to ensure that the total average annual serious injury/mortalities of these stocks does not exceed its PBR, the most precautionary approach is to implement a cap on the number of seriously injured or killed individuals from the CA/OR/WA stock of short-finned pilot whales and ENP stock of humpback whales. However, assessing serious injury may be difficult at sea. The current protocol requires that observers record as much information as possible from an entanglement event with marine mammals and take photographs if possible. The SWFSC would review the record and determine if any injuries resulting from the entanglement should be considered a serious injury (defined as an injury likely to lead to mortality). In the Hawaii-based SSLL targeting swordfish, the majority of observed marine mammal takes (11 of 14) were either serious injuries or mortalities (Forney 2004). The Council may therefore choose to take a precautionary approach and assume that most marine mammal takes could result in a serious injury or mortality and set caps at incidental takes.

Although caps are not specified under this alternative, it is possible to qualify the relative impacts of this alternative on the marine mammals stocks from which the take(s) may occur. As noted in table 4–8, there are a number of marine mammal stocks with very low PBRs and three of these have been observed in the DGN fishery, which operates in approximately the same time and area as the proposed SSLL EFP fishery. If caps are implemented for these stocks, there is greater certainty that average annual serious injury/mortalities would not exceed the stock's PBR.

Turning to the questions developed to analyze the impacts of the alternatives on marine mammals, if the Council decides to implement caps on selected marine mammal stocks, based upon the material presented in this section, this alternative offers greater certainty that serious injury/mortalities of marine mammals resulting from this proposed action would not exceed 10 percent of the stock's PBR and/or exceed the total PBR for certain stocks.

4.4.3.2 Take Caps for Sea Turtles

As noted above, it is difficult to estimate the likely bycatch of sea turtles under this proposed action; however, based upon observer records from the Hawaii-based SSLL fishery, the Atlantic-based SSLL fishery, and the California- and Hawaii-based SSLL fishery in the high seas near the West Coast EEZ, along with the known biology and distribution of sea turtles that may be in the proposed action area, the level of take is expected to be low (five or less leatherbacks) with consequent low levels of post-hooking mortalities. The exposure analysis in section 3.4 suggests that only a small number of leatherbacks may be affected by this action. Loggerheads could be affected, although this is considered very unlikely based upon the known distribution of loggerheads and records of bycatch. Loggerhead takes are more likely during El Niño events or periods of unusually warm water (NMFS 2001) and current climate models from the National Weather Service Climate Prediction Center[25] indicate that La Nina conditions are expected through the end of 2007 and into early 2008. Also, as described in preceding sections, the likelihood of loggerheads being affected by the proposed fishery is extremely low in part due to the proposed action

[25] http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.html

area, which excludes the SCB. Take of green and olive ridley sea turtles is not anticipated (as described in section 3.4.2.1), so the only take cap that may be set, consistent with the ITS developed by NMFS, is for leatherback sea turtles.

Similar to the analysis of this alternative for marine mammals, setting turtle take caps provides greater certainty that the level of impact on sea turtles is minimized, although impacts are expected to be low. As described above, records of interactions from various SSLL fisheries provide the best insight into the effects of the fishery on individual turtles (e.g., the ways in which turtles may be hooked, immediate mortality rates, etc). A review of those records suggests that take levels will be low and mortality rates will be very low. NMFS has conducted a Section 7 consultation on the Council's preferred alternative which included the recommendation that turtle caps be adopted into this EFP, consistent with the incidental take statement. NMFS anticipates that up to five leatherbacks will be taken under fishing operations authorized by the proposed EFP and that of these five, one turtle is likely to die, post-hooking, due to its injuries. NMFS determined that the turtles most likely to be affected by this action are adult and sub-adult leatherbacks. NMFS determined that the loss of one adult or sub-adult leatherback sea turtle is not likely to jeopardize the continued existence of endangered leatherback sea turtles or their recovery in the wild. The proposed action is likely to result in leatherback takes and mortalities that exceed the existing ITS for the HMS FMP, but would not be likely to cause a measurable adverse impact on the Western Pacific leatherback population or the species globally (as listed on the ESA).

The indirect effects of this alternative would be the same as those described for alternative 2 in section 4.4.2.

4.4.4 Direct and Indirect Impacts of Alternative 4 (Preferred Alternative)

The Council's preferred alternative, alternative 4 is the most precautionary of the four considered by the Council and is likely to have the least direct impact on protected species. The caps imposed on the number of striped marlin (12 for the duration of the EFP) may affect the level of effort in this EFP fishery. It is a reasonable presumption that reductions in the effort and areas fished make it less likely that protected species would be incidentally taken and/or killed by the proposed action.

Another key element that may reduce impacts on protected species is the prohibition on fishing north of 45° N. latitude. As described in section 3.4.2, levels of incidental takes, particularly of leatherback sea turtles, may be higher in the waters off northern Oregon and Washington. Although some limited DGN fishing did occur in the waters north of 45° N. latitude, the bulk of the effort occurred to the south of this area, thus the analysis done utilizing patterns of exposure from the DGN fishery, is most applicable to the proposed action area of the preferred alternative.

It is difficult to evaluate the impacts of moving the inshore boundary of the proposed action area to 40 nmi offshore, rather than 30 nmi offshore (north of Point Conception). The fishing area south of Point Conception, outside the SCB, remains unchanged. Because many marine mammals utilize waters closer to shore for feeding and migration, it is likely that moving the fishing activity farther offshore will reduce the likelihood of marine mammal interactions. However, most of the dolphin species considered most likely to be affected by the action are distributed across with entire West Coast EEZ, beyond 40 nmi from shore. Northern right whale dolphins have a more coastal distribution than other dolphin species; therefore, moving the fishing activity farther offshore may reduce the likelihood of interactions. Similarly, California sea lions have most often been surveyed close to shore, so moving the fishing activity farther offshore is likely to reduce the likelihood of interaction, although both California sea lions and elephant seals have been observed taken in the DGN fishery farther than 40 nmi from shore. Cuvier's beaked whales and Risso's dolphins are distributed across the entire West Coast EEZ, so the change in the proposed action area is not likely to significantly affect their likelihood of exposure. The distribution of leatherback sea turtles within the proposed action area is less well known than that of marine mammals. It is known that leatherbacks utilize nearshore neritic waters (generally within 30 miles of shore) for foraging in parts of central California (Benson, *et al*. 2007). It is possible that by moving fishing activities farther from known leatherback foraging areas, that the likelihood of entanglement is reduced, at least within the waters closest to the nearshore foraging area. However, there is insufficient data on leatherback habitat utilization throughout the West Coast EEZ to state this with certainty.

The take cap of one short-finned pilot whale may limit effort in the SSLL EFP fishery. As described previously, it is unlikely that a short-finned pilot whale will be incidentally taken in the SSLL EFP fishery. However, this cap ensures that the mean 5-year take of this stock in fisheries does not exceed the current PBR of 1.2.

The USFWS consultation resulted in a cap of one short-tailed albatross. Similar to the other take caps proposed under this alternative, there may be indirect benefits to other protected species due to a limitation on the level of effort.

With regard to the questions developed as criteria for determining significance of the alternatives, the possible constriction of effort imposed by the various take caps under this alternative may have a direct benefit on short-finned pilot whales (by limiting the take to one animal) and indirect benefits to other marine mammals, by limiting fishing effort. Although low numbers of marine mammals are expected to be taken in the SSLL EFP fishery (based upon records from other fisheries), constraining effort will presumably lessen the likelihood of exposure to this gear. This, in turn, will make it less likely that takes of individuals from stocks will exceed the stocks' PBRs, or 10 percent of PBRs.

If effort under this alternative is not constrained due to hitting caps of striped marlin, short-finned pilot whale or seabird species, then up to five leatherbacks may be taken with an anticipated mortality, post-hooking, of one leatherback. As described above in section 4.4.3.2, a Section 7 consultation was conducted on the preferred alternative and NMFS determined that the anticipated level of leatherback take and mortality associated with this proposed action is unlikely to jeopardize the continued existence of endangered leatherback sea turtles. This level of mortality would exceed the current ITS for the HMS FMP, however, is unlikely to have an adverse impact on the Western Pacific leatherback population. This assumes that post-hooking release of gear is consistent with performance in the NED experiments, that is, all or most trailing gear is removed, entangled leatherbacks are complete disentangled, and hooks are removed, when possible.

NMFS may consider additional measures that may increase the likelihood of successful release of hooked animals, as well as, make recommendations on areas that may be avoided in order to limit the likelihood of interactions between SSLL gear and protected species.

4.5 Direct and Indirect Impacts of Alternatives 2, 3, and 4 on Seabirds

Seabird impacts of alternatives 2, 3 and 4 are calculated using the applicant's proposed average EFP effort level (56,000 hooks) along with seabird interaction rates from the Hawaii shallow-set pelagic longline fishery from 2004 to 2006. The Hawaii longline fishery switched to nighttime setting in 2004. During this period, observers recorded 10 black-footed albatross and 71 laysan albatross captured in 2,133,096 hooks observed. Zero short-tailed albatross have been observed caught in the Hawaii pelagic longline fishery. Using these take rates, the proposed action would be expected to take one black-footed albatross, two laysan albatross, and zero short-tailed albatross. An ITS does not exist for black-footed albatross or laysan albatross, since these species are not listed under the ESA. The 2004 USFWS BO on the HMS FMP does not expect that short-tailed albatross would be taken by any of the HMS fisheries.

The effects of this proposed action on seabirds are consistent with the USFWS Opinion. Any take caps imposed under alternative 4 would further serve to limit impacts of the proposed action on seabirds.

4.6 Direct and Indirect Impacts of Alternatives 2, 3, and 4 on the Socioeconomic Environment

4.6.1 Introduction

NEPA regulations define the human environment "to include the natural and physical environment and the relationship of people with that environment" (40 CFR 1508.14). In examining the socioeconomic effects of longline EFP alternatives, benefits, costs, and economic impacts are evaluated by comparing the estimated impact under each EFP alternative to the level under the baseline or no action alternative. Primarily qualitative analysis of the socioeconomic impacts of EFP alternatives is provided, as the proposed fishery did not exist historically and hence there are no data on which to base a quantitative assessment. Cost and earnings data from the California high seas longline fishery are used to gauge the potential scale of the economic impacts, but should not be interpreted as predictive for what would occur under the proposed EFP, as many relevant factors would likely differ between the proposed EFP and the high seas longline experience. Otherwise—particularly with regard to indirect effects, and non-consumptive and non-use values associated with EFP alternatives—socioeconomic evaluations of management alternatives are primarily theory-informed, qualitative descriptions (Herrick, *et al*. 2003).

Benefit-cost analysis concerns the change in net benefits resulting from the various EFP alternatives that would be realized by society as a whole, known as welfare effects. Benefits are measured by willingness to pay and costs are opportunity costs or the value of the next best alternative. These are primarily quantified here through measures of economic producer surplus (anticipated economic benefits to society of increased effort under the EFP alternatives).

Net economic benefits primarily consist of economic producer surplus, which on an individual commercial fishing vessel basis is the difference between gross ex-vessel revenues and all fishing costs, including labor costs for captain and crew and a return to the vessel owner. The net economic benefit also includes consumer surplus, which is the net value of finfish products to the consumer. The net benefit to the consumer is the difference between what the consumer actually pays and what they are willing to pay, i.e., the value to the consumer over and above the actual purchase price or the total consumer willingness to pay less the amount actually paid. Producer surplus can increase through decreases in unit harvesting costs (improved economic efficiency), or an increase in ex-vessel prices received. Consumer surplus can increase through a decrease in prices paid, increases in the quantities consumed, or improvements in product quality. If the inputs used to harvest fish and the resulting landings are traded in competitive markets, then theoretically, consumer and producer surplus can be measured or approximated by market demand and supply curves.

Financial impacts relate to the potential consequences of the action alternatives on the financial well being of small entities. This concerns changes in profitability, i.e., changes in firms' cost and earnings. For small organizations (such as small-scale commercial fishing enterprises), concern is with the potential impact of the action alternatives on their economic viability. In the case of small government jurisdictions, the impacts deal with how the action alternatives would affect the income and expenditures of public authorities.

4.6.2 Evaluation Criteria

The evaluation criteria employed to assess economic consequences of the action alternatives, including the proposed EFP and regulatory changes, to the human environment have both a quantitative component and some qualitative components. The former involves the use of an estimate of potential effort together with the observed range of profits per unit of effort from the California high seas longline fishery to produce a corresponding estimate of producer surplus. The latter involves a number of considerations, addressed below in this section.

A separate estimate of producer surplus was not developed for alternatives 3 or 4, as there is no means of quantifying the effect of the additional species protection measures contemplated under alternatives 3 or 4. However, the direction of the effect is clear, as any changes made under alternatives 3 or 4 could only serve to reduce allowable effort relative to the level of allowable effort permitted under alternative 2. In particular, the take caps contemplated under alternatives 3 and 4 could result in earlier termination of effort than would occur under alternative 2, while the area restriction imposed under alternative 4 would potentially limit effort that could otherwise occur in the restricted area. Thus the producer surplus estimates under alternative 2 can be interpreted as upper limits on what could be achieved under alternatives 3 or 4.

4.6.3 Direct and Indirect Impacts of Alternatives 2, 3, and 4

Direct economic effects of changes in economic production are normally measured by the change in producer surplus, an economic concept intended to measure the net benefit of changes in production, which is calculated as the difference between the anticipated increase in revenues less the anticipated increase in costs due to a change in the level of production effort. In the case of the proposed longline EFP, two measures of producer surplus were taken into consideration: economic producer surplus and financial producer surplus. Financial producer surplus is the estimated increase in producer revenues less the estimated increase in pecuniary costs under each alternative. Economic producer surplus adjusts the financial producer surplus downwards to reflect the opportunity cost of alternative potential sources of income. For instance, if the participating fisherman expected to earn a net profit of $100,000 in longline fishing but could earn $80,000 in alternative employment over the same period, his financial producer surplus would be $100,000 while his economic producer surplus would be $20,000.

Estimates of potential financial producer surplus are presented in table 4–9. The producer surplus estimates scale with estimated EFP effort. Economic producer surplus estimates are not produced, due to a lack of information about the sole participant's opportunity costs of participation, but they would generally be lower that the levels of financial producer surplus. The financial producer surplus estimates are sensitive to the assumed level of profitability of $6 per hook, which may be unrepresentative of what would occur under the proposed EFP.

Indirect effects of the EFP would potentially include downstream effects on fish processors who would purchase and process the catch, and on consumers who would benefit from an additional supply of locally caught fresh swordfish.

Table 4–9. Estimates of potential longline EFP effort

Effort (No. of Hooks)	Sets per trip		
Hooks per set	6	10	14
400	9,600	16,000	22,400
1,000	24,000	40,000	56,000
1,200	28,800	48,000	67,200

The California-based high seas longline costs and earnings survey was used to obtain an estimated range of variable financial profits per longline hook, which was roughly between $2 and $10 when adjusted to 2007 dollars. Effort was multiplied by an assumed level of variable financial profit per longline hook of $6 to estimate potential financial producer surplus, as shown in table 4.10 below:

Table 4–10. Estimates of potential financial producer surplus

Financial Producer Surplus	Sets per trip		
Hooks per set	6	10	14
400	$57,600	$96,000	$134,400
1,000	$144,000	$240,000	$336,000
1,200	$172,800	$288,000	$403,200

The estimates in the above table may be adjusted to any other assumed level of financial profit $x per longline hook by ratioing (multiplying by x/6); for instance, to scale up to estimated variable financial profit at $10 per hook, multiply any of the table entries by 10/6 = 5/3. For comparison purposes, it should be understood that the estimates of financial producer surplus are based on experience from the California-based high seas longline fishery over the years from 2001–2004, which may not accurately represent what would occur under the proposed EFP for many different reasons:

1. Fuel costs are likely higher currently than they were in the earlier period;
2. Travel distances (and hence travel costs) from port to fishing grounds would likely be lower for the EFP than they were for the high seas fishery;
3. The sole EFP participant's decisions about where and when to fish would have an uncertain and unquantifiable impact on profitability;
4. Differences in fishing conditions, environmental conditions and skipper skills between the high seas longline fishery observer sets and the experience which could occur under the EFP would have an uncertain and unquantifiable impact on profitability.

There are a number of further considerations which should be taken into account when considering the likely economic impact of the EFP. These are considered in turn below.

- Economic producer surplus takes into account the private opportunity cost to the EFP participant of longline effort in conjunction with this EFP, compared to whatever other use of his time was available. Since there is no way to objectively predict a single individual's private opportunity cost of time, no effort to explicitly measure economic producer surplus is made here, other than to mention that it would adjust downward from the level of financial producer surplus.

- Participation in the EFP is based on the sole participant's willingness to assume the risks and potential rewards of participating. Standard results in economics suggest that a rational individual will only enter into such an arrangement if the anticipated economic value of doing so (including any nonmarket value involved) exceeds the costs. The participant's willingness to participate and bear the economic risks involved with implementing the EFP and providing valuable data about the potential for longline fishing to serve as an economically and environmentally favorable alternative to other swordfish gear should be taken into consideration.

- The fishermen who have devoted time and financial resources to learn to fish with specialized gear and skills cannot fully replace the value of lost opportunity in their optimum fishing environment with less suitable opportunities of equal value elsewhere. The indirect positive effects of the EFP on the value of the participant's specialized skills and gear (human and physical capital) are not quantified in the analysis, but work in the direction of an increase in economic value of allowing the EFP to proceed.

- The positive indirect effect of revenues and local catch to downstream industries is not covered in the analysis, but is considered below in the discussion of affected fishing communities.

- Non-market value plays a hidden role in the participation decision, as part of the decision to undertake an occupational endeavor is based on a tradeoff between relative enjoyment of the work and pecuniary remuneration. As pointed out above, the participant presumably would not willingly enter the EFP if he had another more attractive employment opportunity, taking nonmarket values into account.

- A potential loss of nonmarket existence value of protected species affected under EFP alternatives 2, 3, and 4 could work against the economic gains under the EFP. However, this effect is ambiguous, due to the unknown and unmeasured indirect impact of changes in EFP effort on the global level of endangered and threatened species take. When the protected species as well as the target species are migratory, as with endangered leatherback turtles and swordfish, a curtailment of fishing effort in the West Coast EEZ may lead to an export of consumption demand for the target species to other fisheries which would otherwise be satisfied by U.S. production. Evidence presented in Bartram and Kaneko (2003) and in Sarmiento (2006) suggests that an increase in U.S. longline effort could potentially result in both greater fishing opportunity for U.S. fishermen, and a reduction in the global level of marine turtle bycatch, if the increase in U.S. catch offsets swordfish caught and imported to the United States from other fisheries with less stringent environmental protection measures and monitoring.

- There is potentially an increase in value to the U.S. economy associated with increased access to the global swordfish stock through an increase in U.S. EEZ effort to harvest swordfish which would otherwise be harvested by foreign fleets. Some of this foreign harvest will be imported back into the United States to replace the potential longline-caught swordfish, but the value of the resource is lost to the U.S. economy, with less certainty or control over the level of migratory protected species bycatch.

- Based on an April 2007 assessment, the Monterey Bay West Coast Seafood WATCH[26] program has listed U.S. domestic longline-caught swordfish as a "Good Alternative" from the standpoint of whether the fisheries which caught them are "healthier for ocean wildlife and the environment." By contrast, Seafood WATCH places imported longline caught swordfish on their "Avoid" list since there are no integrated international laws to reduce bycatch and these international longline fleets are contributing heavily to the long-term decline of threatened or endangered species such as sea turtles and seabirds. By contrast, due to strict bycatch regulations and management oversight in the U.S. domestic longline fleet, swordfish from our domestic fleet is listed as a "Good Alternative".

- Observer costs of the EFP theoretically should be included as a reduction in economic producer surplus, at an approximate cost of slightly over $1000 per day at sea. However, the cost of observer coverage is mitigated to an unknown degree by a gain in nonmarket value due to the added assurance that not too many protected species interactions will occur under the EFP, plus an important opportunity for NMFS to obtain relevant information as the basis for future management decisions.

Indirect effects of the EFP would potentially include downstream effects on fish processors who would purchase and process the catch, and on consumers who would benefit from an additional supply of locally caught fresh swordfish.

[26] http://www.mbayaq.org/cr/SeafoodWatch/web/sfw_regional.aspx

4.6.4 Summary Evaluation

The estimated economic surplus is positive but may be unrepresentative of what would occur under the EFP due to the inability to reliably predict what level of profit per unit of effort would occur. By any reasonable objective standard, the direct impact of the EFP would be limited and small, given the sole participant and the tight limit on the level of allowable effort.

4.6.5 Fishing Communities Involved in the Longline EFP (Including Buyers/Processors)

Socioeconomic impacts of alternatives 2 and 3, and 4 on affected communities would be realized by: (1) the commercial fishing sector (harvesters, processors and consumers); (2) the recreational fishing sector (charter/party boat operators, charter/party boat patrons and private boat anglers); (3) the non-consumptive use sector (e.g. recreational divers); (4) non-use sectors (protectionists and preservationists); and, (5) fishing communities. Because there is a sole participant who would be limited to a total of four trips, any impact on affected communities would be small and of limited duration.

The primary affected communities of concern are the members of the recreational fishing community and members of the non-use sector (protectionists and preservationists). The 12-fish marlin cap under alternative 4 is used to address recreational fishermen's concern that marlin take may be excessive. Alternative 2 requires gear and fishing practice restrictions to address protected species bycatch concerns, and alternative 3 and 4 propose protected species take caps to further limit bycatch concerns. Alternatives 2, 3, and 4 limit effort to four trips, with further limits on the numbers of sets per trip and the number of hooks per set.

4.7 Summary of the Impacts of the Alternatives

The effects of the alternatives are briefly summarized here, considering the analysis in sections 4.2–4.6 and the description of baseline conditions in chapter 3, which allows consideration of cumulative effects.

4.7.1 Alternative 1 (No Action)

As noted above under no action, the conditions described in chapter 3, without the incremental effect of fishing under the EFP, would prevail. There is currently no West Coast-based SSLL fishery either inside or outside the EEZ.

4.7.2 Alternative 2

The following finfish-related issues are highlighted:

- There are high catch rates of blue shark in HMS fisheries targeting swordfish. The use of circle hooks alone does not appear to appreciably reduce blue shark catch rates but it does appear to lead to increased survivorship (Kerstetter and Graves 2006; Gilman, *et al*. 2006b). The switch from squid bait to mackerel type bait, however, has shown to reduce blue shark catch rates in longline experiments conducted in the Atlantic (Watson, *et al*. 2005). Hawaii SSLL observer records for trips utilizing circle hooks indicate approximately 95 percent of captured blue sharks are released alive (Gilman, *et al*. 2006b). Estimated blue shark mortality under the EFP, utilizing circle hooks and mackerel type bait, would represent a small incremental increase in overall fishing mortality.

- Using the Hawaii SSLL data as a proxy, an estimated maximum of 59 shortfin mako shark may be caught using the highest effort scenario. The catch rate could be higher if fishing occurs near the SCB or in surrounding waters because the area is a known juvenile nursery habitat for mako sharks. High recapture rates for tagged juveniles show that newly born mako sharks may remain in the SCB and surrounding waters for about two years, after which they appear to move offshore or to the south (Leet, *et al*. 2001). Shortfin mako shark catch rates in the DGN fishery are estimated to be 0.4 animals per set south of Point Conception and 1.2 animals per set north of Point Conception based on NMFS observer records.

- No catches of common thresher shark are expected based on the Hawaii SSLL catch rates and less than two thresher sharks of any species would be expected to be caught. However, given the fishing area and catch rates in the DGN fishery, the EFP would most likely result in higher catches than expected based on the Hawaii SSLL data. Thresher shark catch rates in the DGN fishery are an estimated 5.3 animals per set south of Point Conception and 8.5 animals per set north of Point Conception based on NMFS observer records, keeping in mind that the catches south of Point Conception include fishing inside the SCB which is out of the proposed action area for this EFP.

- The striped marlin stock is currently not listed as overfished or experiencing an overfishing condition, but the recreational fishing community has raised a concern about commercial catches and the potential for local depletion. Using the Hawaii SSLL data as a proxy, an estimated 57 striped marlin may be caught using the highest effort scenario. It is uncertain whether catch rates in the Hawaii fishery would reflect those in West Coast EEZ waters. Striped marlin catch rates in the DGN fishery are an estimated 0.006 animals per set south of Point Conception and 0.08 animals per set north of Point Conception based on NMFS observer records. Anecdotal information suggests that striped marlin are able to avoid drift gillnets to some degree so the DGN estimates should be viewed with caution in regards to an abundance and/or presence/absence indicator.

- Several non-target tuna stocks are being overexploited. A Secretarial determination has been made that bigeye and yellowfin tuna are experiencing overfishing and the Council is responding to this status. The IATTC and WCPFC have adopted resolutions calling on member parties not to increase fishing effort on North Pacific albacore. Overfishing of bigeye and yellowfin tuna is principally a result of catches in the tropical North Pacific by fleets from other nations, especially the purse seine sector targeting floating objects. Addressing overfishing requires action at the regional level through the IATTC. The United States abides by conservation measures adopted by the Commission and the EFP would be subject to any such applicable measures.

The following protected species issues are highlighted:

- The results of the exposure analysis presented in section 3.4.1 suggests that a small number of marine mammals—most likely the California sea lion, northern elephant seal, short-beaked common dolphin, Risso's dolphin, Cuvier's beaked whale, and northern right whale dolphin—may be affected by the EFP fishery. Fishing under the proposed EFP is not expected to result in mortalities or serious injuries to these stocks which would exceed the stock's PBR, although serious injury and/or mortality of California sea lions and northern right whale dolphins would cause the take of animals from these stocks to move further from ZRMG (10 percent of PBR). Marine mammal stocks with very low PBRs—short-finned pilot whales, sperm whales, and humpbacks whales—could be incidentally taken during fishing under the proposed EFP, although this is considered very unlikely.

- Of sea turtles, leatherbacks are the most likely to be affected by the proposed action. Anticipated take levels are low and mortality rates are expected to be only a fraction of anticipated takes (10–15 percent if all of the gear is removed and the animal is lightly hooked, which is likely based upon observer records from the Hawaii-based SSLL fishery and experiments conducted in the Atlantic). Loggerhead sea turtles could be incidentally taken during fishing under the proposed EFP, but this is unlikely due to their distribution. In addition, the only observed takes of loggerheads in the DGN fishery have occurred nearshore during El Niño years, most often in the summer, when it is believed that the range of red crabs (a prey species) expands into southern California. Current information does not suggest the occurrence of El Niño conditions during the time period of the EFP.

No concerns were raised with respect to incidental mortality of seabirds.

The EFP would result in modest gains in terms of producer and consumer surplus. The estimated economic surplus is positive but may be unrepresentative of what would occur under the EFP due to the inability to reliably predict what level of profit per unit of effort would occur.

4.7.3 Alternative 3

Alternative 3 differs from alternative 2 in the imposition of additional mitigation measures. The following issues are highlighted with respect to alternative 3:

- Use of a long-nosed de-hooking device (required under this alternative) was shown to increase survival rate of blue sharks, the major non-target species (O'Brien and Sunada 1994). The impact of this requirement on the commercial viability of fishing is expected to be negligible.

- A catch cap for striped marlin could be imposed to address concerns raised by the recreational fishing community. The cap could be based on a proportion of annual average recreational striped marlin catch (based on fishing club records) or the anticipated catch using Hawaii SSLL data.

- Catch caps could have been considered for those marine mammals most likely affected by the EFP, based on the exposure analysis presented in chapter 3. Those species with very low PBR values would have been given greater consideration than those species with relatively high PBR values. As noted previously, the Council used the information provided in the analysis of this alternative to develop take caps in their preferred alternative.

- A catch cap could have been considered for leatherback sea turtles. Based on the conservative exposure analysis a cap of up to five turtles is considered reasonable. Mortality rates associated with this gear type are low and dependent upon how the animal is hooked. Anticipated post-hooking mortality rate for this action is approximately 13 percent; therefore, of the up to five leatherbacks that may interact with fishing operations, only one is expected to die as a result of the interaction. As with marine mammals, the Council used the analysis of this alternative in crafting its preferred alternative.

- The requirement to set the gear at night would substantially reduce incidental catch of seabirds and conservation concerns are likely to be negligible.

- Additional mitigation measures, such as caps, represent a tradeoff against the financial and economic returns of the EFP. Establishing caps increases the likelihood that the EFP would be terminated before the maximum number of sets proposed by the applicant was deployed, representing some level of forgone income.

- Early termination due to caps would also limit the amount of data gathered through this EFP; more data would allow more accurate estimates of the likely effects of any future longline EFP of this type as well as determining if a longline fishery could eventually replace the DGN fishery.

As indicated, the principal mitigation measure under this alternative is the imposition of catch or take caps. The analysis of alternative 3 indicates the possible catch or take of species of concern. Imposition of caps would limit the effects of the EFP to the mortality level associated with any such caps.

4.7.4 Alternative 4

Alternative 4 is very nearly identical to alternative 3 but additionally specifies caps on allowable catch levels of various key species of concern, including a catch cap of 12 striped marlin, an incidental take cap of one short-finned pilot whale, a cap of one short-tailed albatross, and caps on the incidental take of ESA-listed humpback and sperm whales, and leatherback and loggerhead sea turtles based on the Biological Opinion prepared by NMFS (for marine mammals and sea turtles) and informal consultation with USFWS (for seabirds). With 100 percent observer coverage, these caps serve to ensure that EFP effort would not be allowed to continue if take (catch) of key species of concern proves higher than anticipated. However, as fishing effort under the EFP would end at the point when any of these caps were hit, there is a risk that EFP effort would be terminated before the completion of the maximum allowable effort of 56 sets. Because commercial longline fishing in the West Coast EEZ has not previously occurred, there is no data available to reliably quantify the risk of premature termination of the EFP due to reaching a take cap before 56 sets of effort have occurred. A closure of fishing north of 45° N. latitude is expected to reduce the commercial viability of fishing, due to the potential foregone fishing opportunity in case the swordfish migrate into this area before allowable effort ends. Alternative 4 would also restrict the action area for the EFP by prohibiting fishing within 40 nmi of the coastline. This restriction to the action area could reduce the commercial viability of fishing to an unknown degree, due to the potential foregone fishing opportunity in case the swordfish CPUE was relatively high between 30 nmi and 40 nmi of the coast.

Because many marine mammals utilize waters closer to shore for feeding and migration, it is likely that moving the fishing activity farther offshore will reduce the likelihood of marine mammal interactions. The distribution of leatherback sea turtles within the proposed action area is not as well known as that of marine mammals. Nonetheless, it has been established that leatherbacks utilize nearshore neritic waters for foraging in some parts of California (generally within 30 nmi of shore). It is possible that by moving fishing activities farther from known leatherback foraging areas, that the likelihood of entanglement would be reduced. However, there is insufficient data on leatherback habitat utilization throughout the West Coast EEZ to state this with certainty. These conservation measures may provide, in a qualitative sense, additional positive mitigation benefits in terms of reduced non-target and protected species interactions although quantitative data to substantiate this claim is currently not available.

4.7.5 Cumulative Effects

Effects of the proposed action have been considered principally in terms of any increase in mortality to various species that may be caught/taken in the EFP fishery. Chapter 3 describes the range of other actions/activities contributing to mortality. The incremental effect of the proposed action is very small relative to baseline mortality levels and cumulative effects are not expected to materially alter any finding with respect to significant impacts resulting from the proposed action.

4.7.5.1 Finfish

Factors that may cumulatively affect finfish are sources of fishing mortality other than the change in catch due to the alternatives and environmentally-driven changes in stock productivity. The target and non-target species in the SSLL fishery have a Pacific-wide distribution and are subject to fishing mortality from other U.S. domestic fisheries and to a greater degree, distant water fleets from various Pacific Rim and insular nations. These fisheries were described in chapter 3 as part of the baseline description. Although several of the HMS species of concern being addressed in this document have a wide migratory range that cross established political and management boundaries in the Pacific, the majority of the catch and effort from these fisheries is significantly displaced from the action area. In addition, for most of these distant water fishing fleets, little or no data exist regarding bycatch of marine species, including HMS of interest. Without such information, it is difficult to assess the cumulative impacts of these fisheries on the species under review in this EA.

Target Species

The catch and effort data presented for other fisheries that interact with HMS populations, including swordfish, are parameters that for the most part are utilized by regional stock assessment scientists, including NMFS scientists, to produce status of the stock and other key population level estimates. As detailed under the baseline stock status information for swordfish presented in section 3.3.2.1 of this document, the best available science at this point does not indicate an overfished or overfishing condition for swordfish. The proposed action, taken as a very minor component of existing commercial and recreational fisheries throughout the Pacific region, would not increase the regional catch of swordfish to a level triggering a resource conservation concern nor a finding of significant impact for the purposes of this document.

Major Non-target Species

The catch and effort data presented for the cumulative effects of the major non-target species projected to be captured by the SSLL EFP are parameters that for the most part are utilized by regional stock assessment scientists, including NMFS scientists, to produce status of the stock and other key population level estimates. These species include albacore, bigeye, yellowfin, bluefin, and skipjack tunas; blue, thresher, and mako sharks; and striped marlin. As detailed under the baseline stock status information for these species presented in section 3.3.2.2 of this document, the best available science at this point does not indicate an overfished or overfishing condition for these species with the exception of bigeye and yellowfin tuna whose stocks have been determined by NMFS to be subject to overfishing. Given the relatively low SSLL CPUE for these tropical tunas that may occur in the more temperate waters of the proposed action area, coupled with corrective actions being contemplated and/or taken by Pacific regional fisheries management organizations (RFMO), the proposed action would not increase the regional catch of these species to a level triggering a resource conservation concern nor a finding of significant impact for the purposes of this document.

The catch and effort data presented for those major non-target finfish species for which population assessments have not been conducted to date (e.g., pelagic stingray, common mola, and pomfret), do not allow for a stock status determination at this point. It is assumed that the proposed action would not increase the regional catch of these species to a level triggering a resource conservation concern nor a finding of significant impact for the purposes of this document. An additional point to consider is the high rate of release and survival for several of these longline-caught species, including the pelagic stingray and common mola, which further mitigates the impacts of the proposed action in regards to bycatch mortality.

Prohibited Species

Given the low interaction rates of HMS FMP prohibited species with the fisheries noted, the proposed action would not increase the regional catch of these species to a level triggering a resource conservation concern or a finding of significant impact for the purposes of this document. The HMS FMP mandates release of all prohibited species captured unless a valid scientific collecting permit has been obtained through the proper State channels. There are currently no population assessment estimates, nor management reference points or thresholds available for basking, megamouth, and great white sharks, against which projected catch under this EFP could be measured for purposes of triggering a possible resource concern.

4.7.5.2 Protected Species

Marine Mammals

General threats to marine mammals in the North Pacific are detailed in section 3.4.1.2. These include entanglement in fishing gear (active fishing gear and discarded gear), ship strikes, exposure to toxins, pollution, loss of habitat or prey, and underwater sound. The effects of these threats are difficult to quantify, but may be reflected in stock trends, some of which are increasing (e.g., Eastern North Pacific humpback whales).

The species considered most likely to be affected by this action, California sea lion, northern elephant seal, short-beaked common dolphin, Risso's dolphin, northern right whale dolphin, and harbor seal are all from stocks that are not listed on the ESA-listed or considered depleted under the MMPA. Very low levels of take of animals from these stocks are anticipated under the proposed EFP. When combined with existing known threats to these stocks, it is not expected that the proposed action will change the status of these species or trigger concern over the stocks' status.

Sea Turtles

General threats to Pacific sea turtles are detailed in section 3.4.2.2. These include poaching of eggs, killing of females at nesting beaches, human encroachment (development), beach erosion, microclimate-related impacts at nesting sites, low hatchling success, and incidental capture in fisheries. Leatherbacks are most likely to be affected by the proposed action and likely only a few individuals. Of these, very low or no mortalities are anticipated, thus the proposed action is unlikely, within the context of other effects, to change the status of leatherbacks in the Pacific.

4.7.5.3 Seabirds

Seabirds are killed in the longline fisheries referenced above. In addition, domestic longline fisheries in Alaska have been a contributor to mortality. However, both Alaskan and Hawaiian longline fisheries have implemented mitigation measures that have substantially reduced incidental seabird mortality.

4.7.5.4 Socioeconomic Environment

Cumulative effects consider events outside of the proposed action. When "external" effects combine with the direct and indirect effects of the action they have a net cumulative effect. Due to the limited scale and short-term nature of the EFP, no cumulative socioeconomic effects are anticipated as a direct result of fishing effort under the EFP.

5.0 CONSISTENCY WITH MSA NATIONAL STANDARDS

An FMP or plan amendment and any pursuant regulations must be consistent with ten national standards contained in the MSA (§301). These are:

National Standard 1 states that conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the U.S. fishing industry.

As discussed in chapter 4, the proposed action is not expected to result in overfishing of any target or nontarget species.

National Standard 2 states that conservation and management measures shall be based on the best scientific information available.

The measures applicable to the EFP are based on the best scientific information available. The literature cited in chapter 9 lists the sources of this information.

National Standard 3 states that, to the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

Target species stocks have a distribution wider than the West Coast EEZ. The HMS FMP recognizes the need for managing these stocks in the international context through RFMO organizations such as the Inter-American Tropical Tuna Commission.

National Standard 4 states that conservation and management measures shall not discriminate between residents of different States. If it becomes necessary to allocate or assign fishing privileges among various U.S. fishers, such allocation shall be (A) fair and equitable to all such fishers; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

The proposed action does not involve allocation or the assignment of fishing privileges, except for the exemption allowed to the vessel participating in the EFP.

National Standard 5 states that conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.

The proposed action has no effect on efficiency of utilization.

National Standard 6 states that conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

The proposed action focuses on a single fishery and is not expected to affect other fisheries catching the same fish species. The evaluation in this EA recognizes differences in the status of target and nontarget species to the degree known.

National Standard 7 states that conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

The proposed action involves an exemption from certain regulations and does not duplicate existing management measures or regulations.

National Standard 8 states that conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

The proposed action is intended mitigate adverse socioeconomic impacts while avoiding significant adverse natural environmental impacts.

National Standard 9 states that conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

The MSA defines "fish" as all forms of marine animal and plant life other than marine mammals and birds. To the degree that overall fishing effort increases as a result of the proposed action, there could be an increase in bycatch. The proposed action is intended to test measures to reduce the incidental take of protected species. The new and innovative gear being tested has proven effective in other domestic and international SSLL fisheries at increasing the post-hooking survivorship of finfish bycatch species such as blue sharks. In addition, the applicant would be required to use a NMFS approved shark de-hooking device which would further minimize bycatch mortality of hooked sharks.

National Standard 10 states that conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

The proposed action involves one vessel and is not expected to affect safety. This vessel normally operates outside the EEZ so no increased exposure to adverse conditions is expected.

6.0 CROSS-CUTTING MANDATES

6.1 Other Federal Laws

6.1.1 Coastal Zone Management Act

Section 307(c)(1) of the Coastal Zone Management Act (CZMA) of 1972 requires all Federal activities that directly affect the coastal zone be consistent with approved State coastal zone management programs to the maximum extent practicable. NMFS believes that the Council-preferred alternative would be implemented in a manner that is consistent to the maximum extent practicable with the enforceable policies of the approved coastal zone management programs of Oregon and California. This determination was submitted to the responsible State agencies for review under Section 307(c)(1) of the CZMA. Subsequent to NMFS submitting a Consistency Determination for this action to the California Coastal Commission, a legal interpretation of the CZMA was rendered compelling the applicant, not the permitting agency (NMFS), to submit a Consistency Certification for the proposed EFP under CZMA 307(c)(3)(a). The applicant will be submitting the necessary documentation at a future California Coastal Commission's meeting.

The relationship of the HMS FMP with the CZMA is discussed in section 10.7 of the 2003 HMS FMP (PFMC 2003). The HMS FMP has been found to be consistent with the Oregon and California coastal zone management programs. The recommended action is consistent and within the scope of the actions contemplated under the framework of the HMS FMP. Under the CZMA, each State develops its own coastal zone management program which is then submitted for Federal approval. This has resulted in programs which vary widely from one State to the next. The proposed action is expected to be consistent, to the maximum extent practicable, with California and Oregon's coastal management programs.

6.1.2 Endangered Species Act

NMFS is required under Section 7(a)(2) of the ESA to insure that any action it carries out is not likely to jeopardize the continued existence of any endangered or threatened marine species or adversely modify designated critical habitat. To fulfill this obligation, NMFS has conducted a Section 7 consultation which determined that the SSLL EFP fishery would not jeopardize the continued existence of endangered or threatened species. Because NMFS would implement the proposed action and must protect ESA-listed marine species, it functions as both the action agency and the consulting agency during the Section 7 consultation. However, different divisions within the agency fulfill these roles. Additionally, USFWS is responsible for potential impacts to listed seabirds. On June 6, 2007, NMFS initiated consultation with the USFWS on the potential effects of the proposed action on short-tailed albatross and brown pelican; USFWS has made a determination that a formal consultation and preparation of a biological opinion is not necessary. The USFWS concurs with NMFS's determination that the proposed EFP is not likely to adversely affect ESA-listed seabird species.

6.1.3 Marine Mammal Protection Act

The MMPA of 1972, as amended, is the principle Federal legislation that guides marine mammal species protection and conservation policy in the United States. Under the MMPA, NMFS is responsible for the management and conservation of 153 stocks of whales, dolphins, porpoise, as well as seals, sea lions, and fur seals; while the USFWS Service is responsible for walrus, sea otters, and the West Indian manatee.

Off the West Coast the following marine mammal stocks are considered depleted under the MMPA: the Steller sea lion (*Eumetopias jubatus*) eastern stock, Guadalupe fur seal (*Arctocephalus townsendi*), southern sea otter (*Enhydra lutris*) California stock, sperm whale (*Physeter macrocephalus*) Washington, Oregon, and California stock, humpback whale (*Megaptera novaeangliae*) Eastern North Pacific stock, blue whale (*Balaenoptera musculus*) Eastern North Pacific stock, fin whale (*Balaenoptera physalus*), Washington, Oregon, and California stock, killer whale (*Orcinus orca*) Eastern North Pacific southern resident DPS, sei whale (*Balaenoptera borealis*), and northern right whale (*Eubalaena glacialis*) (Carretta, *et al*. 2007). Any species listed as endangered or threatened under the ESA is automatically considered depleted under the MMPA.

Chapter 4 evaluates impacts of the alternatives on marine mammals.

6.1.4 Migratory Bird Treaty Act

The MBTA of 1918 was designed to end the commercial trade of migratory birds and their feathers that, by the early years of the 20th century, had diminished the populations of many native bird species. The MBTA states that it is unlawful to take, kill, or possess migratory birds and their parts (including eggs, nests, and feathers) and implements a multilateral treaty between the United States, Canada, Japan, Mexico, and Russia to protect common migratory bird resources. The MBTA prohibits take of seabirds. The MBTA applies within 3 nmi off California, Oregon, and Washington coastline. Because the EFP would occur in Federal waters (seaward of 3 nmi) the fishery would not be subject to the MBTA. Chapter 4 of this EA evaluates the effect of the alternatives on seabirds.

6.2 Executive Orders

6.2.1 EO 12898 (Environmental Justice)

EO 12898 obligates Federal agencies to identify and address "disproportionately high adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations in the United States" as part of any overall environmental impact analysis associated with an action. NOAA guidance, NAO 216-6, at §7.02, states that "consideration of EO 12898 should be specifically included in the NEPA documentation for decision-making purposes." Agencies should also encourage public participation—especially by affected communities—during scoping, as part of a broader strategy to address environmental justice issues.

The environmental justice analysis must first identify minority and low-income groups that live in the project area and may be affected by the action. Typically, census data are used to document the occurrence and distribution of these groups. Agencies should be cognizant of distinct cultural, social, economic, or occupational factors that could amplify the adverse effects of the proposed action. (For example, if a particular kind of fish is an important dietary component, fishery management actions affecting the availability, or price of that fish, could have a disproportionate effect.) In the case of Indian tribes, pertinent treaty or other special rights should be considered. Once communities have been identified and characterized, and potential adverse impacts of the alternatives are identified, the analysis must determine whether these impacts are disproportionate. Because of the context in which environmental justice is developed, health effects are usually considered, and three factors may be used in an evaluation: whether the effects are deemed significant, as the term is employed by NEPA; whether the rate or risk of exposure to the effect appreciably exceeds the rate for the general population or some other comparison group; and whether the group in question may be affected by cumulative or multiple sources of exposure. If disproportionately high adverse effects are identified, mitigation measures should be proposed. Community input into appropriate mitigation is encouraged.

It should be noted that fishery participants make up a small proportion of the total population in these communities, and their demographic characteristics may be different from the community as a whole.

However, information specific to fishery participants is not available. Furthermore, different segments of the fishery-involved population may differ demographically. For example, workers in fish processing plants may be more often from a minority population while deckhands may be more frequently low income in comparison to vessel owners.

Participation in decisions about the proposed action by communities that could experience disproportionately high and adverse impacts is another important principle of the EO. The Council offers a range of opportunities for participation by those affected by its actions and disseminates information to affected communities about its proposals and their effects through several channels. In addition to Council membership, which includes representatives from the fishing industries affected by Council action, the HMSAS, a Council advisory body, draws membership from fishing communities affected by the proposed action. While no special provisions are made for membership to include representatives from low income and minority populations, concerns about disproportionate effects to minority and low income populations could be voiced through this body or to the Council directly. Although Council meetings are not held in isolated coastal communities for logistical reasons, they are held in different places up and down the West Coast to increase accessibility.

The Council disseminates information about issues and actions through several media. Although not specifically targeted at low income and minority populations, these materials are intended for consumption by affected populations. Materials include a newsletter, describing business conducted at Council meetings, notices for meetings of all Council bodies, and fact sheets intended for the general reader. The Council maintains a postal and electronic mailing list to disseminate this information. The Council also maintains a website[27] providing information about the Council, its meetings, and decisions taken. Most of the documents produced by the Council, including NEPA documents, can be downloaded from the website.

6.2.2 EO 13132 (Federalism)

EO 13132, which revoked EO 12612, an earlier federalism EO, enumerates eight fundamental federalism principles. The first of these principles states "Federalism is rooted in the belief that issues that are not national in scope or significance are most appropriately addressed by the level of government closest to the people." In this spirit, the EO directs agencies to consider the implications of policies that may limit the scope of or preempt States legal authority. Preemptive action having such federalism implications is subject to a consultation process with the States; such actions should not create unfunded mandates for the States; and any final rule published must be accompanied by a federalism summary impact statement.

The Council process offers many opportunities for States (through their agencies, Council appointees, consultations, and meetings) to participate in the formulation of management measures. This process encourages States to institute complementary measures to manage fisheries under their jurisdiction that may affect federally-managed stocks.

The proposed action does not have federalism implications subject to EO 13132.

6.2.3 EO 13175 (Consultation and Coordination with Indian Tribal Governments)

EO 13175 is intended to ensure regular and meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications, to strengthen the United States government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes.

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[27] www.pcouncil.org

The Secretary recognizes the sovereign status and co-manager role of Indian tribes over shared Federal and tribal fishery resources. In Section 302(b)(5), the Magnuson-Stevens Act reserves a seat on the Council for a representative of an Indian tribe with federally-recognized fishing rights from California, Oregon, Washington, or Idaho.

The U.S. government formally recognizes the four Washington coastal tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to marine fish. In general terms, the quantification of those rights is 50 percent of the harvestable surplus of groundfish available in the tribes' usual and accustomed fishing areas (described at 50 CFR 660.324). Each of the treaty tribes has the discretion to administer their fisheries and to establish their own policies to achieve program objectives.

There is no tribal involvement with this fishery.

6.2.4 EO 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds)

EO 13186 supplements the MBTA (above) by requiring Federal agencies to work with the USFWS to develop memoranda of agreement to conserve migratory birds. NMFS is in the process of implementing a memorandum of understanding. The protocols developed by this consultation will guide agency regulatory actions and policy decisions in order to address this conservation goal. The EO also directs agencies to evaluate the effects of their actions on migratory birds in environmental documents prepared pursuant to the NEPA.

Chapter 4 in this EA evaluates impacts to seabirds.

7.0 LIST OF PREPARERS

Name and Affiliation	Responsibility
Dr. Kit Dahl, Staff Officer – Highly Migratory Species, Pacific Fishery Management Council	Project management, draft EA; overall editing; principal author chapters 1, 2, 5, and 6
Mr. Lyle Enriquez, Fishery Biologist, NMFS SWR	Principal author seabird impacts, chapters 3 & 4
Mr. Pierre Gorodo, NMFS SWR	Technical assistance, chapters 3 and 4
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Ms. Charlene Hurst, Heidi Hermsmeyer and Gabrielle Dorr	Copy editors
Ms. Elizabeth Petras, Liaison Officer, NMFS SWR Office of Protected Resources	Principal author protected species impacts, chapters 3 & 4
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Dr. Suzanne Kohin, Research Fishery Biologist, NOAA Southwest Fisheries Science Center	Principal author on finfish stock status, chapter 3
Mr. Stephen Wertz, Associate Marine Biologist, California Department of Fish and Game	Technical assistance, chapters 3 & 4
Dr. Yonat Swimmer, NOAA Southwest Fisheries Science center	Longline fishery bycatch reduction research

8.0 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE EA WERE SENT

A draft EA, which did not contain an evaluation of the preferred alternative, was distributed as part of the meeting materials available for the Pacific Council's April 2007 meeting. Paper copies were distributed to Council members and selected Council advisory bodies. Paper copies were also made available to the public at the meeting. This final EA was prepared to support NMFS's decision to issue the EFP. NMFS will distribute copies of this final EA upon request and an electronic version of the document will be posted on the Agency's Southwest Region website (http://swr.nmfs.noaa.gov/).

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APPENDIX A: NMFS RESPONSE TO PUBLIC COMMENTS ON THE SSLL EFP APPLICATION AND DRAFT EA

Pacific Council's Public Comment Summary

A substantial number of public comments have been received to date by the Council and NMFS. As established under the Council's Operating Procedure (COP 20) for reviewing EFP applications[28], NMFS utilized the Council's public meeting as an initial forum for public input on Pete Dupuy's SSLL EFP application. A draft EA document was prepared by the Council's HMSMT for Council deliberation and was made available to the public on March 6, 2007. The Council also accepted public testimony at their regularly scheduled March and April meetings. In total, over 2,100 e-mails, letters, or comments through public testimony, were received by the Council on this proposed action. The majority of the comments urged the Council to recommend denial of the EFP application. The Council does not formally respond to written public comments (Dahl 2007). A summation of the Council received public comments are posted at http://www.pcouncil.org/bb/2007/bb0407.html#highly.

The Council made a final recommendation to approve the EFP, following COP 20 protocols, on April 6, 2007, and transmitted that decision shortly thereafter to NMFS.

NMFS's Public Comment Summary

NMFS published a notice of receipt of the EFP in the Federal Register on June 13, 2007 (72 FR 32618), with a formal request for public comments. An email public comment box was established for this proposed action at SWR.0648-XA73@noaa.gov. The public comment period for this proposed action closed on July 13, 2007. Public comments were also received by Dr. William Hogarth, AA for NMFS, and forwarded to NMFS Southwest Region. In total, over 5,000 e-mails and 4,300 letters were received by NMFS on this proposed action.

The majority of the public comments were in opposition of the proposed issuance of the EFP with approximately 98 percent of the comments delivered to the email comment box via a form letter developed by Non-Governmental Organizations (e.g., Sea Turtle Restoration Network). The form letter urged NMFS not to approve the EFP, primarily out of concern over the bycatch and population status of Pacific leatherback sea turtles and marine mammals. Very few of the letters, e-mails, or public testimony, had substantive comments on the associated EA. Those that did were noted below along with NMFS's responses. Substantive public comments on the EA were considered in the review and revision of the draft EA and the document was changed and improved to address those comments. The comments and responses are sorted by major category and/or Federal statutes.

NMFS consideration of the EFP application is illegal

Comment: Most of the public comments received by NMFS for this action were part of an e-mail campaign utilizing a pre-written format that urged NMFS not to approve the EFP. The replicated comment stated that is was a bad idea at best and illegal at worst for NMFS to even consider this application.

Response: NMFS has a statutory obligation under the MSA to consider valid EFP applications and make a determination as to whether the applications warrant further consideration. The EFP application contained all of the required information requested as part of the Council's EFP Operating Protocol and as

[28] http://www.pcouncil.org/operations/cops.html

part of the NMFS National EFP Guidelines. Per Council direction, the EFP application was reviewed by the Council's HMSMT and it's Advisory Subpanel, and these bodies forwarded a recommendation to the Council that the application met the goals and objectives of the COP and the HMS FMP. The Council then voted to recommend approval of the EFP and transmitted that approval to NMFS. NMFS proceeded with preparation of the documentation needed to allow an informed and analytical decision to be made on the EFP application. This decision will be based in part on the management goals and objectives of the HMS FMP and utilizing the best available science while adhering to the applicable Federal statutes and regulations.

ESA

Comment: The issuance of the EFP would violate the ESA based on impacts to the short-tailed albatross. Self-reports of seabird interactions with the former California-based longline fishery acknowledge take of 100 albatross of various species. Dozens of albatross were also observed taken in the handful of trips with actual observer coverage. It is therefore reasonable to assume that short-tailed albatross are likely to be entangled and killed if the EFP is approved…we do not believe any additional take authorization for the species can be lawfully granted.

Response: We do not anticipate any take of short-tailed albatross. The reported and observed albatross takes in the California longline fishery were all black-footed and laysan albatross. This action does not grant additional take authorization because no takes of short-tailed albatross are anticipated. There will be a conservative catch cap of one short-tailed albatross for the proposed action.

Comment: One of the purposes of the EFP is to determine "environmental effects, including the potential impacts to protected species". As such, any take occurring from the EFP cannot be considered "incidental" and authorized under Section 7 of the statute, but is instead part of the proposed action and falls under Section 10(a).

Response: A Section 10(a)(1)(A) permit would be the appropriate permit to issue if take were deliberate (not incidental) for scientific purposes or to enhance the propagation or survival of the affected species. The fishing authorized under the EFP would not deliberately take ESA-listed species. Any takes would be incidental to the purpose of the EFP which is to evaluate whether the fishery can operate in a commercially viable manner, with minimal environmental impacts. It acknowledges that takes of ESA-listed leatherback sea turtles may occur, but this is not the purpose of the EFP. A Section 10(a)(1)(B) permit would also be applicable for a non-Federal action; however, the issuance of the EFP is a Federal action, thus it is appropriate that a Section 7 consultation be conducted.

Comment: Given that the closure of shallow-set longlining east of 150º W. longitude was promulgated pursuant to NMFS's authority under the ESA, rather than under the MSA, we do not see how an EFP issued under the MSA could lawfully be issued in direct contravention of ESA regulations prohibiting such fishing.

Response: The prohibition on setting shallow set longline gear east of 150° W. longitude applies only on the high seas, west of the EEZ. The proposed EFP would occur within the EEZ. The regulation promulgated under the ESA is not applicable to the proposed EFP. The HMS FMP prohibits SSLL fishing within the EEZ (50 CFR §660.712). Therefore, it is appropriate that the applicant apply for an exemption from this section of the regulations implementing the HMS FMP.

Comment: If any ESA-listed marine mammal interacts with the EFP fishery, both NMFS and the applicant will have violated Section 9 of the ESA and be subject to civil and criminal penalties there under. See also 16 U.S.C. §1538(g).

Response: NMFS does not anticipate the take of any species of marine mammals listed on the ESA during fishing operations authorized by the proposed EFP. This is based upon NMFS's review of the best available information on the distribution and behavior of ESA-listed marine mammals within the proposed action area in addition to reviewing observer records from other fisheries that have occurred in the proposed action area and longline fisheries from other areas. Because no takes of ESA-listed marine mammals are anticipated, NMFS does not anticipate a violation of Section 9 of the ESA. NMFS also did not issue an Incidental Take Statement for ESA-listed species of marine mammals as part of the biological opinion that was prepared for this project after conducting a consultation under Section 7(a)(2) of the ESA. As provided in 50 CFR 402.16, reinitiation of Section 7 consultation would commence immediately if a take of a marine mammal occurs during fishing operations authorized by the proposed EFP.

Comment: We believe, as NMFS stated in 2000, that authorization of any leatherback take in the Pacific would violate the requirement to avoid jeopardy to the species. Therefore… the EFP… would violate Section 7(a)(2) of the ESA.

Response: Substantial new information on the distribution and abundance of Pacific leatherbacks is available that was not available when the 2000 biological opinion was written. Among the new information are estimates of Western Pacific leatherbacks that are higher than the estimates available in 2000. As described in section 3.4.2.1, new population estimates are available for Western Pacific leatherbacks. These are based upon a meeting of researchers, managers, and tribal community members with extensive knowledge of local leatherback nesting beach populations and activities in Papua (Indonesia), Papua New Guinea, the Solomon Islands, and Vanuatu who met to identify nesting beach sites, and share abundance information based on monitoring and research, as well as anecdotal reports. Data from this meeting have been incorporated into the most recent population estimates by Dutton, *et al.* (2007) of between 2,700 and 4,500 breeding females in the Western Pacific population. Since 2000, NMFS has issued three no jeopardy opinions for actions that would likely take leatherback sea turtles in the North Pacific. The determinations were made, in part, based upon recent work by the SWFSC. These takes and the current environmental baseline were taken into consideration as part of the Section 7 consultation on this proposed action. NMFS would not issue an EFP if it is likely to jeopardize leatherback sea turtles, and any take would be covered by an Incidental Take Statement and therefore not violate Section 9 of the ESA. There would be a take cap of five leatherback turtles, or one leatherback mortality for the proposed action based on the Incidental Take Statement for this EFP.

Comment: EFP fishing would put the loggerhead sea-turtle at risk. NMFS instituted the closure of shallow-set longlining east of 150° W., in part to protect North Pacific loggerhead turtles. The North Pacific loggerhead population has declined by upwards of 80 percent in recent decades, and is likely approaching the perilous state of the leatherback.

Response: As noted in the response above, the closure of the SSLL fishery east of 150° W. applies to the high seas only, outside the U.S. West Coast EEZ. The closure was necessary to avoid jeopardizing loggerheads that were anticipated to be taken in longline gear in the high seas in North Pacific feeding areas. The State of California has not authorized the use of longline gear in the U.S. West Coast EEZ off of California. When the HMS FMP was developed, this State law and many others were adopted into the final rule. This was not identified as a measure necessary to protect loggerhead sea turtles, since loggerheads are generally found in waters warmer than most of the U.S. West Coast EEZ.. Studies over the past ten years have identified foraging areas for loggerhead sea turtles in the North Pacific. Juvenile loggerheads utilize these areas as they migrate from natal beaches in Japan to productive foraging areas off of Baja California, Mexico, thus exposing them to longline fisheries in the high seas of the North

Pacific. Loggerheads are very rarely observed in the proposed action area and are not expected to be affected by the proposed action, so no risk to loggerheads is anticipated.

Comment: Issuing the EFP and allowing longline gear into critical leatherback foraging areas would violate the recommendation of the Pacific Leatherback Recovery Plan, as well as NMFS's affirmative conservation mandates under the ESA. As such, doing so would violate Sections 2(c), 4(f), and 7(a)(1) of the ESA.

Response: Recovery plans are guidance documents, not regulatory documents. They should, however, guide Federal agencies in fulfilling their obligations under Section 7(a) of the ESA which calls on all Federal agencies to use their authority to support the purposes of the ESA, and also ensure that Federal actions do not jeopardize the continued existence of listed species. One of the threats to leatherback sea turtles identified in the recovery plan is bycatch in traditional longline fisheries, and one of the recommendations in the plan is the development of gear modifications to reduce mortalities. The fishing gear and techniques being proposed in this EFP are consistent with commercial and experimental SSLL fisheries that have demonstrated substantial reductions in sea turtle takes and mortalities. Limited testing of this gear in the West Coast EEZ is consistent with gear testing in other areas. NMFS is continuing to study leatherback foraging areas within the West Coast EEZ and will provide guidance to the fishermen that has applied for this EFP on ways to reduce his likelihood of interacting with leatherbacks. Finally, the standard to which this action must be measured is whether the action is likely to result in a level of take or mortality that will jeopardize the continued existence of leatherback sea turtles. Therefore, NMFS is engaged in an intra-agency Section 7 consultation, as required under the ESA, and has determined that leatherback sea turtles are the only ESA-listed species likely to be adversely affected by the proposed action. It is estimated that no more than five leatherbacks are likely to interact with the fishery and of these one or zero mortalities are likely to occur following a hooking interaction.

Comment: Issuance of, and/or fishing under the EFP, would compromise the recovery of loggerhead, green and olive ridley sea turtles.

Response: As described in section 3.4.2.1, the best available information on the distribution of loggerhead, green and olive ridley sea turtles suggests that it is very unlikely that individuals from these species will be in the area of the proposed EFP (i.e., north of Point Conception and outside the Southern California Bight); therefore, they are not expected to be incidentally taken in fishing operations authorized by the proposed EFP.

Comment: NMFS stated in its 2000 Biological Opinion that authorization of any leatherback take in the Pacific would violate the requirement to avoid jeopardy to the species.

Response: NMFS acknowledges that the overall number of leatherback sea turtles has declined in the Pacific over the past few decades. Unfortunately, the status of Eastern Pacific leatherbacks appears to be substantially worse than their counterparts in the Western Pacific. However, NMFS is also now aware of substantive population differences between the Eastern Pacific leatherbacks and Western Pacific leatherbacks off the U.S. West Coast. As described in section 4.3.2.1, genetic analyses of stranded, incidentally caught, and at-sea captures of leatherbacks off California and Oregon, leatherbacks in this area likely originate from Western Pacific nesting beaches. Therefore, it is unlikely, but not impossible, that the leatherbacks that may be hooked or entangled in the proposed EFP would be from the Eastern Pacific population. Also as described in section 4.3.2.1 and in response to comment above, the current population estimate of Western Pacific breeding females is substantially higher than the estimate in 2000, due to the inclusion of nesting sites and populations not previously considered in the Western Pacific range. Due to this new information on the status of Pacific leatherback populations, particularly the population most likely to occur off the U. S. West Coast, NMFS does not feel that the assessment made in the 2000 Biological Opinion, that any take would jeopardize the species, is still applicable.

Comment: It would be inappropriate to allow the capture of turtles by a California-based fishery – EFP or otherwise, when the Hawaii fishery was closed for exactly this reason only one year ago.

Response: The Hawaii-based SSLL fishery was closed on March 20, 2006, because takes of loggerheads had reached the annual cap of 17 animals. The cap is the incidental take statement for the biological opinion and is the average anticipated takes in the fishery based upon past observed interactions in the fishery and applying an anticipated reduction similar to the level observed in gear experiments conducted in the Atlantic Ocean. The observer records tracked takes based upon a typical distribution of effort. The CPUE of loggerheads and other turtles is highly variable inter- and intra-annually. The fishery in 2006 did not follow normal patterns of effort as an unusually high level of effort was made in the first quarter, which is a time of high interactions rates, or CPUEs with loggerheads. The Hawaii fishery is actively involved in developing methods to minimize takes of sea turtles in their longline fishery and in 2007 has yet to reach the cap for loggerhead or leatherback sea turtles. Since 2004, the Hawaii SSLL fishery has not met or approached the cap for leatherback sea turtles, which is the species considered most likely to be affected by the proposed action.

MMPA

Comment: The proposed action would likely kill marine mammals at rates in excess of those authorized by the MMPA. The applicant is not applying for, nor is NMFS requiring, the issuance of an MMPA 101(a)(5)(E) permit. The decision by the applicant and NMFS to forgo permitting under the MMPA constitutes a known violation of the statute. This would likely subject the applicant to civil and criminal liability for knowing violations of Federal law.

Response: NMFS thoroughly reviewed all of the available information on the distribution of ESA-listed marine mammals within the proposed action area to determine which species may be exposed to the fishery. Reviews of other fisheries in the proposed action area and an extensive review of the literature on marine mammal takes in longline fisheries were conducted. Based upon this information, it is considered very unlikely that ESA-listed marine mammal will be adversely affected by the proposed action, therefore, a 101(a)(5)(E) permit under the MMPA is not necessary. A Section 101(a)(5)(E) permit is only required when incidental take of an ESA-listed marine mammal is anticipated.

Comment: There are no take limits for numerous species likely to be exposed to the EFP fishery, such as…long-beaked common dolphins, which are a strategic stock under the MMPA because take exceeds sustainable levels; northern fur seals, which are listed as depleted under the MMPA; and northern right whale dolphins which are subject to take from existing fisheries at levels above the MMPA's ZRMG. Take of any of these species would exceed important legal and/or biological thresholds.

Response: NMFS disagrees that long-beaked common dolphins and fur seals are likely to be exposed to the EFP fishery. As described in section 3.4.1.1, NMFS reviewed the available information on the distribution of marine mammals to determine which species are most likely to be affected by the proposed action. NMFS also reviewed observer records from the California DGN fishery, particularly sets made 40 nmi or more offshore, to determine marine mammal species most likely to be affected. Long-beaked common dolphins and northern fur seals are very unlikely to be affected by the proposed action due to their more nearshore distribution; therefore, this action is not considered likely to cause serious injury or mortality to individuals in these stocks. Northern right whale dolphins may be taken in fishing operations authorized by the EFP; however, takes are likely to be low since the species may not be in the area of the proposed action. This is based upon the observed takes in the DGN fishery, in which most occurred within 40 nmi of shore, and the distribution of this stock was generally along continental shelf and slope waters, which are inshore of the proposed action. The current mean annual takes of northern right whale dolphins is 23 and the PBR is 164. As described in section 3.4.1.1, very few takes of northern right whale dolphins are expected, and there is no way to estimate how may takes may result in serious injury or mortality. NMFS believes the commenter is incorrect in their interpretation of the MMPA. Please see response below for additional information on the MMPA.

Comment: The issuance of the EFP would violate the unambiguous command of the MMPA that all fisheries "shall reduce incidental mortality and serious injury of marine animals to insignificant levels approaching a zero mortality and serious injury rate by April 30, 2001. NMFS has defined ZMRG by regulation as ten percent of PBR. The likely take of marine mammal species under the EFP would exceed this threshold.

Response: NMFS disagrees and believes that this comment misinterprets the MMPA. The ZMRG, as described in Section 118 of the MMPA, has four parts. First, there is a threshold level of mortality and serious injury (insignificant levels approaching a zero mortality and serious injury rate) and a deadline by which commercial fisheries should reach the threshold. Second, there is a statement that fisheries that have achieved the threshold level of mortality and serious injury are not required to further reduce incidental mortality and serious injury. Third, there is a requirement for a review of fisheries progress toward the threshold. Fourth, there is a mechanism for reducing incidental mortality and serious injury (i.e., Take Reduction Plans). Although the threshold and deadline are stated without condition, there is no statement in the MMPA that excess removals (mortality and serious injury exceeding threshold values after the deadline) cannot be authorized. The fourth part of the ZMRG states that these excess removals must be addressed through the Take Reduction Plan process.

The MMPA is a retrospective statute, that is, fisheries are reviewed and assessed based upon past interactions with marine mammals through such means as Federal or State observer programs or stranding records. The MMPA has no authority to prohibit a fishery or order the closure of a fishery. Under the MMPA, if a fishery is found to be taking marine mammals at a level that exceeds the stock's PBR or 50 percent of PBR, NMFS will evaluate the fishery and establish a take reduction team to determine means to reduce the fishery's impact on marine mammals in ways that are economically and technically feasible.

Comment: It would be unwise and unlawful to allow an additional marine-mammal killing fishery to operate without a take reduction team prior to at least initiating the take reduction process for the California-based deep-set longline fishery and the Hawaii-based longline fisheries.

Response: The California-based deep-set longline fishery is a very limited fishery with currently only one participant. There has been 100 percent observer coverage on this fishery since it began in 2005 and there have been no observed takes of marine mammals; therefore, there is no evidence to suggest that a take reduction plan is necessary for this fishery. The Hawaii-based longline fishery has been observed taking marine mammals, however, the marine mammal stocks affected by the Hawaii-based longline fisheries are not the same stocks that could be affected by the proposed action in the U.S. West Coast EEZ (see Carretta, *et al*. 2007), so there is no relationship between the takes in the Hawaii-based fishery and the proposed action in terms of affects on marine mammal stocks. In the Hawaii-based longline fisheries, it is the take of false killer whales in the deep-set component of the fishery that is driving the take reduction process. Levels of marine mammal bycatch in the Hawaii-based SSLL, which has 100 percent observer coverage, are extremely low. False killer whales are a tropical and warm temperate water species and have not been observed in the proposed action area, so there is no relationship between stocks. As a result, actions in the Hawaii-based fishery to reduce bycatch of this stock have no relevance to the proposed action.

Comment: Take of short-finned pilot whale from existing fisheries already exceeds PBR… the ZMRG level for pilot whales… equates to fewer than one animal taken every ten years. The proposed EFP would authorize over ten years worth of take in a single fishing season by a single vessel. NMFS cannot lawfully authorize new and additional take of marine mammals for which take levels already exceed the PBR and ZMRG thresholds of the MMPA.

Response: The current PBR for the CA/OR/WA stock of short-finned pilot whales is 1.2. The current draft 2007 Pacific Stock Assessment Report includes a revised PBR of 0.9. However, this is still in draft form with the final document expected to be published in January 2008. The current mean annual mortality of this stock of short finned pilot whales is one animal per year, based upon a five year average. NMFS does not anticipate that a serious injury or mortality of a short finned pilot whale will occur during fishing operations authorized under the proposed EFP. The Marine Mammal Protection Act (MMPA) is unlike the ESA in two key areas: 1) the MMPA is a retrospective statute, that is, fisheries are assessed based upon past interactions with marine mammals through such means as Federal or State observer programs or stranding records. The ESA, in contrast, requires that the agency project likely takes of ESA-listed species that may occur in the future and determine if the projected level of take would result in jeopardy to the continued existence of the species. If the projected level of take is considered likely to result in jeopardy to a species, the fishery may not be authorized by NMFS. 2) In contrast to the ESA, the MMPA has no authority to disapprove a fishery or shut-down a fishery – a second key difference between the statutes. Under the MMPA, if a fishery is found to be taking marine mammals at a level that exceeds the stock's PBR or 10 percent of the PBR, NMFS can evaluate the fishery and establish a take reduction team to determine means to reduce the fishery's impact on marine mammals in ways that are economically and technically feasible.

Finally, in making this recommendation to cap the take of short finned pilot whales at one serious injury or mortality, the PFMC was mindful that mortalities over one per year would result in a five year average mortality of greater than 1.2. In the most recent Stock Assessment Report (Carretta, *et al*. 2007), the one observed mortality of a short finned pilot whale in the CA/OR DGN fishery in 2003 was extrapolated to five, since the level of coverage was 20 percent. Thus, it is assumed that five short finned pilot whales were taken and this is averaged over five years in which no whales were observed taken in four of the five years. Hence, five whales divided by the five years assessed (1999-2003) yields one whale per year, the annual estimated mortality. If one whale is observed killed or seriously injured during fishing operations authorized by the EFP (although this is considered very unlikely), that one take would be added to the five (extrapolated value), so the five year total (2003-2007) would be six whales, which divided by five yields an annual estimated average mortality of 1.2. The PFMC was being conservative in its recommendation and mindful of the current low PBR for this stock.

Comment: One comment letter contained references to material from the Atlantic Pelagic draft Take Reduction Plan, specifically information about interactions between pilot whales and longline gear in the Atlantic.

Response: The analysis of marine mammal impacts in the EA relies upon a variety of data sources, including information from the Atlantic longline fishery. In order to strengthen the analysis, the comments received were reviewed and addressed, as appropriate, in the revised EA.

Comment: The EA states that the Atlantic fishery is subject to a take reduction team and plan; however, no take reduction plan has been published and the fishery is continuing to take marine mammals.

Response: A draft take reduction plan was published by NMFS on June 8, 2006. The take reduction team met for the first time in June 2005. Some measures recommended by the TRP have been implemented and other recommendations are currently being reviewed with plans for future implementation.

Comment: Data provided to the Atlantic Pelagic Longline Take Reduction Team indicated that, although peak bycatch rates occurred at 70-80 degrees F, interactions with pilot whales began to occur at noticeably high rates at between 62 and 66 degrees F (Garrison 2006).

Response: There are difficulties in applying fishery data from the Atlantic to the Pacific. As described in section 3.2.1.1 and the Atlantic Pelagic Longline Take Reduction Plan draft submitted to NMFS in June 2006, short-finned pilot whales are distributed generally in warm and tropical waters. By contrast, long-finned pilot whales are more commonly found in temperate waters. In the Atlantic, it is not possible to differentiate between short-finned and long-finned pilot whales when observed taken in longline fisheries; therefore, it is difficult to apply trends in peak bycatch rates and temperatures to specific species of pilot whales. The waters of the proposed action and time of year are generally colder than the temperatures in which short-finned pilot whales are commonly observed, although short-finned pilot whales have been observed at these temperatures during or shortly after unusually warm water periods (e.g., El Niño conditions). 2007 has been an ENSO neutral year and La Niña conditions are predicted for the rest of the year, therefore the warm water conditions that have been correlated with short-finned pilot whales in the proposed action area do not exist. Further information on the stock size and distribution in the Atlantic and Pacific can be found in section 3.4.1.1. Finally, the water temperatures of 70 to 80 degrees F, at which the highest rates of pilot whale interactions occur in the Atlantic, are not generally found in the waters of the proposed action.

Comment: The EA used catch per unit effort (CPUE) rates for the DGN fleet to calculate likely impacts on target and non-target species; the interaction rates for these two operationally different fisheries are in some cases quite disparate, both in quantity and nature of bycatch species.

Response: As described in sections 3.4.1.1 and 3.4.2.1, utilizing the CPUEs from the DGN fishery was a first step in determining the species most likely to be in the area of the proposed fishing under the EFP and therefore most likely to be affected by the proposed EFP. In addition, NMFS conducted a review of marine mammal biology and distribution within the proposed action area to estimate likely impacts (for example whether the certain species are found only nearshore and therefore not within the proposed action area). An extensive review of other longline fisheries was also conducted to determine possible effects. Section 3.4.1.1 contains a description of the differences in the nature of marine mammal interactions with DGN and longlines. As a summary, although no direct comparisons could be made between a DGN and SSLL fishery operating in the same time and location, observer records from longline fisheries indicate a much lower number of marine mammal species interacting with longline gear than with DGN gear. Most interactions between marine mammals and longlines are due to depredation, in which the marine mammal will feed on bait or hooked fish, but are not necessarily hooked or entangled in gear (see description of sperm whale depredation on Alaska longlines).

MBTA

Comment: The primary species of seabirds taken by longline fisheries in the North Pacific are albatrosses and fulmars. These are included in the list of migratory birds protected by the MBTA. The proposed action would violate the MBTA as the fishery may take black footed albatross which is protected by the MBTA. NMFS claims that the MBTA does not apply beyond the three nautical mile territorial sea cannot be supported. Neither NMFS nor the applicant have obtained, much less applied for, a MBTA permit from FWS authorizing take.

Response: The MBTA was enacted into law when the outer boundary of the United States (i.e., the outer boundary of the territorial sea) was 3 nmi from the coast. The MBTA has not been amended to extend its effect beyond that 3 nmi line. Therefore, NMFS believes that any incidental take of seabirds is not subject to the MBTA. NMFS does, however, seek to regulate fisheries in ways that avoid such take by mandating the use of conservation measures that have been adopted in both domestic and international longline fisheries to minimize interactions with seabirds.

NMSA

Comment: Four National Marine Sanctuaries, the Monterey Bay, Gulf of Farallones, the Cordell Bank, and the Channel Islands, are adjacent to the area subject to the EFP. The leatherback sea turtle as well as the marine mammals, seabirds, and fish that will likely be caught pursuant to the EFP are all resources protected by these sanctuary designations. The proposed EFP would clearly "destroy, cause the loss, or injure" these resources. We are unaware of any action by NMFS to comply with either the consultation provision of the NMSA or its substantive requirements. Absent such compliance, the proposed EFP cannot lawfully be issued.

Response: NMFS has consulted with the National Marine Sanctuary Program on the proposed action. A letter was sent to Sanctuary Program staff on May 16, 2007, which outlined the proposed action and provided all the supporting environmental review documentation that was available at the time. NMFS has worked cooperatively with Sanctuary Program staff to address any concerns that they have in regards to the proposed action. At the request of the applicant, modifications to the preferred alternative were incorporated to further restrict the proposed action area to prohibit fishing within 40 nautical miles of the coastline effectively removing any Sanctuary waters from the action area.

Comment: Several commenters expressed concern that issuance of the proposed permit would violate two requirements of the National Marine Sanctuaries Act (NMSA): to avoid injury to Sanctuary resources and to consult with the National Ocean Service (NOS) about potential effects on Sanctuary resources. The proposed action area would be adjacent to the outer boundaries of four national marine sanctuaries. The fin, humpback, and sperm whales are all resources protected by these sanctuary designations. Fishing under the proposed permit would clearly "destroy, cause the loss, or injure" these resources.

Response: The "Secretary" who is issuing a permit under the MMPA and the "Secretary" who administers the four sanctuaries in question under the NMSA is the same person: the Secretary of the Department of Commerce. The management of both programs is closely coordinated under NOAA to ensure compliance with both statutes. Additionally, and in response to concerns raised by the National Marine Sanctuaries Program, the applicant has requested that a condition of the proposed EFP be that no fishing will occur within the boundaries of any national marine sanctuary in the action area (i.e., the Monterey Bay, Gulf of the Farallones, Cordell Bank, and Channel Islands National Marine Sanctuaries). The exposure analysis conducted for this proposed action indicates that that fin, humpback, and sperm whales are very unlikely to be affected by fishing under the EFP.

CZMA

Comment: The sea turtles, seabirds, marine mammals, and fish that will be caught and killed under the proposed EFP are all "natural resources" protected by California's Coastal Management Program. Hooking, entangling, and killing these animals clearly "affects" these resources triggering the consistency requirement of the Coastal Zone Management Act (CZMA). We are unaware of the appropriate CZMA consistency certification in the application materials for the EFP. Absent such a certification and evidence of California's concurrence in that determination, the EFP application must be rejected as violation of CZMA.

Response: The applicant will be presenting his consistency certification to the California Coastal Commission under CZMA Section 307(c)(3)(a), explaining why this EFP would be consistent with the California Coastal Act.

MSA

Comment: The longline EFP threatens vulnerable finfish populations. Of the five major non-target species, three (yellowfin, bigeye and albacore) have been classified as overfished or experiencing overfishing.

Response: NMFS is active in both the domestic and international fishery management arenas to address potential resource conservation concerns for Pacific-wide bigeye, Eastern Pacific Ocean (EPO) yellowfin, and North Pacific albacore tuna stocks. Only the EPO yellowfin tuna stock and the Pacific-wide bigeye tuna stock have been declared by the Secretary of Commerce to be in an overfishing state (MSA Section 304(e)). The U.S. longline fleet is constrained by an annual bigeye tuna catch quota of 500 mt established by the IATTC and implemented domestically through the Tuna Conventions Act. The proposed action would catch very few bigeye tuna based on the shallow-set gear configuration and the vertical distribution patterns of bigeye tuna which are found at greater depths. The proposed action would catch very few yellowfin tuna based on the distribution and abundance patterns of EPO yellowfin tuna in the proposed action area. This area includes a more temperate ocean environment versus the more tropical ocean environment where the center of yellowfin tuna populations is typically found. North Pacific albacore stocks have not been declared by the Secretary as either overfished or experiencing overfishing. Measures are being considered to implement regional resolutions to cap effort in the main commercial fishing fleets targeting albacore tuna on a pan-Pacific basis. The measures being considered will be principally applied to the surface hook-and-line and baitboat vessels of the major harvesting nations (e.g., Japan, Taiwan).

Comment: The 10 degree offset circle hook/mackerel-type bait requirement in the proposed EFP was designed to minimize interactions with sea turtles. It has not, however, proven to be effective in reducing bycatch of numerous finfish species.

Response: It is important to note that the bycatch gear technology and successful bycatch reduction measures (circle hooks and mackerel or mackerel-type bait) that would be used in this proposed EFP have been implemented in other U.S. fisheries and have been successfully transferred to other SSLL fishing nations. Although the use of circle hooks alone does not appear to appreciably reduce finfish (e.g., blue shark) catch rates but it does appear to lead to increased survivorship (Kerstetter and Graves 2006; Gilman, *et al*. 2006b). The switch from squid bait to mackerel type bait, however, has shown to reduce blue shark catch rates in longline experiments conducted in the Atlantic (Watson, *et al*. 2005). Hawaii SSLL observer records for trips utilizing circle hooks indicate approximately 95 percent of captured blue sharks are released alive (Gilman, *et al*. 2006b). The use of circle hooks and mackerel or mackerel-type bait in these other fisheries has resulted in an increased survivorship, and in some cases reduced capture rates, for incidentally hooked finfish, including blue sharks. However, there is no guarantee that what has been successfully implemented under different oceanographic regimes will necessarily be successful in the California Current oceanographic regime in terms of target catch and/or bycatch reduction. It is for this reason that NMFS is looking at this proposed EFP trial as an initial assessment of SSLL gear as a potential cost effective alternative for reducing bycatch in the West Coast swordfish fishery.

Comment: The EFP is not reasonably designed to meet its stated objective. The EFP would authorize only one vessel to fish for swordfish in a data poor fishery. One vessel fishing for one season will not yield statistically significant results that will allow NMFS to reasonably determine whether re-establishing a SSLL fishery for swordfish off the West Coast is a viable option.

Response: As discussed in section 1.2 of the EA, the proposed action is to issue an EFP to allow one vessel to explore the commercial viability of fishing with new and innovative longline gear in the EEZ off of Oregon and California during the 2007 fishing season. The collection of preliminary data in a small-scale exploratory fashion is a valid objective under the EFP process as referenced in the HMS FMP and as part of the National EFP Guidelines. The proposed action is not designed to conduct a formal experimental test that would produce statistically significant results to compare bycatch rates of protected species among gear types. To achieve that goal would require, among other things, a larger sample size of sets/vessels spread out over an appropriate spatial/temporal scale, along with control groups fishing with other swordfish gear including DGN and pelagic longline gear of earlier vintage (e.g. J-hooks with squid bait). NMFS recognizes that conducting a large scale experiment which randomizes over vessels and fishing areas is not a realistic option at this time given, among other things, the large number of vessels and the logistical requirements needed to conduct such an experiment. Evaluating the success of the proposed EFP could be measured in two ways. First, success may be evaluated in terms of the degree and condition of unmarketable bycatch discarded during the EFP as well as the degree of interactions with marine mammals, sea turtles, seabirds, and other marine resources relative to the amount of swordfish landed. Second, success could be evaluated by examining the difference between the applicant's operating costs and the ex-vessel revenues of his landed catch. Success will also be measured based on the willingness of the applicant to reapply for an EFP in 2008. NMFS would consider the collection of any new fisheries-dependent information as a successful first step towards providing much needed data to address the uncertainties and risk involved. NMFS is also aware of the highly controversial and charged nature that this EFP and previous discussions on a SSLL fishery (e.g., discussion held during the development of the HMS FMP) have created in California. NMFS also realizes that any effort to develop an experiment that would require several vessels, more sets and a larger spatial/temporal scale is likely not politically acceptable in California at this time. Consequently, NMFS believes that by taking this first step to gather preliminary information in a very limited and controlled fishery trial, NMFS may obtain some information to better inform members of the public.

Comment: If the Council wishes to open the leatherback closure area to a longline fishery, it must follow Magnuson Stevens Act (MSA) procedures and not do this under the guise of an EFP.

Response: The current Pacific Leatherback Conservation Area was not established as a permanent closure area for all gear types and fisheries. The Pacific Leatherback Conservation Area was established to prohibit DGN fishing in a time/area stratum coinciding with historic leatherback turtle presence while the animals are in either a foraging or migratory mode. NMFS has no information between the interactions of leatherback turtles and the current SSLL gear requirements in the California Current to impose a similar closure for this gear. NMFS believes that a more precautionary approach for collecting preliminary data would be to incorporate very conservative controls and mitigation measures (e.g., take caps, effort controls, and 100 percent observer coverage) into the EFP. NMFS does not believe that undertaking an FMP amendment as implied by the author is a reasonable way to proceed at this time given the lack of data and information that would be required to address an amendment or regulatory change. The EFP process, under authority of the MSA (16 U.S.C.1801 et seq.), provides the best route for collection of preliminary data in a risk adverse manner.

Comment: This action does not comply with bycatch provisions contained in the MSA requiring NMFS to manage fisheries so that bycatch levels are minimized and avoided to the extent practical.

Response: National Standard 9 of the MSA requires that "conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch" (16 U.S.C. § 1851(9)). Restricting effort in a fishery by its very nature serves to reduce overall bycatch levels. NMFS has several strong mandates for fish and protected species bycatch reduction, including the MSA, ESA, and MMPA. The full retention and use of bycatch species is encouraged by NMFS to minimize waste in fisheries. Bycatch, as defined by the MSA (16 U.S.C. § 1802 (2)), "means fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards". Requiring retention of all species caught does not necessarily eliminate the problem of bycatch and NMFS is aware that it is critical to account for all catch—including target catch, bycatch, and retained incidental catch. The bycatch species in question, however, would not be caught in numbers that would generate a resource conservation concern under the proposed EFP effort levels (i.e., maximum of 67,200 hooks of effort). The use of circle hooks and mackerel or mackerel-type bait has proven in other domestic and international longline fisheries to significantly increase the survival of incidentally captured and released species, including certain species of turtles, sharks and billfish.

Comment: The EFP will put additional pressure on non-target finfish species such as striped marlin that are not actively managed by the Council, and are currently the subject of scientific concern.

Response: Striped marlin is one of 13 HMS FMP management unit species. The status of striped marlin is reviewed periodically by scientists from the IATTC and other regional scientific bodies. The overall Eastern Pacific stock is not currently listed as overfished or experiencing overfishing. There are no domestic or international quotas in place at this time. Commercial harvest of striped marlin is prohibited under the HMS FMP. At this time, there is no harvest guideline recommended for the seasonal influx of fish, which occurs in the U.S. EEZ at the edge of the species' range. A very conservative take cap of 12 striped marlin is being recommended for the proposed EFP as a means to constrain the take of this species. The use of circle hooks has been shown to be less likely to cause serious bleeding or be lodged in areas other than the mouth for striped marlin captured by recreational fishermen in California equating to increased survivorship for released fish (Domeier, *et al*. 2003). Similar findings were demonstrated with blue marlin captured in pelagic longline fisheries in Hawaii (Kerstetter, *et al*. 2003).

Comment: Longlines are one of the "largest impacting technologies of reducing the squid's predators besides also blindly killing endangered species". This is cause for alarm because Giant Humboldt Squid are increasing in numbers and are "extremely effective predators of most of California's favorite fished species including salmon, rockfish, kelp, many bass species and nearly any juvenile fish".

Response: NMFS is aware of the reported recent increase of Humboldt squid off the U.S West Coast. Humboldt squid briefly appeared off of California during an El Niño event in 1997. The squid again appeared in 2002, during another El Niño event and remained in the area. It is not known whether the continued presence of Humboldt squid off the West Coast is temporary or a long term shift in their distribution. NMFS observers are currently collecting swordfish stomachs aboard DGN fishing vessels operating in the U.S. West Coast EEZ in an effort to determine the composition of swordfish diet.

Comment: An increase in effort as proposed in the EFP, coupled with the estimated recreational fisheries catch, will likely exceed the harvest guidelines for certain species, like thresher shark.

Response: Information regarding the catch and effort for most HMS shark species taken in California recreational fisheries is collected by State samplers. Private boaters catch thresher sharks as they migrate from Baja California, Mexico, to Oregon and Washington in the spring and early summer months. From 1982 to 2004, private boaters caught on average 2,000 fish annually. Since 2001, annual catch estimates have ranged from 2,000 to 4,000 fish. However, some uncertainty exists with these catch estimates due to a low number of sampler contacts with fishers. NMFS and the Council recognize the need to collect additional and more accurate data on the private recreational catch and effort of HMS sharks in California and are currently entertaining several alternatives to meet that need, including support of research and monitoring proposals being considered by State and Federal funding agencies. The HMS FMP established harvest guidelines for common thresher and short-fin mako sharks and stipulated that if the harvest guidelines were exceeded for either of these species, NMFS would work with the Council and its Advisory Bodies to address the situation and craft an appropriate plan of action. Using observer data from the Hawaii-based SSLL fishery as a proxy for potential thresher shark take under the maximum effort scenario of the proposed EFP demonstrates a very low projected take (see table 4.1, p. 102). The distribution and abundance of thresher sharks in the proposed EFP action area will most likely be different than those in the proxy Hawaii fishery and catches may likewise be different. The proposed EFP would allow the preliminary gathering of catch data for target and non-target species in an area where very little or no data currently exists.

Comment: Issuing the EFP would be wholly incompatible with the HMS FMP.

Response: Several of the stated management goals and objectives of the HMS FMP deal with the desire to promote conservation and sustainable use of HMS fisheries utilized by West Coast-based fishers who contribute to the food supply, economy, and health of the nation. The goals and objectives include the desire to provide a long-term, stable supply of high-quality, locally caught fish to the public; minimize economic waste and adverse impacts on fishing communities to the extent practicable when adopting conservation and management measures; provide viable and diverse commercial fisheries for HMS based in West Coast ports; and give due consideration for traditional participants in the fisheries. The HMS FMP contemplates a similar EFP approach to investigating the potential of SSLL gear to be a more conservative alternative to DGN gear.

Comment: The EFP application proposes 4 trips with an estimated 56,000 hooks of effort during the period September through December. However, the July 13, 2007, notice published in the Federal Register regarding potential issuance of this EFP indicates a maximum of 1,200 hooks per set for the 4 trips which equates to 67,200 hooks of effort.

Response: The EFP proposal included 56,000 hooks based upon an average of 1,000 hooks per set. In its analysis, NMFS considered the maximum number of hooks that may be set, 1,200 per set or 67,200 total hooks, to determine the maximum effect of the proposed action.

Comment: There are no proposed EFP take-limits for white sharks, which are protected by State and Federal law.

Response: White sharks are one of several species listed as a prohibited species under the HMS FMP and implementing regulations. Prohibited species are to be released immediately back to the water and may not be landed unless previous authorization has been obtained for retaining incidentally captured specimens for educational and/or scientific collecting purposes. Based on the best available information, NMFS does not anticipate any significant catch of white sharks in the proposed action. If catches do occur, however, the applicant will be bound by the applicable State and Federal regulations to safely and expeditiously release the sharks back to the water. Post-trip observer records would be analyzed to assess if a significant number of prohibited species were being encountered and appropriate mitigation measures and/or additional conservation actions would be implemented should additional EFP fishing be considered and approved.

Comment: Despite the scale of effort to be authorized under the EFP, there is no experimental design to meet the EFP's stated purpose. The EFP will place additional fishing pressure on species already subject to overfishing, yet provide no meaningful data.

Response: NMFS is viewing the EFP as a precautionary first step in a potential multi-phase process to assist in constructing future management decisions. Specifically, fishing in the area under the EFP would provide preliminary information on: the commercial viability of fishing for swordfish using modified SSLL gear, circle hook performance, and a first look at target and bycatch species composition. Further information would be generated for allowing some preliminary comparison of the ratios of bycatch to unit weight of swordfish caught.

Comment: The proposed EFP is requested to "determine if longline gear is an economically viable HMS harvest substitute for DGN gear. Additionally, the EFP is for the purposes of determining "environmental effects, including the potential impacts to protected species". This does not meet the regulatory criteria for issuance of an EFP within the categories enumerated at 50 CFR 660.745.

Response: NMFS National EFP Guidelines state that a NMFS Regional Administrator may authorize, "for limited testing, public display, data collection, exploratory, health and safety, environmental cleanup, and/or hazard removal purposes, the target or incidental harvest of species managed under an FMP or fishery regulations that would otherwise be prohibited" (50 CFR 600.745(b)). This requires issuance of an EFP, which is the proposed course of action that NMFS, in conjunction with the Pacific Council's recommendation, is pursuing. This EFP satisfies the data collection and exploratory aspects of the regulations.

NEPA

Comment: The issuance of the EFP would violate the environmental review provisions of NEPA. NEPA's purpose to guarantee that agencies take a hard look at the environmental consequences of their actions before these action occurs… NMFS has completely reversed this process by deciding it wishes to allow pelagic longlining in the area currently closed to such fishing to protect numerous species. Such prejudging of the outcome completely taints the NEPA process and is unlawful.

Response: By preparing an environmental assessment, including the results of formal consultation under ESA and various other environmental and socio-economic related laws and regulations, NMFS is complying with the requirements of NEPA. In considering the request to issue an EFP, NMFS is responding as required in accordance with the provisions of the MSA and following established National EFP Guidelines.

Comment: NMFS is in violation of NEPA by failing to prepare a full Environmental Impact Statement (EIS) for the EFP. An EIS must be prepared if, among other things, "substantial questions are raised as to whether a project…may cause significant degradation of some human environmental factor. Several of the CEQ "significance factors" triggering the need to prepare an EIS are met by the proposed EFP.

Response: Through preparation of the EA and associated analyses, NMFS will determine the likelihood of significant effects on the human environment and whether a finding of no significant impact or the need to prepare an EIS is the most appropriate action.

Comment: The "cumulative effects" analysis in the draft environmental assessment is not sufficient in this case where the fisheries often act as a single unit.

Response: NMFS recognizes the broader ecosystem considerations the question raises. There is a concerted effort at State, Federal, and international levels to move towards ecosystem-based management strategies that will cater for these broader spectrum considerations. At the present time, extensive data to support these efforts is lacking and the cumulative effects analysis in the draft EA utilized the best available information. In addition, there is very little quantitative information available on the bycatch and other fishery-dependent impacts from foreign HMS fisheries upon which to strengthen the cumulative effects analysis. Very little quantitative information exists on the bycatch and other fishery-dependent impacts from foreign HMS fisheries. NMFS is actively engaged in finding solutions to address these data gaps by partnering with regional and international organizations and governments to develop monitoring tools such as VMS and international observer programs.

Comment: Rather than inform the public as required by NEPA as to what actual NEPA document the Agency will rely upon for environmental review and decision making, NMFS simply mentions the existence of an EA used by the Council. If NMFS intends to rely upon this EA, it needs to explicitly state such intentions and recirculate the document for public comment.

Response: NMFS has worked closely with staff from the Pacific Fishery Management Council and our Southwest Fishery Science Center in the development of the draft and final EA for this action. The public had ample opportunity to review and provide comment on the draft EA and the final EA was improved based on upon the comments received. The proposed action and suite of alternatives in the final EA have not appreciably changed to such an extent that the impacts were not within the range of impacts described in the draft EA. As such, NMFS believes it has properly met the public disclosure requirements as outlined by NEPA.

Comment: The Hawaii and California-based fleets fish in the same manner, often in the same area, and catch the same turtles. In addition, the fleets consist of many of the same boats as they have a history of moving back and forth to avoid closures. The cumulative effects analysis in the draft EA is not sufficient as the Hawaii- and California-based longline fisheries often act as a single unit.

Response: There are no SSLL fishing fleets currently working out of California. The draft EA reviewed past observer catch records from both fleets in question. The more relevant question centers around the pertinent changes that switching from J-hooks and squid bait to circle hooks and mackerel bait had on the rates of target and non-target catch, including protected species catch. NMFS did analyze these changes and showed a significant increase in the post-hooking survivorship for bycatch species (e.g., sea turtles and sharks) when circle hooks and mackerel bait were employed versus the traditional J-hooks and squid bait previously utilized.

Socio-Economic Considerations

Comment: If NMFS is legitimately interested in seeking out more sustainable alternatives for targeting Pacific swordfish stocks, the agency should focus its energy and resources on researching ways to expand the high value, low volume, no-bycatch California harpoon fishery.

Response: The U.S. harpoon fishery does not have the growth potential to take-over as the sole swordfish harvesting gear in the U.S. EEZ to meet current demand. Harpoon vessel fishing trips vary according to fishing success, fish carrying capacity, and preservation capability and are largely confined to a relatively small area encompassed by the SCB. Fish are sighted either finning or jumping at the surface or swimming just beneath the surface. Since sightings are of fish on or near the surface, good weather conditions and calm seas are required for successful fishing.

Swordfish caught by harpoon fill a high-end (luxury consumption) market niche, different from swordfish caught by DGN or longline gear. The harpoon fishery is very selective and operates with practically no bycatch. However, because the fishery is highly dependent on suitable environmental conditions for locating swordfish on the surface, the fishery cannot be readily transported to other locations lacking these conditions (i.e., north of Point Conception). Consequently, due to the low catch rates in the fishery and the greater efficiency of the DGN fishery (see table A-1 below) NMFS believes that an increase in the fleet size or catch of this boutique-market fishery for replacing the DGN fishery is neither feasible nor realistic. The expansion limitations include, among others, a narrow band of favorable waters and time periods for sighting and harpooning swordfish (i.e., basking swordfish in the SCB), the negative economic constraints based on increased fuel consumption and operational costs for this gear type, and the narrow market niche for the product.

Besides the harpoon fishery, DGN and SSLL are the only other known commercial gears used to harvest swordfish. Without the ability to meet the U.S. demand from domestic commercial fishing effort, imports from foreign sources would fill the void. Foreign fleets operate under less stringent management and conservation measures; hence an increase in foreign fishing swordfish effort would potentially exacerbate the endangered marine turtle mortality problem[29].

While not as selective as harpoon gear, NMFS finds that ever since the agency adopted new bycatch reduction technologies and measures, SSLL gear has become far more selective. This fact has been substantiated by NMFS's own research as well as the research of others and has been extensively published in peer-reviewed scientific journals (Watson, *et al*. 2005).

Table A–1. West Coast total and West Coast harpoon swordfish landings (round mt) [30].

Year	Total Swordfish Landings	Harpoon Swordfish Landings	% Harpoon to Total Landings
1990	1,236	65	5.26%
1991	1,029	20	1.94%
1992	1,546	75	4.85%
1993	1,767	169	9.56%
1994	1,700	157	9.24%
1995	1,161	97	8.35%
1996	1,191	81	6.80%
1997	1,459	84	5.76%
1998	1,408	48	3.41%
1999	2,033	81	3.98%
2000	2,657	90	3.39%
2001	2,195	52	2.37%
2002	1,714	90	5.25%
2003	2,135	107	5.01%
2004	1,186	69	5.82%
2005	294	73	24.83%

Comment: The proposal would reward and subsidize a special interest and degrade and desecrate the public interest.

Response: NMFS would not be subsidizing any special interest group as suggested by the commenter. NMFS would be providing a properly trained and qualified fisheries observer; otherwise, the applicant is assuming all additional costs that would be incurred to carry out the EFP under the strict terms and conditions applicable. It should also be noted that there is a high consumer demand for swordfish.

[29] Since leatherback and loggerhead turtles are transboundary species, an increase in fishing effort outside the U.S. EEZ due to a transfer of demand not met by U.S. EEZ fishing effort could potentially result in increased marine turtle bycatch.

[30] SAFE Document "Status of the U.S. West Coast Fisheries for Highly Migratory Species through 2005; Stock Assessment and Fishery Evaluation" (September 2006), Pacific Fishery Management Council, Portland, OR.

Between 1989 and 2005, the U.S. annual demand for swordfish (i.e., U.S. landings plus imports) ranged from 10,948 metric tons (mt) to 23,114 mt, averaging 16,556 mt. During this period, U.S. landings averaged 6,444 mt (about 39 percent of demand) and imports averaged 10,111 mt (61 percent). Landings of swordfish in the United States have shown a general pattern of decline from the early 1990s through the early 2000s, with landings in 2005 of 3,039 mt at only 28 percent of the record landings of 10,851 recorded in 1993. In contrast, the share of U.S. swordfish demand supplied by imports increased from 35 percent in 1993 to 77 percent of the total in 2005. In 2005, U.S. imports of swordfish were 10,187 mt, valued at about $77 million. Singapore, Panama, Canada, and Chile are the dominant suppliers of imports. Over the entire period from 1989 through 2005, imports increased from rough parity with U.S. landings to over three times the level of domestic landings in recent years.

Based on an April 2007 assessment, the Monterey Bay West Coast Seafood WATCH program[31] has listed U.S. domestic longline-caught swordfish as a “Good Alternative” from the standpoint of whether the fisheries which caught them are “healthier for ocean wildlife and the environment.” By contrast, Seafood WATCH places imported longline caught swordfish on their “Avoid” list since there are no integrated international laws to reduce bycatch and these international longline fleets are contributing heavily to the long-term decline of threatened or endangered species such as sea turtles and seabirds. By contrast, due to strict bycatch regulations and management oversight in the U.S. domestic longline fleet, swordfish from our domestic fleet is listed as a "Good Alternative".

[31] http://www.mbayaq.org/cr/seafoodwatch.asp

ENDANGERED SPECIES ACT SECTION 7 CONSULTATION BIOLOGICAL OPINION

ACTION:	Issuance of a shallow-set longline exempted fishing permit under the Fishery Management Plan for U.S. West Coast Highly Migratory Species Fisheries
CONSULTATION CONDUCTED BY:	National Marine Fisheries Service, Southwest Region, Protect Resources Division
FILE NUMBER:	151422SWR2007PR00268
DATE ISSUED:	NOV 28 2007

Introduction

NOAA's National Marine Fisheries Service (NMFS) is required under section 7(a)(2) of the Endangered Species Act (ESA) to conduct a consultation which considers the impacts on ESA listed species of the issuance of an Exempted Fishing Permit (EFP) which would allow fishing with shallow-set longline (SSLL) gear in the West Coast Exclusive Economic Zone (3 to 200 nautical miles (nm) from shore). Use of this type of gear in this area is currently prohibited under the Fishery Management Plan (FMP) for U.S. West Coast Fisheries for Highly Migratory Species (HMS). The EFP would authorize a single West Coast-based longline vessel to conduct tightly controlled fishing operations inside the U.S. West Coast EEZ from 40 to 200 nautical miles from shore and outside of the Southern California Bight (SCB) during the time period September-December, in the year of the authorization (expected to be 2007 or 2008). The EFP, if approved, would operate in accordance with the Pacific Fisheries Management Council's (Council) Operating Procedure for EFPs and the NMFS National EFP Guidelines. This action is consistent with goals and objectives embodied in the Fishery Management Plan (FMP) for U.S. West Coast Fisheries for Highly Migratory Species (HMS).

NMFS has determined that ESA listed leatherback sea turtles are likely to be adversely affected by the proposed action. Other ESA listed species that may occur in or near the action area are not expected to be affected or adversely affected by the proposed action.

No designated critical habitat is within the proposed action area, so critical habitat will not be considered further in this opinion.

I. CONSULTATION HISTORY

Formal consultation on the SSLL EFP proposed action was initiated by the Southwest Region (SWR) Sustainable Fisheries Division (SFD) on May 16, 2007. Prior to this, the SWR Protected Resources Division (PRD) engaged in pre-consultation technical assistance with SFD, the Pacific Fisheries Management Council's (Council) HMS Management Team (HMSMT), the Council's

Advisory Subpanel, and the EFP applicant, Mr. Peter Dupuy. The following paragraph details the Council process which staff from PRD participated in and provided technical assistance as part of pre-consultation on this action.

The EFP application was originally submitted to the Council in November 2005 by the applicant, who currently fishes with deep set tuna longline gear outside the EEZ and has also participated in the DGN fishery. At their March 2006 meeting, the Council gave preliminary approval for further consideration of the application. At a November 2–3, 2006, joint meeting of the Council's HMSMT and Advisory Subpanel (HMSAS), a range of alternatives for terms and conditions attached to the EFP was discussed and refined. These alternatives were adopted for public review by the Council at their November 12–17, 2006, meeting. The Council chose a preferred alternative at their April 1–6, 2007, meeting in Seattle, Washington, based in part on public testimony and information contained in the draft Environmental Assessment (EA) submitted as part of the consultation initiation package for this proposed action.

On May 16, 2007, PRD received a memo from SFD requesting formal consultation on the proposed action. On June 28, 2007, PRD provided a preliminary analysis of the action and anticipated interactions with ESA listed species. A key component of the proposed action is the use of take caps on species considered likely to be taken during fishery operations authorized by the EFP. PRD and SFD met on July 9, 2007, to discuss PRD's analysis which included a preliminary incidental take statement (ITS) of leatherback sea turtles. No other ESA listed species are considered likely to be adversely affected by the proposed action. PRD met with SFD on July 16, 2007, to explain methods used to quantify the anticipated level of leatherback takes and associated mortalities due to the proposed action. SFD agreed to the conservative estimate of five anticipated leatherback takes with one associated post-hooking mortality. This take and mortality estimate is included as the take cap in the proposed action which is the subject of this consultation.

In late July, SFD notified PRD that the proposed action area had been changed from 30 nm offshore to 40 nm offshore. This resulted in the proposed action area that is the subject of this consultation.

II. DESCRIPTION OF THE PROPOSED ACTION

NMFS-SWR SFD proposes to issue a one-year EFP to authorize the applicant to conduct fishing operations utilizing SSLL gear to target swordfish within a restricted area of the West Coast EEZ between September 1 and December 31. The following is a list of the terms and conditions of the proposed action:

1. One hundred percent observer coverage.
2. A single vessel participating.
3. Maximum of 14 sets per trip.
4. Maximum of four trips between September and December (up to 56 total sets and 67,200 hooks for the entire duration of the proposed EFP).
5. No fishing within 40 nm of the coastline, all fishing within the U.S. west coast EEZ (see Figure 1).

6. No fishing within the Southern California Bight as defined by the applicant (see Figure 2).
7. Utilizing shallow-set longline gear configuration:
    a. 50–100 km mainline
    b. 18 m floatline
    c. 24 m branchlines
    d. 2–8 hooks between floats
    e. 400–1,200 hooks per set
    f. Set fishing gear so hooks are at a depth of 40–45 meters below the surface
8. Use 18/0 circle hooks with a 10° offset to fish for swordfish (as described at 50 CFR 665.33(f)).
9. Use mackerel or mackerel-type bait (as described at 50 CFR 665.33(g)).
10. Allow the use of light sticks.
11. Require use of Time depth recorders (TDR) to estimate fishing depth. (The number of TDR units deployed per set and per trip would be determined by NMFS in consultation with the applicant.)
12. Gear may not be set until one hour after local sunset and must be fully deployed before local sunrise.
13. Prohibit the use of a line shooter for setting the gear.
14. Require use of a NMFS-approved dehooking device to maximize finfish (e.g., blue shark) bycatch survivability.
15. A catch cap of 12 striped marlin.
16. A take cap of one short-finned pilot whale (this species is not ESA-listed).
17. A limits or cap of five leatherback sea turtles consistent with the Incidental Take Statement (ITS) of this Biological Opinion. No other ESA-listed species are expected to be taken.
18. A cap of one captured short-tailed albatross, per U.S. Fish and Wildlife Service (USFWS) informal consultation.
19. No fishing north of 45° N latitude.
20. All observers shall carry satellite phones provided by NFMS and immediately inform NMFS of any marine mammal, sea turtle, or seabird capture or interaction.

A. Gear and methods

The applicant will deploy from 50 to 100 km of 600 to 1,200 pound test monofilament mainline per set. Mainlines will be rigged with 22-m branch lines at approximately 61-m intervals and buoyed every 1.6 km. Between 400 and 1,200 hooks will be deployed per set. The bait species will be mackerel and mackerel-type fish with various colored light sticks used to attract the target species to the bait. The mainline is deployed from 4 to 7 hours and left to drift (unattached) for 7 to 10 hours with radio beacons attached to facilitate gear recovery. Retrieval typically requires 7 to 10 hours depending on length of mainline and number of hooks deployed. The applicant will be required to set and fish during the night when more swordfish are available in surface waters which will also reduce the potential for seabird interactions.

The applicant may employ a crew of between four to six people, including the captain. A fishing trip is estimated to last up to three weeks. As is typical with most vessels engaged in this type of fishing, the vessel does not have built-in refrigeration equipment, limiting their trip length. The fish will be iced and sold as "fresh."

The proposed action is subject to all the established management requirements in the HMS FMP including longline fishery regulations at 50 CFR 660.712, which include sea turtle and seabird take mitigation measures. Additional sea turtle conservation regulations are required at 50 CFR 223.206(d)(9).

A commercial-scale longline fishery has not been previously allowed within the West Coast EEZ, so precisely how and where gear will be set can not be known. The primary target species for this proposed action is swordfish, although thresher shark may also be targeted. The migratory patterns of these species largely dictate the area in which fishing will occur. NMFS assumes that SSLL fishing under the proposed action will follow the same patterns of fishing as the drift gillnet (DGN) fishery that occurred in approximately the same area targeting swordfish. The DGN fishery is currently prohibited in the portion of the proposed fishing area north of Point Conception from August 15 to November 15. Historically, most DGN fishing occurred between August and January, based largely upon the migratory patterns of swordfish along the U.S. west coast. In the DGN fishery outside the SCB, most effort occurred from three to 150 miles offshore. Areas of fishing activity are largely dependent on oceanographic conditions and many swordfish fishermen in particular seek temperature fronts that concentrate fish which are prey for the large predatory species they are targeting (e.g., swordfish).

B. Action Area and Effort

The proposed action area is the West Coast EEZ delineated by the U.S.-Mexico border on the south, 45°N latitude on the north, and 40 nm off the U.S. West Coast to the outer boundary of the EEZ (see Figure 1). There has not been a commercial SSLL fishery in the proposed action area in the past therefore, the applicant is unable to define precisely where within the proposed action area he will be setting gear to target swordfish. In accordance with the existing regulations promulgated under the ESA (at 50 CFR 223.206) the applicant will not set any gear in such a way that would result in SSLL fishing in the high seas, west of the West Coast EEZ. The vessel will also be excluded from fishing in the SCB. The prohibition on operating more than 40 nm from the mainland coastline and outside of the SCB is intended in part to reduce gear conflicts with other commercial and recreational fishing vessels and to reduce bycatch of striped marlin. The prohibition could also reduce interactions with ESA-listed species, for example humpback whales which have been more commonly found in coastal areas during shipboard surveys (Carretta *et al.* 2007).

The SCB is a marine region including waters of the coastal areas and the Channel Islands south of Point Conception. The coastline is indented, trending to the southeast providing shelter from northwest winds that prevail during summer months. Circulation patterns and bathymetric complexity contribute to high marine biodiversity within the region. Because of its proximity to major metropolitan areas it also attracts heavy recreational use. Under the proposed EFP terms and conditions fishing would not be allowed in this region. Figure 2 shows the boundary line with coordinates as follows:

33° 57' 21" N, 120° 31' 44" W – Intersection with 40 nm mainland buffer
33° 15' 00" N, 119° 40' 00" W – State waters boundary off western tip of San Nicholas Island
31° 06' 08" N, 118° 45' 00" W – Intersection with southern EEZ boundary

A single vessel would be fishing under the proposed EFP. It would make a maximum of four trips, with each trip making a maximum of 14 sets, thus a maximum of 56 sets for the duration of the proposed action. The number of hooks will vary between 400 and 1,200 per set for a maximum of 67,200 hooks for the entire duration of the proposed EFP.

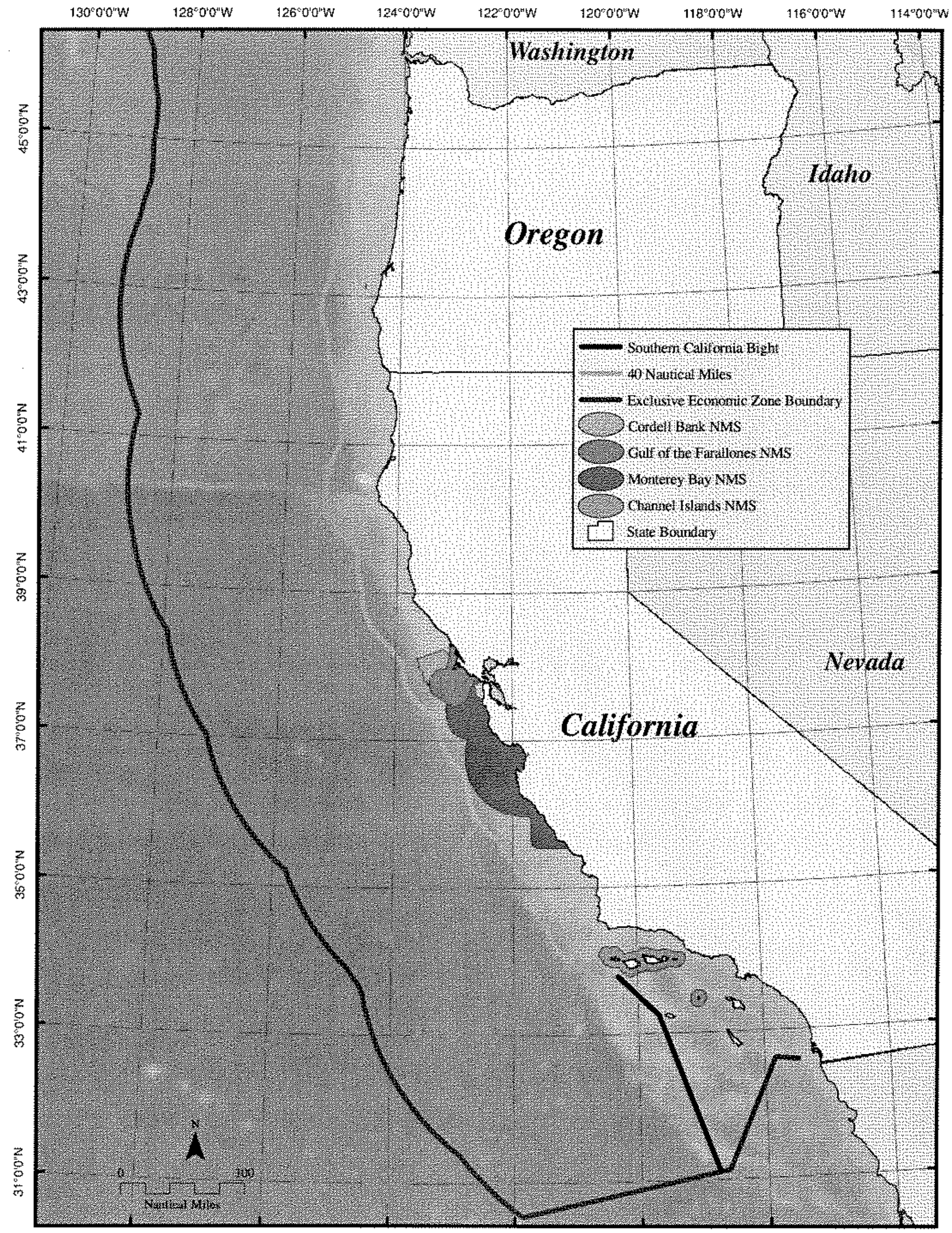

Figure 1. Boundary of proposed shallow-set longline EFP. Green line represents 40 nautical mile shoreward boundary; grey represents EEZ; black line represents SCB boundary.

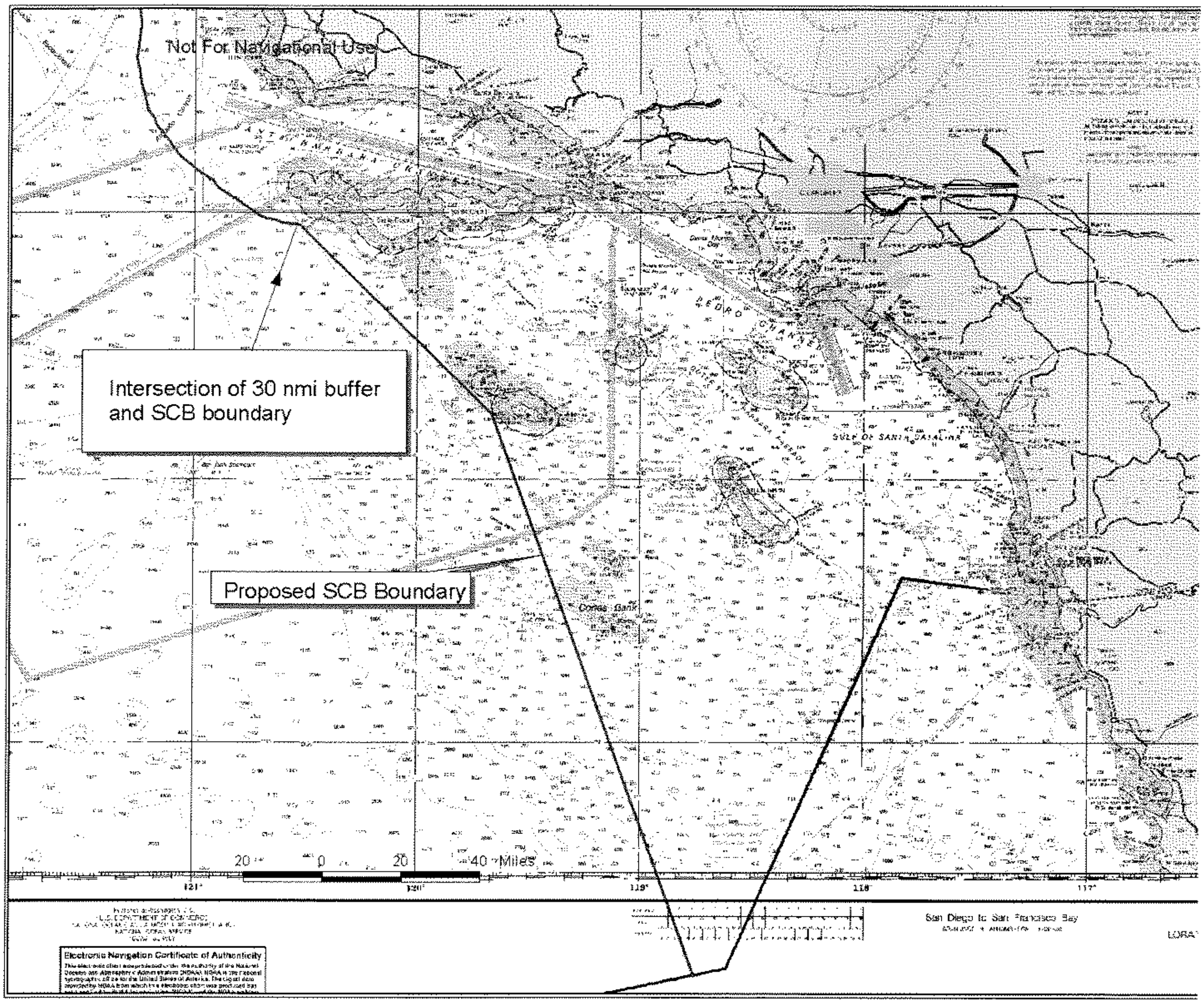

Figure 2: The Southern California Bight (SCB) as described for the proposed action. The proposed action area does not include the SCB.

C. Conservation measures included in the proposed action

In shaping its preferred alternative, the Council choose to include sea turtle conservation measures consistent with the 2004 amendment to the Hawaii based Pelagics FMP (69 FR 17329) that re-opened the SSLL fishery in the Pacific Ocean and around the Hawaiian Islands. Under the terms and conditions of the proposed EFP, the applicant would use shallow-set gear to target swordfish and would not target tuna with deep- set longline gear as part of the EFP. The application states that albacore, bigeye, yellowfin, and northern bluefin tunas may be caught in addition to swordfish. The proposed shallow-set gear configuration is typical of gear being used in Hawaii, with longer branchlines than floatline which are intended to allow any hooked or entangled sea turtles or marine mammals to reach the surface so they will not drown before the gear is retrieved. Light sticks are used. The limitation on the type of hooks and bait used are consistent with current Federal regulations applicable to vessels fishing under the Pelagics FMP. This hook and bait type has been demonstrated to reduce the number of sea turtle incidentally taken in SSLL. In the Hawaii-based fishery, reductions of 90% (loggerheads), 82.8% (leatherbacks), and 89.1% (combined turtle species) have been observed (Gilman *et al.* 2006). In the Northeast Distant (NED) experiments in the Atlantic Ocean, reductions of approximately 65% were observed with this gear configuration (Watson *et al.* 2005). All sea turtle take mitigation measures, at 660 CFR 712(b-e) would be applicable to the EFP fishery. In addition, one of the terms and conditions of the permit would require the skipper and captain to attend a protected species workshop to learn about methods to avoid interactions with turtles and marine mammals and safe handling techniques for de-hooking animals, if caught.

The requirement to set the gear at night and is intended to reduce accidental hooking and/or entanglement of seabirds. Seabirds typically get hooked when the line is being deployed off the back of the vessel while the hooks are flying through the air or on the surface of the water before the gear sinks. The birds dive for the baited hooks, get hooked, and are dragged underwater and drown. Because seabirds are less active at night, the night setting requirement reduces these interactions.

Deployment of TDRs, also required under the EFP, would provide more detailed information on fishing depth and provide additional data related to catch rates and gear interactions with protected species and finfish.

The conservation measures for the proposed action include a cap of five leatherback takes or which one take is likely to result in mortality, the capture of one short-tailed albatross, a limit or one short-finned pilot whale take and a cap of twelve striped marlin. Observers must call in any interactions with marine mammals, sea turtles and sea birds. If any of the caps is reached, fishing operations would cease pending retrieval of remaining gear in the water at which time fishing under the EFP would be terminated for the year.

D. Observer Program

The proposed action requires 100% observer coverage on all trips. All observers will be trained on species identification and appropriate data collection if an interaction occurs. While at sea, observers will, to the extent possible, collect information on observed species in the area, particularly leatherbacks and marine mammals. This information will add to the body of knowledge on the distribution of protected resources off the coasts of California and Oregon.

The observers will be responsible for notifying NMFS if any of the take caps are reached or approached. Additonally, observers will call in to report any interactions with marine mammals, sea turtles, or sea birds during fishing operations authorized by the EFP. Final determination on whether take caps have been reached and/or the EFP must be revoked will be made by the SWR.

III. APPROACH TO THE ASSESSMENT

A. Method

After receiving a complete description of the proposed action from SFD, PRD began an assessment of how best to analyze the effects of the proposed action. These steps were:

1. Deconstruct the action

Our first step was to deconstruct the proposed action and all conservation measures included in the proposed action in order to ensure that we understood what was proposed and how the action would be implemented. For this we relied primarily upon the initiation package provided by SFD, which included the "Draft Environmental Assessment on the Issuance of an Exempted Fishing Permit to Fish with Longline Gear in the West Coast EEZ" prepared by the HMS MT, PFMC staff, and NMFS (NMFS & PFMC 2007). The deconstruction of the proposed action is described in the sections above.

2. Exposure

Determining which ESA listed species were most likely to be exposed to the proposed action and adversely affected was challenging due the lack of observer data from a SSLL fishery in the proposed action area. We relied upon observer data from other fisheries that have operated in the action area, data from other SSLL fisheries, other relevant longline fisheries, and available information on the abundance and distribution of ESA-listed species within the action area and during the time year of the proposed action. Our determinations of effects on listed species is based upon the "weight of evidence" available for the analysis. Interactions between ESA-listed species and longline gear are extremely rare and difficult to predict and quantify, so our assessment includes a level of uncertainty that is higher than most section 7 consultations on fishery actions for which at least some direct data is available.

The exposure analysis to determine which species are most likely to be affected by the proposed action proved to be a challenging part of this section 7 consultation. There has not been a longline fishery within the proposed action area, the West Coast EEZ from 40 to 200 nm offshore and outside the SCB. We developed a methodology for estimating the species that are likely to be affected and adversely affected by the proposed action by using a variety of other fisheries as proxies for the SSLL EFP fishery. This method is reviewed here briefly.

We began by reviewing the DGN observer records, which we used an as indication of the presence of species in the proposed action area. We assumed that interactions between DGN fishing gear in the proposed action area and ESA-listed species could indicate a likelihood of interactions between SSLL gear and ESA-listed species, while being mindful of the differences in the types of interactions (i.e., entanglement in a DGN net of approximately one linear mile as opposed to hooking due to depredation or entanglement on longlines). We limited our review to observer records from within the proposed action area. Species that were not observed taken in the DGN fishery within the action area and had not been observed taken in other longline fisheries were determined to be not likely to be adversely affected by the proposed action, this included species such as blue whales. Some species were considered unlikely to be exposed to the proposed action based upon their biology and behavior (e.g., white abalone), others were eliminated because their range does not overlap the proposed action area (e.g., Guadalupe fur seals).

We recognized that the differences in the two gear types, DGN and SSLL, and the differences in where the two gears did and may fish are sufficiently different that using only DGN observer records to anticipate takes in the SSLL was not appropriate. Therefore, we reviewed observer records from SSLL fisheries in areas where the fishery and ESA-listed species overlap spatially and temporally, particularly in areas where the behavior (e.g., feeding or migrating) and distribution (e.g., along the continental shelf) of ESA-listed species is similar to their behavior and distribution in the proposed action area. Other variables that may affect the distribution of species were also considered, particularly the influence of El Niño or warm water events.

3. Response

The third step was considering how leatherback sea turtles would respond once exposed to the proposed action. These analyses relied upon the most recent observer information from the Hawaii SSLL fishery, the Atlantic SSLL fishery, and the NED experiments that recorded the nature of interactions between leatherbacks and SSLL gear and associated immediate and post-hooking mortality rates. The fisheries used in this analysis were chosen because they each use gear and fishing techniques similar to that in the proposed action. As described in detail in Section VI.B. none of the fisheries used to approximate leatherback responses from the proposed action were a perfect proxy, either due to differences in the fisheries such as bait types and behavior of the leatherbacks in the respective areas (e.g., whether the areas were likely to be foraging areas or migratory corridors).

4. Number of individuals exposed and risk to populations and species

Our final step in the analysis includes the results of the previous two steps and our best estimation of takes based upon the rates of takes observed in other, similar SSLL fisheries and what is known of the distribution and abundance of leatherbacks within the proposed action area. The fisheries reviewed include the Hawaii SSLL, the Atlantic SSLL, the NED experiments in the Atlantic, and the California and Hawaii SSLL that operated outside the EEZ.

We considered the effects of the proposed action within the context of the leatherbacks' current status, environmental baseline and factors affecting the species within the action area. Leatherbacks are highly migratory, we therefore considered a variety of effects both within and outside the action area that can have profound and sometimes unquantifiable effects of the species.

Our charge in this is not to identify all sources of mortalities and threats to all relevant species and rank these in order of significance. Neither is it to rank the proposed action within the existing threats. Our task is to determine if the anticipated exposure and response of species, when added to the existing and ongoing threats, conservation efforts, and species viability, would be reasonably expected to reduce the species likelihood of survival and recovery in the wild.

B. Information available for the assessment

There has not been a longline fishery in the proposed action area in the past, so there are no observer records available to project anticipated takes or species most likely to be affected.

Given the lack of direct data, a number of fisheries were reviewed and considered as proxies for the proposed action. These included the historical DGN fishery, which operated within a portion of the proposed action area (north of Point Conception) until 2001, the current DGN fishery which operates outside of the SCB, the SSLL fishery outside the EEZ which operated until 2004,.the SSLL fishery managed under the Hawaii-based Pelagics FMP and the SSLL fishery managed under the Atlantic HMS FMP. We also reviewed observer data from the bottom longline fishery in Alaska, since this is one of fisheries known to interact with, although not necessarily adversely affect, ESA-listed sperm whales. The limitations of each of these fisheries as a proxy for the proposed action are described within the exposure analysis. We also reviewed the abundance and distribution of ESA-listed species in areas outside the West Coast EEZ, where they may be exposed to SSLL gear to determine if patterns of exposure observed in other areas may be repeated in the proposed action area. We also reviewed the distribution and abundance of ESA-listed species within the action area to inform our exposure analysis and determinations on the likelihood of interactions.

A substantial amount of research has been done to better understand the western Pacific populations of leatherbacks. Populations in the eastern Pacific have been much more extensively studied, in part due to the accessibility of the major nesting sites, located primarily in Mexico and Costa Rica, both which have well identified and monitored nesting beaches. In the western Pacific, two major nesting sites have been identified, at Jamursba-Medi, in Papua, Indonesia, where the highest numbers of nesters have been recorded in the months of June, July and August (Austral winter), and in Wermon, Papua, Indonesia, where the highest number of nesters have been recorded in the months of November through February (Austral summer) (Wermon has only recently been monitored and only year round monitoring for the past three years). These beaches in north Papua may be the largest extant nesting population of leatherbacks in the Pacific. The remoteness of many nesting sites throughout Asia has made it difficult to fully assess the status of leatherbacks in the western Pacific. In 2004, a number of researchers from the U.S. and Asia met to coordinate research and information and shared data on the location of 25 nesting sites, previously unidentified in the published literature on western Pacific leatherbacks. However, there is no information on the status of the populations at these beaches or the trends in their respective sites. Other new information available for this analysis includes six years of satellite tagging of leatherbacks leaving nesting beaches in Indonesia and summer feeding areas in California. The post-nesting behavior of tagged leatherbacks indicates that these turtles travel along a variety of different routes and the animals do not share one pattern of dispersement. Further, it appears that nesting females may utilize more than one nesting site, indicating lower nesting site fidelity than other sea turtle species. All new information on the status of leatherbacks is provided in the status section of this opinion. Much of this new information is just recently published. This new data provides future opportunities for research and suggests that the western Pacific nesting population may be larger and more geographically dispersed than previously published reports indicate.

IV. STATUS OF THE SPECIES

The following ESA listed species under NMFS jurisdiction may occur in the action area:

Marine Mammals		**Status**
Blue whale *(Balaenoptera musculus)*		Endangered
Fin whale *(Balaenoptera physalus)*		Endangered
Humpback whale (*Megaptera novaeangliae*)		Endangered
Sei whale (*Balaenoptera borealis*)		Endangered
Sperm whale (*Physeter macrocephalus*)		Endangered
Steller sea lion - eastern distinct population segment (DPS) (*Eumetopias jubatus*)		Threatened
Killer whales - southern resident DPS (*Orcinus orca*)		Endangered
Northern Right Whale (*Eubalaena glacialis*)		Endangered
Guadalupe fur seals, (*Arctocephalus townsendi)*		Threatened
Sea turtles		
Leatherback turtle (*Dermochelys coriacea*)		Endangered
Loggerhead turtle (*Caretta caretta*)		Threatened
Olive ridley (*Lepidochelys olivacea*)		Endangered/threatened
Green turtle (*Chelonia mydas*)		Endangered/Threatened
Marine fish		
Green Sturgeon, southern DPS (*Acipenser medirostris*)		Threatened
Salmonids		
Chinook (*Oncorhynchus tshawytscha*)	Sacramento River winter, evolutionarily significant unit (ESU)	Endangered
	Central Valley Spring ESU	Threatened
	California Coastal ESU	Threatened
	Snake River Fall ESU	Threatened
	Snake River Spring/Summer ESU	Threatened
	Lower Columbia River ESU	Threatened
	Upper Willamette River ESU	Threatened
	Upper Columbia River Spring ESU	Endangered
	Puget Sound ESU	Threatened
Chum (*Oncorhynchus keta*)	Hood Canal Summer Run ESU	Threatened
	Columbia River ESU	Threatened
Coho (*Oncorhynchus kistuch*)	Central California Coastal ESU	Endangered
	S. Oregon/N. CA Coastal ESU	Threatened
	Lower Columbia River ESU	Threatened
Sockeye (*Oncorhynchus nerka*)	Snake River ESU	Endangered
	Ozette Lake ESU	Threatened
Steelhead (*Oncorhynchus mykiss*)	Southern California DPS	Endangered
	South-Central California DPS	Threatened

	Central California Coast DPS	Threatened
	California Central Valley DPS	Threatened
	Northern California DPS	Threatened
	Upper Columbia River DPS	Endangered
	Snake River Basin DPS	Threatened
	Lower Columbia River DPS	Threatened
	Upper Willamette River DPS	Threatened
	Middle Columbia River DPS	Threatened

A. Species considered not likely to be affected by the proposed action

There have been no observed takes of salmon, steelhead, or green sturgeon in the DGN fishery and no record could be found of takes of these species on pelagic longline gear in the Pacific. Therefore, NMFS reasons that theses species (the ESUs and DPSs of salmon and steelhead) are not likely to be adversely affected by the action and these species will not be considered further in this opinion.

Sei whales, northern right whales, and Guadalupe fur seals are not expected to be affected by the action. Aerial and ship based surveys conducted throughout the area indicate that these species are rarely observed in the West Coast EEZ (Carretta *et al.* 2007). These species have not been observed incidentally taken in the DGN fishery which operated within the proposed action area of the SSLL EFP. Therefore, NMFS reasons that these species are not likely to be adversely affected by the proposed action and they will not be considered further in this opinion.

B. Species that may be affected by the action, but considered unlikely to be adversely affected

A number of ESA-listed marine mammals and sea turtles could be affected by the proposed action. As described above, we used information from a variety of sources to identify which species are most likely to be exposed to the proposed action. We begin this section with a review of marine mammal interactions with DGN and SSLL fishing gears.

Gillnet gear has been identified as a major source of anthropogenic mortality for marine mammals species globally (Perrin *et al.* 1994). The cause of entanglements in gillnets is usually attributed to marine species being unable to detect the net and becoming entangled. This is supported by the substantial decline of marine mammal entanglements in the DGN fishery during field testing of pingers (Barlow and Cameron 2003) and following the implementation of the Pacific Offshore Cetacean Take Reduction Plan (POCTRP) which includes a requirement that acoustic pingers be attached to DGN nets (62 FR 51805). By contrast, marine mammal takes in longlines are generally attributed to depredation by odontocetes, either feeding on the bait or fish caught on the hooks although entanglements are also possible (Gilman *et al.* 2006a). Takes of small toothed whales or dolphins (e.g., short-finned pilot whales, false killer whales, and Risso's dolphins) occur at high rates in some SSLL fisheries. Entanglements of ESA-listed odontocetes and large baleen whales have been recorded in the Hawaii based SSLL fishery although they are not common and do not always lead to serious injury or mortality (Forney 2004).

The DGN observer records provided us with a means to assess whether ESA-listed species may be in the proposed action area and could be exposed to gear (based upon the assumption that species entangled in DGN gear would also interact with SSLL gear). We tried to quantify the differences between rates of marine mammal take in the two fisheries, but a direct comparison could not be made for this consultation as no comparable fishery records could be found of gillnets and longline occurring in the same area, time, and target species. In the Atlantic, a DGN fishery and a longline fishery both targeting swordfish, operated in more or less the same areas, although effort in the year round Atlantic longline fishery was much higher than DGN effort, which was limited to short seasons of 14 days or less. Despite these differences the number of species of marine mammals observed taken in the DGN fishery is much higher than the number observed in the longline fishery. This is consistent with a review of the observer records from California, Hawaii, and the Atlantic longline observer records which suggest that entanglements of most ESA-listed marine mammals are generally quite low in longline fisheries. Therefore, it is likely that the number of species incidentally taken in the proposed action will be lower than the number observed in the DGN fishery. The numbers of ESA listed marine mammals observed taken in the DGN fishery are provided in Table 1.

Table 1. ESA-listed marine mammals observed taken in the DGN fishery, 7,721 sets

Species	Total observed	Observed in proposed action area
Sea Lion, Steller	2	0
Whale, Fin	1	0
Whale, Humpback	3	0
Whale, Sperm	8	6

1. ESA-listed baleen whales

The lack of observed takes of ESA-listed baleen whales in the DGN fishery that operated in the proposed action area suggests that takes are very unlikely (as noted above the limited information available suggests that marine mammals are generally more likely to interact with DGN gear than longline gear). Several species of large baleen whales, blue, fin, and humpback whales, spend the summer and fall feeding the in waters off California and Oregon within the EEZ which places them in the area of the proposed action. Feeding aggregations have been observed in the summer and fall in central California and the waters around the Channel Islands and migrate south in the late fall and winter (Carretta *et al.* 2007). A number of individuals from ESA-listed whale species migrate through the action area in the fall (including humpbacks that spend their summers feeding off Oregon, Washington, and British Columbia, Canada). For the species that utilize the action area for feeding and as a migratory corridor, exposure to and entanglement in longline gear is possible. Because there is no direct information on interactions between ESA-listed marine mammals and a longline fishery within the EEZ, other sources of information were used to evaluate the likelihood of interaction with these species.

All observed takes of humpback and fin whales in the DGN fishery within the west coast EEZ occurred within the SCB, which is not a part of the proposed action area. When considering the DGN observer data it must be remembered that it is possible that these large species (up to 100 foot long blue whales) may have interacted with gear, but were able to "burst" through the DGN gear before becoming entangled. So, the observed interactions may not include all incidents of interactions. Observer data from the California-based SSLL outside the EEZ was reviewed and indicated that no ESA-listed baleen whales were observed taken during that fishery. This data may not directly reflect the likelihood of interactions with ESA-listed baleen whales, since it does not include the nearshore migratory corridors or feeding areas utilized during the summer and fall by listed whales. Surveys conducted in the West Coast EEZ suggest that humpback whales generally stay nearshore, often within 40 miles of shore and in the SCB, thus out of the action area. Fin whale distribution extends beyond the EEZ and overlaps areas of the SSLL on the high seas, therefore observer records from the SSLL fishery could be used as a proxy to assist in determining the likelihood of fin whales interacting with this gear type. There have been no takes of fin whales observed in the SSLL fishery on the high seas adjacent to the West Coast EEZ.

In order to assess likelihood of interactions within a similar environment (i.e., baleen whale feeding area and migratory corridor), information from the Atlantic HMS observed program was reviewed. The fishery has been observed for twelve years (at approximately five percent annually) and there are no records of entanglements between ESA listed whales commonly found in the area (e.g., sei, blue, humpback, fin) and the commercial pelagic longline fishery along the Atlantic coast (NMFS 2004d). There was one account of an unidentified large whale entangled in gear during the Northeast Distant (NED) experiments testing modified longline gear (circle hooks) and methods. While the animal could not be positively identified, it was likely a listed species based upon the known distribution of whale species in the NED (Watson *et al.* 2006). The animal was released unharmed without any trailing gear (NMFS 2004d).

As a final step, the Hawaii based SSLL records were observed, although it should be noted that the timing of the much of the effort in the SSLL fishery, the first and second quarter of the year, is a time when many humpbacks move into the waters off Hawaii to calf and mate, so observed interactions in that area may not necessarily compare to humpback and other baleen whales in their foraging areas. In the Hawaii SSLL fishery, only one humpback whale has been observed entangled in SSLL gear (in 2006) during 2,631 observed sets and 2,150,681 hooks since 2004 (NMFS, Pacific Islands Regional Office (PIRO) observer program). The whale entangled in 2006 was released alive, although final assessment of its condition (i.e., seriously injured or not) has not been made (Yates 2007). In the Hawaii based SSLL fishery from 1994-2002, there were no observed takes of ESA listed baleen whales (Forney 2004).

The data we reviewed suggests that takes of large baleen whales is unlikely in the proposed action. As a final step, we considered the relative populations of species in the Atlantic, around Hawaii, and the West Coast EEZ. NMFS assumes that higher populations of species may result in higher potential instances of interactions with fishing gear. The N (min), which is the minimum population estimates of the marine mammal populations in these different regions, are not so dissimilar that the relative populations would make comparisons to the West Coast EEZ unreasonable. Table 2 below provide the most recently published population estimates for four species of ESA-listed whales that could interact with the proposed action. We also include estimates of takes in 100 sets based upon observed take rates in the Hawaii SSLL fishery, since there have been no observed takes in the Atlantic HMS fishery and one take in the NED experiments, but the animal freed itself from the gear before it could be identified and was considered not seriously injured (Lawson 2007). As described previously, takes of most species of marine mammals is very rare in longline fishing and projecting anticipated take levels based upon very rare events is difficult. Nonetheless, the marine mammal take rates shown in Table 2 add to the weight of evidence that the likelihood of ESA-listed whales being incidentally taken in the proposed action is very low (the proposed action includes a maximum of 56 sets).

Table 2. Observed takes in SSLL fisheries and minimum population estimates for ESA-listed whales that may be affected by SSLL EFP.

Species	Observed takes in HI SSLL	Takes per 100 sets	N(min) (HI stock)	Observed takes in Atlantic SSLL	N(min) (Atlantic stock)	N(min) (US west coast stock)
Humpbacks	1	.0005	1,234	0	647	1,396
Fin	0	0	174	0	2,362	3,454
Blue	0	0	308	0	unknown	1,384
Sperm	2	.0713	7,082	0	3,539	2,265

Based upon the rarity of observed interaction between DGN gear and large baleen whales and the rarity of entanglements in SSLL fisheries in Hawaii and the Atlantic, and the distribution and relative population size of the species within the action area, it is considered very unlikely that the fishing that would occur under the EFP would adversely affect ESA listed baleen whales, blue, fin, or humpback whales.

2. Sperm whales

Sperm whales are listed as endangered and are found throughout the California Current off the West Coast, reaching peak abundances off of California from April to mid-June and the end of August through mid-November (Rice 1974) demonstrating seasonal movements but not a clear migration common among most large baleen whales. There have been eight observed takes of sperm whales in the 16 years of the DGN fishery observer program. The takes occurred within two relatively limited areas; one area is around 36° N latitude and 122° W longitude (south and west of Monterey Canyon), where six animals have been observed taken in the DGN, including one haul with three animals in the net and the other around 32° N latitude and 120° W longitude (southwest of the Channel Islands and near Cortes Bank), where two animals were observed taken in one haul. Six of the eight observed takes occurred in El Niño years (1992 and 1993). It is not known how or if the unusually warm water off the West Coast affected the whales' behavior or made them more susceptible to exposure to DGN gear. At this time, El Niño conditions are not expected through the end of 2007.

Sperm whales are more abundant in waters around Hawaii than the West Coast EEZ; therefore, a review of the Hawaii-based SSLL observer records was done. There have been no observed entanglements in the SSLL fishery as it has been operating since 2004 (2,631 observed sets and 2,150,681 hooks) (NMFS, Pacific Islands Region observer program). There has been only one observed take from1994 through 2002 and the animal was not seriously injured (Forney 2004). One sperm whale was observed taken in an experimental fishery outside the Hawaii EEZ, but an assessment of its condition (i.e., seriously injured or not) could not be made (Carretta *et al.* 2007).

The Atlantic SSLL was reviewed as a possible proxy for the SSLL EFP fishery since SSLL effort and sperm whale feeding areas overlap temporally and spatially in the Atlantic, similar to the proposed action area. Although both the Atlantic SSLL fishery and sperm whales utilize the same regions (100, 200 and 1000 meter isobath) sperm whales have not been observed taken in the fishery, despite high levels of effort. There were over one million SSLL hooks set in the regions of sperm whale feeding, primarily the Mid-Atlantic Bight (MAB) and Northeast Coastal (NEC) (Fairchild-Walsh and Garrison 2007).

To complete our review of sperm whale takes in other fisheries, we reviewed observer data from the California based SSLL adjacent to the West Coast EEZ and there were no reports of interactions.

The rarity of observed sperm whale takes in the historical DGN fishery, the Atlantic and Hawaii SSLL fisheries, and California based SSLL fishery suggests that entanglements in longline gear are rare events and at the level of effort in the proposed action, entanglements are considered very unlikely.

Sperm whales have been observed interacting with longline fisheries in Alaska, feeding on sablefish that have been caught on bottom longlines. In 2000, one animal was observed with trailing longline gear attached and was determined to be seriously injured due to the amount of gear observed on the animal (Angliss and DeMaster 1997). No other serious injuries were recorded during this time, 1999–2003 (Angliss and Outlaw 2006). Sperm whales feed primarily on large and medium-sized squids, although the list of documented food items is fairly long and diverse. Prey items include other cephalopods, such as octopuses, and medium- and large-sized demersal fishes, such as rays, sharks, and many teleosts (Berzin 1972; Clarke 1977, 1980; Rice 1989). The diet of large males in some areas, especially in high northern latitudes, is dominated by fish (Rice 1989), which may explain the depredation events (removing fish off hooks) observed in the Alaska longline fisheries. All observed depredation events were done by males (Hill *et al.* 1999).

It is not impossible that sperm whales may begin a pattern of depredation on longlines within the proposed action area, although this is considered unlikely to occur during the four months of 2007 in which this proposed action is to occur. The causes for sperm whales and other odontocetes depredation on longline gear are not known but the animals are likely to become familiar with the sounds of the fishery (e.g., boat engines and gear hydraulics) and associate the sounds with feeding opportunities (Gilman *et al.* 2006). There is also evidence that the same individual whales will feed on longline (Hill *et al.* 1999) suggesting that this is a learned and specialized behavior. NMFS considers it unlikely that sperm whale depredation will develop over the short time, four months, of the proposed SSLL EFP since this does appear to be a specialized and learned behavior that is likely developed over time and exposure to the fishery. The relatively low level of effort of the proposed action is unlikely cause a change in sperm whale behavior. Also, the fishing activity will occur over a very large geographical area and sperm whales are believed to use passive acoustics to locate longline vessels, particularly during hauling operations. The distances at which the vessels can be heard by sperm whales is not known although sperm whales have been observed not reacting to longline vessel sounds over 10 miles away, that is in an area of Alaska where depredation is common, sperm whales did not swim towards longline vessels hauling their gear is the vessels were far away (NMFS 2006). Based upon the low amount of effort it is quite likely that the fishing operations will be outside of the hearing range of sperm whales. If the SSLL fishery were to expand, additional analysis of potential of depredation may be necessary, but as described in Hill *et al.* (1999) and Angliss and Outlaw (2006) high levels of depredation on the sablefish bottom longline fishery was not correlated with high levels of serious injury or mortality, sperm whales were very effective at removing fish from lines without entangling in the gear. In Hill *et al.* (1999), no serious injuries or mortalities were observed; in the 2000 through 2004 fishing seasons, the estimated rate of serious injuries or mortalities is 0.45 animals annually.

Due to the overlap of sperm whale distribution and the proposed action, it is not impossible that sperm whales may be exposed to the proposed action, but given our review of other SSLL, the relative abundances of these sperm whale stocks in areas with longline fisheries, and the relatively low level of effort anticipated in the proposed action, NMFS considers it very unlikely that sperm whales would be adversely affected by the action, either by entangling in lines while depredating or getting caught on line or hooks while moving through an area.

3. Steller sea lions

Steller sea lions may be exposed to the longline fishery although NMFS considers this unlikely. Incidents of observed entanglements in DGN are extremely rare, only two observed entanglements in 16 years of observations. This lack of observed takes is consistent with surveys conducted in the fall and late summer that indicate a nearshore distribution of Steller sea lions, generally within 20 miles of shore (Forney 2007) and thus out of the area of most DGN fishing and not within the proposed action area. This distribution is consistent with the distribution of Steller lions off the coast of California and Oregon. Males and females will congregate at rookeries with most breeding activity occurring in May through early July. Rookeries near the proposed action area are at Año Nuevo, Southeast Farallon Island, and Sugarloaf Island and Cape Mendocino, and St. George Reef within waters off California and Rogue River and Orford Reef off of Oregon, all of which are inshore of the proposed action area. Based upon the timing of the proposed action it is unlikely that Steller sea lions will be within the proposed action area. Males typically leave the rookeries soon after mating, traveling north to waters off of Washington state and British Columbia (NMFS 2007). Studies from western Pacific Steller sea lions in Alaskan waters indicate that females with young pups generally stay within 20 km of haul-out sites (Raum-Suryam 2002). Weaned juveniles less than three years old will also stay close to shore, with 90% of foraging occurring within 15 km of nearshore haul-out sites (Raum-Suryam 2002). It is possible that females without pups may be within the proposed action area but based upon surveys conducted during the fall and Steller sea lions' tendency for forage nearshore and over the continental shelf (Reeves *et al.* 1992), it is unlikely.

Steller sea lions have been observed taken in Alaska fisheries; one western Pacific Steller sea lion was been observed incidentally taken and killed in the Alaska Pacific cod longline fishery (estimated mean annual mortality of 0.74) and one eastern Pacific Steller sea lion in the sablefish longline fishery (estimated mean annual mortality of 1.37) (Angliss and Outlaw 2007)). However, the Alaska longline fisheries may not be reflective of what may be anticipated in the proposed action. The target species, cod and sablefish, are identified prey species of Steller sea lions in the area, swordfish and sharks are not identified prey species for Steller sea lions off the waters of California and southern Oregon (NMFS 2007). Also, the Alaskan longline fisheries operate in areas known to be foraging areas for Steller sea lions, as described above, the proposed action is not likely to be a foraging area for Steller sea lions based upon their utilization of the habitat at the time of the proposed action.

Due to the low probability of Steller sea lions being within the proposed action area, based upon their life history and surveys from the area, and the rarity of observed takes within DGN fishery, and the low likelihood that Steller sea lions in the area would depredate on swordfish, NMFS reasons that Steller sea lions are unlikely to be affected by the proposed action.

4. Killer whales

One stock of killer whales is listed as endangered, the Eastern North Pacific (ENP) southern residents. These animals have been observed feeding primarily on salmon and are thought to be fish eaters (as opposed to transients that prey primarily on marine mammals and other non-fish species). The fall distribution of this stock is not precisely known. There have been no sightings of this population in the action area during the months of September through December. During this time, sightings of this stock are most common within the inland waters of Washington State. The late fall and winter distribution of this stock is not well known although within the proposed action area, the ENP southern residents have been observed five times in central California, generally near Monterey Bay from December through February (NMFS 2006). In Alaska, killer whales have been observed predating on longline fisheries in the Bering Sea and Gulf of Alaska (Sigler *et al.* 2003). Recent genetics studies indicate that it is the resident killer whales that depredate on longlines targeting cod and flatfish (which may be part of their normal diet) while transients predate on fisheries targeting pollock (usually trawls) (Angliss and Outlaw 2006). The most recent data indicates one observed mortality of a resident killer whale in the cod longline fishery in 2003 (Angliss and Outlaw 2006). In the historical DGN fishery, there was one observed take of a transient killer whale. Swordfish, the target species of the proposed fishery, are unlikely to be a prey species for the endangered killer whale population since they feed primarily on salmon (NMFS 2006b). Due to the rarity of this population in the area, the extremely rare occurrence of killer whale takes in the DGN observer records, and the low likelihood that this population would depredate on swordfish or tuna, NMFS reasons that the likelihood of interaction in the proposed EFP fishery is very low to non-existent.

5. Sea turtles

Similar to the analysis of marine mammals, we begin with the historic DGN observer data to identify the species in the proposed action area that may be exposed to the proposed action. Data on the observed takes of ESA-listed sea turtles is provided in Table 3.

Table 3. Observed sea turtle takes in the DGN fishery (7,721 observed sets from 1990 to 2005)

Species	Observed takes	Observed takes in the proposed action area
Green	1	0
Olive Ridley	1	0
Loggerhead	14	2
Leatherback	23	19

a. Green and olive ridley sea turtles

There has been only one observed take of a green turtle and one observed take of an olive ridley in the DGN fishery since 1990. Generally, both greens and olive ridleys are found in warm waters, greater than 18° C, which is warmer than the targeted sea surface temperature (SST) identified by the applicant. Further, the observed takes of these species both occurred in southern California during a period of a warm water intrusion from Baja, California, Mexico, which is believed to have brought individual sea turtles into the SCB (NMFS 2004). No observer records of take of these two sea turtles species in fisheries in the proposed action area could be found. There have been a very low number of greens and olive ridley strandings in the West Coast EEZ (NMFS SWR and NWR stranding data bases). But generally, these two species are considered constrained by their preferred temperature of greater than 18° C which is most commonly observed, during the time of the proposed action, only within the SCB. The available information suggests that it is very unlikely that greens or olive ridleys will be affected by the proposed action.

b. Loggerhead sea turtles

In order to determine whether or not loggerhead sea turtles may be affected by the proposed action observer records were reviewed along with an extensive review of the literature on loggerhead distribution within the north Pacific. Loggerhead sea turtles have not been observed incidentally taken in the DGN fishery north of Point Conception, fifteen loggerheads have been observed taken south of Point Conception. All but one observed takes of loggerheads occurred during years in which an El Niño had been declared and all but two occurred within the SCB. As described in the proposed action section above, there will be no SSLL fishing in the SCB under this EFP. The observed takes of loggerheads in the SCB by the DGN fishery are likely related to oceanographic conditions and its effects on the distribution of loggerheads. The waters off Baja, California, Mexico, have been identified as a key feeding area for juvenile and sub-adult loggerheads where they feed on their primary prey, red crab, which are found in high concentrations in coastal warm waters off Baja. Observer records from the DGN fishery strongly suggest that juvenile loggerheads only move into the waters off California during El Niño years and are generally found within the SCB, where SSLL fishing will not occur under the proposed action. During public comments received on this proposed EFP concerns were expressed that loggerhead sea turtles may be adversely affected by the proposed action. Therefore, to better understand the distribution of loggerheads throughout the Pacific and particularly differences in the likelihood of exposure in the proposed SSLL fishery a review of the recent literature was conducted, with particular focus on the Hawaii based SSLL fishery.

Satellite tracking of loggerheads has provided insights into their behavior and distribution in the Pacific. Loggerheads exhibit shallow dive patterns with >90 percent of their dives within the top 40 m of water (Polovina *et al.* 2004), which is similar to the hook depth range of the proposed fishing gear (hook depths of 40–45 meters below the water's surface). Genetic analysis of loggerheads that may be exposed to the longline gear in the North Pacific indicate that they are likely to be from nesting beaches in Japan and forage off Baja California (Bowen *et al.* 1995) and the Central North Pacific. Satellite tracking of loggerheads indicates that they occupy a wide range of SST from 15–25° C while in the Central North Pacific, although tracks of turtles within narrowly defined temperature bounds were also observed (Polovina *et al.* 2004). The published temperature range is within the applicant's stated preferred water temperature for fishing under the proposed action. However, based upon recent satellite tracking and ongoing studies it does not appear that the waters of the West Coast EEZ are utilized by loggerheads. Satellite tracking indicates that loggerheads tagged and released from north Pacific fisheries and from Japan travel in the North Pacific Transition Zone (NPTZ) and the Kuroshio Extension Current perhaps spending years as juveniles feeding in these large Pacific currents (Polovina *et al.* 2004, Polovina *et al.* 2006). Satellite tracks of juvenile loggerheads in the NPTZ end at approximately 130° W longitude (Polovina *et al.* 2004), which is the eastern boundary of the Subarctic and Subtropical gyre in which the NPTZ is found. This area is west of the proposed action area and on the western edge of the California Current. It has been speculated that when the gyre meets the south-moving California Current, objects in the gyre, including juvenile loggerheads, are moved into the waters off Baja (Nichols *et al.* 2000). After spending years in the nearshore environment feeding, loggerheads head back across the Pacific to nesting beaches in Japan. Limited satellite tracking of loggerheads tagged in Baja indicate a due east movement that suggests that they may be utilizing the subtropical front at 25°–30° N latitude on their eastward migration (Nichols *et al.* 2000).

Due to a lack of satellite tracks of loggerheads east of 130° W longitude, a review of observer records from the California based SSLL fishery outside the EEZ and stranding records were reviewed for indications of loggerheads in the proposed action area. The California-based SSLL was observed for three years and high concentrations of loggerhead takes occurred between 140°–150° W longitude. Data from the Hawaii-based SSLL fishery, observed from 1997–2001, were also reviewed. The total number of observed SSLL sets in the California based and Hawaii-based SSLL fisheries is 586 sets. In this data set, there were no observed takes of loggerhead at or east of 130° W longitude (NMFS, SWR observer program). This lack of observed loggerhead takes in an area adjacent to the proposed action area suggests that loggerheads are unlikely to be in area and therefore not likely to be exposed to the proposed action.

To further assess the likelihood of interactions between the proposed action and loggerheads, records from the SWR stranding database were reviewed. The majority of strandings occurred in counties bordering the SCB (i.e., Los Angeles, Orange, and San Diego counties). Less than five strandings were recorded north of the SCB. This is consistent with oceanographic differences between the two areas, with warmer waters to the south of Point Conception and colder waters to the north. The available data suggests that while loggerheads may be occasionally found in waters north of Point Conception and west of the SCB, it is considered quite rare based upon fishery observer records, stranding records, along with the preferred temperature range identified for the species. Given all these lines of evidence, NMFS finds that loggerheads are unlikely to be found in the proposed action area and are unlikely to be affected by the proposed action.

C. Species likely to be adversely affected by the proposed action

NMFS anticipates that leatherback sea turtles are likely to be exposed to the proposed action and adversely affected. This determination is based upon the number of observed takes in the DGN fishery that operated within the proposed action area and takes of leatherbacks in the SSLL fishery in areas near the west coast EEZ. Also, over the past few years, much information has been gained on the distribution and foraging patterns of Pacific leatherbacks. The California coast has been identified as a foraging area for leatherbacks from the Western Pacific nesting population (Benson *et al.* 2007a). More information on this will be provided below.

Based upon our analysis of the available data, the weight of evidence suggests that only leatherback sea turtles are likely to be adversely affected by the proposed action.

For the purposes of this consultation, this opinion focuses on the effects of the proposed SSLL EFP on 1) leatherback nesting aggregations most likely to be affected by the proposed action, 2) leatherback populations in the Pacific Ocean, as distinct from their global distribution, and 3) the leatherbacks as they are listed globally. NMFS reasons that the loss of leatherback populations in the Pacific Ocean would result in a significant gap in the distribution of this species and would reduce the numbers of the species such that the species likelihood of survival and recovery could be affected. Substantial new information on leatherbacks in the Pacific, particularly those nesting in the western Pacific, has become available in the past five years. This opinion incorporates the best available information on the status of western Pacific leatherbacks, including recently published and unpublished data provided directly from scientists in the field. This opinion will highlight new information relevant to the analysis at hand. For a comprehensive review of the status of leatherbacks, please see NMFS 2004 biological opinion on the HMS FMP.

This section will provide a brief leatherback species description and life history, population status and trends (as available), threats to the species and conservation actions.

1. Leatherback sea turtles

a. Species description and life history
Leatherback turtles are the largest of the marine turtles, with a curved carapace length (CCL) often exceeding 150 cm and front flippers that are proportionately larger than in other sea turtles and may span 270 cm in an adult (NMFS and USFWS 1998). In view of its unusual ecology, the leatherback is morphologically and physiologically distinct from other sea turtles and easily identifiable on land and at sea.

Leatherbacks are widely distributed throughout the oceans of the world. The species is found in four main regions of the world: the Pacific, Atlantic, and Indian Oceans, and the Caribbean Sea. Leatherbacks also occur in the Mediterranean Sea, although they are not known to nest there. The four main regional areas may further be divided into nesting aggregations. Leatherback turtles are found on the western and eastern coasts of the Pacific Ocean, with nesting aggregations primarily in Mexico and Costa Rica (eastern Pacific) and primarily in Malaysia, Indonesia, the Solomon Islands, Papua New Guinea, and Vanuatu (western Pacific). In the Atlantic Ocean, leatherback nesting aggregations have been documented in Gabon, Sao Tome and Principe, French Guiana, Suriname, and Florida. In the Caribbean, leatherbacks nest in the U.S. Virgin Islands and Puerto Rico. In the Indian Ocean, leatherback nesting aggregations are reported in India and Sri Lanka.

Leatherbacks have the most extensive range of any living reptile and have been reported circumglobally from 71°N to 47°S latitude in the pelagic Pacific and in all other major pelagic ocean habitats (NMFS and USFWS 1998). For this reason, however, studies of their abundance, life history and ecology, and pelagic distribution are exceedingly difficult. Leatherback turtles lead a completely pelagic existence, foraging widely in temperate waters except during the nesting season, when gravid females return to tropical beaches to lay eggs. Males are rarely observed near nesting areas, and it has been proposed that mating most likely takes place outside of the tropical waters, before females move to their nesting beaches (Eckert and Eckert, 1988).

Leatherbacks are highly migratory, exploiting convergence zones and upwelling areas in the open ocean, along continental margins, and in archipelagic waters (Morreale *et al.*. 1994; Eckert 1998; Eckert 1999a). In a single year, a leatherback may swim more than 10,000 kilometers (Eckert 1998). Recent satellite tagging by the SWFSC indicates that post-nesting females leave the beaches of Papua, Indonesia and travel across the Pacific to feed in upwellings off the coast of the contiguous U.S.

Ongoing work has provided insights into leatherback migration and foraging behavior. Satellite telemetry studies indicate that adult leatherback turtles follow bathymetric contours over their long pelagic migrations and typically feed on cnidarians (jellyfish and siphonophores) and tunicates (pyrosomas and salps), and their commensals, parasites and prey (NMFS and USFWS 1998). Because of the low nutritive value of jellyfish and tunicates, it has been estimated that an adult leatherback would need to eat about 50 large jellyfish (equivalent to approximately 200 liters) per day to maintain its nutritional needs (Duron 1978, *in* Bjorndal 1997). Compared to greens and loggerheads, which consume approximately 3-5% of their body weight per day, leatherback turtles may consume perhaps 20-30% of their body weight per day (Davenport and Balazs 1991). Leatherbacks have been observed at or near the surface feeding at upwelling relaxations in the waters off central California (Benson *et al.* 2007a). However, satellite tagging suggests deeper dives, likely for feeding once the animals move offshore (generally in October and November) (Benson, 2006).

Surface feeding by leatherbacks has been reported in U.S. waters, especially off the West Coast (Eisenberg and Frazier 1983), but foraging may also occur at depth. Based on offshore studies of diving by adult females nesting on St. Croix, U.S. Virgin Islands, Eckert *et al.* (1989) proposed that observed internesting[1] dive behavior reflected nocturnal feeding within the deep scattering layer (strata comprised primarily of vertically migrating zooplankton, chiefly siphonophore and salp colonies, as well as medusae). Hartog (1980, *in* NMFS and USFWS 1998) also speculated that foraging may occur at depth, when nematocysts from deep water siphonophores were found in leatherback stomach samples. Davenport (1988, *in* Davenport and Balazs 1991) speculated that leatherback turtles may locate pyrosomas at night due to their bioluminescence; however direct evidence is lacking. This tendency to feed at night may make leatherbacks more susceptible to exposure to SSLL gear as the gear is set at night.

The maximum dive depths for post-nesting female leatherbacks in the Caribbean have been recorded at 475 meters and over 1,000 meters, with routine dives recorded at between 50 and 84 meters. The maximum dive length recorded for such female leatherback turtles was 37.4 minutes, while routine dives ranged from 4-14.5 minutes (*in* Lutcavage and Lutz 1997). Leatherback turtles also appear to spend almost the entire portion of each dive traveling to and from maximum depth, suggesting that maximum exploitation of the water column is of paramount importance to the leatherback (Eckert *et al*, 1989).

Migrating leatherback turtles also spend a majority of time at sea submerged, and they display a pattern of continual diving (Standora *et al.* 1984, *in* Southwood *et al.* 1999). Based on depth profiles of four leatherbacks tagged and tracked from Monterey Bay, California in 2000 and

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[1] Internesting – time spent between laying clutches of eggs during a single nesting season.

2001, using satellite-linked dive recorders, most of the dives were to depths of less than 100 meters and most of the time was spent shallower than 80 meters. Based on preliminary data analysis, 75-90% of the time the leatherback turtles were at depths less than 80 meters (P. Dutton, NMFS, personal communication, January 2004). This area of the water column is where most SSLL gear will be found (with the hook depth estimated to average 40 to 45 meters) meters).

Migratory routes of leatherback turtles originating from eastern and western Pacific nesting beaches are not entirely known. However, satellite tracking of post-nesting females and foraging males and females, as well as genetic analyses of leatherback turtles caught in U.S. Pacific fisheries or stranded on the West Coast of the U.S. present some strong insight into at least a portion of their routes and the importance of particular foraging areas. Aerial surveys conducted during the late summer and fall months of 1990-2003 reveal that leatherbacks forage off central California, generally at the end of the summer, when upwelling relaxes and sea surface temperatures increase. Leatherbacks were most often spotted off Point Reyes, south of Point Arena, in the Gulf of the Farallon, and in Monterey Bay. These areas are upwelling "shadows," regions where larval fish, crabs, and jellyfish are retained in the upper water column during relaxation of upwelling. Researchers estimated an average of 178 leatherbacks (CV=0.15) were present between the coast and roughly the 50 fathom isobath off California. Abundance over the study period was variable between years, ranging from an estimated 20 leatherbacks (1995) to 366 leatherbacks (1990) (Benson *et al.* 2007a). Other observed areas of summer leatherback concentration include northern California and the waters off Washington through northern Oregon, offshore from the Columbia River plume. Seasonal abundance of prey due to upwelling relaxations appear to attract foraging leatherbacks to central California and other areas on the west coast. For example, in 2003 and 2005, females tagged at Jamursba-Medi were observed heading north into waters off Washington and British Columbia, Canada. These two turtles, one each year, were recorded within 50 km and 220 km within shore (http://las.pfeg.noaa.gov/TOPP/TOPP_tracks.html, accessed August 9, 2006). Further, in 2006, no leatherback sea turtles were observed in the waters around Monterey Bay, where leatherbacks have been tracked and satellite tagged by the SWC since 2000 (leatherbacks commonly use central California as an area for summer foraging). No leatherback foraging habitat studies have been conducted across the U.S. west coast, however, stranding data and satellite tagging suggest that leatherbacks utilize a wide range of the waters off the US West Coast. Leatherbacks originating from the eastern Pacific have not been tracked moving into the water off the U.S. West Coast; tracks from turtles with attached satellite tags indicate that post-nesting, leatherbacks at Mexican and Costa Rican beaches all move south and southwest, away from the U.S. West Coast.

The leatherback life cycle is broken into seven stages (1) egg/hatchling; (2) neonate; (3) warm water juvenile, (4) cool water juvenile, (5) immature, (6) sub-adult, and (7) adult. Unlike most other sea turtle species, sexual maturity occurs relatively early for leatherbacks. Using a small sample size of leatherback sclerotic ossicles, analysis by Zug and Parham (1996) suggested that mean age at sexual maturity for leatherback turtles is around 13 to 14 years, giving them the highest juvenile growth rate of all sea turtle species. Zug and Parham (1996) concluded that for conservation and management purposes, 9 years is a likely minimum age for maturity of leatherback turtles, based on the youngest adult in their sample. A presentation at the 27th

Annual Symposium on Sea Turtle Biology and Conservation reported the findings of skeletochronological analysis of leatherbacks in the Western North Atlantic suggesting that animals within this population do not reach reproductive maturity until 29 (95% CI 26-32) years old (Avens and Goshe 2007). Because sampling of Pacific leatherbacks has not occurred as part of the work presented, the estimates in Zug and Parham (1996) are considered the most appropriate for Pacific leatherbacks by the lead researcher on the Atlantic leatherback study (Larisa Avens, NMFS, personal communication, July 2007). The natural longevity of leatherback turtles has not been determined (NMFS and USFWS 1998), although there are recorded documentations of post-maturation survival on the order of about 20 years (Pritchard 1996).

Adult and sub-adult female leatherbacks have been observed migrating long distances between foraging and breeding grounds, at intervals of typically two or four years (García and Sarti 2000, Benson *et al.* 2007c). Spotila *et al.* (2000), found the mean re-nesting interval of females on Playa Grande, Costa Rica to be 3.7 years, while in Mexico, 3 years was the typical reported interval (L. Sarti, Universidad Naçional Autonoma de Mexico (UNAM), personal communication, 2000). Leatherbacks in the western Pacific nesting aggregations may have a re-migration interval of approximately 2.5 years, consistent with Atlantic and Caribbean leatherbacks, although at this time there is insufficient information to state this with certainty (P. Dutton, NMFS, personal communication, April, 2006). Determining more precisely the re-migration interval for western Pacific leatherbacks is key to estimating the nesting population (which is used to monitor trends in the population). The migratory patterns of males are poorly understood. Males have been observed taken in commercial fisheries in the north Pacific. Males have also been captured in the study being carried out by the SWFSC in the waters off central California.

The distribution of juvenile leatherback turtles has long been a mystery. However, compilation and analysis of sighting and stranding data for the species has provided some insight into the developmental habitats of this species at earlier life stages. It appears that young leatherback turtles (carapace length <100 cm) reside only in waters warmer than 26°C (Eckert 1999b; Eckert 2002), which should generally place them outside of areas in which SSLL EFP gear will operate under the proposed action. This is consistent with observer records of adult and sub-adult leatherbacks being entangled in DGN gear within the proposed action area.

Because leatherback turtles spend most of their lives in pelagic environments, it is very difficult to gather the basic information on their abundance, life history and ecology, and pelagic distribution. The data that are available suggest that leatherback turtles follow patterns that are similar to other long-lived species that delay the age at which they become mature (Chaloupka 2001, 2002; Crouse 1999; Heppell *et al.*. 1999; Spotila *et al.* 1996, 2000). That is, leatherback turtles can be expected to have low and variable survival in the egg and hatchling stages and high and relatively constant annual survival in the subadult and adult life stages (Heppell *et al.* 2003 *in* Lutz *et al.* 2003).

In addition, growth rates of leatherback turtle populations are probably more sensitive to changes in the survival rate of juvenile, sub-adult, and adult turtles than other stages. As a result, the survival rate of reproductive adults, sub-adults, and juvenile leatherback turtles will largely determine the growth, decline, or maintenance of the population (Crouse 1999; Heppell *et al.* 1999, 2003; Spotila *et al.* 1996, 2000). Conversely, the population's rates of increase or decrease would be relatively insensitive to changes in the survival rates of eggs or hatchlings; this does not imply that other life stages can be disregarded, but does imply that the species has evolved to withstand low survival rates at these stages as well as large amounts of year-to-year variation (Heppell *et al.*. 2003 *in* Lutz *et al.* 2003). However, the importance of nest protection and increases in hatchling production should not be dismissed. In the Caribbean, long-term studies of female leatherbacks on Sandy Point, St. Croix, U.S. Virgin Islands, indicate an increase in the number of nesters of approximately 13% annually since the early 1990s. Aggressive beach protection actions and egg relocation (resulting in higher egg success rates) appear to be the drivers of the increasing leatherbacks (Dutton *et al.* 2005). Similarly, nesting site protection (including limiting or eliminating hunting on nesting beaches, collection of eggs, and egg relocation) has been credited as a contributing factor in the observed increases of green turtles in Tortuguero, Costa Rica (Troeng and Rankin 2005) and Hawaii (Balazs and Chaloupka 2004). Nest protection and increasing the number of hatchlings have been identified as key elements for the survival and recovery of western Pacific leatherbacks (Bellagio 2004)

Finally, like other sea turtles, female leatherbacks exhibit nesting site fidelity. However, unlike hard shelled species which appear to return to the same beach throughout their lives for nesting, leatherbacks appear to have a large home range and may nest at more than one beach in a single season (Lutz *et al.* 2003). This has been observed in the western Pacific, one female observed on Jamursba-Medi was observed nesting on Wermon a few weeks later (Benson *et al.* 2007c). There is insufficient information on the internesting behavior and distribution of female leatherbacks, particularly in the western Pacific, to determine whether it is reasonable to state that once a nesting aggregation declines to a few individuals or becomes extinct, it will not be "rescued" by adult females from other nesting aggregations. However, given the genetic isolation and observed differences in behavior, it may be appropriate to state that loss of a geographical population (e.g., Malaysian leatherbacks) is final and irreversible. Also, different leatherback populations exhibit different nesting timing. Timing of nesting, at least in the western Pacific, appears to be tied to available nesting habitat. Monsoons and severe weather make certain beaches unavailable at different times of the year.

As described above, due to the pelagic nature of leatherbacks, information on populations and trends of various populations is based upon counts of females when they come onshore to nest. As a result, it is difficult to estimate the total population including the number of males within a population or the age-structure of the population. Leatherbacks are identified by the nesting beaches used by adult and sub-adult females. The following sections provide status information for various populations of leatherbacks based upon the available information.

b. Population status and trends

The leatherback turtle is listed as endangered under the ESA throughout its global range. Increases in the number of nesting females have been noted at some sites in the Atlantic, but these are far outweighed by local extinctions, especially of island populations, and the demise of once large populations throughout the Pacific, such as in Malaysia and Mexico. Spotila *et al.* (1996) estimated the global population of female leatherback turtles to be only 34,500 (confidence limits: 26,200 to 42,900) nesting females; however, the eastern Pacific population has continued to decline since that estimate, leading some researchers to conclude that the eastern Pacific leatherback may now on the verge of extinction in the Pacific Ocean (e.g., Spotila *et al.* 1996; Spotila, *et al.*, 2000). However, the status of Western Pacific leatherbacks appears to be less dire. Recently published estimates of breeding females suggest that the Western Pacific population is 2,700 to 4,500 (Dutton *et al.* 2007). This number is substantially higher than the population estimate of 1,775 to 1,900 Western Pacific breeding females published in 2000 (Spotila 2000). The larger population is due to adding in the number of nesting females from beaches that were not previously included in population estimates. The authors caution that their estimate of adult nesting females should not be viewed as a population estimate due to uncertainties in the basic information needed to develop population level estimates from nesting counts; this includes a lack of information on the number of nests laid per female in the region and uncertainties associated with the nest counts themselves. The author suggest improved monitoring of the region, including aerial surveys to identify nesting sites, is needed before estimates of the total Western Pacific population can be made with confidence.

Leatherback turtles are widely distributed throughout the oceans of the world, and are found in waters of the Atlantic, Pacific, and Indian Oceans, the Caribbean Sea, and the Gulf of Mexico (Ernst and Barbour 1972). Globally, leatherback turtle populations have been decimated worldwide. In 1980, the leatherback population was estimated at approximately 115,000 (adult females) globally (Pritchard 1982). However, this number should be viewed with caution since it was based in part upon a one year aerial survey of Mexican nesting beaches in 1980, which may have had an unusually high nesters (Pritchard 1996). The 1980 survey did record the killing of females on the beaches and removal of eggs from the nests – two factors that could have decimated the populations (Pritchard 1996). By 1995, this global population of adult females was estimated to be 34,500 (Spotila *et al.* 1996). Populations have been observed to have declined in Mexico, Costa Rica, Malaysia, India, Sri Lanka, Thailand, Trinidad, Tobago, and Papua New Guinea. Throughout the Pacific, leatherbacks have declined over the past three decades at all observed major nesting beaches. The decline can be attributed to many factors, including fisheries interactions, direct harvest, egg collection, and degradation of habitat. On some beaches, nearly 100% of the eggs laid have been harvested. Eckert (1996) and Spotila *et al.* (1996) note that adult mortality is likely to have increased from the 1980's to the 1990's as a result of driftnet and longline fisheries. However, the ban on large-scale drift gillnets in 1992 likely reduced the level of bycatch. Further, U.S. shallow set longline fisheries on the Pacific high seas have implemented gear restrictions that have been shown to reduce the level of sea turtle bycatch and mortalities (Gilman *et al* 2006). Similar regulations have been implemented in the U.S. Atlantic pelagic longline fisheries to protect turtles. In additional, numerous countries in the Pacific are either experimenting with modified gear (e.g., circle hooks) or have implemented this gear type in their fisheries in order to reduce sea turtle bycatch and mortality. (Read 2007).

<u>Atlantic Ocean/Caribbean Sea</u>
In the Atlantic and Caribbean, the largest nesting assemblages of leatherbacks are found in the U.S. Virgin Islands, Puerto Rico, and Florida. Since the early 1980s, nesting data has been collected at these locations. Of the six major management units (units are based upon the geographical range of the nesters), five of the six showed a positive population growth trend,

only the western Caribbean nesting population did not show a positive population trend (TEWG 2007). Despite these encouraging trends, it is certain that some nesting populations (*e.g.*, St. John and St. Thomas, U.S. Virgin Islands) have been extirpated (NMFS and USFWS 1995). The largest leatherback nesting site in the western North Atlantic remains along the northern coast of South America in French Guiana and Suriname. An overall trend in the population is difficult to assess, but based upon a recent population of 20,000 to 56,000 adult females (TEWG 2007), the Atlantic leatherback population is in much better condition than the Pacific leatherbacks. Leatherbacks are exposed to commercial fisheries in many areas of the Atlantic Ocean and it is estimated that hundreds die annually in nets. Recent satellite tagging work in the eastern Atlantic indicates that post-nesting females travel in a number of different area in the Atlantic, with some individuals making pan-oceanic movements from nesting beaches in the Caribbean and French Guiana to the waters off Africa, others travel into the central north Atlantic, and others move into the waters of the U.S. East Coast (Hays *et al.* 2004; Ferraroli *et al.* 2004) In some countries, females are killed for their meat when they come ashore to nest.

Indian Ocean

Surveys conducted during 2000-01 at the Nicobar Islands provided an estimate of approximately 845 nesting females on Great Nicobar Island and a minimum of 82 females on Little Nicobar Island. Andrews *et al.* (2001) (*in* Andrews and Shanker 2002) estimated approximately 150 nesting females on the Andaman Islands and other Nicobar islands. Threats include egg predation by feral dogs and pigs and occasional predation on adults by saltwater crocodiles (Andrews and Shanker 2002). In Sri Lanka, Godawaya beach hosts the largest nesting population of leatherbacks in the country. In 2001, an estimated 170 adult females comprised the nesting population in this area; however, only 2 females nested in 2005. The 2004 tsunami may be partly responsible for this low nesting, since much sand erosion occurred. Other nesting beaches have not been adequately monitored to estimate leatherback nesting populations. Threats to leatherbacks in this area include killing of adults for meat, illegal poaching of eggs, beach erosion, fisheries bycatch (431 leatherbacks estimated entangled, based on a survey of turtle bycatch conducted between 1999 and 2000), habitat loss due to tourism, and natural predators (feral dogs, jackals, wild boars, mongooses, ants, and crabs) (Kapurusinghe 2006).

Pacific Ocean

There are two major population groups within the Pacific leatherback population, the eastern and western Pacific. These populations are distinguished by the areas in which the females nest and can be identified genetically.

Eastern Pacific

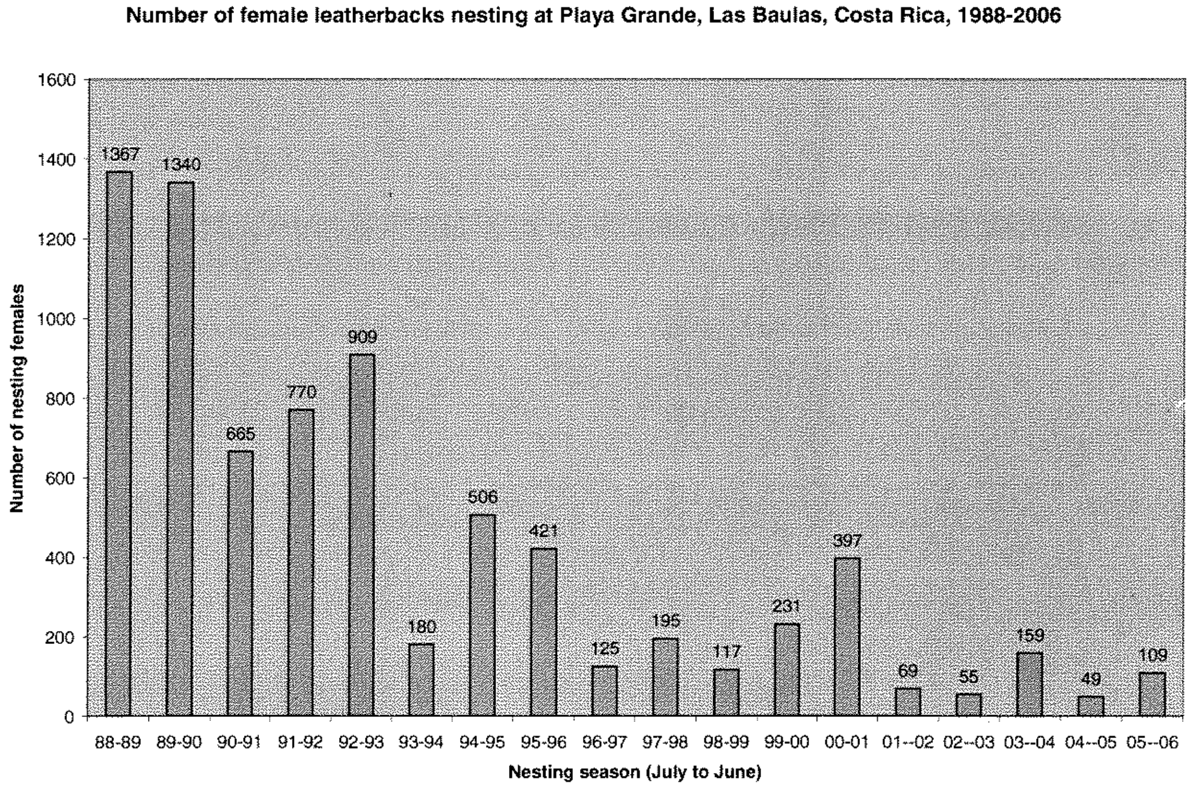
Leatherback nesting populations are declining at a rapid rate along the Pacific coast of Mexico and Costa Rica. Three countries which are important to leatherbacks nesting in the eastern Pacific are Costa Rica, which has the highest abundance and density in this area, Mexico, with several important nesting beaches, and Nicaragua, with two important nesting areas. Leatherbacks have been documented nesting as far north as Baja California Sur, Mexico and as far south as Panama, with few areas of high nesting (Sarti 2002). Detailed descriptions of this population can be found in the 2004 HMS FMP opinion. That information is summarized briefly here with latest information provided as available.

Satellite tagged post nesting females at Mexiquillo Beach, Mexico and Costa Rica, the two major nesting sites of eastern Pacific leatherbacks, indicate that animals followed precisely defined, long-distance migratory pathways, moving into fishing grounds of large commercial gillnet fishing fleets south of the equator (Eckert 1997; Morreale *et al.* (1994)). Most of these eastern Pacific nesting stocks migrate south, although a genetic sample from one leatherback turtle caught south of the main Hawaiian Islands by the Hawaii-based longline fishery indicated that the animal was from the eastern Pacific population (P. Dutton, NMFS, personal communication, October 2002).

Although the causes of the decline in the eastern Pacific nesting populations are not entirely clear, Sarti *et al.* (1998) surmises that the decline could be a result of intensive egg poaching on the nesting beaches, incidental capture of adults or juveniles in high seas and artisanal fisheries, and natural fluctuations due to changing environmental conditions, however, one recent hypothesis on the lack of recovery of this population focuses on their at-sea movements. As described above, eastern Pacific leatherbacks show little variation in their post-nesting movements, with all turtles traveling in the same direction at virtually the same time. The eastern Pacific foraging areas often have low productivity due to El Niño events (Dutton 2006). By comparison, Atlantic leatherbacks in the Caribbean and western Pacific leatherbacks utilize a variety of foraging areas post-nesting, which may buffer the population from anthropogenic impacts (e.g., fisheries) and natural perturbations (Dutton 2006). The lack of diverse foraging strategies may be part of the reason that protections on eastern Pacific nesting beaches have not been as successful as those carried out in the Caribbean (Dutton *et al.* 2005). Some eastern Pacific leatherbacks are also believed to experience a level of at-sea incidental mortality that is keeping the population suppressed despite years of conservation actions on the beaches, although the increases in hatching success is credited with maintaining the population and slowing its decline (Santidrian-Tomillo *et al.* 2007).

<u>Costa Rica</u>
The number of nesters has declined substantially at Playa Grande, Las Baulas, Costa Rica and has been highly variable the past two decades. These trends are likely due to high female mortalities between breeding intervals (Spotila 2000) and high embryonic death and low hatchling success in this population (Bell *et al.* 2003). There have been anecdotal reports of leatherbacks nesting at Playa Caletas and Playa Coyote. Leatherbacks also nest in small numbers on the Osa Peninsula (Bedoya and Nahill 2005).

Figure 3. Number of female leatherbacks nesting at Playa Grande (Las Baulas, Costa Rica) from 1988-2006. (Source: R. Reina and P. Tomillo, Drexel University, personal communications, 2003-2006).



Mexico

The decline of the eastern Pacific leatherback subpopulations is even more dramatic off the Pacific coast of Mexico. One survey was conducted in 1980 that suggested an eastern Pacific Mexican population of adult female leatherback turtles of approximately 70,000[2] (Pritchard 1982, *in* Spotila *et al.*. 1996). If this survey is indeed representative of the population in the early 1980s, then the population suffered a significant decline through the early 2000s. Since the very low nestings in 2001-2003, there has been a positive trend in the population, which could be due to increased conservation efforts both at sea and on the nesting beaches (García *et al.* 2004)

[2]This estimate of 70,000 adult female leatherback turtles comes from a brief aerial survey of beaches by Pritchard (1982), who has commented: "I probably chanced to hit an unusually good nesting year during my 1980 flight along the Mexican Pacific coast, the population estimates derived from which (Pritchard, 1982b) have possibly been used as baseline data for subsequent estimates to a greater degree than the quality of the data would justify" (Pritchard, 1996).

Table 4. Annual number of estimated leatherback nestings (# nests) from 2000-2005 on index beaches and total nesting beaches.

Index beach	2000-01	2001-02[1]	2002-03[2]	2003-04[3]	2004-05[4]	2005-06[4]
Primary Nesting Beaches (40-50% of total nesting activity)						
Mexiquillo	624	20	36	528	42	190*
Tierra Colorada	535	49	8	532	57	292*
Cahuitan	539	52	73	349	31	230*
Barra de la Cruz	146	67	3	275	28	121*
Total - primary index beaches	**1,957**	**188**	**120**	**1,684**	**158**	**833***
Total - Mexican Pacific	**4,513**	**658**	**n/a**	**4,045**	**n/a**	**n/a**

[1]Source: Sarti, pers. comm, March, 2002 – index beaches; Sarti *et al.*, 2002 for totals;
[2]Source: Sarti, pers. comm, December, 2003 – index beaches, totals.
[3]Source: García *et al.* 2004.
[4]Source: Sarti, pers. comm., May, 2006 [*note that these numbers are preliminary]

Most conservation programs aimed at protecting nesting sea turtles in Mexico have continued since the early 1980s. Since protective measures have been in place, particularly emergency measures recommended by a joint U.S./Mexico leatherback working group meeting in 1999, there has been greater nest protection and nest success.

Very limited leatherback nesting has also been observed in Nicaragua and Guatemala. In both countries, poaching of nests is substantial thus few hatchlings are believed to be contributing to the eastern Pacific population.

Western Pacific

Satellite tagging and genetic sampling suggest that the leatherbacks found in the proposed action area are likely western Pacific leatherbacks. This is based upon satellite tags of turtles in the western and eastern Pacific and leatherback samples, either from the SWFSC tagging program in central California or samples from observers in the DGN fishery, which were all were determined to be from the western Pacific aggregation (Peter Dutton, SWC, personal communication, August 2006). Only one eastern Pacific leatherback has been identified from genetic samples from fishery observers; it was in the Hawaii longline fleet fishing south of the main Hawaiian Islands. This is consistent with satellite tagging data that suggests that there may be a seasonal feeding area in the central Pacific that both eastern and western Pacific leatherbacks utilize, particularly in the winter months. The weight of evidence suggests that any leatherbacks exposed to the SSLL gear used in the proposed action from September 1 through December 31 will be from the western Pacific population. Therefore, in the sections below, we focus our analysis and discussion on the western Pacific leatherback population and provide more data on recent trends in this population, as compared to the eastern Pacific leatherback population.

Similar to their eastern Pacific counterparts, leatherbacks originating from the western Pacific are also threatened by poaching of eggs, killing of nesting females, human encroachment on nesting beaches, incidental capture in fishing gear, beach erosion, and egg predation by animals. Less is known about the status and trends of the western Pacific leatherback nesting populations, but once major leatherback nesting assemblages are have declined, some to the point of extirpation.

In May, 2004, researchers, managers and tribal community members with extensive knowledge of local leatherback nesting beach populations and activities in Papua (Indonesia), Papua New Guinea, the Solomon Islands and Vanuatu assembled in Honolulu, Hawaii to identify nesting beach sites, and share abundance information based on monitoring and research, as well as anecdotal reports. Dutton *et al.* (2007) report that there may be 1,100 to 1,800 females nesting annually at 25 nesting sites in the western Pacific. Calculations using the same methods used by Spotila *et al.* (1996) yields a minimum total estimate of nesting females in this area of approximately 2,700 to 4,500 animals (taking into account an estimated re-nesting interval of 2.5 years, Spotila *et al.* (1996)). The actual re-nesting interval for western Pacific leatherbacks may vary from this estimate.

Malaysia

The decline of leatherback turtles is severe at one of the most significant nesting sites in the western Pacific region - Terengganu, Malaysia, with current nesting representing less than 2 percent of the levels recorded in the 1950s, and there are no signs of a population increase. In the 1960s, the leatherback turtles nesting on the beaches in Terengganu represented one of the largest remaining nesting aggregations for this species in the Pacific Ocean. Since then, the population has declined to a handful of individual, nesting females. The nesting population at this location has declined from 3,103 females estimated nesting in 1968 to 2 nesting females in 1994. The causes for the decline in this population include: many years of excessive egg harvest, egg poaching, the direct harvest of adults in this area. Incidental takes in fisheries that developed during the 1970's and 1980's likely helped fuel the population decline, particularly the high seas Japanese squid fishery and gillnets and pot fisheries near Terangganu (Chan and Liew 1996), A report published in 2006 by the United Nations Environmental Programme (UNEP) suggests that the Malaysia population is effectively extinct (www.bernama.com, accessed 8/14/06). Some scientists working within Malaysia dispute this, citing leatherback nests found annually, albeit at very low abundances in areas other than the sanctuary at Rantau Abang (e.g., five nests found in 2006) (http://www.malaysiakini.com/rentakini/55145; accessed 8/16/06). Conservation measures began in 1961 and focused on trying to increase the number of new recruits into the population through hatcheries. However, these efforts were largely ineffective due to poor hatchery practices and a very high proportion of females hatchlings (due to high incubation temperatures at hatcheries) (Chan and Liew 1996). Hatchery practices have been improved as of the late 1980's and additional conservation measures were implemented, including designation of the Rantau Abang Turtle Sanctuary and development of the Turtle Sanctuary Advisory Council in 1988 (Chan and Liew 1996). Despite fishing regulations to limit coastal fisheries and protection of some nesting beaches, only ten nests were counted in 2006, although a number of smaller nest sites are believed to exist in Malaysia. There is particular concern over the fate of this population because for the past six years, hatcheries have had low to zero hatching success (www.bernama.com, accessed 8/14/06). This may be due to the lack of males in the population available to fertilize eggs.

Western Pacific and eastern Pacific leatherbacks can be identified through genetic markers. All leatherbacks captured off central California (n=40) have been found to originate from western Pacific nesting beaches, based on genetic analyses (P. Dutton, NMFS, personal communication, 2006). The Malaysian nesting population, a portion of the western Pacific population, has unique genetic markers and none were identified in the leatherbacks sampled. This may be related to the extremely small extent nesting population; only two to ten females have been recorded nesting at Terengganu since 1994.

Indonesia

In Indonesia, leatherbacks have been protected since 1978 and low density nesting occurs along western Sumatra (200 females nesting annually) and in southeastern Java (50 females nesting annually), although these estimates are from the early 1980s (*in* Suarez and Starbird, 1996a; Dermawan 2002). Nesting beaches in East Java are monitored generally by National Park officers; there is sporadic low nesting on Suka Made (Meru Betiri National Park) and higher levels of nesting at Alas Purwo National Park (~4,500 eggs laid in 2000) (Adnyana 2006).

The largest leatherback rookery is at the north coast of Papua. Leatherback nesting generally takes place on two major beaches, located 30 km apart, on the north Vogelkop coast of the State of Papua: Jamursba-Medi (18 km) and Wermon beach (6 km) (Starbird and Suarez 1994; Hitipeuw *et al.* 2007). Declines in annual nests largely due to commercial exploitation of eggs led to beach protections being implemented in 1992. No clear trend in the population since 1993 can be detected from the available information; however, it is clear from discussions with locals that the number of leatherbacks observed nestings at these beaches has declined substantially since the 1970s and 1980s.

Leatherbacks nest on Jamursba-Medi during April through September, with a peak in June, July and August (Suarez *et al.* 2000; Hitipeuw *et al.* 2007. A summary of data collected from leatherback nesting surveys from 1981 to 2005 for Jamursba-Medi has been compiled, re-analyzed, and standardized and is shown in Table 5 (Hitipeuw and Maturbongs 2002; Hitipeuw 2003b; Hitipeuw *et al.* 2007).

Table 5. **Estimated numbers of female leatherback turtles nesting on Jamursba-Medi Beach, along the north coast of the State of Papua (Summarized by Hitipeuw and Maturbongs, 2002 and Hitipeuw, 2003b; Hitipeuw *et al.* 2007)**

Survey Period	# of Nests	Adjusted # Nests	Estimated # of Females[3]
Jamursba-Medi Beach:			
September, 1981	4,000+	7,143[1]	1,232 - 1,623
April - Oct. 1984	13,360	13,360	2,303 - 3,036
April - Oct. 1985	3,000	3,000	658 - 731
June - Sept. 1993	3,247	4,091[2]	705 - 930
June - Sept. 1994	3,298	4,155[2]	716 - 944
June - Sept. 1995	3,382	4,228[2]	729 - 961
June - Sept., 1996	5,058	6,373[2]	1,099 -- 1,448
May - Aug., 1997	4,001	4,481[4]	773 -- 1,018
May - Sept. 1999	2,983	3,251	560 – 739
April - Dec., 2000	2,264	No	390 – 514
March - Oct., 2001	3,056	No	527 – 695
March - Aug., 2002	1,865	1,921	331 – 437
March – Nov., 2003	3,601	2,904	621 – 818
March – Aug., 2004	3,183	3,871	667 – 879
April – Sept., 2005	2,666	2,562	441 - 582

[1]The total number of nests reported during aerial surveys was adjusted to account for loss of nests prior to the survey. Based on data from other surveys on Jamursba-Medi, on average 44% of all nests are lost by the end of August.
[2]The total number of nests have been adjusted based on data from Bhaskar's surveys from 1984-85 from which it was determined that 26% of the total number of nests laid during the season (4/1-10/1) are laid between April and May.
[3]Based on Bhaskar's tagging data, an average number of nests laid by leatherback turtles on Jamursba-Medi in 1985 was 4.4 nests per female. This is consistent with estimates for the average number of nests by leatherback turtles during a season on beaches in Pacific Mexico, which range from 4.4 to 5.8 nests per female . The range of the number of females is estimated using these data.
[4]Number adjusted from Bhaskar (1984), where percentage of nests laid in April and September is 9% and 3%, respectively, of the total nests laid during the season.

Nesting of leatherbacks on Wermon beach primarily takes place during the austral summer, but occurs throughout the year, from October through September, with a peak in December through March (Thebu and Hitipeuw 2005). In recent years, the beach has been monitored during much of the nesting season, including the peak period, and researchers have documented approximately 2,000 – 3,000 nests per year (Thebu and Hitipeuw 2005; Hitipeuw *et al.* 2007), which may equate to several hundred females nesting per year (given 4.4 to 5.8 nests per female). Given shorter monitoring periods in past studies, it is difficult to analyze any trends for this nesting beach (see Table 5).

Table 6. Number of leatherback turtle nests observed along Wermon Beach

Monitoring Period	# nests	Source
Nov. 23-Dec. 20, 1984 and Jan. 1-24, 1985	1,012	Starbird and Suárez, 1994; Suárez *et al.*, 2000
Dec. 6-22, 1993	406	Starbird and Suárez, 1994; Suárez *et al.*, 2000
Nov., 2002 - June, 2003	1,442	Hitipeuw, 2003b
Nov., 2003 – Sept., 2004	2,881	Thebu and Hitipeuw, 2005
Oct. 2004 – Sept. 2005	1,980	Hitipeuw, WWF, pers. comm., 2006

The leatherback turtles nesting on the beaches in the State of Papua represent one of the largest remaining nesting aggregations for this species in the Pacific Ocean. The nesting aggregation appears to be relatively large and has fluctuated between 400 and 1,000 individuals annually throughout most of the 1990s and early 2000s although there is insufficient data available to determine if the population growth is positive, negative, or stable.

Recently, attention at these nesting beaches has turned to a study of hatchling success. In 2005 a pilot study was conducted to quantify hatchling success at four primary nesting beaches, three at Jamursba-Medi and one at Wermon. Hatchling success at the three beaches of Jamursba-Medi was significantly lower than at Wermon, 25.5% (SD = 32%, range = 0% - 85%) n=48 and 47.1% (SD = 23.6%, range = 3.8% - 100%) n = 52, respectively (Tapilatu and Tiwari 2007). The mean hatching success rates for the individual beaches of Jamursba-Medi in 2005 were calculated to be the following: Wembrak: 9.2%, Batu-Rumah: 44.7%, and Warmamedi: 31.4% (Tapilatu and Tiwari 2007). High rates of tidal inundation, animal predation, and possible temperature effects were cited as likely causes for the low hatchling success (Tapilatu and Tiwari 2007). Low hatching success among leatherbacks in other areas has been documented in the past (Bell *et al.* 2003) and reliable data on the past hatching success in Indonesia is not available. The results from 2005 and 2006 nesting seasons at these two sites point to the need for further research to understand the variables affecting hatching success. The need for long-term stable funding to, among other objectives, protect nesting sites and potentially develop hatcheries to improve hatchling success in the Western Pacific, was one of the key recommendations of the recent Bellagio Sea Turtle Conservation Initiative meeting held in Terengganu, Malaysia, July 17-20, 2007.

<u>Papua New Guinea</u>
In Papua New Guinea, leatherbacks nest primarily along the coast of the Morobe Province, mostly between November and March, with a peak of nesting in December. Researchers are analyzing all known data to determine status and trends. Aerial surveys in Papua New Guinea have been flown for the last three years (2004-2006) during the peak of the leatherback nesting season (January). Results from the January, 2005 survey estimated 1,195 leatherback nests in an area covering 2,692 kilometers of coastline, including the Madang, Morobe and Oro provinces (north coast of mainland PNG), New Britain, Bougainville, Buka, and the southwestern coast of New Ireland (Benson *et al.* 2007c).

Solomon Islands
In the Solomon Islands, the rookery size has been estimated to be less than 100 females nesting per year (D. Broderick, personal communication, *in* Dutton, *et al.* 1999); however recent reports indicate considerable scattered nesting around the islands and that there may be on the order of hundreds of females, rather than tens of females (Dutton *et al.* 2007).

Vanuatu
Leatherbacks have been reported nesting on some of the over 80 islands in Vanuatu. Because this country consists of many remote islands, there is still much to be learned regarding the importance of the beaches of Vanuatu to western Pacific leatherbacks. Currently, Epi Island has the largest number of nests, with approximately 20-30 nesting females on the southwestern beaches and a smaller number on the east coast. There is scattered nesting on the other islands, based on survey data and anecdotal reports.

There is also very limited leatherback nesting activity in Viet Nam, Thailand, Fiji, and Australia.

While the trend of leatherback nestings on western Pacific beaches has not shown the precipitous collapse that has been observed on the eastern Pacific nesting beaches, there are obviously fewer females nesting than were observed in the early to mid-1980s. Nesting beach conservation programs have been established in a number of countries, such measures include bans on egg collection, reduction of egg predation, and protection of the nesting beach from coastal development. Efforts have also been made to reduce the harvest of subadult and adult leatherbacks, and many Pacific Rim countries have worked hard in recent years to reduce bycatch of leatherbacks in their fisheries, and improve survival. These sustained efforts may help to reverse or slow any declining trend, but there likely needs to be more effort to understand and address all threats to this population, if feasible. The impact of coastal artisanal fisheries on leatherbacks is largely unknown, and global climate change, pollution, and marine debris may also be impacting the population. Continued monitoring, protection and research of these nesting populations throughout its range will be necessary to ensure its recovery.

c. Factors affecting leatherbacks

Nesting aggregations of leatherbacks that may interact with the SSLL EFP have been declining over time. These population declines are primarily the result of a wide variety of human activities, including legal harvests and illegal poaching of adults, immatures, and eggs; incidental capture in fisheries (coastal and high-seas); and loss and degradation of nesting and foraging habitat as a result of coastal development, including predation by domestic dogs and pigs foraging on nesting beaches associated with human settlement and commercial development of coastal areas (Heppell *et al.* 2003a, Lutcavage *et al.* 1997). Increased environmental contaminants (e.g. sewage, industrial discharge) and marine debris, which adversely impact nearshore ecosystems that turtles depend on for food and shelter, including sea grass and coral reef communities, also contribute to the overall decline. In addition to anthropogenic factors, natural threats to nesting beaches and marine habitats such as coastal erosion, seasonal storms, predators, temperature variations, and phenomena such as El Niño also affect the survival and recovery of leatherback populations. More information on the status of leatherbacks along with an assessment of overall impacts are found in this section as well as the Pacific Sea Turtle Recovery Plans (NMFS and USFWS 1998a), NMFS and USFWS five year review (NMFS/USFWS 2007), and are reviewed extensively in Eckert (1993). While turtle biologists and others generally accept that these factors are the primary cause of leatherback population declines, the limited amount of quantitative data on the risks posed by these different activities makes it difficult to rank the absolute risks these different activities pose to leatherbacks.

Leatherback sea turtles are highly migratory, which makes them susceptible to being incidentally caught by fisheries operating throughout the Pacific Ocean. The following section details fisheries, outside the action area, that are known to interact with Pacific leatherbacks.

1. Fisheries impacts

A number of U.S. fisheries outside the proposed action area are known to entangle and kill leatherbacks. All of these have undergone ESA section 7 consultations.

a. The DGN fishery

The DGN fishery operates outside the leatherback conservation area, primarily south of Point Conception. Participation has declined from 78 active vessels in 2000 to 39 in 2005 (the number of CDFG permits has declined from 127 in 2000 to 96 in 2005). There is no opportunity for growth in this fishery, as it is a limited entry fishery. Permits may be transferred but only under strict guidelines administered through CDFG that ensure no increase in permit holders. The number of sets made in 2001 was 1,665, in 2004, 1,084 sets were made. Using a five year average, it is expected that 1,463 sets will be made in the DGN fishery during the 2007-2008 fishing year (April through March). This fishery is observed at approximately 20% annually.

The DGN fishery typically begins in late May and continues through the end of January, although 90 percent of the fishing effort typically occurs from mid-August to the end of December. Effort in the fishery is initially concentrated in the southern portion of the fishing grounds, historically expanding to its full range by October before retreating back to the south because of the dissipation of oceanographic water temperature breaks caused by storm systems moving down from the north. However, the majority of fishing effort is concentrated south of Pt. Conception due to the current leatherback closure limitations. Some limited effort does take place to the south and west of the closure, in international waters off of Mexico and the U.S. EEZs, and north of the closure.

Vessel size in the DGN fishery currently ranges from 30–85 ft, with 60 percent of the vessels less than 50 ft in total length. Fishers use nets constructed from 3-strand twisted nylon, tied to form meshes that range from 16 to 22 inches stretched, and average 19 inches stretched. The depth of a drift gillnet is measured in meshes. They usually range from 95 to 155 meshes deep with the majority between 125 and 140 meshes deep. Nets are hung with the apex of the square meshes oriented vertically. Although termed "gillnets," the nets actually entangle fish, rather than trap them by the gills. Nets are also size selective; large fish such as swordfish get entangled while smaller fish pass through the mesh. Net length ranges from 4,500 ft to 6,000 ft and averages 5,760 ft and net depth ranges from 145 ft to 165 ft and averages 150 ft. The top of the net is attached to a float line and the bottom to a weighted lead line.

The 2004 opinion includes an ITS of three leatherbacks taken annually in the DGN fishery, of which two are likely to be killed. There have been no observed takes of leatherbacks in the DGN fishery since the leatherback conservation area closure was put in place in 2001.

b. Hawaii pelagics fisheries

In 2004, the Hawaii based shallow longline fishery was re-opened under strict sea turtle mitigation measures and caps on the levels of take and mortalities of loggerhead and leatherback sea turtles. In 2004 and 2005, the fishing year was completed without reaching the turtle caps. However, in 2006, an unexpected high level of loggerhead takes occurred, forcing the fishery to be shut down on March 20, 2006 (see Table 7). At the time of its closure, the Hawaii based shallow set longline fishery had taken one leatherback sea turtle, which was released alive.

Table 7. Leatherback and loggerhead turtle interactions in the shallow-set Hawaii-based longline fishery

	Observer coverage	Leatherbacks	Loggerheads
Annual limits		*16*	*17*
Interactions in 2007*	100%	5	15
Interactions in 2006	100%	1	17**
Interactions in 2005	100%	8	12
Interactions in 2004	100%	1	1

*As of October 1, 2007
**Fishery was closed on March 20, 2006 when it reached the 2006 annual limit for loggerhead takes.

The Hawaii based deep-set fishery has been observed taking ESA listed species, including leatherbacks and other sea turtles. Interaction numbers are given in Table 8.

Table 8. ESA listed species interactions in the Hawaii-based deep-set longline fishery targeting tuna

	Observer coverage	Leatherbacks	Other species
Interactions in 2007*	7.0%	1	2 – olive ridleys 1 - loggerhead
Interactions in 2006	21.2%	2	2 - green sea turtles 11 - olive ridleys
Interactions in 2005	26.1%	1	4 – olive ridley sea turtles
Interactions in 2004	24.6%	3	13 – olive ridley sea turtles 1 – green sea turtle

*As of October 16, 2007

Since October 2003, the Hawaii-based bottomfish fishery has been monitored under a mandatory observer program administered through the Pacific Islands Regional Office. Observer coverage in 2004 was 18.3% and in 2005 it was 25.0%. No ESA listed sea turtles or marine mammals were observed taken in this fishery. There are no observers in the Hawaii handline, pole, or troll fisheries and no data on turtle interactions, however the 2004 ITS for this component of the fishery is one leatherback take. An observer program commenced in 2006 for the American Samoa based longline fishery, 3 green turtles were observed (8.1% coverage) all dead. No other sea turtle species were observed taken.

For most of fishing fleets throughout the world, little or no data exists regarding the incidental take of leatherbacks or other ESA listed species. Without such information, it is difficult to assess the impacts of these fisheries on populations. Given their highly migratory behavior, leatherback turtles are the species under consideration in this opinion that are most likely to interact with fisheries on the high seas or foreign fisheries. Some limited bycatch information, including survival rates following entanglements, collected by observers and through fisher self-reporting does exist for some fisheries in the Pacific Ocean. The following sections present leatherback bycatch information for known fisheries, including some of which are likely to have significant impacts on sea turtle populations, simply due to the enormous amount of effort, the broad areas fished and the basic nature of the fishing strategy.

c. Longline fisheries in the western and central Pacific Ocean

The western and central Pacific Ocean (area west of 150°W longitude, and between 10°N and 45°S) contains the largest industrial tuna fisheries in the world. Much of the effort takes place in the EEZs of Pacific island countries, in the western tropical Pacific area (10°N - 10°S). Annual tuna catches in this area have averaged around 1.5 million metric tons, with around 60% of the catch taken by purse seine vessels, and the rest taken by longline vessels and other gears (e.g. pole-and-line, troll, ring-net).

The tuna fisheries are regulated by a number of international bodies and individual countries. The two main international regulatory bodies are the Inter-American Tropical Tuna Commission (IATTC) and the Western and Central Pacific Fisheries Commission. Both of these commissions have adopted management measures or resolutions designed to limit the amount of tuna fishing effort in the Pacific.

Approximately 5,000 commercial longliners operate throughout the western and central Pacific (45°N to 45°S), using up to 3,000 baited hooks per line to catch tuna. The proportion of the number of vessels originating from countries throughout the world have changed in the past decade and may consist of large freezer vessels that undertake long voyages and operate over large areas of the region to smaller domestically-based vessels operating in more tropical areas. The distant-water fleets operate throughout the western and central Pacific Ocean, targeting bigeye and yellowfin in tropical waters and albacore in the subtropical waters. Meanwhile, the offshore fleets generally fish in the tropical waters of the Federated States of Micronesia, Indonesia, Marshall Islands, Palau, and Solomon Islands and the adjacent international waters, where they will target bigeye and yellowfin tuna (Oceanic Fisheries Programme 2001).

Observers have been placed on both purse seiners and longliners in this area, and operate and report to the Oceanic Fisheries Programme of the Secretariat of the Pacific Community (SPC). Considering the low observer coverage (<1%) for the longline fisheries, patterns of observed interactions show that sea turtles are more likely to encounter gear in tropical waters and that they are much more likely (by an order of magnitude) to encounter gear that is shallow-set versus deep-set. When encountered on deep-set gear, sea turtles were likely to be taken on the shallowest hooks.

From available observer data, the longline fisheries operating in the western and central Pacific are estimated to take 2,182 sea turtles per year, with 500-600 expected to die as a result of the encounter (23-27% mortality rate). Based on the data, 1,490±376 turtles (0.06 turtles/1,000 hooks) are estimated taken by offshore/fresh tuna vessels using shallow-night sets, 129±79 turtles (0.007 turtles/1,000 hooks) are estimated taken by offshore/fresh tuna vessels on deep-day sets, and 564±345 turtles (0.007 turtles/1,000 hooks) are estimated taken by distant water freezer vessels on deep-day sets. The species observed taken include (ranked by highest occurrence first): olive ridley, green, leatherback, loggerhead and hawksbill. Given the low observer coverage, this estimate has very wide confidence intervals (Oceanic Fisheries Programme 2001).

Over the past several years, new gear technology has developed for longline fisheries that have been documented to reduce sea turtle bycatch and mortalities (Watson *et al.* 2005; Gilman et al 2006; Read 2007). It has been found that the use of 18/0 circle hooks with mackerel bait significantly reduce sea turtle interactions (65% to 90%) and the U.S. has implemented regulation to require the use of circle hooks in the Hawaii based shallowest longline fishery and the Atlantic pelagic longline fishery. Experiments on and use of this gear are being carried out by a number of countries fishing in the Pacific (Read 2007). It is believed that the adoption of modified gear in Pacific fisheries could substantial lower the impact of longline fisheries on sea turtles, including leatherbacks. The use of modified gear is required in the proposed action that is the subject of this biological opinion.

d. Australian longline fishery in and beyond the Australian Fishing Zone

Australia has two fisheries that target pelagic fish within and beyond its Australian Fishing Zone (AFZ) using longlines: (1) the Eastern Tuna and Billfish Fishery (ETBF), which extends along the east coast of Australia from Cape York, Queensland to the South Australia-Victorian border, targeting yellowfin tuna, bigeye tuna, and swordfish; and (2) the Southern and Western Tuna and Billfish Fishery (SWTBF), which extends from Cape York, Queensland across the northern coastline, down the western coastline of Western Australia and east to the South Australian-Victorian border, also targeting bigeye, yellowfin, and swordfish. Hooks are often set around sea mounts. Since Japanese longliners were denied access to fishing within the AFZ since 1997, both fleets have developed rapidly. In 2001, the ETBF consisted of approximately 150 active vessels, which deployed 11,250,000 hooks, while during that same year, the SWTBF consisted of 44 active vessels deploying 6,183,000 hooks. Both fisheries generally set shallow, at maximum depths of between 20 and 100 meters, although occasionally gear is set to depths greater than 150 meters (Robins *et al.* 2002a).

Sea turtle catch rate estimates in these two fisheries were calculated using data from skipper logbooks and interviews. Since 1997, Australian pelagic longline skippers have been required to log all sea turtle interactions. From 1997 to 2001, skippers logged a total of 272 turtles taken in both fisheries. Without verified catch data, however, it was difficult for researchers to determine the accuracy of the data. In 2001, skippers were interviewed regarding their sea turtle bycatch, and through these interviews, researchers determined that logbook data was likely inadequate, since very few fishers indicated that they had never caught sea turtles (Robins *et al.* 2002a).

Sea turtle catch rates and total turtle take by both fisheries were estimated from fisher interviews. The average sea turtle catch rate was 0.024 turtles/1,000 hooks, with a standard deviation of 0.027. Given this catch rate and the amount of effort in the fishery yields an estimated total of 402 sea turtles (95% confidence limits of 360 to 444) taken by the ETBF and SWTBF. Of the sea turtles identified to species, leatherbacks were most commonly reported as taken, with 66% in the ETBF and 90% in the SWTBF. However, 70% and 41% of all reported turtles were not reported to species in the ETBF and SWTBF, respectively. Therefore, these percentages may be underestimates. Because of the greater difficulties in identifying hard-shelled species, the proportion of other species composition in these fisheries was undeterminable (Robins *et al.*, 2002a).

e. *Japanese tuna longliners in the eastern tropical Pacific*

The most recent sea turtle bycatch information for Japanese tuna longliners is based on data collected during 2000. At a bycatch working group meeting of the IATTC, held in Kobe, Japan on January 14-16, 2004, a member of the Japanese delegation stated that based on preliminary data from 2000, the Japanese tuna longline fleet in the eastern tropical Pacific was estimated to take approximately 6,000 turtles, with 50 percent mortality. Little information on species composition was given; however, all species of Pacific sea turtles were taken, mostly olive ridleys, and of an estimated 166 leatherbacks taken, 25 were dead (Meeting Minutes, 4th Meeting of the Working Group on Bycatch, IATTC, January 14-16, 2004).

f. *Costa Rican longline fisheries*

Several studies have been undertaken in recent years in order to document the incidental capture of sea turtles in Costa Rican longline fisheries. The longline fleet consists of a "medium" artisanal fishery, which targets mahi mahi and tunas within the country's EEZ, and an "advanced" fleet, which targets billfish and tunas within and outside the EEZ.

Two studies in 1997 and 1998 on two longline fishing cruises (one experimental) documented a high incidental take of sea turtles. On one cruise east of the Galapagos Islands targeting billfish and shark (mean depth of 25-50 meters), a total of 34 turtles (55% olive ridleys and 45% east Pacific green turtles) were taken on two sets containing 1,750 hooks (19.43 turtles per 1,000 hooks). Mortality was 8.8%. One additional set caught two leatherbacks. The second cruise took place within the EEZ of Costa Rica and targeted billfish and mahi mahi. Researchers documented the incidental take of 26 olive ridleys, with 1,804 hooks deployed (14.4 turtles per 1,000 hooks). Mortality was 0%; however, of the turtles captured, 88.5% were hooked in the mouth (Arauz *et al.* 2000).

An observer program was put in place on advanced artisanal vessels from August, 1999 through February, 2000 within the EEZ of Costa Rica. In this fishery, "mother lines" are set from between 12 and 15 miles with hooks attached every 5 to 10 meters, for a total of 400-800 hooks/set. Seventy seven longline sets were observed on 9 cruises; seven of the cruises targeted mahi mahi (daytime soak) and 2 of the cruises targeted yellowfin tuna (night-time soak). Of the nearly 40,000 hooks deployed, turtles represented 7.6% of the total catch, with olive ridleys constituting the second most abundant species captured (catch per unit effort of 6.364 turtles/1,000 hooks). No leatherbacks were observed taken during the artisanal fishery.

g. Peruvian artisanal longline fishery for shark and mahi mahi

The fishing industry in Peru is the second largest economic activity in the country, and over the past few years, the longline fishery has rapidly increased. Currently, nearly 600 longline vessels fish in the winter and over 1,300 vessels fish in the summer. An observer program was initiated in 2003 to document sea turtle bycatch in the artisanal longline fishery.

From September, 2003 to November, 2004, observers were placed on artisanal longline vessels operating out of the port of Ilo, home to one of the largest year-round artisanal longline fleets. There are two seasons for this fleet: from December through March, the fleet targets mahi mahi, making up to 6-day trips, in an area 20-70 nm from the coast; and from April through November, the fleet targets mako and blue shark, making up to 20-day trips, in an area 250-500 nm from the coast. The fleet uses surface longlines.

During the observation period, 588 sets were observed during 60 trips, and 154 sea turtles were taken as bycatch. Loggerheads were the species most often caught (73.4%), followed by green turtles (18.2%), olive ridleys (3.8%), and leatherbacks (2.6%). Species were most often entangled (74%); the rest were hooked. Of the loggerheads taken, 68% were entangled, 32% were hooked. Of the two fisheries, sea turtle bycatch was highest during the mahi mahi season, with 0.597 turtles/1,000 hooks, while the shark fishery caught 0.356 turtles/1,000 hooks (Alfaro-Shigueto *et al.*, 2005). Sea turtles are rarely released into the sea after being caught as bycatch in this fishery; therefore, the mortality rate in this artisanal longline fishery is likely high because sea turtles are retained for future consumption or sale.

h. Mexican longline fisheries

The Mexican longline fishery for sharks has been observed since at least 1994 with no record of leatherback takes. There is also a Mexican longline fishery for swordfish, but little is known regarding the incidence of sea turtle bycatch. In 1999 and 2000, observers recorded target species and bycatch species on board drift gillnet and longline vessels targeting swordfish off Baja California, Mexico. During 26 trips and 132 sets, observers recorded 10,774 organisms, with 0.44% comprised of sea turtles, all of which were released without apparent harm (Instituto Nacional de la Pesca, 2001). Levels of take in the Mexican longline and drift gillnet fishery are not known, although levels of marine mammal take may be similar to these fisheries observed off the US West Coast (Carretta *et al* 2006).

i. *Tuna purse seine fishery in the eastern tropical Pacific*

The international purse seine fleet in the eastern tropical Pacific Ocean (ETP) represents the majority of the fishing effort and carrying capacity in the ETP tuna fishery, with much of the total capacity consisting of purse seiners greater than 400 short tons (st) (363 mt). The latest information from the Inter-American Tropical Tuna Commission (IATTC) shows that the number of active purse seiners of all sizes is 239 vessels, with Mexico and Ecuador comprising the majority of the fleet (66 and 86 vessels, respectively) (Source: IATTC, 2005 (www.iattc.org)).

The most recent data from the IATTC indicate that between approximately 17 and 172 total sea turtles per year were killed by vessels over 400 st (364 mt) in the ETP purse seine fishery from 1993-2004. The primary species taken were olive ridleys (Table 8; M. Hall, IATTC, personal communication, 2006), likely because they are proportionately more abundant than any other sea turtle species in the ETP and they have been observed to have an affinity for floating objects (Arenas and Hall, 1992). The mortality estimates contain fractions because while the IATTC has a known number of sets and turtle mortality from their observer database, they only have a known number of sets (not turtle mortality) from the national observer programs. Therefore, the mortality is pro-rated to make up for the sets for which the IATTC has no known turtle mortality data. The numbers of sea turtles killed by the fishery dropped significantly in 2002, and the years following, likely as a result of increased awareness by fishermen through educational seminars given by the IATTC and conservation measures implemented through Resolutions adopted by the IATTC. In 2007, the IATTC passed an even stronger Resolution on Bycatch, so sea turtle mortalities in this fishery should continue to decrease.

Table 9. Estimated sea turtle mortality by species for the ETP tuna purse seine fishery (including US) from 1994 to 2005. Includes only large (364 metric ton capacity and greater) vessels.

Name	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Green	16.1	13.0	12.0	13.0	9.0	10.9	6.1	7.8	2.1	0.0	0.0	1.4
Hawksbill	1.8	0.0	1.0	0.0	3.0	2.0	1.0	1.3	0.0	0.0	0.0	0.0
Leatherback	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loggerhead	1.8	2.0	0.0	4.6	1.0	4.0	1.8	1.3	0.0	0.0	0.0	0.0
Olive Ridley	80.1	91.3	65.8	93.8	107.6	109.1	92.1	74.2	30.7	17.1	11.0	149.0
Unidentified	45.3	34.0	37.6	42.0	41.0	46.2	29.4	55.3	13.8	9.1	5.9	11.1
Total	**146.3**	**140.3**	**116.4**	**153.4**	**161.6**	**172.2**	**130.4**	**139.9**	**46.6**	**26.2**	**16.9**	**27.5**

[Source: M. Hall, IATTC, 2006]

The data contained in Table 9 indicates that some sea turtles killed by the ETP purse seine fishery were "unidentified," although the reasons for this were not given. Assuming that these unidentified turtle mortalities occurred in the same proportions as the identified turtle mortalities, 86% would be olive ridleys, 10.8% would be green turtles, 2.1% would be loggerheads, 1% would be a hawksbill, and 0.1% would be leatherbacks.

As mentioned, the US fleet (large vessels only) has 100 percent observer coverage; therefore, the fate of every sea turtle taken is documented. Because the US fleet does not set on dolphins, sea turtles are taken in school sets and log/FAD sets. The fate of sea turtles that interact with the US purse seine fleet during such sets may only be comparable to the non-U.S. fleet that sets on logs/FADs and tuna schools. Table 9 shows sea turtle interactions with the US purse seine fleet from 1998 through 2004. Similar to the entire purse seine fleet (Table 9), the majority of the sea turtles taken by the fishery are olive ridleys, and as shown in Table 10, most sea turtles are released unharmed.

Table 10. Sea turtle interactions with the US tuna purse seine fleet (large (>363 mt (400 st)) vessels only) in the ETP, 1998-2005.

Name	Fate	1998	1999	2000	2001	2002	2003	2004	2005
Green	Released unharmed	3	5	2	2	1	5	0	1
Hawksbill	Released unharmed	0	0	0	1	1	0	0	0
Loggerhead	Released unharmed	0	1	5	0	0	0	0	0
Olive Ridley	Released unharmed	38	27	3	16	10	34	23	7
	Escaped/evaded net	0	0	1	0	0	0	0	0
	Light injuries*	4	6	2	0	0	7	1	1
	Grave injuries**	1	0	0	3	0	0	0	0
	Killed	0	0	0	0	0	1	0	0
Unidentified	Released unharmed	2	0	3	6	1	10	5	0
	Escaped/evaded net	2	1	1	0	0	0	0	0
	Light injuries*	0	0	0	1	0	0	0	0
	Other/Unknown	1	0	0	0	0	1	0	0
	Killed	0	0	0	0	0	0	0	1
Total		**51**	**40**	**17**	**29**	**13**	**58**	**29**	**10**

*Light injuries are considered to be non-lethal injuries.
**Grave injuries are considered to be eventually lethal to the turtle.
[Source: M. Hall, IATTC, 2005]

Since 1999, seminars have been given by the IATTC to skippers and their crews to educate them on, among other issues, status of sea turtles, and handling and recovery of turtles taken by purse seiners in the ETP. In addition, during the 69th meeting of the IATTC held in Manzanillo, Mexico from June 26-28, 2002, the IATTC passed a Resolution on Bycatch C-02-05. The Resolution has been reaffirmed and strengthened over the years. At the 70th meeting of the IATTC held in Antigua, Guatemala, from June 24-27, 2003, a Consolidated Resolution on Bycatch was adopted. Under the resolution, purse seine fishermen are required to promptly release unharmed, to the extent practicable, all sea turtles. In addition, crews are required to be trained in techniques for handling turtles to improve survival after release. Vessels should be encouraged to release sea turtles entangled in FADs and recover FADs when they are not being used in the fishery. Specific to the purse seine fishery operation, whenever a sea turtle is sighted in the net, all reasonable efforts should be made to rescue the turtle before it becomes entangled, including, if necessary, the deployment of a speedboat. If a sea turtle is entangled in the net, net roll should stop as the turtle comes out of the water and should not start again until the turtle has been disentangled and released. If a turtle is brought aboard the vessel, all appropriate efforts to assist in the recovery of the turtle should be made before returning it to sea (IATTC Resolution C-04-05, Action #4).

j. Purse seine fisheries in the western tropical Pacific Ocean (WTP)

There are nearly 400 active purse seine vessels originating from a variety of countries and operating nearly exclusively in tropical waters of the central and western Pacific Ocean. The purse seine fishery in the WTP is observed, and observer effort generally covers the extent of the fleet's activity. Although there has been less than 5% observer coverage for the entire fishery, the US fleet has maintained up to 20% coverage since the mid-1990s. For the purse seine fisheries operating in the WTP, an estimated 105 sea turtles are taken per year, with approximately 17% mortality rate (less than 20 sea turtles dead per year). The species included green turtles, hawksbills and most often olive ridleys. Encounters with sea turtles appeared to be more prevalent in the western areas of the WTP, where log sets are more prevalent. However, observer data for both the Philippines and Indonesia, which both fish in the east, were unavailable. These countries have purse seiners and ring-net fleets that fish predominantly on a variety of anchored FADs in this area (Oceanic Fisheries Programme, 2001); therefore, the sea turtle take estimate in this fishery is likely underestimated and incomplete.

Animal-associated, drifting log and anchored-FAD sets had the highest incidence of sea turtle encounter (1.115, 0.807, and 0.615 encounters per 100 sets, respectively). In contrast, drifting FAD sets were observed to have only 0.07 encounters per 100 sets. With less than 5% observer coverage, confidence intervals for these estimates are also very wide (Oceanic Fisheries Programme, 2001).

k. Mexican (Baja California) fisheries and direct harvest

Sea turtles have been protected in Mexico since 1990, when a federal law decreed the prohibition of the "extraction, capture and pursuit of all species of sea turtle in federal waters or from beaches within national territory ... [and a requirement that] ... any species of sea turtle incidentally captured during the operations of any commercial fishery shall be returned to the sea, independently of its physical state, dead or alive" (*in* Garcia-Martinez and Nichols, 2000). Despite the ban, studies have shown that sea turtles continue to be caught, both indirectly in fisheries and by a directed harvest of eggs, immatures, and adults. Turtles are principally hunted using nets, longlines and harpoons. While some are killed immediately, others are kept alive in pens and transported in trucks, pick-ups, or cars. The market for sea turtles consists of two types: the local market (consumed locally) and the export market (sold to restaurants in cities such as Tijuana, Ensenada, Mexicali, and U.S. cities such as San Diego and Tucson). Consumption is highest during holidays such as Easter and Christmas (Wildcoast *et al.* 2003).

Based on a combination of analyses of stranding data, beach and sea surveys, tag-recapture studies and extensive interviews, all carried out between June, 1994 and January, 1999, Nichols (2002) conservatively estimated the annual take of sea turtles by various fisheries and through direct harvest in the Baja California, Mexico region. Although there are no solid estimates of fisheries-related sea turtle mortality rates for the region, sea turtles are known to interact with (and be killed by) several fisheries in the area. As in other parts of the world, shrimp trawling off Baja California is a source of sea turtle mortality, although since 1996, shrimp fishermen are required to use TEDs. Prior to this requirement, Figueroa *et al.* (1992 *in* Nichols, 2002) reported that nearly 40% of known mortality of post-nesting green turtles tagged in Michoacán was due to shrimp trawlers. Based on stranding patterns, Nichols, *et al.* (2000) speculated that mortality of loggerheads due to local fishing in Baja California may primarily be due to a net-based fishery, likely the halibut (*Paralichthys californicus*) gillnet fishery, which reports regular loggerhead bycatch and coincides with the movement of pelagic red crab into the shallower continental shelf. Fishermen also report the incidental capture of sea turtles, primarily loggerheads, by pelagic longlines and hook sets used to catch sharks and pelagic fish. Lastly, sea turtles have occasionally been found by fishermen entangled in buoy and trap lines, although this is apparently a rare occurrence (Nichols 2002). Although fishermen may release sea turtles alive after being entangled in or hooked by their gear, based on information on the directed harvest and estimated human consumption of sea turtles in this region, incidentally caught sea turtles are likely retained for later consumption.

Sea turtle mortality data collected between 1994 and 1999 indicate that over 90% of sea turtles recorded dead were either green turtles (30% of total) or loggerheads (61% of total) (Table 11), and signs of human consumption were evident in over half of the specimens. Most of the loggerheads were immature, while size ranges for both green and olive ridleys indicated representation from both immature and mature life stages (Nichols 2002).

Table 11. Recorded sea turtle mortality by species during 1994-1999 on the Gulf of California coast and the Pacific coast of Baja California, Mexico.

Species	Gulf of California	Pacific	Totals
green turtle	30	276	**306**
leatherback	1	0	**1**
loggerhead	3	617	**620**
olive ridley	1	35	**36**
unidentified	0	57	**57**
Total	**35**	**985**	**1,020**

Source: Nichols (2002).

A more focused study was conducted from June to December, 1999 in Bahia Magdalena, a coastal lagoon to determine the extent of sea turtle mortality. Researchers searched for sea turtle carapaces in local towns and dumps as well as coastal beaches. The majority (78%) of the carapaces were found in towns and dumps and green and loggerhead turtles most frequently observed. Both species found were generally smaller than the average size of nesting adults. Researchers estimated that the minimum sea turtle mortality rate for the Bahía Magdalena region was 47 turtles per month, or 564 turtles per year. Based on observations, approximately 52% were green turtles, 35% were loggerheads, 2% olive ridleys, and 1% hawksbills (10% unidentified) (Gardner and Nichols 2002). A study conducted from 1995 to 2002 in Bahía de Los Angeles, a large bay that was once the site of the greatest sea turtle harvest in the Gulf of California, revealed that the populations of green turtles in the area had decreased significantly since the early 1960s. Despite the 1990 ban, sea turtle carcasses were found at dumpsites, so human activities continue to impact green turtles in this important foraging site (Seminoff *et al.* 2003).

Based on surveys conducted in coastal communities of Baja California, extrapolated to include the entire coastal peninsula, Nichols (2002) estimated the annual mortality of green turtles in this region to be *greater* than 7,800 turtles, impacting both immature and adult turtles. Mortality of loggerhead turtles, based on stranding and harvest rates, is estimated at 1,950 annually, and affects primarily immature size classes. The primary causes for mortality are the incidental take in a variety of fishing gears and direct harvest for consumption and [illegal] trade. With the local declines of green turtles, a market for loggerhead meat has developed in several Pacific communities. Olive ridleys are not found as commonly in Baja California waters as loggerheads and greens; however, they are consumed locally and occasionally strand on beaches. No annual mortality estimates of olive ridleys in the area were presented. Lastly, anecdotal reports of leatherbacks caught in fishing gear or consumed exist for the region; however, these instances are rare, and no annual mortality estimates of leatherbacks were presented (Nichols, 2002). A recent estimate by Wildcoast *et al.* (2003) reiterates that there is likely high mortality of turtles in the Californias (defined here is the region encompassing the Gulf of California including the coast of Sonora and Sinaloa, Mexico; Baja California and Baja California Sur, Mexico, and California, USA) estimating 15,600 to 31,200 sea turtles consumed annually (no differentiation between species).

The latest research on fisheries mortality and poaching of sea turtles in Mexico focused again on the Bahia Magdalena region of Baja California. In this area, small-scale artisanal fisheries are very important. The most commonly used fishing gear are bottom set gillnets and have been documented interacting at high rates with loggerheads and green turtles. From April 2000 to July, 2003 throughout this region (including local beaches and towns), Koch *et al.* (2006) found 1,945 sea turtle carcasses. Of this total, 44.1% were loggerheads and 36.9% were green (also known as "black") turtles. Of the sea turtle carcasses found, slaughter for human consumption was the primary cause of death for all species (91% for green turtles, 63% for loggerheads). Mortality due to fisheries bycatch was difficult to document, simply because evidence of trawl and gillnet interactions is rarely seen on a sea turtle carapace. Less than 1% of mortality was documented as due to fisheries bycatch. Over 90% of all turtles found were juveniles or subadults. Koch *et al.* (2006) estimate conservatively that at least 15,000 sea turtles are killed per year for the Baja California peninsula. Again, no differentiation is made between species; however, the percentages of the various sea turtle species found in Bahia Magdalena may provide an idea of the species composition taken throughout the peninsula.

l. Directed capture/trade of sea turtles in Southern Peru

Sea turtles have been protected in Peru since 1977; however, there is little governmental control over the illegal taking and killing of sea turtles. Researchers focused observations on the Pisco-Paracas area of southern Peru to determine the extent of the hunting and trade of sea turtles, as it is a recognized foraging area for sea turtles and is also a known area for the sea turtle trade, particularly the San Andrés port. Fishermen sell sea turtle (sometimes alive) for its meat, oil, or shell to a dealer, who may sell in the nearby market of Pisco. The observation period occurred from July, 1999 through June, 2000. An estimated 204 ±17.6 sea turtles were killed at San Andrés. Species composition was: 67.8% green turtles, 27.7% olive ridleys, and 2.9% leatherbacks. Peak captures were during the Peruvian spring (October – December), while leatherbacks were only captured in December and February. This estimate is considered a minimum since sea turtles are not always butchered on the beach and therefore may not be observed by researchers. Sea turtles were most often taken by fishermen and retained for future sales. Most of the animals were caught in a medium sized (600 m x 10m) multifilament nylon drift gillnet set for small sharks and rays, with a stretched mesh size up to 20 cm (de Paz *et al.* 2005).

The fishing industry in Peru is the second largest economic activity in the country, and over the past few years, the longline fishery has rapidly increased. Currently, nearly 600 longline vessels fish in the winter and over 1,300 vessels fish in the summer. An observer program was initiated in 2003 to document sea turtle bycatch in the artisanal longline fishery.

From September, 2003 to November, 2004, observers were placed on artisanal longline vessels operating out of the port of Ilo, home to one of the largest year-round artisanal longline fleets. There are two seasons for this fleet: from December through March, the fleet targets mahi mahi, making up to 6-day trips, in an area 20-70 nm from the coast; and from April through November, the fleet targets mako and blue shark, making up to 20-day trips, in an area 250-500 nm from the coast. The fleet uses surface longlines.

During the observation period, 588 sets were observed during 60 trips, and 154 sea turtles were taken as bycatch. Loggerheads were the species most often caught (73.4%), followed by green turtles (18.2%), olive ridleys (3.8%), and leatherbacks (2.6%). Species were most often entangled (74%); the rest were hooked. Of the loggerheads taken, 68% were entangled, 32% were hooked. Of the two fisheries, sea turtle bycatch was highest during the mahi mahi season, with 0.597 turtles/1,000 hooks, while the shark fishery caught 0.356 turtles/1,000 hooks (Alfaro-Shigueto *et al.* 2005). Sea turtles are rarely released into the sea after being caught as bycatch in this fishery; therefore, the mortality rate in this artisanal longline fishery is likely high because sea turtles are retained for future consumption or sale.

2. Scientific research permits

a. Scientific Research Permit #1514
This permit allows Pacific Islands Region staff to measure, photograph, tissue sample, flipper tag, PSAT tag, release, salvage (if dead) of sea turtles incidentally taken during longline fishing operations carried out under the Western Pelagic fishery management plan. Takes of these animals is covered under the ITS issued in the 2004 biological opinion on the FMP.

b. Scientific Research Permit #1596
The permit was issued under Section 10 of the ESA to the Southwest Region and authorized the annual non-lethal take of up to 78 leatherbacks. The research area is an important forage area for leatherbacks in the Pacific. The purpose of the research activities is to continue long-term monitoring of the status of the species off the coasts of California, Oregon, and Washington. The research will study the species to determine their abundance, distribution, size ranges, sex ratio, health status, diving behavior, local movements, habitat use, and migration routes. Animals will be located through aerial surveys at a high altitude to prevent harassment and subsequently captured by hoop net from a research vessel. The primary goal is to address priorities outlined in the U.S. Pacific leatherback Recovery Plan. The Permit Holder will identify critical forage habitats, genetic stock structure, migratory corridors and potential fishery impacts on this species in the Pacific. This information is necessary to make informed management decisions concerning these turtles and their habitat.

3. Other impacts
Threats to leatherbacks are described above and include nesting habitat destruction, poaching of adults and eggs at nesting beaches, entanglements and mortalities in fishery gear, directed harvest, pollution, marine debris (see USFWS and NMFS 1998; NMFS 2004 HMS BiOp). The

following provides summary information on the impacts of the December 2004 Tsunami, which impacted areas utilized by leatherbacks along with a brief review of possible impacts of climate change and variability on leatherbacks.

a. Effects of the December 26, 2004 Tsunami on Sea Turtles

The tsunami that occurred on December 26, 2004 affected many nations in the Indian Ocean basin. Many of these nations - including Indonesia, Malaysia, Thailand, India, and Sri Lanka - contain important areas for sea turtle foraging and nesting. The effects of the December 2004 tsunami have been provided in a report by the signatory states to the Indian Ocean and Southeast Asia Marine Turtle Memorandum of Understanding (Hamann *et al.* 2006)). The report's assessment of effects on leatherbacks in the region are briefly summarized here.

The tsunami hit the northern coast of Indonesia, the country with perhaps the largest nesting populations of leatherbacks in the Pacific. However, the area hit was not a major nesting area. Low nesting densities have been observed in Sumatra, but nesting does not occur in December, thus immediate effects were not recorded although it wasn't reported how changes in the beach may affect leatherback use. The tsunami did not hit the area where leatherbacks in Malaysia nest. A number of research and conservation centers in Thailand were lost (including the loss of two young volunteers). A small number of leatherbacks nest in the winter along the Indian Ocean in Thailand. Eggs from nests laid before and after the tsunami likely did not survive.

Reports in the media shortly after the tsunami suggest that long-term there may be some benefit to sea turtles, as previously developed beaches have returned to conditions closer to pristine. New building regulations may prevent the development of these beaches, thus adding to usable nesting habitat, but at this point such suggestions are speculative. Research is planned by conservation groups in Thailand to assess the longer-term effects of the tsunami on nesting and foraging of sea turtles in the area. In India, all leatherback nests laid were likely lost to the tsunami (which occurred during the nesting season). Some of the most important nesting sites have been severely damaged, although new nest sites may develop due to the creation of new beaches.

The longer terms effects of the tsunami are at this point speculative, but loss of nesting habitat is a clear concern, along with loss of beach vegetation (vegetation helps prevent beach erosion and provide shade to nest sites). The effects of the tsunami on foraging habitats in all areas are not known, although loss of seagrass, mangroves, and coral reefs has been reported. Fortunately, the major leatherback nesting areas were not affected by the tsunami. Perhaps the greatest loss is within the research and conservation community, which lost not only members, but also facilities, data, and animals. Most organizations are currently trying to re-build their operations.

At the most recent Sea Turtle Symposium a presentation was given on actions being taken to assess the long term impacts of the Tsunami and plans for coastal re-development, including impacts on sea turtles in terms of foraging and nesting habitats. The project is a joint effort between the United Nations and local environmental organizations in India (Shanker et al 2007).

b. Climate effects

The effects of climate on sea turtles are just beginning to be studied and are largely still speculative. Some effects have already been observed and others are considered likely in the future. These effects range from relatively short term effect from El Niños to longer term climatic changes to the ocean environment. Long-term changes in climate could have a profound effect of leatherbacks and other sea turtles. Changes in temperature (rising air temperatures) may affect nesting success; very high temperatures while eggs are incubating in the sand may kill the offspring. The sex of turtles is temperature dependent, that is, eggs incubated at higher temperatures produce more females while eggs incubated at lower temperatures result in more males (Chan and Liew 1996). Increased air temperatures may result in a bias of the sex ratio of offspring, which over the long-term could lead to reduced nesting success (insufficient males to fertilize eggs). Thus, while the number of nesting females may be stable or increasing now, the eggs may not be viable or the hatchling output may not produce a balanced sex ratio necessary for future successful reproduction.

The climate may also affect turtle nesting habitat. Long-term climate change (e.g., rising average temperatures) will likely result in rising sea levels due to loss of glaciers and snow caps coupled with thermal expansion of warming ocean water which may lead to the loss of usable beach habitat. (Baker *et al.* 2006). Studies suggest that leatherbacks do not have the same high level of nesting site fidelity as hard shelled turtles, so they may be able to better adapt to the loss of habitat by seeking out new nesting areas. Similarly, short-term climate variability may cause in increase in storm or tidal activity that causes inundation of nesting sites in the short-term, causing loss of nesting habitat or loss of that season's nests.

Oceanographic changes due to climate may also affect leatherback sea turtle prey availability, migration and nesting. Leatherbacks that may be exposed to the SSLL EFP are believed to travel across the Pacific for large concentrations of prey, particularly jellyfish. Short term variability in climate such as El Niño events may limit prey due to a reduction in upwellings brought by warm surface waters and limited or no wind. Over the longer term, climate models suggest a number of possible changes in oceanographic conditions, including the slowing down of the thermohaline circulation, higher precipitation storms, rising sea surface temperatures and rising sea levels (IPCC 2001). Also, as temperature patterns change in oceans, current foraging habitats may shift (McMahon and Hays 2006). There is already evidence to suggest that some sea turtles' re-migration periods are being affected by variations in SST (Solow *et al.* 2002; Chaloupka 2001). Finally, loss of nesting habitat due to rising sea levels is an obvious concern (Baker *et al.* 2006).

Additional study will be necessary to determine how climate may be affecting leatherbacks and the entire marine eco-system in the Pacific and elsewhere (Kintisch 2006). The possible effects are included here to provide a very brief review of possible effects and areas of necessary additional study in the field. These effects are likely over the long-term and immediate effects are not known or quantified. Further, the possible effects of climate variability or change are likely to have little detectable influence on the proposed action, which is a four month action from September to December of 2007.

d. Recent conservation efforts for Pacific leatherbacks

For the past several years, the Western Pacific Fishery Management Council (WPFMC) has worked with NMFS' Pacific Island Fishery Science Center (PIFSC), Pacific Islands Region (PIR), and the SWFSC have worked together to identify priorities for regional sea turtles conservation efforts. The priorities for this program are: data management to fill information gaps; conservation measures to reduce direct harvest of sea turtles and protect nesting beach habitat; education and outreach about sea turtle conservation; international management and networking; and fishery mitigation through research and transfer of gear technologies designed to reduce bycatch of sea turtles to foreign fisheries. These include more extensive surveys, beach monitoring and protection programs, observer training programs for fisheries, and education and outreach programs for local communities.

Information on these projects comes from the 2005 biological opinion on the continued authorization of the Hawaii-based Pelagic, Deep-Set, Tuna Longline Fishery based on the Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region and is provided in Appendix 1.

Within the five areas of concentration, six projects have been implemented and have reached completion. In addition to the projects listed below, numerous meetings and workshops regarding and sea turtle conservation planning and strategizing and reducing sea turtle bycatch in the world's fisheries have been supported by either the WPFMC or NMFS. These efforts were developed and initiated with the overall goal of increasing the capacity for sea turtle recovery in the Pacific and are anticipated to result in beneficial effects for sea turtle populations in the Pacific Ocean.

The Southwest Regional Office funds several sea turtle conservation projects each year, depending on the available funding. In 2007, the office provided funds to: (1) War Mon Smolbag Theatre for monitoring and protecting leatherback nesting beaches in Vanuatu; (2) Aquatic Adventures for support towards experiments to reduce sea turtle bycatch in gillnets and longlines; and (3) Earth Resource Foundation for support towards outreach in southern California to reduce the introduction of plastic into the marine environment.

Conservation efforts at nesting beaches are being carried out in the eastern and western Pacific. During the last few years conservation effort at nesting beaches in Mexico and Costa Rica have led to increased survival of eggs, and therefore greater hatchling production per nesting female. This has the potential for increasing future recruitment if post-hatchling survival is not further reduced; however, since numbers of nests are so low, and post-hatchling and juvenile natural mortality are assumed to be high, this increase in hatchling production may only result in the addition of a few adults annually. However, the increases in numbers of adult leatherbacks and greens following years of aggressive beach and nest protection suggest that this is an important area for conservation efforts.

In addition to direct conservation measures, a number of international agreements have been signed over the past several years that are designed to benefit sea turtles, including leatherbacks, in the Pacific. These include the adoption in 2003 of the Bellagio Blueprint, a multinational effort to help save Pacific sea turtles; a Memorandum of Understanding signed by Indonesia, Papua New Guinea, and the Solomon Islands to coordinate efforts to protect and save sea turtles in their collective countries and the Indian Ocean and Southeast Asia Memorandum of Understanding. In 2007, the Inter-American Tropical Tuna Commission adopted a resolution to address sea turtle bycatch in fisheries for tuna and tuna-like species in the eastern tropical Pacific (Resolution C-07-03).

Conclusion of Status of leatherbacks

It is difficult to provide a summary of the status of leatherbacks given all of the unknowns associated with this species and its populations. It is undeniable that the available information indicates a major decline in Pacific leatherbacks at their nesting beaches over the past 30 years. The status of eastern Pacific leatherbacks seems particularly dire. The numbers of nesters at the major leatherback nesting sites in Mexico and Costa Rica have declined significantly over the past 30 years. It has been estimated that the Mexican leatherback nesting population may have been as high as 70,000 adult females in 1980 and recent nest counts since 2000 have ranged from 120 to nearly 2,000. In Costa Rica, the numbers of nesting females in 1988-1990 were over 1,300; in the past five years the numbers have ranged from approximately 50 to 160. The reasons for the declines include incidental take in fisheries, harvest of eggs, direct harvest especially females at nesting beaches, and beach habitat degradation. In both Mexico and Costa Rica, important conservation measures have recently been implemented. In Mexico, Protyecto Laud coordinates efforts to protect nesting habitat at the four index beaches, including protecting nesting females from poaching and protecting nests with a goal of increasing the number of hatchlings that survive and emerge (Martinez *et al.* 2007). In Costa Rica, ongoing beach protection and monitoring occurs at major nesting sites including a recent commitment to fully protect Las Baulas National Marine Park, the site of the two largest nesting aggregations on the Pacific coast of Costa Rica.

Most of the Western Pacific populations have not experienced the same level of decline. Recent studies conducted by scientists from the SWFSC and their colleagues in Asia suggest that the western Pacific leatherbacks have life history traits (e.g., variation in nesting areas, timing of nesting activity, foraging patterns) that may make them more resilient to population level perturbations and perhaps more abundant than previously thought.

As described above, in 2004, researchers, managers and tribal community members with extensive knowledge of local leatherback nesting beach populations and activities in Papua (Indonesia), Papua New Guinea, the Solomon Islands and Vanuatu assembled in Honolulu, Hawaii to identify nesting beach sites, and share abundance information based on monitoring and research, as well as anecdotal reports. Dutton *et al.* 2007 report that there may be a minimum of 1,100 to 1,800 females nesting annually at 28 nesting sites in the western Pacific. Using the same assumptions used in Spotila *et al.* (1996), including five nests per female per nesting season and 2.5 years between nestings, yields an estimated 2,700 to 4,500 adult females in the western Pacific population, which is substantially higher than previously published estimates.

Although it can not at this time be proven, based upon the limited observations of leatherbacks utilizing a variety of nesting beaches, sometimes within the same season, this population may be more resilient to losses at individual beaches than other sea turtle species or other leatherbacks. Most of the western Pacific leatherbacks share a haplotype. This suggests that there may be mingling within the nesting sites throughout the region, thus the distribution of this population is quite large and may not be isolated to specific beaches. Western Pacific leatherbacks also show a wider range of migratory patterns than eastern Pacific leatherbacks (which all follow the same post-nesting route). The variation in foraging areas may help make this population less vulnerable to environmental perturbations. Leatherbacks in the Atlantic, which generally have positive population growth trends, exhibit a similar pattern of exploiting many foraging areas post-nesting. The plasticity exhibited by this population may help it overcome environmental stochasticity, but many of the at-sea threats to leatherbacks persist and remain unquantified (largely due to a lack of observers on foreign fleets).

Western Pacific leatherbacks appear to utilize a variety of beaches throughout Southeast Asia and have been observed nesting in a number of countries including Malaysia, Indonesia, Papua New Guinea, the Solomon Islands, Vanuatu, Viet Nam, Thailand, Fiji, and Australia. Major nesting sites are known, although leatherbacks will utilize a number of beaches and have been observed nesting on different beaches within a single season, thus, perhaps, limiting the vulnerability of eggs placed at only one location. Leatherbacks are not limited to one season of nesting, with nesting activity having been observed in both winter and summer months at some beaches. These factors, which suggest a greater resilience to one time threats, also make it difficult to estimate the population or trends, as females may move from beach to beach. Recent genetic work indicates a shared haplotype among most western Pacific leatherbacks. This may suggest that most western Pacific leatherbacks can mate with one another, thus limiting the threat of small populations and restricted gene pools, although the genetic diversity may be limited.

One Western Pacific population that has shown significant decline is the Malaysian nesting population. Numbering over 3,000 nesting females in the 1960s, this population has been labeled functionally extinct with less than ten females returning to nest annually. This population is genetically unique from the rest of the Western Pacific populations and does not share the common haplotype found in the other western Pacific leatherback populations. Conservation efforts continue to sustain this population, but years of poor hatchery practices may have skewed the sex ratios resulting in too few males to mate with the remaining females. The decline in this population coincided with the development of large fisheries in the high seas and in coastal waters near nesting beaches, which likely affected the population. This population was also likely affected by the many years of very high levels of nest poaching, which likely severely limited the number of new recruits into the population. This population may serve as an example of better practices for conserving leatherbacks in other areas, including taking actions to improve the status of leatherbacks before the population reaches very low levels; in Malaysia no conservation measures were taken until the late 1980's when annual number of nestings was under 300.

In the Atlantic, the population of leatherbacks is estimated to be between 34,000 and 94,000 with most rookeries increasing (TEWG 2007). The reasons for the differences in leatherback abundance and population trends in the Atlantic and Pacific oceans is unknown. However, it has been suggested that due in part to the variation in nesting sites and foraging areas, that Atlantic leatherbacks are more likely to respond to nesting conservation efforts, in part because they are less susceptible to environmental perturbations or human impacts such as fishing. Two nesting beaches in the Atlantic, St. Croix and Tongaland, KwaZulu-Natal, South Africa, have both seen dramatic increasing in nesting females following years of aggressive nesting beach protection.

Leatherbacks still face many threats to the species' survival. Leatherbacks still experience harvests of their eggs, they are still killed for subsistence purposes, their beaches continue to erode, and adult and sub-adult leatherback turtles are still captured and killed in fisheries interactions. Two recent papers attempt to evaluate threats to leatherbacks, both globally and in the Pacific. Lewison *et al.* (2004) attempted to quantify leatherback bycatch globally in longline fisheries, relying upon a model which used catch data and bycatch rates from a limited number of fisheries and extrapolating these globally. The model predicted that tens of thousands of leatherbacks may encounter longline gear annually, although not all encounters result in mortalities. The model results are provocative, but like all models, are limited by the available data. Large data gaps exist for longline effort and bycatch rates. The paper points out the limitations of making large scale assessments of impacts due to lack of observers and monitoring of longline effort. The level of extrapolation necessary in this model makes the results questionable, but point to the need for more monitoring of longline vessels globally. Kaplan (2005) also relies upon a model and extrapolates longline effort and leatherback bycatch across the entire Pacific region, but also considers the impact of coastal fisheries and direct harvest of females and eggs at nesting beaches. As with all models, the quality of the output is limited by the quality and availability of data, which is quite limited for Pacific populations. Nonetheless, these two papers highlight the need for additional monitoring and data on the status and threats to leatherbacks internationally.

The threats to leatherbacks due to climate change and variability have been getting more attention in the scientific community as evident in the rise in published papers on the topics. The predictions of sea level rise and associated increases in beach erosion and inundation present new risks to this species at their nesting beaches. In addition, temperature changes may affect the sex and hatchling success of leatherback nests and may alter foraging migrations.

It is clear that much has been learned about leatherbacks, particularly the western Pacific over the past few years. However, in order to fully assess the status of leatherbacks in the Pacific, many more years of data are necessary as well as more extensive monitoring programs. Basic information such as the re-migration interval of various nesting aggregations, inter-nesting behavior, migration and seasonal distribution, and stage structure of all age groups of leatherback populations will be necessary to fully understand the status of this species. In this opinion we rely upon the best available data at this time to assess the status of Pacific leatherbacks.

V. ENVIRONMENTAL BASELINE

A. Federal fisheries in the action area of the proposed SSLL EFP

Within the West coast EEZ four federal fisheries are prosecuted under FMPs, the HMS fishery (which includes recreational fishers), the coastal pelagic species (CPS) fishery, the salmon fishery and the groundfish fishery. All of these fisheries occur both within and outside the proposed action area. NMFS has observed the CPS, salmon, and groundfish fisheries and has recorded no incidental takes of ESA-listed whales or sea turtles during fishing operations.

The HMS FMP includes a number of fisheries and authorizes the use of many gear types to fish on HMS species. No takes of ESA-listed species have been recorded in the harpoon, surface hook-and-line, tuna purse seine. One olive ridley sea turtle was observed taken in the pelagic deep-set longline fisheries authorized through the HMS FMP. The take was not covered under the existing ITS for the HMS FMP and formal section 7 consultation on this fishery is currently on-going.

Sea turtles are rarely documented interacting with albacore troll gear and there have been no recorded interactions with marine mammals. There have been anecdotal reports of sea turtles being snagged by troll lines off California (NMFS 2004). Since most gear is retrieved nearly immediately, any sea turtle snagged is likely to be released alive and unharmed, provided the hook and line are removed. Observer coverage on this fishery is approximately 1% annually.

B. State fisheries within the action area

1. California Angel Shark/Halibut and Other Species Large Mesh (>3.5") Set Gillnet

This fishery operates year-round and is managed by the CDFG in accordance with state and federal laws. Under California law, this fishery may not operate within state waters. The state maintains regulatory authority over this fishery which occurs in federal waters adjacent the California state waters. This fishery was not incorporated into the HMS FMP. Angel shark and halibut are typically targeted using 8.5 inch mesh, while the remainder of the fishery targets white seabass and yellowtail using 6.5 inch mesh. No interactions with listed marine mammal species have been observed in any of these fisheries.

The California set gillnet fishery for angel shark/halibut has been observed to take sea turtles and marine mammals. In July, 1990, NMFS implemented an observer program for this fishery in order to monitor marine mammal bycatch. NMFS observer coverage ranged from 0% to 15.4% between July, 1990, and July, 1994. The observer program for the set gillnet fishery was terminated in July, 1994, because of a significant decrease in fishing effort in that fishery (due to regulations that restricted areas open to gillnet fishing) (Julian and Beeson 1998) and after area closures were implemented in 1994, which prohibited gillnets within 3 mile of the mainland and within 1 mile of the Channel Islands in southern California. NMFS re-established an observer program for this fishery in Monterey Bay in 1999-2000, due to a suspected increase in harbor porpoise (*Phocoena phocoena*) mortality. In the autumn of 2000, due to concerns for high incidental catch of seabirds, the CDFG implemented the first in a series of emergency area closures to set gillnets within 60 fathoms along the central California coast, from Point Sal to Point Arguello and between Point Reyes and Yankee Point. A ban on gill and trammel nets inside of 60 fathoms from Point Reyes to Point Arguello became effective in September 2002.

Overall, the current number of legal permit holders for gill and trammel nets, excluding swordfish drift gillnets and herring gillnets has declined since 1998 (CDFG website http://www.dfg.ca.gov/licensing). Mortality of marine mammals continues in this fishery, as evidenced by fisher self-reports under the Marine Mammal Authorization Program, from 2000-2005. Under the authority of the MMPA, NMFS is reinitiating an observer program for this fishery and placing observers on vessels in southern California in the summer of 2006, with approximately 10-20% coverage (L. Enriquez, NMFS, personal communication, 2006).

2. Pot gear fisheries

Since 2000, humpbacks, unidentified whales, and leatherbacks have been observed entangled in various type of pot gear (e.g., crab pots) off the coast of California. Most pot and fish trap fisheries are regulated by the states, although sablefish pot gear (fished off the coast of California) is part of the groundfish FMP. Sightings of marine mammal and leatherback entanglements are detailed in Table 12. All of these are opportunistic sightings from the California Marine Mammal Stranding Network Database. Sighting data includes whether the animal was dead when observed and likely killed as a result of the entanglement (i.e., body not in a state of decomposition), if the animal was released alive without injury, or if the status of the animal could not be determined or was not recorded (i.e., "unknown"). There is no way to extrapolate an annual average mean take from pot gear. There is also no way to estimate mortality due to entanglements due to limited information and lack of repeated sightings of individuals.

Table 12. Numbers of pot/fish trap gear entanglement incidents reported to NMFS (2000-2005)

	2000	2001	2002	2003	2004	2005
Alive	0	1	0	1	0	0
Unknown	0	0	0	0	0	0

D. Status of the species within the action area

Leatherbacks are highly migratory and based upon recent satellite tagging, travel great distances between nesting and foraging areas. Leatherbacks have been observed at high densities in the nearshore, neritic zone (approximately 0 to 30 miles from shore) with highest densities in central California at approximate latitudes of 37° N to 39° N (Benson *et al.* 2007a). These leatherbacks have been observed feeding on the seasonally abundant jellyfish in the nearshore upwelling relaxation zones. This area is outside of the action area of the proposed action. Satellite tracking indicates that concurrent with upwelling beginning to subside, generally in late September and October, leatherbacks begin to move offshore, thus placing them in the areas where fishing activity is likely to be occurring under the proposed action. Leatherbacks may also be feeding in the waters of the proposed action. Future research and analysis of leathererbacks' utilization of the nearshore waters, beyond the neritic zone are planned, but at this point, it is not known if leatherbacks utilize the deep waters off the continental shelf for feeding. Recent studies in the Atlantic have shown the leatherbacks utilize both shelf and slope waters for feeding throughout the summer and early fall (James 2005). It is possible that leatherbacks are using the West Coast EEZ in a similar manner, but data are currently lacking to support or refute this.

The SWFSC has been capturing and tagging leatherbacks off the coast of California since 2000 and no clear pattern of sex ratios has emerged, but both adult and sub-adult females and males have been captured and tagged. It is unlikely that younger leatherbacks would be in the area, as they are most often found in water temperatures over 26 degrees Celsius (Eckhert 2002). In a recently published paper, the average annual number of leatherbacks observed in the nearshore waters off California is 178 (Benson *et al.* 2007a). This number likely underestimates the number of leatherbacks in the West Coast EEZ, since the study was limited to the waters off California and do not include Oregon, Washington or Canada. Leatherbacks show a high degree on inter-annual variation in terms of feeding locations. Satellite tracks show that some animals will head farther north than central California. In 2006, a female was tracked in Washington state and into British Columbia, Canada. Also in 2006, no leatherbacks were observed in the Monterey Bay area that been used by SWFSC staff since 2000 for capturing and tagging turtles. The reason for this shift in what is considered normal summer and fall leatherback distributions is unknown although the low level of primary production during the summer in waters off California may contributed. The presence and abundance of leatherbacks in the action area is likely related to oceanographic conditions that cause prey species to be available in sufficient quantities. A recently published paper showed a positive correlation between positive Northern Oscillation Index (NOI) and abundance of leatherbacks in the nearshore (Benson *et al.* 2007a). Positive NOI is characterized by strong upwelling and wind (Schwing 2003), conditions that lead to high primary and secondary production, particularly in nearshore waters.

E. Factors affecting species within the action area

Leatherbacks within the action area are vulnerable to a variety of threats. These include entanglements and mortality in fishing operations within the action area, although no interaction between leatherbacks and fishing gear have been observed or reported to NMFS since the leatherback conservation zone for the DGN fishery was implemented in 2001. Between 2000 and 2005, there have been three boat collisions with leatherbacks recorded in NMFS SWR stranding data base. One report was from a salmon troller, although stranding responders at the scene could not find the animal. The stranding records from the other two incidents did not indicate whether the animals were killed by the collision with the boat, although both clearly showed damage to the carapace, head, or flippers. Ship strikes likely go largely unreported although may pose a significant threat to leatherbacks in foraging areas such as the Gulf of the Farallones (Benson *et al.* 2007a). Other threats to sea turtles within the action area are less easily identified or as tangible. For example, marine debris has been identified as a cause of sea turtle mortality or illness (ingesting objects such as plastic bags).

VI. EFFECTS OF THE ACTION

A. Exposure

Based upon past interactions in the historic DGN fishery and the known distribution of leatherbacks within the proposed action area, it is likely that leatherbacks will be affected by the proposed SSLL EFP. Determining the number of individual leatherback taken and associated mortalities is difficult because there has not been a SSLL fishery in the proposed action area, so there are no observer records from area-specific longline fisheries that can be utilized to make projections. In contrast, a DGN fishery operates in the proposed action area and targets swordfish, the target species of the proposed EFP. As described previously, comparing one set of DGN gear to one set of SSLL gear is not considered a reasonable means of estimating bycatch given the differences in the gear and the lack of evidence to support an assumption that the gear types are comparable. We attempted to find an example where longline and DGN gear had been used to target the same species in the same time and area, but none could be found. Therefore, rather than rely on DGN gear interaction rates to estimate SSLL anticipated takes, we used data from other longline fisheries in the U.S.

The Hawaii-based SSLL, which re-opened in April 2004 was considered as a possible proxy for estimating the likely number of leatherbacks that may be captured during fishing operations authorized by the EFP. The annual CPUEs of leatherbacks in the Hawaii-based SSLL fishery were highly variable from 2004 through 2006, ranging from 0.0027 to .013 per 1,000 hooks, reflective of the dynamic nature of interactions between sea turtles and fishing gear. These CPUEs applied to the proposed action (maximum number of hooks of approximately Using 67,000 hooks) yields an anticipated take of one or less leatherbacks. CPUEs from Hawaii may not be appropriate to the West Coast EEZ given the differences in fishery effort (2,120 sets in the HI based SSLL and 56 sets anticipated in the SSLL EFP) and leatherback behavior in the two areas (the waters off Hawaii have been identified as migratory and perhaps feeding areas, whereas the areas of the West Coast EEZ have been identified as foraging areas for western Pacific leatherbacks). However, if the leatherback CPUE used in the 2004 biological opinion for the Hawaii pelagics FMP (NMFS 2004c) is applied to the level of effort proposed in the SSLL EFP, the anticipated rate of captures is extremely low, approximately one leatherback during the entire four month season. This estimate of captures likely does not accurately reflect the dynamics of leatherback behavior within the proposed action area and likely interactions with SSLL gear.

Recent work from the East Coast suggests that leatherbacks of the northeast coast of the U.S. and southeast coast of Canada utilize shelf and slope waters during the summer as foraging areas. Two areas in particular, the Northeast Coast (NEC) and Mid-Atlantic Bight (MAB) may most closely resemble some of the foraging areas on the West Coast, particularly central California. Leatherbacks were satellite tagged (n=38) between 1999-2003 off Nova Scotia, Canada (within the NEC) (James et al 2005). Tracks from the tags indicate that leatherbacks travel extensively in the shelf and slope waters (James et al 2005). On the water observations of "prey handling" at the surface of the water and dive patterns suggest that the NEC and MAB are high-use foraging areas for western Atlantic leatherbacks (James and Herman 2001). Recent work by staff at the SWFSC indicates that some areas of the West Coast are utilized by leatherbacks in a similar manner as in the Atlantic, that is, leatherbacks migrate into the area seasonally to forage on abundant gelatinous plankton and jellyfish, the primary prey of leatherbacks in these areas (Benson *et al.* 2007a).

A number of different approaches for applying data from the Atlantic to the proposed action to in order to estimate leatherback captures were considered. First we calculated a simple CPUE based upon total number of observer leatherback captures divided by the total number of observed hooks in the NEC and MAB in 2005 and 2006 and applied this to the anticipated maximum 67,200 hooks in the SSLL EFP. The result was an estimated capture of four leatherbacks. Second, using observer fishing records from 2006 only, which is the most complete fishing year (i.e., regulations had been in place in the fishery for over a year and there were no effects of the 2005 hurricanes on the fishing effort), we calculated a CPUE for the MAB and NEC during the quarters when leatherbacks are found in highest concentrations. Based on this approach, we estimate that the proposed action may capture up to five leatherbacks. This second method may be more appropriate for the proposed action as it uses data from time periods in which leatherbacks in the Atlantic are most likely to be exposed to the longline fishery as they forage in the area and move out of nearshore foraging areas. This is similar to the proposed action, which will occur from September through December. As described above, leatherbacks have been observed utilizing the proposed action area during the late summer and fall, particularly September and October, as they move through the EEZ, likely moving offshore from nearshore foraging areas. However, it is possible that this may over-estimate the likely takes, since it is not clear if all nearshore areas along the California and southern Oregon are utilized to the same extent as nearshore areas in the MAB and NEC.

Similar to other SSLL fisheries that were considered as possible proxies for the SSLL EFP, there are a number of problems with using the Atlantic bycatch data and applying it to the Pacific. One of the key problems is the differences in scale in terms of leatherback populations and fishing effort. Satellite tracking work done by James et al (2005) indicates that leatherbacks moving into the NEC and MAB foraging areas are from western Atlantic nesting beaches. The most recent population estimate for adult females from the western Atlantic nesting beaches is 10,000 to 31,000 (TEWG 2007). Satellite tracking indicates that western Atlantic nesting females migrate north into the waters of the NEC and MAB and waters off Nova Scotia, Canada, to forage (James 2005), thus a high abundance and density of leatherbacks is likely to be present in the waters where SSLL fishing is occurring in the Atlantic. Also, effort in known leatherback foraging areas is high; in 2005, the logbook reported level of effort in the third and fourth quarters in the MAB and NEC was 945,700 hooks, in 2006 the effort was 1,158,100 hooks. By comparison, the most recent population estimate of the entire Western Pacific leatherback adult females is 2,700 to 4,500 (Dutton *et al.* 2007). Of these adult females, satellite tracks suggest that females from a specific region, Jamursba-Medi, Papua, Indonesia, travel across the Pacific and forage in the West Coast EEZ (Benson *et al.* 2007b) although not all tagged females have been tracked moving towards the U.S. West Coast. The precise number of leatherbacks in the Jamursba-Medi nesting aggregation is not known, but it is estimated to be between 933 and 1801 (based upon 373 to 720 female nesters annually) thus the number of leatherbacks likely to be exposed to SSLL fishing under the proposed EFP is a sub-set of the entire Western Pacific population. Based upon the available data, the abundance and density of leatherbacks in the proposed action area is likely much lower than the abundance and density of leatherbacks exposed to the Atlantic SSLL, so the level of interactions are likely lower. Also, the much lower total number of hooks anticipated to be set in the SSLL EFP, 67,200 over four months, is much lower than the approximately one million hooks set in the Atlantic SSLL in just two regions in six months. It is reasonable to assume that the relative population of stock of animals will affect the CPUE. For example, in the DGN fishery, CPUEs are highest for species known to have the highest overall abundance, e.g., short-beaked common dolphins and CA sea lions, whereas CPUEs of lower population stocks, e.g., long-beaked common dolphins, are much lower. The population of Atlantic leatherbacks is at least an order a magnitude higher than the Pacific leatherbacks, so applying CPUEs from the Atlantic may over-estimate the expected captures.

Finally, observer data from the SSLL fishery outside the West Coast EEZ was examined, along with estimated CPUEs developed by the SWFSC for the Council in 2003. In order to best approximate the areas likely to be fished under the SSLL EFP, data from east of 130° W longitude was reviewed. This area is closest to the West Coast EEZ and included sets made by California- (2001–03) and Hawaii- (1997–2001) based vessels. Utilizing the CPUE developed for the SSLL fisheries, as it operated in this area at that time, and applying it to the maximum number of hooks in the SSLL EFP yields an expected capture of four leatherbacks. However, the SWFSC's report also calculated expected captures if gear and bait modifications similar to those tested in the NED experiments were applied to the SSLL fishery CPUEs. Assuming an approximately 65 percent decline in leatherbacks takes (Watson et al. 2005), yields an estimated take in the SSLL EFP of three turtles (with a range of two to four). If most fishing effort in the SSLL EFP occurs between 33° and 38° N latitude and offshore, than this estimate may be the most reasonable approximation of what may occur during fishing operation authorized by the SSLL EFP. However, there is insufficient refinement on the proposed area that will be fished to determine how closely it will follow the historical SSLL effort off the West Coast EEZ. Reviewing these records and using them to calculate a range of anticipated takes in the SSLL EFP does again suggest that the levels of take are likely to be quite low, if we assume that records from a nearby area can be reliably used to project takes.

Based upon a review of relevant other SSLL fisheries and the known distributions and abundance of leatherbacks exposed to these fisheries, we took a precautionary approach in estimating the anticipated level of leatherback takes. It is reasonable to assume that rates of take in the SSLL EFP will be higher than rates of take in the Hawaii-based SSLL since leatherbacks distribution and fishing effort do not appear to overlap in the Hawaii-based fishery to the extent of overlap in the proposed action. Using the take rates calculated for some parts of the Atlantic SSLL fishery, where leatherbacks are knows to forage, may more closely approximate the proposed action area, but may over-estimate take rates based upon the relative abundance and densities of leatherbacks in the two areas. Finally, the anticipated leatherback takes calculated using the historic SSLL just off the West Coast EEZ may slightly underestimate the anticipated takes within the proposed action area, as leatherbacks may be more densely aggregated in the EEZ than outside, as they migrate through the area or possibly feed. Due to the uncertainties in estimating anticipated takes in a fishery without historic observer records and in an area known as a foraging area for some individuals from the Western Pacific leatherback population, we took a very precautionary approach in our estimation of takes. We estimate that up to five leatherbacks may be taken in the SSLL EFP. This is slightly higher than the high range of takes estimated using the observed leatherback CPUE of the SSLL east of 130° W longitude (range of two to four) and consistent with the rate estimated using the Atlantic SSLL data for 2006 (which is a more complete data set than the 2005 data). This number may over-estimate the actual amount of leatherback take, but is a good conservative estimate based on the available information. As described previously, take rates of sea turtles in fisheries are highly variable among years, seasons, and areas, thus any projection of takes based upon observer data from the past is difficult to make with accuracy. In light of this, a conservative approach was taken in the development of the anticipated take in the SSLL EFP in which there is no observer data and there has been no historic fishery.

Any estimate of leatherback takes must be considered with caution, particularly given the high inter-annual variability of take. The reasons for the variability and possible correlations between turtle distribution and oceanographic conditions are a topic of on-going studies by NMFS. A recently published paper described the positive relationship between years with positive

Northern Oscillation Index (NOI) and higher abundance within the neritic zone off California, north of Point Conception (Benson *et al.* 2007a). A similar pattern could not be found between NOI conditions and leatherback takes in the DGN fishery, but work in this area will continue.

In the last six years, researchers have documented movements of leatherback turtles between nesting beaches in the Western Pacific and the U.S. West Coast. Observations of tracked leatherbacks captured and tagged off the West Coast have revealed an important migratory corridor from central California, to the south of the Hawaiian Islands, leading to Western Pacific nesting beaches. Researchers have also begun to track female leatherbacks tagged on Western Pacific nesting beaches, both from Jamursba-Medi and Wermon, Papua, Indonesia, and from the Morobe coast of Papua New Guinea. Most of the females that have been tagged in Jamursba-Medi, Papua, where nesting has been observed year round, with peak activity between May and September (Hitipeuw *et al.* 2007), have been tracked heading on an easterly pathway, towards the West Coast or heading north toward foraging areas off the Philippines and Japan. In addition, one female that was captured in central California in 2005 still had a tracking device that had been attached to her on Jamursba-Medi, confirming this trans-Pacific migration (P. Dutton, NMFS, personal communication, 2005). Research and tagging of leatherbacks is part of ongoing work by the SWFSC.

From the available data we anticipate that any leatherbacks exposed to the proposed action likely originate from western Pacific beaches, and primarily from Jamursba-Medi, Papua, Indonesia. It is important to note that not all leatherbacks found off the U.S. West Coast come from all leatherback nesting subpopulations in the western Pacific. Nesting female leatherbacks in the western Pacific exhibit varying seasonal, migratory, and behavioral differences, depending on the rookery at which they nest. Based upon satellite tagging studies conducted to date, most (if not all) of the female leatherbacks found off central California probably originate from the Jamursba-Medi nesting beaches. The Jamursba-Medi nesting site is one of the largest in the western Pacific. It is estimated that between 1,000 and 2,000 females make up the Jamursba-Medi nesting population. However, in 2004, year round monitoring at Wermon beach showed that leatherbacks nesting activity year round with peak activity between October and March (Hitipeuw *et al.* 2007). At this point, there are no satellite tracks to determine if these austral winter nesters may travel across the Pacific and forage off the US West Coast. The first satellite transmitters were put on post-nesting females at Wermon in August 2006 (Benson 2006) which will help to determine if these animals follow the same foraging migration as the austral winter nesters at Jamursba-Medi. It is also not known to what extent male leatherbacks utilize the proposed action area. The migratory routes of males are not as well known as those of females (Benson 2006) and the sex ratio of this population is also not unknown. Staff from the SWFSC have been sampling leatherbacks off the central California coast for over five years and annually the sex ratio of animals captured varies. Pooling all samples, n=40, the sex ratio is 2:1, females to males. Dutton *et al.* 2007 also report that, based on genetic analyses from limited samples from Malaysia and other nesting females throughout the western Pacific, that the haplotype frequencies for Terengganu, Malaysia are significantly different from the four western rookeries. This indicates that the Malaysian population is distinct from the western Pacific populations of Papua, PNG, Solomon Islands, and Vanuatu. None of the leatherbacks sampled off the central California coast had the Malaysian haplotype. We therefore assume that leatherbacks exposed to the proposed action will be from the western Pacific population and are likely to be from the

Jamursba-Medi nesting population.

B. Response

Potential impacts from the proposed action on leatherbacks will generally be related to injury or mortality, although any entanglement or hooking, whether or not it develops into an injury or mortality, may also impact sea turtles due to the forced submergence, and/or impairment or wounds suffered as a result of entanglement. Observer records from Hawaii and the Atlantic of SSLL using similar gear and configuration recorded 0% and 1% immediate mortality, respectively (Gilman et al 2006; Fairfield-Walsh and Garrison 2007). Therefore any mortalities in this fishery are likely to occur after the animal is released; whether a sea turtle dies will depend on the nature of the injury and/or whether gear remains on the animal and the amount of gear on the animal.

Leatherbacks, like all sea turtles, are prone to entanglement as a result of their body configuration and behavior (Balazs 1985). Records of stranded or entangled sea turtles reveal that fishing debris can wrap around the neck or flipper, or body of a sea turtle and severely restrict swimming or feeding. Over time, if the sea turtle is entangled when young, the fishing line will become tighter and more constricting as the sea turtle grows, cutting off blood flow and/or causing deep gashes. Sea turtles have also been found trailing gear that has been snagged on the bottom, thus causing them to be anchored in place (Balazs 1985). It is difficult to estimate whether leatherbacks entangled or hooked and released from SSLL gear would be caught again. Presumably, however, a leatherback recovering from a forced submergence would most likely remain resting on the surface, which would reduce the likelihood of being entangled or hooked again on SSLL gear. Recapture would also depend on the condition of the turtle and the intensity of fishing pressure in the area. There will be only one fisherman engaged in SSLL, so the likelihood of recapture in this type of gear is likely to be low although other fisheries may occur in the area.

Once entangled or hooked, factors such as size, activity, water temperature, and biological and behavioral differences between species bear directly on metabolic rates and aerobic dive limits and will therefore also influence survivability. For example, larger sea turtles are capable of longer voluntary dives than small turtles, so juveniles may be more vulnerable to the stress of forced submergence than adults.

1. *Hooking (Longline Gear)*
Sea turtles are either hooked externally - generally in the flippers, head, beak, or mouth - or internally, where the animal has attempted to forage on the bait, and the hook is ingested into the gastro-intestinal tract, often a major site of hooking (E. Jacobson, in Balazs, et al., 1995). Even if the hook is removed, which is often possible with a lightly hooked (i.e. hooked in the beak) turtle, the hooking interaction is believed to be a significant event. Like most vertebrates, the digestive tract of the sea turtle begins in the mouth, through the esophagus, and then dilates into the stomach. The esophagus is lined by strong conical papillae, which are directed caudally towards the stomach (White, 1994). The existence of these papillae, coupled with the fact that the esophagus snakes into an s-shaped bend further towards the tail make it difficult to see hooks, especially when deeply ingested. Not surprisingly, and for those same reasons, a deeply

ingested hook is also very difficult to remove from a turtle's mouth without significant injury to the animal. The esophagus is attached fairly firmly to underlying tissue; therefore, when a hook is ingested, the process of movement, either by the turtle's attempt to get free of the hook or by being hauled in by the vessel, can traumatize the internal organs of the turtle, either by piercing the esophagus, stomach, or other organs, or by pulling the organs from their connective tissue. Once the hook is set and pierces an organ, infection may ensue, which may result in the death of the animal. If a hook does not become lodged or pierce an organ, it can pass through to the colon, or even be expelled through the turtle (E. Jacobson in Balazs, et al., 1995). In such cases, sea turtles are able to pass hooks through the digestive track with little damage (Work, 2000). Of 38 loggerheads deeply hooked by the Spanish Mediterranean longline fleet and subsequently held in captivity, six loggerheads expelled hooks after 53 to 285 days (average 118 days; Aguilar, et al. 1995). If a hook passes through a turtle's digestive tract without getting lodged, the chances are good that less damage has been done. Tissue necrosis that may have developed around the hook may also get passed along through the turtle as a foreign body (E. Jacobson, in Balazs, *et al.*, 1995). Since implementation of the requirement to use of 18/0 circle hooks in fisheries in the Atlantic and Pacific, no leatherbacks have been observed deeply hooked.

In SSLL fisheries, most leatherbacks are lightly hooked, usually externally in the shell, flipper, or shoulder. In the Atlantic, about two-thirds of observed interactions are lightly hooked leatherbacks, with the other third being entangled only (no hooking) (Fairfield-Walsh and Garrison 2006). Hooking can occur as a result of a variety of scenarios, some of which will depend on foraging strategies and diving and swimming behavior of the various species of sea turtles. For example, necropsied olive ridleys have been found with bait in their stomachs after being hooked; therefore, they most likely were attracted to the bait and attacked the hook. In addition, leatherbacks, loggerheads and olive ridleys have all been found foraging on pyrosomas which are illuminated at night. If lightsticks are used on a shallow set at night to attract the target species, the turtles could mistake the lightsticks for their preferred prey and get hooked externally or internally by a nearby hook. Similarly, a turtle could concurrently be foraging in or migrating through an area where the longline is set and could be hooked at any time during the setting, hauling, or soaking process. Based upon data from the Atlantic pelagic longline fishery, it is considered likely that the majority (two thirds) of leatherbacks that interact with SSLL gear in the U.S. EEZ will be lightly hooked and the remaining one third will be entangled only, not hooked.

2. *Trailing Gear*

Trailing line is line that is left on a turtle after it has been captured and released, particularly line trailing from an ingested hook. Turtles are likely to swallow line trailing from an ingested hook, which may occlude their gastrointestinal tract, preventing or hampering the turtle when it feeds. As a result, trailing line can eventually kill a turtle shortly after the turtle is released or it may take a while for the turtle to die. Trailing line can also become snagged on a floating or fixed object, further entangling sea turtles or the drag from the float can cause the line to constrict around a turtle's appendages until the line cuts through the appendage. With the loss of a flipper a turtle's mobility is reduced, as is its ability to feed, evade predators, and reproduce. Observers on the vessel operating under the EFP will be directed to release any turtles captured (hooked) by cutting the line as close to the hook as possible in order to minimize the amount of trailing gear. This is difficult with larger turtles, such as the leatherback, which often cannot practicably be brought on board the vessel, or in inclement weather, when such action might place the observer or the vessel and its crew at risk.

Based upon the amount of trailing gear observed on vessels in the Atlantic, it is likely that leatherbacks that interact with this fishing gear will have most if not all trailing gear removed. As part of the terms and conditions of this proposed action, the applicant must carry, and use, equipment to remove gear from turtles and must attend a PRD workshop to learn how to properly use the equipment. These measures should increase the likelihood that all gear will be removed.

3. *Post-hooking Survival*

Research has been conducted in both the Atlantic and the Pacific to estimate post-hooking survival and behavior of sea turtles captured by longline gear. NMFS has hosted two workshops to analyze the post-hooking survival rates of hard-shelled and leatherback sea turtles (Long and Schroeder 2004; Ryder 2006). The most recent post-hooking mortality rates, based upon the nature of the interaction with longline gear, can be found in Table 13.

In addition, two recent papers have examined post-hooking mortality of turtles by utilizing pop-off satellite archival tags and these studies suggest a low level of post-hooking mortalities (Sasso and Epperly 2007; Swimmer *et al.* 2006)

4. *Forcible Submergence*

Sea turtles can be forcibly submerged by longline gear. Forcible submergence may occur through a hooking or entanglement event, where the turtle is unable to reach the surface to breathe. This can occur at any time during the set, including the setting and hauling of the gear, and generally occurs when the sea turtle encounters a net or line that is too deep below the surface, or is too heavy to be brought up to the surface by a swimming sea turtle. For example, a sea turtle that is hooked on a 3 meter branchline attached to a mainline set at depth by a 6 meter floatline will generally not be able to swim to the surface unless it has the strength to drag the mainline approximately 3 more meters (discussed further below). When interacting with longline gear, hooked sea turtles will sometimes drag the clip, attached to the branch line, along the main line. If this happens, the potential exists for a turtle to become entangled in an adjacent branch line which may have another species hooked such as a shark, swordfish, or tuna. According to observer reports, most of the sharks and some of the larger tuna such as bigeye are still alive when they are retrieved aboard the vessel, whereas most of the swordfish are dead. If a turtle were to drag the branch line up against a branch line with a live shark or bigeye tuna attached, the likelihood of the turtle becoming entangled in the branch line is greater. If the turtle becomes entangled in the gear, then the turtle may be prevented from reaching the surface. The potential also exists, that if a turtle drags the dropper line next to a float line, the turtle may wrap itself around the float line and become entangled. Due to the lightness of the gear and length of the branch lines to be used in the proposed action and the size and power of leatherbacks, it is probable that turtles will not be forcibly submerged and will be able to get to the surface to breath.

5. *Survival of Sea Turtles that Interact With Longline Gear*

In 2003, NMFS' Office of Protected Resources was charged with conducting a review of NMFS' February 2001 post-hooking mortality criteria and recommending if and how the earlier criteria should be modified. As part of that review, the Office of Protected Resources convened a Workshop on Marine Turtle Longline Post-Interaction Mortality on 15-16 January 2004, during which seventeen experts in the areas of biology, anatomy/physiology, veterinary medicine, satellite telemetry and longline gear deployment presented and discussed the more recent data available on the survival and mortality of sea turtles subsequent to being hooked by fishing gear. Proceedings from that workshop and revised criteria for assessment of post-hooking mortality were published in 2006 (Ryder *et al.* 2006). The revised criteria are provided in Table 13.

Table 13. Post-hooking mortality rates of hardshell and leatherback sea turtles in longline gear.

Nature of interaction	Released with hook and line ≥ half the length of the carapace	Release with hook and line < half the length of the carapace	Release with all gear removed
Hooked externally with or without entanglement	20 (30)*	10 (15)	5 (10)
Hooked in lower jaw with or without entanglement	30 (40)	20 (30)	10 (15)
Hooked in cervical esophagus, glottis, jaw joint, soft palate, or adnexa with or without entanglement	45 (55)	35 (45)	25 (35)
Hooked in esophagus at or below level of the heart with or without entanglement	60 (70)	50 (60)	n/a
Entanglement only	50 (60)	50 (60)	1 (2)
Comatose/resuscitated	n/a	n/a	60 (70)

*Hardshell (leatherback rates are in parenthesis)

In order to estimate likely mortality associated with the incidental take of five leatherbacks, observer records from other SSLL fisheries were again reviewed. In the Hawaii-based and Atlantic fisheries, there were 0 percent and less than 1 percent immediate mortality rates, respectively. Based upon these rates, it is very unlikely that any leatherbacks taken in the SSLL EFP will be killed immediately. However, post-hooking mortality is a concern and the NMFS post-hooking mortality matrix (Ryder *et al.* 2006) was used in this assessment. Observer records from the Hawaii-based based SSLL after regulations indicate that all leatherbacks (n=10), were alive and lightly hooked when retrieved from the gear. All species of sea turtles taken in the Hawaii-based SSLL fishery following the 2004 regulations were alive when brought to the vessel (i.e., no immediate mortalities from drowning on SSLL gear) (Gilman *et a*l. 2006c). Leatherbacks lightly hooked with all gear removed have a post-hooking mortality rate ranging from 10 to 15 percent; if the hook is not removed and gear is left on the leatherback, post-hooking mortality rates range from 15 to 40 percent (Ryder *et al.* 2006). As shown in Table 14, in the Hawaii-based based SSLL fishery, 30 percent of leatherbacks were released without any gear attached, and 70 percent were released with gear attached (Gilman *et al.* 2006c). There is insufficient detail in the records from the Hawaii-based SSLL to link the observed takes to the post-hooking mortality matrix. Therefore, the larger data set of the NED experiments on modified gear (Watson *et al.* 2005), was considered for estimating mortality rates.

Table 14. Post-hooking condition of leatherbacks caught in Hawaii SSLL, 2004-2006, n=10

	Lightly hooked	Post hooking mortality
All gear removed	30%	10 - 15%
Released with gear attached	70%	15 – 40%

There is insufficient detail in the records from the Hawaii-based SSLL to link the observed takes to the post-hooking mortality matrix. Therefore, the larger data set of the NED experiments on modified gear (Watson et al 2005), was considered for estimating mortality rates. In the NED experiment, with high levels of observer coverage, most leatherbacks had most, if not all gear removed and most were externally hooked (i.e., hooked in the shoulder, flipper, or shell), which reduces the likelihood of post-hooking mortalities, compared to swallowed hooks (Fairfield-Walsh and Garrison 2007; Watson *et al.* 2005). Proper and complete, or near complete, removal of SSLL gear was tied to the training received by the participants and the willingness to use the gear and release tools (NMFS 2004). Approximately one third of the leatherbacks incidentally taken in the Atlantic SSLL fishery were entangled, while none of the leatherbacks observed in the Hawaii-based SSLL fishery were recorded as entangled. This may simply be related to the differences in sample sizes; in the Hawaii-based SSLL the number of observed takes over three years is 10, in the Atlantic the number of takes was 103 (NMFS 2004). If we assume that the larger sample size better reflects the nature of the interactions between leatherbacks and SSLL gear and that post-hooking removal of gear will be comparable to the trained vessel crew in the NED experiments, then the calculated leatherback post-hooking mortality rate developed for the Atlantic HMS is appropriate to use, that is 13.1 percent (NMFS 2004). The low rate of post-hooking mortality is likely due in part to the nature of the hookings (externally hooked) and removal of trailing gear. This low rate of post-hooking mortality is consistent with studies of turtles released from longlines and equipped with pop-up satellite archival tags (Sasso and Epperly 2007, Swimmer *et al.* 2006). Results from these experiments suggest a post-hooking mortality as low as approximately 9%. NMFS reasonably assumes that a similar situation will occur in the SSLL EFP since attending a PRD workshop is a term and condition of the proposed action; therefore, anticipated post-hooking mortality associated with the five takes is one leatherback. Based upon very low observed immediate mortality rates in the Hawaii based and Atlantic SSLL fisheries, 0 and less than 1%, respectively, no immediate mortalities are anticipated.

Table 15. Estimated post-hooking mortalities in the NED experiments based upon condition of incidentally taken leatherbacks (n=103) (from NMFS 2004)

Externally hooked			Hooked in lower jaw			Hooked in upper mouth or throat			Hooked deep in esophagus	
Hook,line ≥ .5 CL	Hook, line < .5 CL	All gear removed	Hook,line ≥ .5 CL	Hook, line < .5 CL	All gear removed	Hook,line ≥ .5 CL	Hook, line < .5 CL	All gear removed	Hook ,line ≥ .5 CL	Hook, line <.5 CL
7	20	32	0	0	1	0	1	8	0	0
2.1	3	3.2	0	0	0.15	0	0.45	2.8	0	0

Entangled only		Comatose and resuscitated		Dead	*Total*
Released entangled	Disentangled	Hook, line < .5 CL	All gear removed		
2	32	0	0	0	*103*
1.2	0.64	0	0	0	*13.1%*

Table provides the total number of injuries/interactions observed and percentage of total observed interactions.

C. Risk to individuals and populations

To analyze the impacts of five captures of leatherbacks (total post-hooking mortality of one) on the Pacific population, we began by identifying the population from which the leatherbacks are most likely to have come. As described in section IV, leatherbacks utilizing the U.S. West Coast as a foraging area are likely to have originated from the western Pacific population. Although we can not completely eliminate the possibility that an eastern Pacific leatherback may be exposed to the proposed action, the weight of evidence suggests that western Pacific leatherbacks are much more likely to be captured and possibly killed by the proposed action and the probability of an eastern Pacific leatherback being captured is very low. Based upon satellite tagging of post-nesting females and turtles tagged in central California, and the timing of the arrival of leatherbacks into the U.S. west coast, post-nesting (Benson *et al.* 2007b) it appears likely that leatherbacks taken in the proposed action come from the Jamursba-Medi nesting aggregation.

Based upon the carapace lengths of leatherbacks entangled in DGN gear fished in the proposed action area and leatherback field studies being conducted in central California by the SWFSC, adult and sub-adult leatherbacks are the age-class most likely to be affected by the proosed action. The available data do not allow us to determine with certainty the sex ratio of leatherbacks likely to be exposed to the SSLL gear. Studies on leatherbacks in the central California area since 2000 have shown annual variations in the sex ratio of animals caught, although when pooling all leatherbacks captured by the SWFSC, the sex ratio is 2:1 females to males (27 and 13, females and males, respectively). Given this, it appears that of five leatherbacks taken, three would be females, however, given the limited data available to identify sex ratios, we considered that the all leatherbacks captured could be all males, all females, or 3:2 females to males or males to females. Based upon a total anticipated mortality rate of 13.1% and that both male and female turtles could be captured, we considered the impacts to the Western Pacific population from the loss of one male or one female.

As described previously in the *Status of Species* section, there are fundamental life history parameters that are unknown for the western Pacific leatherback population, therefore developing quantitative models for this population is difficult. Also, existing quantitative models used in previous biological opinions considered only the effects on the female nesting populations and may not be sensitive enough to detect changes in population extinction probabilities when very small numbers of individuals are removed from the population. Model results could be interpreted to suggest that either small losses do not affect population viability or are indicative that the power of the model may be insufficient to detect population level effects from small losses even if such effect would occur. Thus, one line of evidence would indicate that the loss of one female leatherback would not impact the viability of the western Pacific population. Due to the lack of basic life history data on male turtles, existing models can not be used to evaluate the impacts of the removal of males from the population. Given the uncertainty in relying on strictly quantitative methods and the limitations of these methods in terms of impacts on males, we therefore base our risk analysis upon what is known about the strengths and vulnerabilities in the dynamics of the population most likely to be affected and consider case studies of other relevant sea turtle populations.

Population Dynamics

In general, very little is known about the population dynamics of Pacific leatherbacks, such as the number of individuals at various age stages, whether the sex ratio is skewed, and fecundity of individuals and the population. In order to answer some of these basic questions, many years of research and an extensive tagging program will be necessary. Some basic life history information is available that suggests that the Jamursba-Medi nesting aggregation and entire western Pacific population appear to have qualities that may make this population resilient to the one time loss of up to one individual or other impacts. As described in the *Status of the Species* section, western Pacific leatherbacks exhibit variations in migration patterns, timing of nesting activity, nesting areas, and foraging areas. These types of life history patterns may better reflect a population's likelihood of survival, than just numbers of individuals. While populations are generally monitored by the number of individuals in the population, methods that consider the overall fitness of the population are also useful. Measures of a population's health, beyond counts of individuals, include the geographical distribution of individuals in the population, the genetic diversity, the growth rate of the population, the diversity in reproductive strategies, and differences in foraging strategies. Western Pacific leatherbacks appear to utilize a variety of beaches throughout Southeast Asia and have been observed nesting in a number of countries including Malaysia, Indonesia, Papua New Guinea, the Solomon Islands, Vanuatu, Viet Nam, Thailand, Fiji, and Australia. Major nesting sites are known, although leatherbacks will utilize a number of beaches and have been observed nesting on different beaches within a single season; thus, perhaps, limiting the vulnerability of eggs placed at only one location. Leatherbacks are not limited to one season of nesting, with nesting activity having been observed in both winter and summer months at some beaches. These factors, which offer a greater resilience to one time threats, also make it difficult to estimate the population or trends, as females may move from beach to beach. Based upon limited satellite tagging that has been done at nesting beaches, post-nesting leatherbacks exhibit differences in foraging patterns (Benson *et al.* 2007b). Leatherbacks in the Caribbean exhibit a similar post-nesting strategy of utilizing a variety of foraging areas.

This strategy may buffer this subpopulation against environmental perturbations or anthropogenic threats. In contrast, the eastern Pacific leatherbacks generally utilize the same foraging areas at the same time, exposing this subpopulation to the same threats (Dutton 2006). Leatherbacks in the Caribbean have responded well to conservation measures at beaches and it has been suggested that the at-sea diversity of foraging areas may have contributed to this success, so it seems reasonable that this trait in western Pacific leatherbacks may contribute to the success of programs to increase the population through beach conservation measures.

Recent genetic work indicates a shared haplotype among most western Pacific leatherbacks. The Malaysian population is the only one that does not share the haplotype. This may suggest that most western Pacific leatherbacks mate with one another, thus limiting the threat of small populations and restricted gene pools, although the genetic diversity may be limited. Conversely, it has been speculated that one of the reasons for the lack of recovery of Malaysian leatherbacks is the lack of males within the small population, thus eggs over the past several years have not have been fertilized.

While nesting counts at the Jamursba-Medi nesting beach have been relatively stable (that is, numbers have not plummeted over the past few decades, as has been observed in the eastern Pacific), it is currently not possible to determine if new breeders are moving into the population or if the same females are returning to nesting areas. Obtaining this type of information will require extensive tagging of adult females and monitoring throughout the nesting areas. As noted above, it is also very difficult to detect trends in the western Pacific leatherback population based solely on nesters, since females do not exhibit high levels of site fidelity (e.g., females that do not return to a beach to nest may have simply nested at another beach) and re-migration intervals are not known for this population (for the western Pacific or for the Jamursba-Medi population). However, if it is assumed that each leatherback lays five nests per season and the period between nesting is on average 2.5 years (consistent with leatherback populations in the Caribbean), then the total number of nesting females in the western Pacific population is estimated to be between 2,700 and 4,500 western Pacific nesting females and Jamursba-Medi (currently the largest nesting aggregation in the western Pacific population) is estimated to be between 933 and 1803 adult nesting females.

The western Pacific leatherback population faces a number of threats at nesting beaches and at sea. The major threats at the nesting beaches are predation of eggs and hatchling, beach erosion resulting in loss of usable habitat or nest inundation, and logging, which compromises the availability of the nesting beach habitat. A recently detected concern is the low level of hatching success at Jamursba-Medi and Wermon (25.5% and 47.1%, respectively, for nests that had not been disturbed due to predation). Many of these threats are being addressed through conservation measures. As detailed in Appendix A, NMFS is involved in many of these efforts. They include aerial surveys, satellite tagging, nesting beach management and protection and outreach to fishermen to reduce interactions with leatherbacks. As described in the *Status* section, there are a number of recent cooperative management agreements that have gone into effect over the past few years to protect western Pacific leatherbacks. At a recent meeting of turtle experts at the Bellagio Sea Turtle Conservation Initiative, one of the key recommendations was long-term funding for research and habitat protection at nesting beaches in the Western Pacific to help increase the hatchling success in this population. Although funding for this and other actions under the Bellagio Blueprint has not been secured, the plan highlights the need for these actions, which if taken, may significantly contribute to the recovery of western Pacific leatherbacks.

The major at-sea threat to this population continues to be incidental capture in fisheries. As described in the *Status of the Species* section, the development of numerous fisheries in the 1970s through the 1990s, is believed to be one of the major factors leading to the rapid decline of the once large Malaysian leatherback population. There is no indication from the international bodies regulating high seas fisheries that fishing effort will increase and indeed a number of resolutions and management actions suggest that high seas tuna fishing should remain stable or decline. However, coastal fisheries still remain an unknown impact.

There are reasons to believe that conservation efforts or changes in fisheries over the past 15 years will begin to be detected through increases in the number of nesters in the western Pacific population. For example, eggs harvest was common in Papua, Indonesia for many years but was effectively eliminated with the implementation of nightly beach patrols in 1993 (Hitipeuw *et al.* 2007). This work closely coincides with the 1992 ban on large scale drift gillnet in the high seas. While the level of leatherback bycatch in many fisheries is unknown, it has declined in U.S. fisheries such as the California and Hawaii longline over historical levels, and fishing techniques (e.g., circle hooks) are now required in the Hawaii based shallow set longline fishery. For example, in 2004, 2005, and 2006, leatherback captures in the Hawaii shallow-set longline fishery were 1, 8, and 1, respectively, with zero mortality.

These measures are in contrast with conditions in Malaysia, which once had over 10,000 nests laid annually on its beaches, (Chan and Liew 1996), but now have only around ten females returning to nest (P. Dutton, NMFS, personal communication, 2006). This population is now considered functionally extinct. The dramatic loss of this population was due to a variety of factors including near complete harvest of eggs in the 1950's and 1960's and incidental capture in commercial fisheries, particularly the Japanese squid fishery which is estimated to have taken over 500 leatherbacks in 1989 and 1990 (Chan and Liew 1996). In addition, poor hatchery practices produced exclusively females for years and all eggs collected for the past six years have been infertile. By comparison, no new fishing effort is expected in the high seas; egg poaching is illegal; there is no indication of a lack of males (e.g., no data to indicate a high level of infertile eggs). Finally conservation measures did not begin until the nesting population had reached low numbers, approximately 60, which may have limited the population's ability to respond to conservation measures. By contrast, there are likely still thousands of females nesting in the western Pacific.

Aggressive beach monitoring (and either limiting or eliminating egg harvest and poaching of adults) has led to increases in annual leatherbacks nest counts in the Caribbean (Dutton *et al.* 2004) and in Tongaland, KwaZulu-Natal, South Africa (Hughes, 1996). Nesting beach protection is credited with increasing green turtle nesters at Tortuguero (Bjorndal *et al.* 1999) and Hawaii (Balazs and Chaloupka 2004). Based upon these case studies and recent conservation activities in the western Pacific, NMFS expects that increases in the western Pacific population are likely to occur. It has been approximately 15 years since egg protection and fishery reduction measures began, so this expectation can be tested in the next few years as monitoring efforts improve and the turtles hatched in those early years begin to return as mature adults.

All populations experience some variation in their numbers due to environmental and demographic stochasticity, and populations are usually able to sustain themselves through these periods. When populations reach low numbers, their ability to recovery from these perturbations may be compromised. Roberts and Hawkins (1999) described various characteristics of marine species that tend to make them more or less vulnerable to extinction or extirpation. These include traits related to population turnover, reproduction, range and distribution. Leatherbacks have various traits that lend resilience or vulnerability to viability of their populations in the face of human or natural disturbance. For example, their long lives and large size at sexual maturity are indicative of a species that faces high extinction risks at low population abundances (Pimm *et al.* 1988). On the other hand, the species' range in the western Pacific for both foraging and nesting areas provides a buffer against local disturbances that could extirpate small endemic populations of a long-lived, large size species.

Because the leatherback (like most species) has characteristics that can work for or against its chances of survival, care must be taken when assessing the implications of human actions. Evidence provided by the case studies discussed above shows that when human intervention occurs at the right time and scale, turtle populations can rebound. However, in instances where intervention is too late or does not consider the underlying status of the population (*e.g.* little or no males left in the Malaysian population), population collapse may still occur. Based on what we know or expect for the western Pacific population of leatherbacks, we expect that ongoing conservation and impact minimization measures will result in an increase in adult female population numbers measured at the nesting beaches. However, given the potential future effects of climate change, which include possible reductions in hatching rates, skewed sex ratios of hatchlings, nesting beach temperature effects on the current and future production of male leatherbacks, and reduced available nesting habitat, we cannot say if the expected increase in numbers will equate to a temporary increase before population numbers decline again or an increase in the viability of the population.

The proposed action is projected to result in the death of one leatherback. As discussed earlier, because we cannot determine the sex of the affected turtle, this analysis considers the loss of either one male or one female leatherback. We expect, given the observed sex ratio in the waters off of California, that it is more likely the proposed action will incidentally capture and kill a female leatherback. If the killed leatherback is a male, it is not possible to assess the impact of losing one adult male leatherback in any quantitative manner, since the number of males in the total population is not known. Once hatched, males do not return to land for the rest of their lives, so there is no reliable means of assessing their population. The little that is known about male leatherbacks is based upon limited in-water surveys. It is known that males and females do not develop long-term pair bonds and that males may mate with a number of females, although the number of males needed to sustain a genetically healthy and diverse population is not known (Hamann *et al.* in Lutz *et al.* 2003). Also, changes in sex-ratios based upon temperature changes at beaches may cause the overall proportion of males within a population to decline (hatchling sex is determined by the temperature of eggs while in the nest (Chan and Liew 1996)), with more males being produced in cool nests and more females being produced in warm nests. Currently, nesting beach temperatures at Jamursba-Medi are within ranges expected to produce more females than males. Conversely, at Wermon, nesting beach temperatures are such that more males than females are likely to be produced. We do not know if the production at both beaches results in overall balanced production of males and females. Finally, we expect that the measures taken in various fisheries to reduce incidental capture and related injury and mortality of leatherbacks also improve the survival of the current population of adult and sub-adult males. Given the weight of the evidence on the current status of the species and the lower likelihood that the captured and killed leatherback will be a male, we do not find it reasonable to expect that the death of one male leatherback will have a detectable effect on the western Pacific population.

Based upon what is known of the reproductive behavior of leatherbacks, we expect that the females are of most value to the population and the loss of one adult female represents the worse case scenario of impacts from this proposed action. We considered the potential effects of the loss of one adult or sub-adult in one year, relying upon published reports, case studies, and our knowledge of population dynamics of the western Pacific population of leatherbacks. If we assume that the population is increasing or stable, it is reasonable to assume that the loss of up to one adult female in one year would be insufficient to detect a change in the reproductive output of the population from which she came. In other words, an increasing or stable population would likely not be affected by the loss of one adult female in one year. If the population is declining, the loss of one female would be more likely to have an effect. While it is clear that the number of leatherbacks in both the western and eastern Pacific population has declined in the past 30 years, the decline has continued steadily and dramatically in the eastern Pacific, but there is no evidence of a similar rate of decline in the western Pacific. The growth rate of western Pacific leatherback populations is not currently known. Researchers at the SWFSC are attempting to estimate a population level trend from the available data, but this is not likely to be available for years.

Therefore, we consider the impact to the female population in terms of the characteristics of the population that may make it more, or less, able to withstand the loss of one adult female in one year, and not have an effect on the viability of the population. Currently, the abundance of the western Pacific population is estimated to be several thousand breeding females, although there is uncertainty associated with the abundance counts based on the methods used for estimation. Western Pacific leatherback females utilize a variety of nesting beaches and nest throughout the year, providing some population resilience to localized impacts. Nest counts have not shown a significant decline in recent years and may be stable since the 1990's. As discussed above, the production of female hatchlings has increased as a result of nesting beach temperatures at some beaches, although more males are produced at other beaches. Sub-adult and adult females also forage in several areas of the Pacific Ocean, further buffering the sub-adult and adult life stages against localized impacts. In addition, we project that nesting beach adult counts may increase in the future as a result of protective measures taken at the nesting beaches and in ocean fisheries. Given these population and biological characteristics, we do not expect that the one time loss of an adult or sub-adult female leatherback would have a detectable effect on the western Pacific population.

As a result, NMFS does not expect that the impacts of the death of up to one adult male or female leatherback in the proposed SSLL EFP fishery, scheduled to last up to four months, are sufficient to reduce appreciably both the likelihood of survival and recovery of either the Jamursba-Medi nesting aggregation or Western Pacific population of leatherbacks. Because we expect no reductions in the likelihood of survival and recovery to the Western Pacific leatherback population, we therefore also expect no impacts to the leatherback sea turtle species as globally listed.

VII. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this opinion (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

On-going threats to endangered leatherbacks are described in the status of the species section and factors affecting species in the action area section are expected to continue. NMFS is unaware of any human-related actions or natural changes (including variation in SST) occurring within the action area over the next year that would substantially change the impacts of the proposed action on the marine mammals and leatherbacks covered in this opinion.

VIII. CONCLUSION

After reviewing the available scientific and commercial data, current status of leatherback turtles, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is NMFS' biological opinion that the shallow set longline fishing that would be conducted under issuance of an exempted fishing permit through the Highly Migratory Species Fishery Management Plan, is not likely to jeopardize the continued existence of endangered leatherback sea turtles. No other ESA-listed species under NMFS's jurisdiction are considered likely to be adversely affected by the proposed action.

IX. INCIDENTAL TAKE STATEMENT

Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. NMFS further defines "harm" as an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and 7(o)(2), taking that is incidental to and not the purpose of the proposed action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are nondiscretionary, and must be undertaken by NFMS for the exemptions in section 7(o)(2) to apply. NMFS has a continuing duty to regulate the activity covered by this incidental take statement. If NMFS (1) fails to assume and implement the terms and conditions the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, NMFS must monitor the progress of the action and its impact on the species as specified in the incidental take statement. (50 CFR §402.14(I)(3))

Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA and the proposed action may incidentally take individuals of listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. It also states that reasonable and prudent measures, and terms and conditions to implement the measures, be provided that are necessary to minimize such impacts. Only incidental take resulting from the agency action and any specified reasonable and prudent measures and terms and conditions identified in the incidental take statement are exempt from the taking prohibition of section 9(a), pursuant to section 7(o) of the ESA.

A. Amount or Extent of Take

Mortality and interaction rates of leatherbacks have been calculated using a number of other fisheries to approximate the likely effects of the proposed action, since no observer data is available as there has not been a SSLL fishery within the proposed action area. The latest information on the distribution and abundance of leatherbacks in the proposed action area was also reviewed and factored into the estimated takes and mortalities. A turtle cap of five leatherbacks or one mortality is part of the proposed action, therefore if five leatherbacks are observed taken or one observed killed due to interactions with the proposed action, the fishery will immediately cease for the year.

The numbers below are for the proposed time period of the SSLL EFP, September 1 through December 31.

Table 16. Anticipated incidental takes of leatherbacks in the proposed action

Species	Captured	Killed
Leatherback	5	1

This proposed action is for 2007 only. If the applicant applies for an exempted fishing permit again in 2008, a new consultation will be required.

B. Effect of the Take

In the accompanying biological opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to the leatherback sea turtle.

C. Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures, as implemented by the terms and conditions are necessary and appropriate to minimize impacts to ESA-listed species considered in this opinion. The measures described below are non-discretionary, and must be undertaken by NMFS for the exemption in section 7(o)(2) to apply. If NMFS fails to adhere to the terms and conditions of the incidental take statement, the protective coverage of section

7(o)(2) may lapse. Thus, the following reasonable and prudent measures must be implemented to allow activities under the SSLL EFP.

1. NMFS shall require that sea turtles captured alive be released from fishing gear in a manner that minimizes injury and the likelihood of further gear entanglement.

2. NMFS shall require that, if practicable, comatose or lethargic sea turtles be retained on board, handled, resuscitated, and released according to the procedures outlined at 50 CFR 223.206 (d)(1).

3. NMFS shall require that dead sea turtles be disposed of at sea unless an observer requests retention of the carcass for sea turtle research.

4. NMFS shall continue to collect data on capture, injury, and mortality of any ESA-listed species encountered during fishing operations authorized by the EFP in addition to life history information.

D. Terms and Conditions

In order to be exempt from the prohibitions of Section 9 of the ESA, NMFS must comply or ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above, and apply to the proposed action. These terms and conditions are non-discretionary.

1. The following terms and conditions implement reasonable and prudent measure No. 2.

    1A. Any incidentally taken ESA-listed animal shall be handled with due care to prevent injury to live animals, observed for activity, and returned to the water as soon as practicable.

    1B. Any ESA-listed animal shall be freed of all gear, ensuring the least harm possible to the animal.

    1C. The following release gear shall be required onboard the vessel while engaging in fishing under the EFP:
    1. Long-handled de-hooker for ingested hooks (hook removal device plus extended reach handle)
    2. Long-handled line-cutter
    3. Long-handled devise to pull an "inverted V"

    1D. ESA-listed species shall be released away from the gear and vessel in an area where they are unlikely to be recaptured and with the engine gears in neutral position.

    1E. Any ESA-listed species brought on board must not be dropped on to the deck.

1F. The vessel owner and operators of the vessel shall be required to attend training provided by the SWR Protected Resources Division on the safe handling and release of sea turtles and training on require release gear.

2. The following term and condition implements reasonable and prudent measure No. 3.

2A The vessel owner and the operators of the vessel must receive training on sea turtle resuscitation requirements, as outline at 50 CFR 223.206(d)(1).

2B Vessel operators shall bring comatose or lethargic leatherbacks on board, if practicable, and perform resuscitation techniques according to the procedures described at 50 CFR 223.206(d)(1).

3. The following term and condition implements reasonable and prudent measure No. 4.

3A Dead sea turtles may not be consumed, sold, landed, offloaded, transshipped or kept below deck. Dead sea turtles must be returned to the ocean after identification unless the observer requests the turtle remain onboard for further study.

4. The following terms and conditions implement reasonable and prudent measure No. 5.

4A. NMFS shall continue to collect data on any incidental take of marine mammals, sea turtles, and other protected species (in addition to those considered in this opinion) through its observer program. A report summarizing protected species bycatch data taken during EFP fishing shall be prepared and disseminated to the NMFS Southwest Region – Protected Resources Division following fishing authorized by the EFP.

4B. NMFS shall continue to collect life history information on sea turtles, such as species identification, measurements, condition, skin biopsy samples, and the presence or absence of tags, through its observer program. NMFS observers shall directly measure or visually estimate tail length on any leatherbacks caught during the fishing under the EFP.

XI. REINITIATION NOTICE

This concludes formal consultation on the action outlined above. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of the incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. If the incidental take causes the termination of the SSLL EFP fishery, then reinitiation of consultation will not be necessary, as the action will have ceased.

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Appendix A

Recently completed Sea Turtle Projects in the Western Pacific Region			
Project Name	**Region**	**Funding Agency**	**Purpose**
Education to Reduce Adverse Interactions Between Commercial Fishing Operations and Sea Turtles	Federated States of Micronesia (FSM)	PIR (S-K grant)	To improve the capabilities of observers in recognizing, handling, and reporting interactions between turtles and commercial tuna fisheries in FSM
Leatherback satellite tagging (March 2003: 10 ARGOS and 4 PAT satellite tags deployed)	Papua New Guinea (PNG)	PIR/SWFSC	To provide clues to additional nesting sites, and will be used as a basis to design aerial surveys.
Sea turtle in-water survey	Confederated States of Northern Mariana Islands (CNMI)	PIR	Population assessments, capacity building
Tagging & surveys	Guam	DAWR/PIR	Population assessments, capacity building
Tagging & surveys	America Samoa	DMWR/PIR	Population assessments, capacity building
Cultural survey	Republic of the Marshal Isl. (RMI)	MIRFA/GPA/PIR	Define parameters for potential research. ID past and ongoing research; literature search; feasibility and logistics study

Recently completed Sea Turtle Projects in the Western Pacific Region			
Project Name	**Region**	**Funding Agency**	**Purpose**
International Meetings 1) 2nd International Fishers Forum -IFF 2) 23rd Annual Sea Turtle Symposium 3) Japan Fisheries Agency 4) People & the Sea Conference 5) Bellagio, Italy 6) IATTC Bycatch (PIRO) Other A) www.seaturtle.org Server fund donation B) Marine Turtle Newsletter (MTN) – Publication support	Liaison & Networking: 1) Hawaii, U.S.A. 2) Malaysia 3) Japan 4) Amsterdam, Netherlands 5) Bellagio, Italy 6) Japan	WPFMC	1) IFF2: Forum for fishermen and scientists to exchange information and ideas on technologies and strategies to mitigate sea turtle and seabird interactions with longline fisheries. 2) 23rd Sea Turtle Symp.: Travel support to Kuala Lumpur for 30 Pacific Islanders and Asian participants. 3) Japan Fisheries Agency: Liaison & collaboration activities to develop sea turtle mitigation measures 4) People & the Sea: (Sept.2003) Increase awareness of Pacific Island sea turtle issues 5) Bellagio, Italy: (Nov. 2003) Conservation and sustainable management of sea turtles in the Pacific Ocean 6) IATTC Bycatch: (Jan 2004) Sea Turtle working group meeting in Kobe, Japan
Hawksbill Simulation Model	Pacific Oceanic Region	WPFMC	To develop an interactive simulation model of hawksbill turtle population dynamics for stocks exposed to various mortality risks in the Oceania region.
Tagging & surveys	Federated States of Micronesia (FSM)	MIRFA/GPA/ PIR	Yap tagging and monitoring program, re-initiate genetic stock identification.
Ostional Wildlife Refuge – workshops	Costa Rica	WPFMC	Fishermen Workshops to increase awareness to reduce sea turtle mortality
Transfer sea turtle conservation technology	PNG & MI	PIR/NFA	Efforts to take the FSM "success" on the road to transfer conservation technology and assist with observer training implementation

Ongoing WPFMC and PIR funded Sea Turtle Projects in Progress since 2004			
Project Name	**Region**	**Funding Agency**	**Purpose**
Leatherback Aerial Survey	PNG	PIR/SWFSC	Four year study to quantify leatherback nesting stocks of the W. Pac. Region. Year one (Jan –Feb 2004): logistics & feasibility
Leatherback satellite tagging	PNG	PIR/SWFSC	To fill information gaps regarding migratory movements.
Green & hawksbill turtle survey	Palau	PMRD/PSC/TNC/PIR	Population assessment, education & outreach
Education & Outreach	Guam	WPFMC	Education Poster
Regional Tagging Database	Western Pacific Region (SPREP)	WPFMC	Rehabilitate SPREP's tagging database in collaboration with five international colleagues
Policy Post-Doc	Pacific Ocean basin	SWFSC/PIR	A two-year post-doctoral position in the economics of sea turtle conservation.
Wermon Beach	Papua	WPFMC	Leatherback nesting beach management: Dec 2003 – Oct. 2004
Kei Islands	Western Papua	WPFMC	To study and reduce direct harvest pressure of leatherbacks in foraging grounds. Nov 2003 – Oct 2004
Kamiali Wildlife Area	Papua New Guinea	WPFMC	Leatherback nesting beach management: Nov 2003 – April 2004
Japan Loggerheads	Japan	WPFMC	Loggerhead nesting beach management to save doomed eggs at four sites: May – Sept 2004
Baja, Mexico Loggerheads	Baja, Mexico	WPFMC	Measure to reduce incidental capture of juvenile loggerheads in the halibut gillnet fishery: March – Sept 2004

Ongoing WPFMC and PIR funded Sea Turtle Projects in Progress since 2004			
Project Name	**Region**	**Funding Agency**	**Purpose**
TED Introduction - Observer Training and Capacity Building	PNG	PIR/NFA	Measure to implement TED's in the shrimp fishery in the Gulf of Papua, PNG
Mitigation of sea turtle bycatch	Ecuador	WPFMC	To introduce mitigation measures (circle hooks/mackerel bait) to artesinal longline fishers to reduce interaction rates.
International Meetings (Liaison & Networking)	1) Costa Rica 2) Bangkok 3) Second WPFMC Sea Turtle Workshop	WPFMC	1) 24th Annual Sea Turtle Symp – Feb. 22-29, 2004 2) 2nd IOSEA MoU meeting Conference support, Bangkok -March 16, 2004 3) WPFMC office – Hawksbill & Leatherbacks May 17-21, 2004
Capacity building, assessments	Guam, CNMI Am. Samoa,	PIR/PIFSC	Year 2 - Continue beach monitoring, tracking, education and outreach
Observer Training and Capacity Building	WWF-Bali, Indonesia	PIR	Application being processed by the NOAA GMD - expected start in fourth calendar quarter of 2004
Observer Training and Capacity Building	Solomon Is.	SWFSC	Evaluation of the longline regulatory impacts
Observer Training and Capacity Building	Marshall Islands	PIR	Field work under way as of August 2004

HIGHLY MIGRATORY SUBPANEL ADVISORY SUBPANEL REPORT ON EXEMPTED FISHIN PERMIT (EFP) FOR LONGLINE FISHING IN THE WEST COAST EXCLUSIVE ECONOMIC ZONE

The Highly Migratory Species Advisory Subpanel (HMSAS) welcomes the support of the World Wildlife Fund for the EFP under consideration. The HMSAS continues to support Pete Dupuy's EFP as they have for the last three years.

Minority Opinion

A minority of the HMSAS (Meghan Jeans, Ocean Conservancy and Bob Osborn, United Anglers of Southern California) oppose issuance of the longline EFP due to the potential impact on vulnerable non-target fish populations such as striped marlin, bluefin and albacore tuna and the risk it poses to protected and endangered species such as leatherback and loggerhead sea turtles. Moreover, the EFP is not reasonably designed to achieve its stated objective.

PFMC
4/11/08

HIGHLY MIGRATORY SPECIES MANAGEMENT TEAM REPORT ON EXEMPTED FISHING PERMIT (EFP) FOR LONGLINE FISHING IN THE WEST COAST EXCLUSIVE ECONOMIC ZONE (EEZ)

The Highly Migratory Species Management Team (HMSMT) reviewed the proposed EFP for longline fishing in the EEZ for consistency with Council Operating Procedure (COP) 20: Protocol for Consideration of Exempted Fishing Permits for Highly Migratory Species Fisheries. Based on its review summarized below, the HMSMT determines that the EFP is consistent with COP 20 and recommends it for Council consideration.

The COP requires the HMSMT to consider a series of questions in its recommendation of whether or not an EFP should move forward for Council consideration. HMSMT responses to these questions follow:

a. *Is the application complete?* Yes
b. *Is the EFP proposal consistent with the goals and objectives of the West Coast HMS FMP?* Yes. Specifically, the EFP explores the potential for a viable commercial fishery for swordfish within the area of the Council's jurisdiction which may minimize bycatch of non-targeted finfish and protected species. Although it is not specifically relevant to some of the goals, for example that of promoting outreach and education of the general public, it is consistent with many of the goals and objectives of the HMS Fisheries Management Plan (FMP).
c. *Does the EFP account for fishery mortalities, by species*? Yes. As required under the proposed EFP, the 100% observer coverage will provide complete catch and mortality data by species, including protected species.
d. *Can the harvest estimates of overfished species and/or protected species be accommodated?* Yes. As described in the Environmental Assessment for the 2007 EFP, the proposed action would not increase the regional catch of yellowfin or bigeye tuna to a level triggering a resource conservation concern nor a finding of significant impact. For protected resources, the finding in the November 28, 2007 Biological Opinion will not jeopardize the continued existence of leatherback sea turtles. No other Endangered Species Act (ESA)-listed species under National Marine Fisheries Service (NMFS) jurisdiction are likely to be affected by the proposed action.
e. *Does the EFP meet one or more of the Council's priorities listed in the COP?* Yes, the EFP specifically meets the following priorities:
    1. *Emphasize resource conservation and management with a focus on bycatch reduction (highest priority).* The EFP will provide information on the bycatch by shallow-set longline gear in the EEZ, and give a preliminary indication of whether the gear fished under EFP conditions may have a lower bycatch or interaction rate, especially of protected species, compared to other existing fisheries.
    2. *Involve data collection on fisheries stocks and/or habitat*. In addition to these data, the EFP will also collect data on the economic viability of a fishery using methods allowed via the EFP.
    3. *Encourage innovative gear modifications and fishing strategies to reduce bycatch*.
    4. *Encourage the development of new market opportunities.*

f. *Is the EFP proposal compatible with the Federal observer program effort?* Yes, NMFS has an existing program that can accommodate this proposal.
g. *What infrastructure is in place to monitor, process data, and administer the EFP?* NMFS is already set up to monitor, process and administer the EFP. NMFS will implement a daily observer call-in system to report any interactions with protected species and determine if take caps are met. If met, the EFP will be immediately terminated.
h. *How will achievement of the EFP objectives be measured?* The purpose of the EFP is to initially assess whether shallow-set longline gear using the latest gear modifications is a cost-effective alternative to potentially reducing bycatch in the California and Oregon swordfish fishery. Catch and revenue will be reported to assess its economic viability. Data on bycatch will be reported to determine if or how bycatch in the action area may differ from bycatch taken in longline fisheries elsewhere. A premature end to the EFP fishery can indicate that the objectives are not being met, e.g, if take caps for protected species are met before the allowable EFP fishing is completed, or if the applicant prematurely ceases fishing under the EFP due to low harvests of target species or other factors.
i. *Are the data ready to be applied? If so, should they be used, or rejected? If not, when will sufficient data be collected to determine whether the data can be applied?* There may be a need for additional data before a determination can be made regarding its applicability and use for management.
j. *What are the benefits to the fisheries management process to continue an EFP that began the previous year?* Not applicable to this EFP, which would be conducted for the first time, if approved.
k. *If integrating data into management is proposed, what is the appropriate process?* The proposed action is to conduct exploratory longline fishing for swordfish, and it is likely premature to integrate these data into management. The applicant must submit a preliminary and final report to the HMSMT and the Council consistent with Section E of the COP. The NMFS Southwest Region will assist the applicant with processing of the data.
l. *What is the funding source for at-sea monitoring?* NMFS
m. *Has there been coordination with appropriate state and federal enforcement, management and science staff?* Yes. During the past few years, a nearly identical EFP was previously considered through the relevant Council, state, and Federal processes and appropriate staff have been involved throughout this process.

PFMC
4/11/08

Agenda Item J.3.c
Supplemental Public Comment
April 2008

Subject: [Fwd: Pelagic longlining]
From: PFMC Comments <pfmc.comments@noaa.gov>
Date: Thu, 27 Mar 2008 11:55:23 -0700
To: Kit Dahl <Kit.Dahl@noaa.gov>

Subject: Pelagic longlining
From: paul birmele <pbirmele@hotmail.com>
Date: Thu, 27 Mar 2008 11:48:28 -0700
To: pfmc.comments@noaa.gov

Please don't allow the exempted fishing permit (EFP) for the commercial fisherman who wants to longline for swordfish and tuna. This would be detrimental to the state of california. I am also sending this to my congressman in the hopes that the political leaders in this state will make a stand for the environment and the people of this state, and won't give in to commercial pressures purely driven by greed and excess.

Thank you.

Pelagic longlining.eml	**Content-Type:**	message/rfc822
	Content-Encoding:	7bit

Subject: [Fwd: Comments concerning the upcoming commercial fishing proposals]
From: PFMC Comments <pfmc.comments@noaa.gov>
Date: Mon, 31 Mar 2008 08:14:22 -0700
To: Kit Dahl <Kit.Dahl@noaa.gov>, Chuck Tracy <Chuck.Tracy@noaa.gov>

Subject: Comments concerning the upcoming commercial fishing proposals
From: sedgar@toyotascionalameda.dealerspace.com
Date: Thu, 27 Mar 2008 13:32:32 -0700
To: pfmc.comments@noaa.gov

I cant belive this subject is being allowed to be taken to a table to be discussed.......we just shut down over 25% of the west coast for fishing conservation then you want to turn around and start to allow people to do the MOST DESTRUTIVE form of fishing on the planet besides gill nets...........keep the commercial fishing low and see what happens to the public fishing ....you need revenue ...watch when people start to take there kids fishing again....or accually have to go catch some sea food instead of paying for it from some giant steel traller.....Local ports and harbors will boom.....resedent lic #s will increase...people will spend more money at tackel shops and so on so forth...
You want opinions on Longlining.....HELL NO

Scott Edgar
510-522-6400
sedgar@toyotascionalameda.dealerspace.com

Comments concerning the upcoming commercial fishing proposals.eml	**Content-Type:**	message/rfc822
	Content-Encoding:	7bit

WWF

April 08, 2008

Dr. Donald McIsaac
Executive Director
Pacific Fishery Management Council
7700 NE Ambassador Place, Ste. 200
Portland, OR 97220-1384

Dear Dr McIsaac:

I am writing on behalf of World Wildlife Fund (WWF) to support Mr. Pete Dupuy's application for an Experimental Fishing Permit (EFP) to conduct a longline fishery in Council waters.

The current ban on longline fishing in California and PFMC waters is similar to the situation that existed in Hawaiian waters a number of years ago. Because of interactions with sea turtles and their declining populations, the swordfish longlining industry was closed in 2001. By working together, the industry, the Western Pacific Fisheries Management Council and NOAA, were able to adopt measures that enabled the longline fisheries to be reopened. These measures included set limits, mandatory observers, a cap on turtle interactions, the use of circle hooks, and selective use of bait species. Since these measures were adopted turtle interactions and mortality have been dramatically reduced. Leatherback mortalities have averaged less than one per year between 2004-2007, and the potential is there to reduce this to zero with the application of consistently improving techniques.

As outlined in his EFP application and in further discussions, Mr. Dupuy has assured WWF that he plans to operate under similar restrictions to those implemented in Hawaii, as well as undertaking trials of gear sets and gear modifications to further reduce possible bycatch of non-target species. Approval of this EFP would provide further means of testing gear improvements, with funding already being appropriated by NOAA Southwest Fisheries Center to support this EFP. This would be used to place observers on board, create an experimental design, and perform data analysis. This is a move towards bringing consistency among the Hawaiian and West Coast fleets in this fishery.

The Hawaiian example has shown that a longline fishery can be substantially improved with gear and management modifications, rather than simply being shut down. The initiative in Hawaii is an important component of a larger international effort to eliminate the threat of longline fishing to sea turtles. WWF believes that the U.S. fishery needs to lead by example. Improvements adopted and refined in the Hawaii fishery can be instrumental in transforming other fleets. Given the trajectory of Pacific leatherbacks and

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loggerheads, it is essential that we reduce bycatch not only in the U.S. fleet, but in all fishing fleets in the Pacific. International fishery management bodies have recognized this need and called on all fleets to improve fishing gear and techniques to reduce turtle bycatch. The problem is one of international dimension.

Thank you for the opportunity to comment on this application.

Yours sincerely

M. Osmond

Mike Osmond
Snr Program Officer
Fisheries Program
World Wildlife Fund