NATIONAL MARINE FISHERIES SERVICE (NMFS) REPORT

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

In his presentation, Dr. Sakagawa will reference Agenda Items D.1.b., Attachment 1. He will also update the Council on Science Center activities related to assessing the common thresher shark stock.

Council Task:

Discussion.

Reference Materials:

1. Agenda Item D.1.a: Southwest Region NMFS Report.
2. Agenda Item D.1.a, Attachment 2: Undated and March 6, 2009, letters from the Office of Ocean and Coastal Resource Management to the California Coastal Commission on California's Request to Review an Exempted Fishing Permit Application to NMFS for Exploratory Longline Fishing in the West Coast Exclusive Economic Zone.
3. Agenda Item D.1.b, Attachment 1: Draft Report on Swordfish and Leatherback Use of Temperate Habitat (SLUTH) Workshop.

Agenda Order:

a. Southwest Region Activity Report — Mark Helvey
b. Southwest Fishery Science Center Report — Gary Sakagawa
c. Reports and Comments of Management Entities and Advisory Bodies
d. Public Comment
e. Council Discussion

PFMC
03/20/09

Southwest Region NMFS Report
HMS

REGULATORY ACTIONS

HMS FMP Permit Fee Final Rule update – On December 19, 2008, NMFS published a proposed rule for collecting permit fees for vessel owners participating in commercial and charter recreational fishing for HMS in the U.S. West Coast EEZ. The comment period closed on January 20, 2009 and no public comments were received. NMFS is drafting the final rule to implement the regulation with an effective date slated for the summer of 2009. The HMS permits will be issued under the HMS FMP implementing regulations and will specify that an application for an HMS permit, as well as a renewal of an existing permit, will require a fee payable to NMFS. The exact fee amount will be listed on the application form and is expected to be approximately $30-$40 which is the estimated cost of processing and issuing the two-year permits.

Proposed Rule to Address IUU Fishing Activities - On January 14, 2009, NMFS published a proposed rule for implementing identification and certification procedures to address IUU fishing activities and bycatch of protected living marine resources (PLMRs) under authority of the High Seas Fishing Moratorium Protection Act. The proposed rule, requires NMFS to submit a biennial report to Congress that identifies foreign nations whose fishing vessels are engaged in IUU fishing or fishing activities or practices that result in bycatch of PLMRs. Once identified, NMFS would initiate a notification and consultation process with the nation and consider evidence of whether sufficient corrective action has been taken or whether a relevant international fishery management organization has implemented measures effectively ending the IUU fishing activity by vessels of that nation. Nations will either receive a positive or a negative certification. The absence of sufficient action by an identified nation to address IUU fishing and/or PLMR bycatch may lead to the denial of U.S. port privileges for vessels of that nation, imposition of prohibitions on the importation of certain fish or fish products into the United States from that nation, or other measures deemed necessary and permissible under U.S. Federal law.

Written comments on the proposed rule are due to NMFS no later than May 14, 2009. Two public hearings on the proposed rule will be held on the West Coast: Monday, April 13, 2009, 4-6pm, NMFS Southwest Fisheries Science Center; Tuesday, April 14, 2009, 4-6pm, NMFS Northwest Fisheries Science Center.

FISHERY ACTIONS

HMS Recreational Shark and Albacore MRIP Proposals - The Council's HMS Management Team, working in collaboration with the HMS Working Group of the Marine Recreational Information Program (MRIP; the former MRFSS program), has submitted two proposals requesting funding support for HMS survey design, validation, and data collection needs. Proposal one requests funding to develop a Phase 1 sampling design for the collection of recreational fisheries data needed to produce an albacore CPUE index of abundance, an index identified by stock assessment scientists as a high priority need for improving the stock assessment model. If approved, the project team would begin work during the 2009 North Pacific albacore. Phase 2 of the project would entail implementation of the sampling design developed in Phase 1 for the 2010 North Pacific albacore season.

The second MRIP proposal requests funding to initiate a phased development and validation of recreational survey design elements for HMS sharks. This proposal addresses the Council's recommendation to initiate efforts to improve the quality of data used to manage HMS species, in particular, sharks. As with the albacore proposal, the work will be conducted in a two-phase approach in 2009 and 2010 seasons. Included in the proposal is a complete census of HMS shark tournaments as well as investigation of the validity of sampling HMS shark catch and landings via an adaptive sampling framework to cater for the "pulse" or "patchy" nature of the fishery.

OCRM Denial Letter to CCC on their Request for Reconsideration of Review Denial of the Shallow-set Longline Exempted Fishing Permit (EFP) – NOAA's Office of Ocean and Coastal Resource Management (OCRM) twice denied the California Coastal Commission's (CCC) requests to review the shallow-set longline fishing exempted permit on December 18, 2008 and March 6, 2009. In both letters, OCRM concluded that the CCC failed to demonstrate that the EFP application would have a reasonable foreseeable effect on the uses or resources of the California coastal zone.

Status of White Paper on Albacore Management Options - NMFS funded the preparation of a white paper exploring potential management options for the U.S. west coast North Pacific albacore fisheries. A preliminary overview of the white paper objectives and framework that was scheduled to be presented at the April Council meeting has been rescheduled for the June Council meeting. The consultants working on the white paper plan to meet with the HMSMT and HMSAS during the developmental phase of the white paper.

First Biennial IUU Report to Congress - On January 13, 2009, NOAA submitted its initial report to Congress identifying nations whose fishing vessels were engaged in IUU fishing in 2007 or 2008. This report opens the way for consultations between the U.S. government and officials of each of the six nations to encourage them to take corrective action to stop IUU fishing by their vessels. NMFS identified the following nations under Section 609(a) of the High Seas Driftnet Fishing Moratorium Protection Act for having vessels engaged in IUU fishing activity: France, Italy, Libya, Panama, People's Republic of China, and Tunisia. The press release, biennial report to Congress, and draft proposed rule for the identification and certification process can be viewed at: http://www.nmfs.noaa.gov/msa2007/intlprovisions.html.

MEETINGS

IATTC 10th Stock Assessment and Review Meeting – The IATTC will host the 10th Stock Assessment Review on May 12-15, 2009, in Del Mar, California. The provisional agenda includes an update on the stock assessment and status of bigeye, yellowfin and skipjack tunas, and striped marlin, as well as a review of the stock assessments conducted by the International Scientific Committee for North Pacific bluefin tuna and swordfish (preliminary). The provisional agenda and supporting documents can be viewed on the IATTC website at: http://www.iattc.org/PDFFiles2/SARM-10-Provisional-agenda-May-09.pdf.

IATTC Annual Meeting – The IATTC and AIDCP (Agreement on the International Dolphin Conservation Program) annual Commission meetings are scheduled for June 1-12, 2009, in San Diego, California. A meeting venue and provisional agenda are not yet available, but will be posted on the IATTC website (http://www.iattc.org/MeetingsENG.htm).

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
OFFICE OF OCEAN AND COASTAL RESOURCE MANAGEMENT
Silver Spring, Maryland 20910

Mr. Mark Delaplaine, Manager
Energy, Ocean Resources and Federal Consistency Division
California Coastal Commission
45 Fremont, Suite 2000
San Francisco, California 94105-2219

Re: California's Request to Review an Exempted Fishing Permit Application to NMFS for Exploratory Longline Fishing in the West Coast EEZ

Dear Mr. Delaplaine:

Thank you for the California Coastal Commission's (CCC) request to review an application by Mr. Peter Dupuy to the National Marine Fisheries Service (NMFS) for an Exempted Fishing Permit (EFP) for exploratory longline fishing in the U.S. West Coast Exclusive Economic Zone (EEZ). You requested the National Oceanic and Atmospheric Administration's (NOAA) Office of Ocean and Coastal Resource Management's (OCRM) approval to review Mr. Dupuy's application for the EFP as an unlisted "federal license or permit activity" under § 307 of the Coastal Zone Management Act (CZMA)[1] and NOAA's implementing regulations at 15 C.F.R. § 930.54.

For the reasons set forth in this letter, OCRM denies the CCC's request based on its failure to demonstrate that the activity would have reasonably foreseeable coastal effects.

Proposed Exempted Fishing Permit (EFP)

On April 25, 2008, NMFS published a *Federal Register* notice requesting comments on an application by Mr. Dupuy, a California-based commercial fishing vessel owner, for an EFP under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act).[2] The application requested an exemption for a single vessel from the prohibitions on the use of longline fishing gear in the U.S. EEZ off of the West Coast during the 2008 fishing year beginning mid-September 2008, or, if administrative delays occur, during the 2009 fishing year beginning mid-September 2009.

The applicant has applied for the EFP with the intent to conduct an exploratory test fishery to gather information on the economic viability and environmental effects, including potential impacts to protected species and non-target finfish interactions, of modified shallow-set longline (SSLL) fishing for swordfish in the West Coast EEZ.

[1] 16 U.S.C. § 1456.
[2] Application for Exempted Fishing Permit, 73 Fed. Reg. 22,340 (April 25, 2008).

If approved, the EFP would authorize a single vessel to use SSLL fishing gear targeting swordfish in the EEZ off of Oregon and California. The applicant would be allowed a maximum of four trips and a maximum of 14 sets per trip. Fishing would be required to be at least 50 nautical miles off of the coastline. No fishing under the EFP would be allowed within the Southern California Bight.

On May 22, 2008, the CCC requested OCRM approval to review the proposed EFP. As noted in its request, the CCC believes that several species known to inhabit the state's coastal zone – particularly leatherback sea turtles, assorted bycatch species, short-finned pilot whales, and the black-footed albatross – will be impacted by fishing conducted under the authority of this permit. Because permits issued under the Magnuson-Stevens Act are not listed by California as being subject to review under the CZMA, OCRM approval is necessary for California to review the activity.

General Assessment

In order to receive approval to review an unlisted activity, a state must show that it is "reasonably foreseeable" that the proposed activity will affect the uses or resources of the state's coastal zone.[3] Coastal effects are self evident when impacts to a state's resources will occur within that state's coastal zone. Coastal effects may also exist when impacts occur outside of the coastal zone, but only where the state can demonstrate that those impacts will affect the state's coastal resources. The test is whether it is *reasonably foreseeable* that impacts that occur outside of the coastal zone will affect uses and resources of the coastal zone. Merely showing impacts from an activity outside of the coastal zone is not sufficient, by itself, to demonstrate that reasonably foreseeable effects extend to uses or resources of the coastal zone.[4] It is the state's burden to demonstrate that a proposed activity will have reasonably foreseeable effects on uses or resources within the state's coastal zone.[5]

In this instance, the CCC's request is denied because the request fails to demonstrate that it is reasonably foreseeable that any potential impacts occurring outside the coastal zone will affect uses or resources of the coastal zone. While the CCC broadly asserts that the marine species listed above are known to inhabit the waters of the California's coastal zone, it makes no effort to show that impacted members of these species spend part of their life cycle in the waters of California's coastal zone.[6] By the logic of the CCC's position, if any member of a species is found within the California coastal zone, then every member of the species is a resource of the California coastal zone no matter where it is located. The CCC's assertion is problematic because individual members of those species of state concern are highly migratory species that may never enter California's coastal zone. For example, while it is true that some leatherback turtles in the Pacific Ocean enter the three-mile coastal zone, most never do.[7]

[3] 15 C.F.R. § 930.54(c).

[4] 15 C.F.R. § 930.54; 65 Fed. Reg. 77124, 77130 (Dec. 8, 2000).

[5] 15 C.F.R. § 930.54(b).

[6] *See* 15 C.F.R. § 930.11(b).

[7] The total Western Pacific population of adult female leatherbacks is estimated to be 2,700 to 4,500 adult females (Dutton et al. 2007). It is estimated that an average of 178 leatherbacks forage annually within the neritic waters (i.e, part of the ocean extending from the low tide mark to the edge of the continental shelf) off California (Benson et al. 2007). There is no information on what proportion of this fraction actually enter California's three-

Furthermore, according to NMFS, the proposed activity will likely not affect certain resources of state concern. As discussed in more detail below, NMFS has concluded that the proposed activity will most likely not impact any individual short-finned pilot whales or black-footed albatrosses.

I acknowledge this decision differs from a previous conclusion reached by OCRM concerning a similar proposal. In 2007, OCRM granted the CCC approval to review an application for an EFP to be issued to Mr. Dupuy authorizing longline fishing off the coast of Southern California. OCRM's present decision differs from its 2007 decision for two reasons.

First, under the 2008 EFP, fishing would occur at least 50 nautical miles from the coast – 10 nautical miles farther offshore than the 2007 proposal. Pushing fishing further offshore lessens the potential likelihood that fishing-related impacts will affect State coastal resources and uses.

Second, since its 2007 decision, OCRM has received substantial new information on the likely impacts of the proposed activity. When it reviewed this proposed activity in 2007, OCRM relied upon information furnished by the CCC, which examined past activities unrelated to the proposed activity at issue. In particular, OCRM accepted the CCC's extensive reliance on a 2004 biological opinion prepared by NMFS for the U.S. West Coast Highly Migratory Species (HMS) Fishery Management Plan (FMP) (2004 HMS BO). OCRM did not consider information focused upon the nature and scope of the EFP under consideration, and NMFS did not submit comments.

Since its 2007 decision, OCRM has received extensive new information directly bearing upon the impacts of the proposed activity. This information includes: (1) a 2007 environmental assessment (EA) prepared by NMFS relative to issuance of the proposed permit; (2) biological opinions (BOs) prepared by NMFS in 2007 and 2008, examining the effects of proposed fishing activity on listed species and critical habitat; (3) comments from NMFS on the CCC's request to review the proposed EFP as an unlisted activity; and (4) comments from the Office of National Marine Sanctuaries (ONMS) addressing impacts the proposed activity might have on nearby sanctuary resources.[8] This new information was significant in several respects:

- NMFS is the expert federal agency on impacts from fishing to marine resources. Accordingly, NMFS's comments were particularly significant. NMFS's comments demonstrated that, in support of its request to review the EFP, the CCC incorrectly interpreted information developed by NMFS. In particular, NMFS explained that the CCC's reliance upon the 2004 HMS BO is unpersuasive for several reasons. The 2004 HMS BO assessed the impacts of an SSLL fishery within the high seas. This is a different and broader geographical area than that proposed under the 2008 EFP. Additionally, the 2004 HMS BO examined the use of fishing gear which is distinct from that proposed in

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mile coastal zone.

[8] Although the regulations for the review of unlisted activities do not require public comment, comments were also received from Mr. Chuck Janisse and the Ocean Conservancy, joined by the Center for Biological Diversity, Defenders of Wildlife, Turtle Island Restoration Network, and Oceania.

the 2008 EFP. An analysis of a SSLL fishery in the U.S. West Coast EEZ was not included in the 2004 HMS BO because it was not part of the proposed HMS FMP.[9]

- NMFS's recent EA and BOs strongly contradict the CCC's claim that the proposed activity will have reasonably foreseeable coastal effects. Both section 7 consultations found that the proposed action would not negatively affect species listed under the Endangered Species Act (ESA).[10] The 2008 BO focused on leatherback turtles and found that the proposed action would not have a detectable effect on the leatherback population found in California's coastal waters.[11] Moreover, NMFS's 2007 EA for the proposed activity concluded that the EFP would most likely not affect any individual short-finned pilot whales or black-footed albatrosses, and the impact to finfish species through bycatch and incidental catch would not be significant.[12]

Collectively, the change in the scope of the proposed permit, together with substantial new information bearing directly upon the impacts of the proposed activity, lead OCRM to a different conclusion as to the CCC's pending request. In examining the totality of the information provided in NMFS's EA, BOs, CCC's information, and comments by NMFS, ONMS, Mr. Dupuy, and others, OCRM concludes that the CCC has not met its burden to demonstrate that the proposed EFP will have reasonably foreseeable effects on the uses or resources of California's coastal zone.

Specific Responses to Purported Effects Asserted by the CCC

The CCC's request to review the 2008 EFP is based on its assertion that potential impacts to certain marine species known to inhabit the waters of California's coastal zone will have reasonably foreseeable effects on the State's coastal resources or uses. More specifically, the CCC's request focuses on leatherback sea turtles, bycatch and incidental catch, short-finned pilot whales, and the black-footed albatross. None of the purported effects discussed in the CCC's request justifies finding that the proposed activities will have reasonably foreseeable coastal effects.

1. *Leatherback Sea Turtles*

The CCC contends that the potential take of leatherback sea turtles indicates that the proposed activity will have a reasonably foreseeable effect on a California coastal resource. The record before OCRM demonstrates, however, that the CCC has failed to establish that the potentially affected leatherback sea turtles are coastal resources and that the use of SSLL fishing gear will have reasonably foreseeable coastal effects.

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[9] Letter from Mark Helvey, NMFS, to OCRM (Aug. 18, 2008) (comments on the Delaplaine letter, May 21, 2008) (hereinafter, NMFS Comments) at 3.

[10] *Id.* at 5-6.

[11] Biological Opinion for the Issuance of a Shallow-Set Longline EFP under the Fishery Management Plan for the U.S. West Coast Highly Migratory Species, NMFS, Southwest Region, Aug. 6, 2008 (hereinafter, 2008 BO) at 72-73.

[12] Issuance of an Exempted Fishing Permit to Fish with Longline Gear in the West Coast Exclusive Economic Zone, Environmental Assessment, NMFS, Southwest Region, November 2007 (hereinafter, EA) at 20, 114, 120.

According to NMFS, the likelihood of takings associated with this EFP is low. NMFS anticipated that individual leatherbacks likely will be exposed to the proposed action.[13] For that reason, NMFS's Protected Resources Division engaged in extensive pre-consultation technical assistance with the Sustainable Fisheries Division and the Pacific Fisheries Management Council's Highly Migratory Species Management Team to develop conservation measures that would reduce impacts to leatherbacks.[14] As a result, the preferred alternative adopted in the 2007 EA includes conservation measures consistent with the 2004 amendment to the Hawaii-based Pelagics FMP that reopened the SSLL fishery in the Pacific Ocean and around the Hawaiian Islands.[15] More specifically, the conservation measures include longer branchlines than the floatline, which allows any hooked or entangled sea turtles or marine mammals to reach the surface so they will not drown before the gear is retrieved.[16] Due to the lightness of the gear and length of the branch lines, any entangled sea turtles will not be forcibly submerged and will be able to reach the surface to breath.[17] Conservation measures also include the use of circle hooks and mackerel bait, instead of "J" hooks and squid bait, which is demonstrated to reduce the number of sea turtles incidentally taken by SSLL fishing. In fact, when used in the Hawaii SSLL fishery, this hook and bait type resulted in an 82.8 percent reduction in incidental takes of leatherbacks.[18]

Additionally, in an effort to minimize the level of takings, the action area of the proposed activity has been moved 10 nautical miles farther from shore than in the 2007 EFP application, which may reduce potential takes. Leatherback turtles are not found in great numbers in the proposed action area. Rather, a small number of leatherbacks have been observed in the nearshore zone (approximately 0 to 30 miles from shore).[19] This area is outside the action area of the EFP.[20] It is not known how or if leatherbacks use offshore waters within the West Coast EEZ.[21] By moving fishing activities farther from known leatherback foraging areas, the likelihood of entanglement is reduced, at least within the waters closest to the nearshore foraging areas. As a result, setting the action area farther from shore provides additional mitigation benefits in terms of reduced interactions.[22]

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[13] *Id.* at 1, 22.

[14] *Id.* at 2.

[15] *Id.* at 7.

[16] *Id.* at 7.

[17] *Id.* at 66.

[18] *Id.* at 8, 41. It is worth noting that, following the issuance of the 2004 HMS BO, the Western Pacific Fisheries Management Council amended its Pelagics FMP to reopen the Hawaii-based SSLL fishery on the high seas with a requirement that vessels use large circle hooks and mackerel-type bait. The BO that was subsequently prepared for the amended FMP found no jeopardy for all ESA-listed species. Since the adoption of the amendment, the combined interaction rate for both leatherback and loggerhead sea turtles in the Hawaii-based SSLL fishery has been reduced by an estimated 89 percent. *See* NMFS Comments at 3-4. While this does not negate all possibilities of an effect to turtles that may be coastal resources, it speaks further to the totality of information before OCRM that OCRM's decision record and the CCC's arguments do not demonstrate reasonably foreseeable effects to coastal uses or resources.

[19] 2008 BO at 57-58, *see also* EA at 83.

[20] 2008 BO at 58.

[21] *Id.* at 60, 86.

[22] EA at 122.

Nonetheless, these conservation measures will not completely preclude the incidental take of some leatherbacks. NMFS estimates that no more than three leatherbacks will be affected by the proposed activity.[23] NMFS arrived at this figure by analyzing takes observed in other, similar SSLL fisheries and what is known of the distribution and abundance of leatherbacks within the proposed action area.[24] Based upon a review of relevant other SSLL fisheries and the known distributions and abundance of leatherbacks exposed to these fisheries, NMFS took a "precautionary approach" to estimating the anticipated level of leatherback takes.[25] Consequently, the figure of up to three possible entanglements represents the highest possible estimation of potential takes.[26] Actual takes may be lower, and it is possible that no leatherbacks will be affected by the proposed activity.

Of these three possible takes, NMFS predicts a mortality rate of less than one leatherback. Due to the gear type, mortality rates in the Atlantic and Hawaii SSLL fisheries have been 0 to less than 1 percent.[27] Drawing on other SSLL fisheries, using the most conservative estimate, 22.3 percent, and applying this to the anticipated take of three leatherbacks yields an estimated mortality of *up to* one leatherback.[28]

The CCC has failed to demonstrate that the possible entanglement of up to three leatherbacks and/or one mortality will have a reasonably foreseeable coastal effect. The CCC has also failed to show that any particular individual members of the species that may potentially be impacted by the proposed activity are California resources. In fact, the record demonstrates that it is unlikely that any individual leatherbacks affected by the proposed activity would be California resources. It is estimated that only a small fraction – approximately 3.9 to 6.6 percent – of the total western Pacific population of adult leatherbacks forage annually within the neritic zone (i.e, the portion of the ocean extending from the low tide mark to the edge of the continental shelf, approximately 0 to 30 miles offshore) off California, and there is no information on what proportion of this fraction actually enters California's three-mile coastal zone.[29] The CCC has provided no information to rebut or supplement the information in OCRM's decision record. Therefore, the CCC has not provided an evidentiary basis for its assertion that any individual leatherbacks entangled in fishing gear would be California resources.

Regarding the specific assertions made in the CCC's request to review the EFP, first, the CCC asserts that while that the use of circle hooks would decrease the number of turtles caught,

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[23] 2008 BO at 62.

[24] *Id.* at 10.

[25] *Id.* at 62.

[26] [26] A "take," as defined under the ESA, is not necessarily a mortality. It could be a temporary interaction which qualifies under the broader term "harassment" which the ESA definition of "take" includes. Under Section 3 (19) of the ESA, the term "take" means to *harass*, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." 16 U.S.C. § 1532 (19) (emphasis added). As such, "harassment" or temporary behavior modifications of individual members of a species do not necessarily rise to a coastal effect. 65 Fed. Reg. at 77130.

[27] 2008 BO at 66.

[28] *Id.* at 67, 72; EA 86.

[29] While the precise proportion of the entire population is not known, it is estimated that an average of 178 leatherbacks forage annually within the nearshore, neritic waters off California (Benson et al. 2007). This is a small proportion of the total Western Pacific population of adult female leatherbacks estimated to be 2,700 to 4,500 adult females (Dutton et al. 2007).

"circle hooks do not decrease the number to caught to zero, and therefore the proposed EFP will have reasonably foreseeable effects on sea turtles" within the California coastal zone.[30] The 2008 BO for the 2008 EFP application limits the allowable mortalities resulting from the EFP to a single leatherback turtle.[31] If three leatherbacks are entangled in gear or one leatherback is killed, NOAA/NMFS will revoke the EFP through a NOAA-placed onboard fisheries observer.[32] The CCC has not cited any effects to the California coastal zone resulting from this potential impact.[33]

The CCC also argues that the incidental take statement (ITS) for the EFP, which authorized the take of leatherbacks, makes effects "to leatherbacks a virtual certainty."[34] Even if the taking of a leatherback turtle within the EEZ was a "virtual certainty," that fact as a stand alone assertion is insufficient to establish a coastal effect to the resources or uses of the California coastal zone. In any case, it is not a virtual certainty. Although the 2008 BO would effectively authorize three takes of leatherback sea turtles including one mortality,[35] the BO limits are not a prediction of impacts, which may be lower.[36] Rather, the authorization was established by NMFS as an upper limit of possible impacts, a limit which, if reached, would trigger immediate revocation of the EFP.

The CCC further asserts that the proposed EFP will have "reasonably foreseeable effects on leatherbacks" because the EFP will authorize the use of SSLL fishing gear within the Pacific Leatherback Conservation Area.[37] The CCC's position is based on the fact that there have been no mortalities to leatherbacks in the Conservation Area since the establishment of the seasonal ban on the drift gillnet fishery in the area.[38] However, the CCC does not provide any connection between the prohibition of drift gillnetting in the Conservation Area and turtle mortality associated with the proposed action, which involves a different type of gear. Fishing with SSLL gear is distinctly different from fishing with drift gillnets. Indeed, the 2007 EA noted that data from drift gillnet fisheries cannot be extrapolated to SSLL fisheries "given the differences in the gear and the lack of evidence to support an assumption that the gear types are comparable."[39]

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[30] Delaplaine letter at 4.

[31] NMFS Comments at 6 (citing the 2008 BO).

[32] Application for EFP, 73 Fed. Reg. at 22,340.

[33] Indeed, the potential loss of one leatherback is not expected to have a detectable effect on the leatherback population in California's coastal waters. There are two major population groups of Pacific leatherback sea turtles – the eastern and the western Pacific populations. 2008 BO at 29. Satellite tagging and genetic sampling suggest that the leatherbacks found in the proposed action area are "much more likely" to be western Pacific leatherbacks. *Id.* at 32, 67-68; NMFS Comments at 5. And the California coast has been identified as a foraging area for leatherbacks from the western Pacific nesting population. *Id.* at 22. Western Pacific leatherbacks have not experienced the same level of decline that eastern Pacific leatherbacks have experienced over the past 30 years. *Id.* at 53. Given the weight of the evidence, including the current status of the species and population and biological characteristics, NMFS concluded in the 2008 BO that it is not reasonable to expect that the death of one leatherback will have "a detectable effect on the western Pacific population." *Id.* at 72, 73.

[34] Letter from Mark Delaplaine, CCC, to OCRM (May 21, 2008), regarding the April 25, 2008, Federal Register Notice of Application for Exempted Fishing Permit for Longline Fishing in the West Coast Exclusive Economic Zone (hereinafter, Delaplaine letter) at 4

[35] NMFS Comments at 6.

[36] *Id.* at 5.

[37] Delaplaine letter at 5.

[38] *Id.*

[39] 2008 BO at 59.

Turtles caught in drift gillnets typically drown, whereas turtles hooked with the use of circle hooks and mackerel bait are more likely snagged and can swim to the surface to breathe and survive until released.

The CCC also notes that leatherback sea turtles are found in high densities during certain seasons in areas around the Gulf of the Farallones and Monterey Bay.[40] These areas are included within the National Marine Sanctuary System. However, all fishing under the EFP would be outside of all National Marine Sanctuaries. Additionally, NMFS has consulted with NOAA's Office of National Marine Sanctuaries, which concluded that the proposed EFP "would not likely destroy, cause the loss of, or injure any sanctuary resource within a sanctuary."[41]

Finally, because of the strict NMFS requirements that the EFP will be revoked if three leatherbacks are entangled in gear or one leatherback is killed, OCRM believes that cumulative effects, argued by the Ocean Conservancy, *et al*, if any, do not provide any justification for a finding of effects to resources of the coastal zone.[42]

Therefore, OCRM rejects the assertion that the chance of three leatherback turtle entanglements and/or a mortal injury to one leatherback turtle, 50-200 nautical miles offshore, establishes reasonably foreseeable effects on resources of the California coastal zone.

2. *Bycatch*

The CCC asserts that the taking of bycatch associated with the proposed activity will have a reasonably foreseeable coastal effect.[43]

The CCC, however, has failed to furnish persuasive information that would support this claim. The CCC has not provided an accurate estimate of the quantity of bycatch. Indeed, NMFS has concluded that the CCC overstates the number of species in its description of bycatch.[44] Moreover, the CCC has failed to demonstrate that impacted members of these bycatch species are coastal resources of the state.[45]

Conversely, in its 2007 EA, NMFS examined the potential impact of bycatch and incidental catch on non-target species and concluded that impacts to these species would not be

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[40] Delaplaine letter at 8.

[41] Memorandum from William J. Douros, Office of Nation Marine Sanctuaries, West Coast Region, Memorandum to Mark Helvy, NMFS, regarding Consultation Request on a Shallow-set Longline EFP under the Fishery Management Plan for West Coast Highly Migratory Species Fisheries (Aug. 14, 2008).

[42] As noted by NMFS, the U.S. swordfish fishery has been largely displaced by foreign imports. While not determinative in assessing coastal effects, it is important to note that the demonstration of a commercially viable fishery using modified gear that meets the standards established for endangered and protected species could, therefore, be a net benefit for these species. NMFS Comments at 2 (citing Rausser, G., S. Hamilton, M. Kovach, and R. Stifter, Unintended Consequences: The spillover effects of common property regulations, *Marine Policy*, (forthcoming 2008)); *see also* EA at 7 (citing increase in market share of swordfish supplied by imports as rising from 35 percent in 1993 to 77 percent in 2005).

[43] Delaplaine letter at 5-7.

[44] NMFS Comments at 5.

[45] *Id.* (noting that the species listed by the CCC as potential bycatch "are transboundary species that may or may not temporarily occur in California's coastal zone at particular times of the year.").

significant.[46] For that reason, a finding of no significant impact was reached in the 2007 EA.[47] Consequently, the record does not support the CCC's position that bycatch will have a reasonably foreseeable coastal effect.

3. *Short-Finned Pilot Whales*

The CCC claims the potential impact on short-finned pilot whales as a reasonably foreseeable coastal effect.[48] Short-finned pilot whales are not an endangered species, but are a species of concern.[49]

In considering whether there may be reasonably foreseeable effects to coastal resources, NMFS concluded in the 2007 EA that it is unlikely that any short-finned pilot whales would be affected by the proposed EFP for several reasons.[50] Short-finned pilot whales are a tropical and warm-water species, and their range generally appears to be restricted to an area outside of that of the proposed EFP during normal or cold-water ocean conditions.[51] Nevertheless, the short-finned pilot whale is a species of concern in terms of bycatch within West Coast fisheries because the stock's five-year PBR is very low and, at this time, the average annual mortality rate is one.[52] It is also important to note that the estimated average annual mortality rate of one is based upon one observed short-finned pilot whale caught and killed in a drift gillnet fishery in 2003.[53] Furthermore, in eight years of observations of the Hawaiian SSLL fishery from 1994-2002, only two short-finned pilot whales were taken out of 1,308 shallow-sets of longlines targeting swordfish.[54] This was for a short-finned pilot whale population estimated to be 40 times greater than that found within the West Coast EEZ.[55] Since the implementation of gear changes in the Hawaii SSLL fishery, which required a switch from squid bait to circle hooks and mackerel bait, no observed takes have occurred.[56] For these reasons, the 2007 EA concluded that impacts to short-finned pilot whales are "very unlikely."[57] Nonetheless, in an abundance of caution, the EFP allows for a take of a single short-finned pilot whale. NMFS maintains that this limit is not predictive. Instead, it is simply a precautionary threshold, whereby if so much as one member of the species is taken, the EFP will be immediately revoked.[58]

For its part, the CCC relies on data from the East Coast, where longlining is conducted using circle hooks.[59] NMFS estimates that for a minimum population of nearly 25,000, serious injury

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[46] EA at 98-105, 123.

[47] NMFS Comments at 5.

[48] Delaplaine letter at 9-10.

[49] EA at 75.

[50] *Id.* at 77.

[51] *Id.* at 75.

[52] *Id.*

[53] *Id.*

[54] *Id.* at 76.

[55] The November 2007 EA cited a current minimum population estimate for the stock of short-finned pilot whales was 5,986 within the region of the Hawaii-base fishery. For the West Coast EEZ, the current minimum population estimate cited in the November 2007 EA was 149. *Id.* at 75-76.

[56] Squid is a primary prey, so "switching bait may have had an effect on depredation." *Id.*

[57] *Id.* at 20.

[58] Application for EFP, 73 Fed. Reg. at 22,340.

[59] Delaplaine letter at 9-10.

or mortality occurs to an estimated 211 individuals annually from longlining off of the East Coast.[60] NMFS asserts, however, that the incidents of takes in the Atlantic longline fishery are not likely to reflect what will occur in the West Coast EEZ. There is a significantly larger population of short-finned pilot whales in the Atlantic, the gear is set at different depths than proposed in the EFP, and squid bait is used in the Atlantic, which short-finned pilot whales prefer. Such differences make the two fisheries incomparable in terms of take probabilities.[61]

Given the above data, the CCC has failed to show how fishing under the EFP would have a reasonably foreseeable effect upon short-finned pilot whales that are part of the state's coastal resources. Based upon the low abundance of short-finned pilot whales in the U.S. West Coast EEZ, their occurrence in waters generally warmer than those targeted by the applicant, current climate predictions, the rarity of entanglements on Hawaii longlines (where the stock is much more abundant), and the prescribed use of mackerel bait rather than squid bait, it is considered unlikely that short-finned pilot whales would be affected by the proposed action.[62]

4. *Black-Footed Albatross*

Finally, the CCC claims reasonably foreseeable coastal effects resulting from impacts to the black-footed albatross.[63] Relying on take rates for the Hawaii SSLL fishery, NMFS has concluded that the proposed action would be expected to take only one black-footed albatross.[64] An ITS was not issued, however, because the species is not a listed species under the ESA.

Other than noting that the black-footed albatross is under consideration for listing under the ESA, the CCC has failed to provide any evidentiary basis for concluding that an individual impacted black-footed albatross, if any, would be a resource of the California coastal zone. Rather, the CCC simply, and erroneously, asserts that the U.S. Fish & Wildlife Service's (USFWS) issuance of a 90-day finding on a petition to list this species under the ESA somehow provides evidence that the proposed activity will affect coastal resources. But the 90-day finding relates only to whether the black-footed albatross will become a candidate species for listing under the ESA. It does not provide evidence that any particular activity will affect any individual members of the species, or that any impacted individuals would be found in California.[65] In fact, in 2007, USFWS conducted an informal consultation with NMFS because it determined that the proposed activity would not likely affect the species.[66] Consequently, the CCC's conclusory assertions regarding the USFWS's response to a petition to list the black-footed albatross fail to meet its burden of establishing reasonably foreseeable effects to the resources or uses of the California coastal zone.

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[60] EA at 76.
[61] *Id.* at 76-77.
[62] *Id.* at 77, 108, 121.
[63] Delaplaine letter at 10.
[64] EA at 114.
[65] *See* NMFS Comments at 7-8.
[66] *Id.* at 8.

Conclusion

OCRM finds that the CCC has not established that potential impacts from the proposed EFP authorizing a single fishing vessel to make four trips using shallow-set longline fishing gear at least 50 nautical miles offshore will have reasonably foreseeable effects on uses or resources of the California coastal zone. OCRM therefore denies the request of the CCC to review the proposed EFP as an unlisted activity. The applicant shall not be required to submit a consistency certification to the CCC for the proposed EFP.

The CCC, applicant, NMFS, and all parties interested in this matter are reminded that unlisted activity requests are reviewed on a case-by-case basis. Decisions on unlisted activity requests may vary in accordance with the information that is put before OCRM and the persuasiveness of the information presented. This decision to deny the CCC's unlisted activity request for this proposed EFP does not foreclose the possibility that other activities conducted outside of a state's coastal zone can have reasonably foreseeable effects on uses or resources of the coastal zone.

Please contact David Kaiser, Senior Policy Analyst, OCRM, at 603-862-2719, or Kerry Kehoe, Federal Consistency Specialist, OCRM, at 301-563-1151, if you have any questions.

Sincerely,

David M. Kennedy
Director, Office of Ocean and Coastal
Resource Management

cc:

Peter Dupuy, Ocean Pacific Sea Food
Rodney R. McInnis, NMFS, SW
Mark Helvey, NMFS SW
Judson Feder, NOAA-GCSW

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
OFFICE OF OCEAN AND COASTAL RESOURCE MANAGEMENT
Silver Spring, Maryland 20910

Mr. Peter M. Douglas
Executive Director
California Coastal Commission
45 Fremont, Suite 2000
San Francisco, California 94105-2219

MAR 0 6 2009

Dear Mr. Douglas:

Thank you for your letter dated January 22, 2009, in which you requested that the Office of Ocean and Coastal Resource Management (OCRM) reconsider its denial of the California Coastal Commission's (Commission) request to review an application by Mr. Peter Dupuy to the National Marine Fisheries Service (NMFS) for an Exempted Fishing Permit (EFP) for exploratory longline fishing in the U.S. West Coast Exclusive Economic Zone. As noted in OCRM's December 18, 2008 letter to the Commission, requests to review unlisted activities under the Coastal Zone Management Act (CZMA) and its implementing regulations are determined on a case-by-case basis. Based on the record, OCRM concluded that the Commission failed to demonstrate that the activity addressed in this particular EFP application would have a reasonably foreseeable effect on the uses or resources of the California coastal zone. Neither the information in your January 22 letter nor the information in the January 22, 2009 letter submitted by Oceana (and others) leads OCRM to find that its conclusion was in error.

While I continue to believe in the adequacy and correctness of OCRM's denial of the Commission's request as described in my December 18 letter, there are two points on which I would like to provide assurance.

First, regarding the proximity of the proposed action area to the California coastal zone, OCRM did consider whether the EFP would authorize longline fishing in the vicinity of San Nicholas Island. NMFS has informed OCRM that the EFP would be conditioned so that no longline fishing would be permitted within 50 miles of any point of the California coastal zone including San Nicholas Island.

Second, as OCRM's December 18 letter explained, the decision to deny the Commission's request to review the Dupuy EFP application does not foreclose the Commission's opportunity to review future exempted fishing permit applications for longline fishing. At this time, there is no indication that the outcome of the limited activities under the Dupuy EFP application will result in additional longline fishing. If at some later date, however, NMFS receives an additional EFP application and the Commission files another unlisted activity request, then OCRM would evaluate the information available at that time to determine whether coastal effects are reasonably foreseeable. In the meantime, the Commission may consider submitting to OCRM for review and approval an addition to its federally approved coastal management program to list exempted fishing permits as "federal license or permit activities" subject to consistency review by the Commission under 15 C.F.R. 930.53.

Please contact David Kaiser, Senior Policy Analyst, OCRM, at 603-862-2719, or Kerry Kehoe, Federal Consistency Specialist, OCRM, at 301-563-1151, if you have any questions.

Sincerely,

David Kennedy
Director

cc:
Peter Dupuy, Ocean Pacific Sea Food
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Ben Enticknap, Oceana
Meghan Jeans, Ocean Conservancy
Jim Curland, Defenders of Wildlife
Andrea Treece, Center for Biological Diversity
Michael Milne, Sea Turtle Restoration Project

WORKSHOP REPORT (DRAFT)

SWORDFISH AND LEATHERBACK USE OF TEMPERATE HABITAT (SLUTH)

CONVENED BY: National Marine Fisheries Service Southwest Region and Southwest Fisheries Science Center-La Jolla

DATE: May 28-29, 2008

LOCATION: UC San Diego's Scripps Institution of Oceanography

AUTHORS IN ALPHABETICAL ORDER: Scott Benson, Heidi Dewar, Peter Dutton, Christina Fahy, Craig Heberer, Dale Squires and Stephen Stohs

EDITED BY: Heidi Dewar

EXECUTIVE SUMMARY

The leatherback turtle is endangered in the Pacific Ocean and concern about their persistence has increased as a result of declines in nesting populations over the last three decades. Due to the extensive migratory nature and complex life history of this trans-boundary species, population recovery requires a coordinated international effort that will boost reproductive output on nesting beaches while ensuring maximum survival of juveniles and adults in the ocean. To reduce adult mortality in shallow set longline (SSLL) and drift gillnet (DGN) fisheries, the U.S. has implemented a series of measures restricting fishing activity. The implementation of these measures has come at great economic cost to the U.S. fishing industry. For example, there has been a 50 percent decline in both the number of vessels and annual revenue for the west coast swordfish DGN fishery. The conservation benefits of the U.S. fishery management actions are uncertain and may have unintentionally led to a net increase in bycatch in the Pacific due to the potential transfer of fishing effort to foreign fleets, many of which have not instituted conservation measures to protect leatherbacks. Although no analysis has been conducted for west coast swordfish fisheries, two recent papers suggest that there may have been a market transfer when the Hawaii-based SSLL was closed in 2001. Ultimately, these U.S. fishery management actions by themselves will likely fail to reverse the leatherback population declines, since the animals that forage in waters fished by the U.S. fleet represent a small portion of the whole population, and significant threats remain at the nesting sites and adjacent waters in the western Pacific and South China Sea. NMFS is interested in exploring fishery options that would help recover leatherback populations and benefit the U.S. consumer and U.S. fishers. The goals would be a strong, well-regulated U.S. swordfish fishery coupled with a broad cooperative research program to help inform management, and a more holistic approach to turtle conservation that addresses multiple sources of mortality.

An information exchange workshop entitled Swordfish and Leatherback Use of Temperate Habitat (SLUTH) was held May 28-29, 2008 at UC San Diego's Scripps Institution of Oceanography. The purpose of the workshop was to explore a more holistic approach to turtle conservation and to determine if a more adaptive management strategy (i.e., management not based upon large, static time/area closures) for west coast swordfish fisheries is feasible. The basic objectives of this first workshop were as follows:

- Review current science relevant to leatherback and swordfish movement patterns, habitat utilization, trophic dynamics, population status, and management concerns.
- Develop approaches to promote sustainable and economically viable west coast-based U.S. swordfish fisheries while minimizing the impacts on leatherback turtles and other non-target species.
- Develop an advisory team to help guide research, monitoring, and conservation efforts composed of fishermen, scientists, managers, economists, and non-governmental organizations (NGOs).
- Provide a forum to share views, express concerns, and develop future plans.
- Identify data gaps, available tools and practical next steps towards the development of a more holistic approach to turtle conservation, and further develop fishery management options.

The workshop was sponsored by the NOAA Fisheries Southwest Region (SWR) and the Southwest Fisheries Science Center-La Jolla (SWFSC), with over 40 participants including: scientists from the United States and Mexico; DGN, longline and harpoon fishermen; seafood processors; importers/exporters; and State and Federal fisheries managers (Appendix A). Invited representatives from a number of NGOs could not attend due to scheduling conflicts, but expressed an interest in participating in future efforts. The participation of such a diverse group is a promising sign of broad stakeholder support. The success of future efforts will rely heavily on the continued participation of this group.

Two recurring themes that surfaced throughout the workshop were the concepts of an "ecological footprint" and a "transfer effect." The ecological footprint refers, in this context, to the bycatch and mortality of leatherbacks in the swordfish fisheries, however in later discussions all species taken are considered. Transfer effects relate to the shift of bycatch to foreign fleets as the supply of swordfish shifts away from domestic producers. Foreign fleets tend to be less strictly regulated and likely take more turtles per unit effort. Recent analyses suggest a transfer effect may have occurred when the Hawaii-based SSLL fishery was closed in 2001 due to concerns about ESA-listed sea turtles. The possibility that the DGN time/area closure caused a similar transfer effect is listed as a high priority data gap that needs to be further explored.

In addition to the reoccurring themes mentioned above, scientists and fishermen spent considerable time discussing the habits and shared habitat of swordfish and sea turtles. Both fishermen and scientists agreed that there is potential separation of habitat used by swordfish and leatherback turtles that may offer an opportunity to develop an adaptive management strategy to support fishing while minimizing leatherback interactions. Participants strongly supported the development of new research efforts to determine fine-scale habitat use of both species, representing a first step toward identifying dynamic areas of least overlap between the species.

Finally, there was considerable discussion about Pacific-wide leatherback sea turtle conservation efforts and the economic and political landscapes.

The group recommended the following actions:

- Initiate a cooperative research program to obtain the data needed to develop a model-based adaptive management strategy. This includes defining temporal and spatial patterns in habitat use of both swordfish and leatherback sea turtles with an emphasis on the influence of oceanography.
- Evaluate and compare the economic viability and ecological footprint, or bycatch rate, of DGN and SSLL fisheries for turtles and other species, including sharks.
- Test the effectiveness of gear modifications to DGN and SSLL gear to reduce bycatch of both sea turtles and other nonmarketable finfish species if possible.
- Conduct economic studies to: 1) determine if there were transfer effects when the California-based fishery was reduced; 2) estimate the cost of management measures in relation to transfer effects; 3) quantify comparative viability of harpoon, DGN, and longline fleets; and 4) identify and evaluate the most efficient international management measures to promote conservation while supporting a viable U.S. fishery.
- Evaluate conservation investments by which producers and consumers inflicting sea turtle mortality can improve the status of the species. Protections at sea turtle nesting sites and the reduction of bycatch in coastal, small-scale and artisanal fisheries provide natural focal points for conservation biodiversity investments.
- Expand the education and outreach effort to improve the scientific quality of the public policy debate and to engage broad stakeholder participation. This effort would include dissemination of current scientific knowledge on leatherback turtles and swordfish, promotion of a more holistic approach to leatherback conservation, and discussion of the concept of the ecological footprint and transfer effects.

In a larger context, this workshop supported the mandates of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (MSRA) and the Fishery Management Plan for U.S. west coast Fisheries for Highly Migratory Species (HMS FMP). The primary intent of the MSRA is to promote the sustainability of fishery resources off the United States to contribute to the national food supply, economy, and health. The HMS FMP embodies similar objectives in support of domestic U.S. west coast HMS fisheries. National standards contained in the MSRA necessitate that these fishery conservation and management objectives be met while protecting the environment through reducing or minimizing bycatch. U.S. commercial fisheries that interact with marine species protected or listed under the Marine Mammal Protection Act (MMPA) or the Endangered Species Act (ESA) may be managed further, often through regulations, to minimize protected species bycatch or associated mortality (Helvey and Fahy *in review)*.

Report Content and Format

This report provides background information presented by invited speakers, as well as summaries of the discussions of the workshop and breakout sessions. This report will serve as a catalyst to develop and fund a comprehensive multidisciplinary research program aimed at providing managers and policy makers with information necessary to sustainably conserve and manage the west coast highly migratory species fisheries consistent with the mandates of the MSRA, the MMPA, and the ESA. The creation of a working group across broad stakeholders, from fishermen to NGOs, is critical to this process.

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BACKGROUND:

I. The History of the Swordfish Fishery off the U.S. West Coast

Off the U.S. West Coast, the harvest of swordfish for consumption predates European settlement. From at least the 1st century AD, the Chumash tribe in California's Santa Barbara region caught swordfish with harpoons thrown from plank canoes (Davenport et al. 1993). This method depended on a behavioral trait called "finning" where swordfish periodically bask at the surface, a behavior that can easily be sighted on clear, relatively windless days. California's modern harpoon fishery began in the early 1900s (Coan et al. 1998) and grew in response to increased consumer demand for swordfish (Sakagawa 1989).

Harpoon fishing remained the only legal means of harvesting swordfish in U.S. waters until the late 1970s when a few west-coast-based vessels began targeting common thresher sharks using large mesh drift gillnets. Swordfish and shortfin mako sharks were important components of the catch (Hanan et al. 1993) and it soon became apparent that the DGN fishery was more cost effective and yielded greater catches of swordfish than the harpoon fishery. Swordfish was also worth nearly four times the dockside value of sharks (Holts 1988), and by the early 1980s, swordfish became the primary target species for the DGN fleet. Due to the greater economic efficiency of the DGN gear and the harpoon fishery's dependency on sighting swordfish at the surface (Sakagawa 1989; Coan et al. 1998), the DGN fishery evolved as the primary means of harvesting swordfish within the U.S. west coast exclusive economic zone (EEZ) since the early 1990s (PFMC 2007). This efficiency, however, came at a cost in terms of increased bycatch interactions relative to harpoon gear, with marine mammals, sea turtles, and managed and monitored finfish species such as tunas and sharks.

While not allowed in the west coast U.S. EEZ, the primary gear type used worldwide to harvest swordfish is pelagic longline (Watson and Kerstetter 2006). The gear is typically set at night in the upper 100 meters of the water column (i.e., "shallow-set longline" or SSLL) to coincide with the nocturnal movements of swordfish into near surface waters. First attempts at exploring the use of longlines in California occurred in the late 1960s but proved commercially unsuccessful due to large blue shark bycatch (Kato 1969). Then, during the 1991-1992 fishing season, three U.S. flagged high seas[1] longline vessels relocated from the Gulf of Mexico to the West Coast and based their operations out of California. By 1994, the number of vessels grew to 31 (Vojkovich and Barsky 1998). Beginning in 1995, the majority of these longline vessels began following the seasonal east-west movements of swordfish in the North Pacific. In the spring and summer longline vessels operated out of Hawaii and during the fall and winter they operated outside the west coast EEZ (NMFS 2004), with some annual shifts in effort associated with fisheries regulations. The west coast SSLL fishery continued until 2004 when the Pacific Fishery Management Council's (Pacific Council) HMS FMP was adopted and submitted to the National Marine Fisheries Service (NMFS) for review and approval. Due to concerns about the potential for excessive take of loggerhead sea turtles, the SSLL was not approved and regulations issued under the ESA closed the SSLL fishery operating out of California and fishing east of 150^{o} W longitude.

[1] Beyond the U.S. 200 nautical mile Exclusive Economic Zone.

At that time, the California based SSLL fishery did not include gear and bait modifications that had recently been developed to reduce sea turtle bycatch. A shift from J-hooks and squid bait to circle hooks and mackerel-type bait has been shown to reduce sea turtle bycatch and mortality (Watson et al. 2005; Gilman et al. 2007). At about the same time, the Hawaii-based SSLL fishery (which had been closed in 2001) was re-opened after these gear and bait modifications were adopted, including the use of 18/0 circle hooks with a 10^{o} offset. In addition, a maximum annual limit on the number of turtle interactions was established and 100% observer coverage was initiated.

II. Status of Western Pacific Leatherbacks

While the oceanic waters off the U.S. West Coast are considered a productive area for swordfish, they are also considered an important foraging area for ESA-listed leatherback sea turtles and an occasional foraging area for loggerhead sea turtles. Analyses of genetic data and satellite tracking of leatherbacks by the SWFSC indicate that these animals originate from nesting beaches in the western Pacific (e.g., Indonesia and Solomon Islands) (Benson et al. 2007a). These turtles are genetically distinct from turtles nesting in the eastern Pacific that forage in the southeastern Pacific (Dutton et al. 2007). In the western Pacific, there are an estimated 1,100 to 1,800 females nesting each year at 28 nesting sites, and leatherbacks typically nest every other year. The overall estimate of nesting females in this area is approximately 2,700 to 4,500 individuals, although these are considered rough estimates, since they are derived from nest counts (Dutton et al. 2007). While this subpopulation is not experiencing the dramatic declines that are evident in the eastern Pacific subpopulation, there have been significant declines at long-term monitored beaches since the 1980s (Hitipeuw et al. 2007).

III. Regulatory Controls for Reducing Sea Turtle Bycatch in the DGN Fishery

In 2000, NMFS conducted an ESA Section 7 consultation on the issuance of a permit to take endangered and threatened marine mammals in the west coast (California/Oregon) DGN fishery. The resulting biological opinion concluded that operations of the DGN fishery were likely to jeopardize the continued existence of leatherback and loggerhead sea turtles. To reduce leatherback turtle take in the DGN fishery by an estimated 78 percent, NMFS implemented a time/area closure based upon where the majority of leatherback takes had been observed (NMFS 2001a). The Pacific Leatherback Turtle Conservation Area (PLCA) was established and prohibited DGN fishing from Point Conception, California to mid-Oregon and west to 129° W longitude from August 15 to November 15 (Figure 1)[2]. There have been no observed takes of leatherbacks in the DGN fishery since the PLCA was established.

[2] In 2003 NMFS issued a regulation under the ESA to protect loggerhead sea turtles which prohibits the use of DGN gear in the southern California Bight during June, July, and August when El Niño or El Niño-like conditions exist in the area. This closure has not been triggered.

Figure 1. The Pacific Leatherback Turtle Conservation Area

With historical DGN fishing grounds reduced by approximately 200,000 square miles, it is not surprising that the number of vessels participating in the swordfish fishery has declined from 69 in 2001 to 38 in 2006 (PFMC 2007). The establishment of the PLCA also shifted the fishery and supporting infrastructure to southern California ports. The economic impact of the 2001 closure to the domestic swordfish industry has been substantial (Gjertsen *in press*): revenue from the DGN fishery declined by 60 percent, from $5.4 to $2.3 million annually. This does not include loss to supporting infrastructure and other indirect fishery derived revenues.

IV. Efforts to Reduce Bycatch

In addition to the regulatory controls implemented over the last 10 years, a number of projects have been initiated to examine gear alternatives and modifications to reduce bycatch with efforts focusing primarily on reducing marine mammal take. In 1996, the Pacific Offshore Cetacean Take Reduction Team (POCTRT) was formed to produce a plan to reduce marine mammal bycatch in the DGN fishery for swordfish. For various reasons, harpoons were not considered a viable substitute for the DGN fishery. Longlines were also not considered an option at the time because they were not an authorized gear type within the U.S. EEZ. Since then, the Pacific Council adopted the HMS FMP authorizing pelagic longlines as an HMS gear, although longline fishing for HMS within the EEZ is currently not permitted under the HMS FMP. Gear modifications in the DGN fishery, including attaching of pingers to nets as an acoustic deterrence, and the use of net extenders to allow marine mammals to pass over the nets, have successfully reduced overall cetacean take. However, DGN gear modifications are not typically considered to be effective at reducing sea turtle bycatch (Harrington et al. 2005; McShane et al. 2007).

Though longlining has long been synonymous with bycatch concerns, gear modifications to traditional longline gear for reducing turtle bycatch have been successfully implemented in a number of fisheries. As mentioned above, a shift from J-hooks to circle hooks and from squid bait to mackerel-type bait resulted in a dramatic decline in turtle takes in both the Atlantic and Pacific Oceans (Watson et al. 2005; Gilman et al. 2007). In fact, the SSLL fishery operating out of Hawaii was recently endorsed by the Monterey Bay Aquarium's Seafood Watch Program[3] in recognition of the strength of management and conservation measures implemented to minimize bycatch. Given the improvements to longline gear, an Exempted Fishing Permit (EFP) application was submitted to the Pacific Council and NMFS for a single longline vessel to explore the economic viability of using SSLL gear to target swordfish in an area from 50 to 200 nm off the coast of California. The EFP application was met with considerable public resistance despite NMFS receiving a recommendation for approval by the Pacific Council. However, due to administrative delays during a California Zone Management Act consistency determination review by the California Coastal Commission (CCC), the applicant withdrew the EFP late in 2007. In 2008, the permit application was resubmitted to the Pacific Council and is currently under consideration by NMFS. This time the CCC was denied review authorization by NOAA's Office of Ocean and Coastal Resource Management for its failure to demonstrate that the EFP would have reasonably foreseeable coastal effects. Data generated from the EFP activity, if it proceeds, would support the goals of the SLUTH program.

V. Ecological Footprint and Transfer Effects

The curtailment of U.S. domestic fisheries for swordfish may have had unintended consequences with regard to reducing sea turtle mortality due to a shift in supply to foreign fleets. U.S. landings of swordfish show a general pattern of decline from the early 1990s through the 2000s. Landings in 2006 of 2,711 metric tons (mt) were only 25% of the peak recorded in 1993 (U.S. Dept of Commerce Com. Fish. Land. 2008). The share of U.S. demand provided by landings into the U.S. West Coast and Hawaii fisheries has dropped from an average of 20% between 1989 and 2000 to seven percent between 2001 and 2006 (U.S. Dept of Commerce U.S. Foreign Trade 2008). With a relatively larger reduction in domestic supply than the reduction in domestic demand, U.S. swordfish imports have increased. In 1993 imports accounted for 43% of U.S. demand by weight, by 2006 this had increased to 88% with a value of $76 million. Singapore, Panama, Canada, Costa Rica, Mexico, and Chile were the dominant foreign suppliers (U.S. Dept of Commerce U.S. Foreign Trade 2008).

Some of the foreign fleets supplying swordfish to U.S. markets are unregulated and unobserved and likely have a significant bycatch of leatherbacks. Many of these foreign fleets continue to use J-hooks and squid bait. Circle hooks and mackerel-type bait are now required in most U.S. fisheries. In addition, these foreign fleets may have increased their effort in waters previously occupied by U.S. fleets. In 2001, NMFS predicted that there might be negative transfer effects to turtles if the Hawaii SSLL fishery closed (NMFS 2001b). Two recent studies have suggested that the Hawaii-based longline fishery closure did lead to an increase in the number of total sea turtle interactions as a result of this market displacement (Samiento 2006, Rausser et al. 2008), although no similar study has been conducted for the U.S. West Coast and additional research is needed. Any transfer effects are a part of the ecological "footprint" associated with closures or reductions in landings by U.S. domestic fisheries that should ideally be taken into account when making management decisions. Additional factors include the discarded bycatch of other non-target species and the environmental footprint of transporting fish from distant markets. The

[3] http://www.montereybayaquarium.org/cr/seafoodwatch.aspx

continuing decline in swordfish production by U.S. west coast fishermen plus the persistent U.S. demand suggests that reliance on foreign imports will persist. Encouraging the use of modified gear in U.S. fisheries, which result in relatively low bycatch and mortality, could benefit the impacted species of sea turtles particularly if well managed fisheries are coupled with a broad suite of multilateral conservation and education measures (Dutton and Squires 2008; Steering Committee, Bellagio 2008). In order to encourage a more holistic management regime, the United States must have active fisheries. In addition, U.S. fishermen have shown themselves to be global leaders in designing and implementing effective gear modifications to reduce bycatch.

PRESENTATIONS:

Briefly, presentations covered issues relevant to biology, habitat, management, and fisheries interactions of both swordfish and leatherback sea turtles (Appendix B). The first talks covered the fisheries, status of stocks, and history of management in both the United States and Mexico. Both countries have been fishing swordfish in the California Current for more than 20 years, although currently the primary gear types differ in the two countries. Mexican swordfish fisheries use SSLL while U.S. fisheries use DGN gear. While stock structure remains to be resolved, stock status appears to be healthy in the eastern North Pacific based on the last analyses conducted in 2004. In the United States, the temporal and spatial patterns of swordfish fisheries are now largely influenced by regulations implemented to reduce sea turtle take. In addition, increased fuel costs and fluctuating market dynamics are starting to negatively impact U.S. fishermen. Due in part to a reduction in overall fishing effort, the United States now imports a large volume of swordfish from countries, including Mexico, where fuel costs are substantially lower.

To study the movements and behaviors of swordfish and leatherback sea turtles, a number of scientists have been using electronic tags. Studies of swordfish have been conducted in the Southern California Bight where fish are tagged using a modified harpoon. Electronic tag data reveal that swordfish typically prefer deep, cold water during the day but then vertically migrate to the surface at night. Some days are punctuated by basking events, during which local harpooners are able to target swordfish. There are currently no data on the vertical and horizontal movements of swordfish north of Point Conception, where the majority of turtle interactions occurred in the DGN fishery prior to the establishment of the PLCA in 2001. Electronic tags have also provided considerable data on the large-scale migrations and behaviors of leatherbacks. These efforts were instrumental in documenting the migrations of leatherback sea turtles from Indonesia to the central California coast and are helping researchers understand how oceanography influences movements in the California Current region.

Understanding habitat use patterns of leatherback turtles may lead to adaptive management of the fishery. In the subtropical convergence zone in the central Pacific the “TurtleWatch” program developed by researchers at NOAA’s Pacific Island Fisheries Science Center uses a relatively simple environmental indicator (based on sea surface temperature and ocean currents) to define loggerhead sea turtle habitat (http://www.pifsc.noaa.gov/eod/turtlewatch.php). This information is updated in near-real time and is provided to fishermen so that they can avoid specific areas when setting and hauling gear. Similar options were discussed at this workshop for delineating leatherback sea turtle habitat in the California Current. Unfortunately, leatherback sea turtle habitat in the California Current is much harder to define. This is an extremely dynamic system with complex meso-scale features and seasonal upwelling. It is also not clear what influences the distribution of the leatherback turtles' preferred prey, the brown sea nettle (*Chrysaora fuscescens*), which are found in frontal areas also attractive to both leatherbacks and swordfish.

Members of industry also gave presentations and provided valuable input on the behaviors of swordfish and sea turtles, fishing techniques and gear, and the costs associated with certain management decisions, such as time/area closures and gear requirements. Economic concerns were the most prevalent topic from all parties. Drift gillnet fishermen noted that the bycatch mitigation measures, including increased mesh size and the addition of pingers, have successfully reduced the bycatch of protected species without impacting catch rates. They felt, however, that implementation of the PLCA put a lot of fishermen out of business, and with rising gas prices, more fishermen are likely to be pushed out of the industry. The processors indicated that a disruption in the supply of swordfish associated with regulations could negatively impact market demand for fresh local fish. There was some discussion about import tariffs to level the playing field with foreign fleets that tend to be subsidized. The fishermen were apprehensive about the effectiveness of leatherback sea turtle conservation measures. There was some concern that current regulations on the swordfish fishery are pushing fishing effort to other countries with less stringent regulations and higher takes of turtles, thus undermining conservation efforts. Industry participants also suggested a "levy" on fishermen that would support leatherback conservation in other areas where the impact per dollar invested would be greatest.

WORKING GROUP BREAK OUT SESSIONS:

Following the presentations, the participants separated into a series of working groups to discuss, among other things, options for filling in data gaps and research and monitoring needs that were identified during the preceding day and a half. The working groups were organized around three main functional areas: 1) Reducing Encounter Rates; 2) Economics; and 3) Management/Policy Issues.

I. Reducing Encounter Rates

Discussion on efforts to reduce encounter rates focused on: 1) obtaining a better understanding of the underlying factors contributing to bycatch interactions by gear type; and 2) identifying areas of minimal habitat overlap of swordfish and leatherbacks in time and space.

A. Predictive Modeling

To understand the temporal and spatial distributions of bycatch, researchers have used a variety of statistical techniques to quantify patterns. While understanding patterns in bycatch is important, it does not allow us to predict bycatch unless we assume that fishing effort and the distribution of the protected species are constant over time, which is seldom the case. To reliably predict the interactions between fishing operations and protected species, one needs to understand the spatial and temporal distributions of the target catch and the bycatch species. For example, the "TurtleWatch" program based out of Hawaii takes this approach (Howell et al. 2008). TurtleWatch is a mapping tool that helps fishers avoid loggerhead sea turtle habitat and illustrates the advantage of using information on fishing operations and protected species in building a management tool.

To develop predictive models, we treat the distribution of fishing gear and protected species as independent random variables. A variety of factors affect the distribution of fishing gear and protected species. For example, the distribution of protected species is affected by the distribution of prey species, which is determined by time, physical features such as currents, productivity, temperature, and other environmental variables. The distribution of fishing gear, on the other hand, is often affected by regulations and the distribution of target species. Consequently, given an environmental condition and existing regulatory restrictions, the distribution of protected species and fishing gear may be constructed. The probability of interaction between the turtles and gear can then be calculated and used to guide management decisions. To minimize the interactions between wildlife and fishing operations, decisions need to be made such that fishing is allowed in the temporal and spatial strata where the probability of the interactions is small and the fishery is economically viable.

While predictive modeling has proven to be a powerful tool in other systems, it requires detailed information on the habitat use of protected and target species (information on the target species is an important part of predicting the efficiency of the fishing fleet). What is needed is information on the influence of both fine- and meso-scale environmental conditions on both vertical and horizontal movements, as shifts in either could be exploited. For example, while both species are associated with frontal features, there is some suggestion that they are utilizing different parts of the front. Also, there is likely considerable separation in the depths utilized during the day, when swordfish feed on the deep scattering layer and turtles occur generally in the top 100 m of the water column.

B. Swordfish

i. Background

Swordfish support one of the largest U.S. HMS fisheries in the North Pacific and leatherback sea turtles have been taken in both the DGN and longline fisheries targeting them. Collecting data on the distribution and habitat of swordfish is critical to developing models to predict the temporal and spatial patterns in swordfish fisheries; however, model inputs for swordfish are incomplete due to data limitations. While a number of research programs have studied swordfish movements, behaviors, and habitat use in the Southern California Bight, no information is currently available north of Point Conception where the majority of leatherback sea turtle bycatch was documented for the DGN fishery prior to implementation of the PLCA time/area closure. Behavior in this region cannot be predicted using data currently available from other areas. The depths and temperatures swordfish encounter during both the day and night vary dramatically across locations and their behaviors appear to be linked to temperature profiles, bathymetry, light attenuation with depth, and oxygen concentrations (Dewar et al. *in prep*). Given the complexity of their behaviors and lack of information on their response to the regional oceanographic features, we cannot predict behaviors of swordfish off Central California. For data to be relevant to the fisheries off Central California, it must be collected from swordfish in this region.

ii. Data Gaps

1. Vertical and horizontal habitat use patterns of swordfish north of Point Conception.
2. The influence of oceanography on swordfish vertical and horizontal behavior north of Point Conception.
3. Factors affecting timing of arrival of swordfish on Central California fishing grounds.
4. Preferred prey of swordfish off Central California.

iii. Strategy

1. Conduct electronic tagging studies of swordfish off Central California and examine behaviors with respect to detailed oceanography for the region.

The most effective way to collect data on vertical movements will be through the use of electronic tags (pop-up satellite and archival). These devices have revolutionized the study of the biology of pelagic fish over the last decade (Arnold and Dewar 2001). Briefly, archival tags record highly detailed data but must be recovered when the fish is caught. The pop-up satellite tags on the other hand, record data until they release from the animal and upload their data to satellites. While the fish need not be recaptured, the data obtained are only summaries of all data collected. Both tags will record depth and temperature data and will allow us to resolve day/night differences. It is likely that the greatest habitat separation between swordfish and leatherbacks occurs during the day when swordfish are foraging in association with the deep scattering layer.

To develop statistically rigorous models, a large number of animals must be tagged. The optimal method to deploy tags would be to work with an experienced longliner on a chartered fishing vessel. Ideally the fishing boat would be equipped with a plank to allow for tagging of free-swimming fish. This would be the preferred option for any future large-scale tagging program. It occurred to the working group that a second option, which could be implemented within a few months at relatively little cost, was to longline from the NOAA Ship *David Starr Jordan* during the Leatherback Use of Temperate Habitat (LUTH) cruise planned for late summer (2008) off Central California. The SWFSC Fisheries Resources and Protected Resources Divisions, along with a contracted commercial swordfish fisherman, worked together to conduct the experimental longlining. The goal was to deploy satellite and archival tags for both long- and short-term deployments in an area where leatherback turtles have been observed. In this way, swordfish behavior could be linked to available oceanography including in situ data collected during the cruise, satellite imagery, and model results (for a brief cruise report see Appendix C).

2. Examine the oceanography and other environmental factors associated with all catch records for all swordfish fishing activities currently and formerly conducted off Central California.

In addition to vertical habitat use, data on horizontal habitat use, for example, determining how swordfish use frontal features and what signals their arrival in near-shore waters, is also required for optimal model development. One option proposed to examine horizontal habitat use is to conduct a detailed examination of logbook and observer records for the DGN fishery when it operated north of Point Conception and to link these catch records to regional environmental conditions. In addition, the catch data from any efforts to deploy electronic tags could be examined in a similar way. Comparison of catch across years with differing environmental conditions would provide insight into factors influencing the arrival of swordfish into the region.

3. Conduct diet studies of swordfish caught north of Point Conception.

Studies of foraging ecology would be conducted coincident with any effort to deploy electronic tags. In addition, if the proposed EFP is approved by NMFS, stomachs would be collected from swordfish caught north of Point Conception. Stomach contents would be examined to look at the relative contribution by weight, number, and frequency of the different prey types. The Large Pelagics Biology Lab at the SWFSC has an ongoing project to examine swordfish foraging ecology in the Southern California Bight and could easily expand this study.

C. Leatherback Sea Turtles

i. Background

Populations of critically endangered Pacific leatherback turtles (IUCN 2004) have declined precipitously during the past 25 years. A portion of the western Pacific population that breeds in Papua Barat (Indonesia) migrates to foraging grounds off the West Coast of North America where incidental takes have occurred in the swordfish DGN fishery (Dutton et al. 2007; Benson et al. 2007a; Carretta et al. 2004; Julian and Beeson 1998). Previous ecosystem studies of leatherback turtle foraging habitat off California have been confined to shelf waters (<90 m depth) within 30 miles of the coast (Benson et al. 2007b); however, telemetry studies of leatherbacks have suggested they also associate with dynamic oceanographic features (e.g. fronts) within the traditional swordfish fishing area (Benson, unpublished data). Therefore, data are needed to evaluate use of offshore waters where frontal features may aggregate jellyfish prey and provide foraging habitat for leatherbacks. Future studies involving oceanography and prey sampling will be needed to examine and characterize the abiotic and biotic conditions that create and define leatherback foraging habitat within the offshore waters of Central California.

ii. Data Gaps:

1. Characterization of leatherback use of near-shore and offshore habitat, including vertical habitat use and how foraging is influenced by the environment.
2. Determination of the timing of the turtles' departure from coastal foraging areas and subsequent transit through historic swordfish fishing grounds.
3. Factors affecting the abundance and distribution of jellyfish, the main prey of leatherbacks.
4. Factors affecting gear interaction.

iii. Strategy:

1. Characterize leatherback habitat use via telemetry, aerial surveys, and shipboard surveys.

In near-shore waters, leatherback habitat use has been documented since 2000 through fine scale aerial surveys and limited boat-based oceanographic sampling. Beginning in 2005, a few deployments of suction cup VHF radio tags with time depth recorders (TDRs) provided the first information on near-shore diving and foraging behavior (Benson et al. 2007b). These studies will continue during 2008 and beyond, funding permitting. Deployments of satellite and VHF telemetry devices on nesting and foraging leatherbacks between 2000 and 2007 have yielded information on movements to, and use of, near-shore foraging areas off the U.S. West Coast. Analyses of these data are presently underway to identify high-use areas, document daytime vs. nighttime movement rates, and describe diving patterns.

Studies of habitat use in offshore waters will require surveys that utilize remotely sensed and in situ oceanographic data to identify dynamic frontal features – physical mechanisms (i.e., surface currents) that might aggregate jellyfish and leatherback turtles. The LUTH survey will provide the first opportunity to collect these data. The results of this cruise will be used to characterize the ecosystem in the central California swordfish fishing grounds, and its use by leatherback turtles, by combining in situ multidisciplinary oceanographic sampling with aerial surveys for leatherbacks and satellite telemetry data. Results will be used to develop methods to identify leatherback foraging areas in offshore waters via remotely sensed surface features, thereby allowing fishers to avoid areas of potential interaction with leatherbacks.

2. Determine timing of leatherback departure from coastal foraging areas using VHF telemetry and aerial surveys.

The majority of existing satellite telemetry data on leatherbacks (see above) is not suitable for estimating departure time from the foraging grounds, because the process of in-water capture appears to cause most leatherbacks to leave the foraging area prematurely (Dutton unpublished data). Suction-cup VHF telemetry devices, monitored by aircraft (range 5-15 km) offer an alternative means of monitoring the presence of leatherbacks at coastal foraging areas and estimating the departure time of undisturbed turtles. Preliminary studies using suction cup VHF tags (without adhesives) have achieved maximum deployment duration of five days. The use of adhesives on suction cup telemetry devices offers promise to achieve longer attachment durations (weeks to months), but requires further development. We have also been developing techniques to quantify jellyfish biomass at foraging locations along the California coast, and plan to test a new suction cup attached video camera system to record leatherback foraging behavior and determine if the rate of consumption or size of prey decreases during the fall as water temperatures decrease, prompting leatherbacks to leave the foraging ground. Test deployments of this video system are planned for fall 2008.

3. Develop methods to quantify the abundance and distribution of jellyfish.

One large data-gap identified was the lack of information on the abundance and distribution of jellyfish. Unfortunately large-scale studies of jellyfish are lacking and would be difficult to fund. A number of potential options were identified, including initiating discussions with observer programs and with scientists who conduct regular surveys (e.g. CalCOFI, marine mammal surveys). Documentation of information on sightings of jellyfish could be requested as part of their regular course of operations. This would require the development and distribution of a scientific key for basic species identification as well as a list of additional information that would be useful to record. It may also be possible to review existing observer records in search of information on jellyfish that may have been previously documented.

4. Examine DGN fishery records to identify factors that influence probability of leatherback/fishing gear interaction.

There is a relatively large database covering the catch of the DGN fleet that previously operated north of Point Conception. This dataset includes the 23 observed sets in which leatherback sea turtles were taken prior to the closure of this area. Suggestions were made to more closely examine the sets in which these animals were taken, including the experience of the captain, the environmental characteristics at the location, the time of day leatherbacks were caught and the other species caught in association with the turtle. Recent data indicate that leatherback distribution and movements vary in response to ocean conditions.

II. Economics

The Economics Working Group discussed possible research projects aimed at conserving sea turtles and maintaining the economic viability of commercial fisheries that interact with sea turtle populations. A brief summary of potential topics is offered below:

A. Measuring the Economic Impacts of Regulatory Closures on Industry

i. Background

Time/area closures are frequently used to manage fisheries and protected species bycatch. If a closure has the effect of eliminating fishing effort in areas where productivity is higher than in areas still open to fishing, a drop in productivity and producer profits may result, as fishermen are constrained to fishing in less productive areas. In addition to economic implications, closures can also result in increases in bycatch in international waters. Such so-called transfer effects can be due to both economic and biological factors: 1) a reduction in domestic supply results in an increase in the demand for imports; and 2) a reduction in domestic effort reduces partial mortality on the target stock, increasing its availability to the foreign sector. Both factors may serve to stimulate an increase in swordfish imports in response to a unilateral reduction in domestic fishing effort, with an unforeseeable increase in the net level of sea turtle bycatch.

ii. Data Gaps

1. Statistical evidence on whether regulations that limit west coast-based swordfish fishing effort result in a transfer of swordfish fishing effort into other fisheries.
2. Data which could be used to measure the magnitude of any transfer of effort due to regulatory limits on west coast swordfish effort.
3. Data on sea turtle interaction rates in fisheries that either supply the U.S. import market or that might experience an increase in effort in response to regulatory limits on west coast-based effort.

iii. Strategy

1. Review existing data sources to document what could be used to quantify transfer effects and sea turtle interaction rates in other fisheries.
2. Identify data gaps which would need to be filled in order to estimate effort transfer effects and possible resulting increases in sea turtle interactions in other fisheries besides west coast-based swordfish fisheries.

3. Devise and implement a data collection strategy to fill these data gaps.

Proposed research would: 1) gauge the impact of the DGN leatherback conservation area closure on the productivity and economic viability of the fishery; and 2) evaluate the economic and conservation impacts of any transfer of effort which resulted due to a unilateral reduction in domestic DGN swordfish production. Methods similar to those employed in Rausser et al. (2008) would be applied in conjunction with a productivity analysis that considers conservation impacts to gauge the net impact of the 2001 leatherback conservation closure on the productivity of the DGN fishery.

B. Conservation Investments

i. Background

Recent discussions have considered the contribution of conservation investments and mitigation to biodiversity conservation, particularly in developing countries (Bean 1993; Roberts 1999; Heal 2000; Wilcox and Donlin 2007; Dutton and Squires 2008.) Such an approach has been endorsed by the Convention on Biological Diversity (Slootweg et al. 2006), although controversy still surrounds the approach, despite its widespread application (Burgin 2008). Conservation investments may be promising for leatherback sea turtles (Janisse et al. *in press*).

It has been noted in numerous publications that the conservation and recovery of leatherbacks must include protection of nesting beaches, along with reducing incidental takes in fisheries. By improving the nesting habitat of leatherbacks and therefore increasing the number of hatchlings, the overall status of the population should improve. Gjertsen (*in press*) found that nesting beach protection was an appreciably more cost effective conservation strategy than at-sea protection through regulating the Hawaii SSLL and California DGN fleets.

One option for this type of conservation investment that could help improve the status of leatherback sea turtles involves a combination of NGO, consumer, and industry financing to protect turtle nesting beaches used by animals impacted by the fishery. These conservation investments should help improve the overall status of the species, consistent with section 7 of the ESA. Under the U.S. ESA, Federal agencies are encouraged to use their programs to help in the conservation of threatened and endangered species. The SLUTH team is exploring how conservation measures can be integrated into fishery actions in such a way to improve the status of species that may be affected by the fishery.

Another option that was explored was reducing the mortality of turtles returning to unprotected nesting beaches. Investments could be made to improve the oversight and monitoring at nesting beaches to safeguard the presence of adults, the deposition of eggs, and the emergence of hatchlings. Investments could also be made to alter gear and fishing practices around nesting beaches. Such conservation measures generally do not jeopardize the economic viability of fisheries, and as shown by Gjertsen (*in press*), are more cost effective, by an order of magnitude or more. Part and parcel to these investments would be to work with local communities to empower them to take ownership and champion the cause of leatherback protection and conservation. If actions to reduce mortalities are reasonably likely to be successful and are contemporaneous with the action, then the conservation benefit to the species is more clear and immediate.

A possible funding mechanism is the use of a double dividend tax approach to pay for environmental mitigation measures. Such measures may have to be voluntary, such as the current voluntary payments by FISH (Federation of Independent Seafood Harvesters) to ASUPMATOMA, a Mexican conservation group, to aid their Pacific leatherback turtle nesting site protection (Janisse et al., *in press*). A double dividend tax is documented to promote conservation objectives directly by taxing the fishery and indirectly through using the tax proceeds to finance conservation. An issue that would need to be addressed is the feasibility of basing a tax on estimated bycatch rates (Segerson *in press*). Given the international scope of sea turtle bycatch, any tax on the U.S. industry would ideally be matched by a commensurate tax on foreign producers in order to avoid a potential transfer of effort and turtle bycatch to the foreign sector. These efforts could be undertaken in a cooperative fashion with NGOs, industry, or governments working internationally.

ii. Data Gaps

1. Information on the existence and success of environmental conservation investments used in other fisheries to improve the status of sea turtles and/or reduce or eliminate protected species bycatch.
2. A review of environmental conservation investments used in other contexts.
3. Evidence on whether any of the methods identified could potentially be applied to known sea turtle conservation problems.

iii. Strategy

1. Conduct literature review to explore 1) and 2) above.
2. Study the use of conservation investments as a potential policy tool.

This research would identify and describe alternative industry-funded conservation investment strategies from the standpoints of feasibility and cost effectiveness. A potential outcome is to identify a means to simultaneously achieve sustainable U.S. fisheries and increased sea turtle conservation.

C. Integrating Economics into Sea Turtle Conservation

i. Background

A holistic conservation strategy that addresses all sources of anthropogenic mortality is the best hope for conserving Pacific leatherback sea turtle populations (Dutton and Squires 2008; Steering Committee, Bellagio 2004; 2008). One important question is the cost effectiveness of alternative sea turtle conservation strategies. For example, would a dollar spent on reducing sea turtle interactions in fisheries or destruction of nesting beaches achieve the greatest conservation benefit? Gjertsen (*in press*) has shown that nesting beach conservation is cheaper and likely to be more effective than bycatch reduction measures by themselves. However, at sea conservation measures are desirable to complement nesting beach conservation. There are several approaches to reducing potential adverse impacts of fisheries. Research comparable to that on the Hawaii longline fishery by Segerson (*in press*) and Ning et al. (*in press*), but focused on the DGN fishery for the most economically efficient method of at-sea conservation is necessary. Furthermore, the impact of alternative sea turtle conservation strategies on artisanal fishers and coastal fishing communities and conversely, the fishers' impacts on sea turtle mortality need to be further evaluated.

U.S. regulations including the ESA and the MSRA provide the opportunity to focus conservation efforts internationally. New measures in the MSRA include a certification program that identifies nations whose vessels engage in protected species bycatch. If nations receive a negative certification, imports can be prohibited. The advantages of the MSRA certification program could be compared to other trade measures. Other potential measures include the use of an import tariff for fisheries with a greater impact on leatherback turtle mortality. Similarly, Section 8 of the ESA stipulates assistance to foreign countries to help in the development and management of programs aimed at the conservation of ESA-listed species. Programs that provide direct payments for conservation have been considered in theory (Ferraro 2007) but have only been attempted on a very limited basis.

ii. Data Gaps

1. Relevant examples of applications of Section 8 of the ESA to provide assistance to foreign countries to help in the development and management of programs aimed at the conservation of ESA-listed species.
2. Examples of application of MSRA requirements to work internationally at reducing bycatch of protected living marine resources.
3. Evidence on whether similar measures might be effective for addressing sea turtle conservation concerns in west coast-based swordfish fisheries.

iii. Strategy

1. Review available information regarding the range of conservation measures employed in other U.S. fisheries facing similar sea turtle conservation problems as those faced by west coast-based swordfish fisheries.
2. Obtain information that could be used to evaluate the cost and feasibility of employing alternative conservation strategies to those already in use (i.e. turtle caps, time/area closures, and gear restrictions) in west coast-based swordfish fisheries, being aware that a U.S. fishery cannot operate if it is likely to jeopardize the continued existence of an ESA-listed species.

This research would start with an international-level review of activities that pose threats to leatherback sea turtle populations, including industrial and artisanal fisheries, harvest of turtles or their eggs, and loss and degradation of coastal habitat. For example, artisanal and small-scale coastal fisheries throughout Asia, Indonesia, Ecuador, Peru, and Chile are believed to be significant sources of leatherback mortality. Information about the global distribution of threats to protected turtle populations would be used to explore the feasibility for formal and informal international agreements, gear research, and other sea turtle conservation initiatives. Part of the assessment process would be to determine the comparative advantage and efficiency of sea turtle conservation measures to the various countries involved. Next the research would seek to identify the most cost-efficient sea turtle bycatch mitigation and conservation measures and to develop mechanisms for equitable sharing of the costs over domestic consumers, producers, processors, and foreign producers.

D. Is Harpoon a Viable Substitute for Longline or Drift Gillnet Gear?

i. Background

Some commentators have suggested that harpoon gear could serve as an economically viable substitute for SSLL and DGN gear. There are no records of bycatch in west coast-based harpoon fisheries, leading some individuals to view harpoon as a potentially clean and economically viable substitute to using SSLL or DGN to target swordfish in the EEZ. This notion ignores the limitations of harpoon gear, and the comparative advantages of the three known commercial swordfish gear types.

Generally speaking, harpoon gear is best suited to near-shore calm water. Harpoon gear requires that individual fish are spotted basking near the surface during the day. Success depends on fish behavior and on a state of relatively calm seas and clear conditions. Off the California coast, the harpoon fishery is limited to the Southern California Bight. Due to inherent limitations of harpoon gear and the high fossil fuel costs of searching for individual swordfish basking on the surface, many fishing industry participants believe it is not an economically viable substitute for longline or DGN gear.

ii. Data Gaps

1. Cost and earnings data that reflect the economic viability of using different gear and techniques for west coast-based swordfish fishing.
2. Data on sea turtle take rates and other bycatch rates for alternative fishing modes off the West Coast.

iii. Strategy

1. Consider the feasibility of conducting experiments inside the west coast EEZ with alternative swordfish fishing modes to collect relevant bycatch and cost and earnings data for harpoon, DGN, and longline fishing. These data would be used in conjunction with PacFIN fish ticket data to compare the fisheries from the standpoints of environmental impacts and economic viability.

III. Management/Policy Issues

Given the vocal opposition to DGN and/or SSLL fishing on the West Coast on the one hand, and the need for approval of important research and exploratory opportunities on the other, obtaining support from a range of parties prior to engaging in any future cooperative research plan will be imperative. These parties include NGOs, NOAA, the fishing industry, the legislature, and the public. The adversarial political climate resulting from litigation and ongoing opposition from various factions has made it difficult to even engage in a broad policy debate on U.S. west coast fisheries management, or to objectively review proposals and develop initiatives that attempt to reconcile fishing with conservation. To open lines of communication among the diverse stakeholders will require education and outreach both within and outside NOAA.

The SWR has initiated outreach and education efforts to address concerns about swordfish fisheries off the West Coast, including the goals and objectives of the proposed experimental fishing permit using innovative SSLL gear to target swordfish. The SWR and SWFSC have also been working to develop research projects that align with regional management needs. The current SLUTH workshop is an outcome of efforts to develop a coordinated research initiative and to bring industry representatives into the conversation.

As part of the education and outreach program for SLUTH, this report as well as additional supplementary information will be distributed and additional workshops with the various stakeholders will be conducted. When appropriate, information will be distributed via the FishWatch website[4]. Some elements of the education/outreach program viewed as critical by the SLUTH participants are detailed below.

A. Promote the Concept of Ecological Footprint of International Versus Domestic Fisheries

In the Pacific Ocean leatherback recovery will be best served by a healthy domestic fishery with low bycatch and mortality levels coupled with a holistic approach to conservation (Dutton and Squires 2008). The concept of a fishery's "ecological footprint" needs to be further developed and could become an integral component of any outreach campaign. The ecological footprint will include not only turtles taken in domestic or international fisheries, but all target and non-target species that are both marketable and discarded. In particular, it will be important to include sharks, given the global concern about population levels (Bonfil 1994; Myers et al. 2007). Questions that need to be addressed are detailed below. When progress requires additional information, data gaps and strategies are identified.

i. Which U.S. fishery (SSLL versus DGN) has the smallest ecological footprint (i.e. Cleanest Gear Concept)?

1. Background

Both DGN and SSLL are effective gears for targeting swordfish. Based primarily on a time series of DGN observer records, and without considering protected resource interactions, it has been suggested that the ecological footprint associated with finfish bycatch is higher for DGN gear than it is for SSLL gear, even prior to the gear modifications mandated in 2004. Unfortunately, a direct ecological or economic comparison of the two gear types is not possible because of the geographic separation between the two fisheries. The DGN fishery has operated in the U.S. EEZ from the U.S./Mexico border to the Oregon/Washington border but is now constrained primarily to the Southern California Bight due to the PLCA. The swordfish longline fishery has operated primarily outside the U.S. EEZ on the high seas. Nonetheless, observer data are informative in demonstrating differences in the numbers of discarded bycatch (Appendix D).

While comparisons are limited, one can gain insight into potential economic and ecological differences by comparing the catch ratio of target species to non-target species caught[5] using observer data from these two fisheries. One approach is to calculate the numbers of swordfish

[4] www.nmfs.noaa.gov/fishwatch/

[5] With the addition of price data for marketable species catch, one can use such information to relate the financial value of target species (swordfish) catch per 100 incidental catch of a given non-target species.

caught per 100 non-target species caught examining species that are both marketable and discarded bycatch (Appendix D).

From an economic standpoint, NMFS is interested in the question of how many marketable species are caught for a given level of discarded bycatch. One can address this question by considering the right-most columns in the table (Appendix D) showing the numbers of swordfish caught per 100 non-target species, specifically those that are not marketable.

A similar approach can be used to compare the ecological footprint of the two fisheries considering all species. A quick comparison of the two gear types suggests that the number of swordfish caught per 100 non-target finfish species (both marketable and discarded bycatch) is typically higher for longline gear (Appendix D), indicating a lower rate of bycatch. Overall, eight times as many non-target finfish were taken with DGN gear in the EEZ for every swordfish caught in comparison to SSLL gear outside the EEZ. Comparisons between the two fisheries are, however, complicated by the geographic separation of the fisheries and shifts in species distributions. Also, the California Current, where the DGN fishery primarily operates, is a highly productive boundary current system that may have a greater abundance of fish vulnerable to this gear type.

<u>2. Data Gaps</u>

a. Protected species and non-target finfish catch rates (including discarded and marketable species) using modified SSLL and DGN gear in historic swordfish fishing grounds in the U.S. EEZ.
b. The economic viability of SSLL and DGN gear under present market conditions, considering all losses and gains due to fishing activity costs including valuation based on the ecological footprint.

<u>3. Strategy</u>

a. Conduct gear comparison studies to examine composition of catch, both target and non-target species, with special attention to sharks.

An experiment employing SSLL and DGN gear in the PLCA during the fall would help identify differences in the swordfish catch and incidental-take rates for the two gear types. The SSLL used would need to conform to the configuration recently proven in the Hawaii SSLL fishery to reduce sea turtle interactions (i.e. circle hooks and mackerel-type bait). Conducting an experiment during the same season and area should implicitly control for influences that vary across time and location, narrowing the comparison to differences in catch rates and economic viability that are attributable to the distinct gears. Given the long time series data available for DGN observer trips, a scaled-back version of the experiment using only SSLL could be considered. In order to conduct a robust experiment, a power analysis will be needed to determine the number of sets required to obtain a statistically valid comparison. An important component of this experiment would be an evaluation of the economic viability of the two gear types, which requires a comparison of their respective idiosyncratic costs such as bait, net repair, crew, light sticks, pingers, onboard processing time, fuel, etc.

In addition to comparing the ecological footprint of the two gear types, longline operations would provide the opportunity to test gear and bait modifications to minimize bycatch of non-target species, focusing mainly on sharks, but also on rarely caught species such as turtles. The shark species with the highest catch rate in both the DGN and offshore SSLL fishery is the blue shark, which has no market value in the U.S. There are a number of experimental methods under development that show promise in reducing shark bycatch including chemical and electropositive/electromagnetic deterrents (Gilman et al. 2007). Given the high catch rates of sharks, statistically significant results could be obtained with relatively few sets, the number of which would be determined using power analysis. For limiting turtle bycatch, gear modifications that have been proposed include altering the wavelengths emitted by light sticks or shading them so they cannot be seen from above (Wang et al. 2007). Tests on new light sticks could be initiated in the experimental fishery although given the low catch rates of sea turtles, additional studies, possibly in the laboratory or in other areas, may be necessary to make conclusions. In addition, the impacts of different methods on the catch rates of target species could also be calculated. Any experiment would need to be conducted in a way that ensures it does not jeopardize any ESA-listed species.

ii. Where is imported swordfish coming from by season? What management measures, regulations and levels of enforcement exist for those fisheries?

1. Background

Developing greater public awareness of the ecological costs of importing swordfish is critical to efforts to encourage a sustainable U.S. fishery. To estimate this ecological cost requires detailed information on the fisheries from which swordfish are being imported, an assessment of their regulations and fishing methods including hook and bait type, and an estimation of the leatherback bycatch in these fisheries.

2. Data Gaps

a. Fisheries dependent and independent information from foreign swordfish fleets and associated marketing and export sectors.
b. An assessment of management measures and fishing practices in countries from which swordfish are imported into the U.S.

3. Strategy

a. Survey importers and exporters supplying the U.S. market throughout the year to assess the relative contribution of different fleets.
b. Survey international fisheries to obtain an estimate of the ecological footprint.

The approach will be to identify countries providing the majority of U.S. imports annually and examine the regulations, enforcement, and fishing practices. It will be necessary to examine temporal and spatial patterns in fishing activity with the probability of overlap with turtle habitat, factoring in migratory patterns and time spent on foraging grounds. This may include increased observer coverage/data, expanded port sampling programs, and cooperative information exchange programs with regional fishery management organizations.

B. Develop Internal NOAA Support (Regions, Science Centers, and Headquarters).

The campaign to build internal support will require reaching out to NOAA Regional and National line offices and NOAA Fisheries leadership in Silver Spring. In addition, working with NOAA headquarters to tie regional initiatives to international efforts to implement new requirements under MSRA will be important.

C. Bring Conservation NGOs Onboard.

One key partnership that needs further development is between the existing SLUTH team and the NGO community. The SLUTH team has contacted several NGOs that have shown a genuine interest in working cooperatively with managers and fishermen to support the cleanest swordfish fisheries possible for the West Coast, recognizing the importance to turtle conservation of fostering U.S. domestic fisheries. Two in particular, the World Wildlife Fund (WWF) and The Nature Conservancy (TNC), have actively partnered with SWFSC scientists to address Pacific sea turtle conservation within a multidisciplinary framework that goes beyond just bycatch reduction in high seas fisheries (Steering Committee, Bellagio Workshop, 2004; 2008). In addition, WWF has sponsored the International Smart Gear Competition that brings together fishing industries, research institutes, universities, and government to inspire and reward practical, innovative fishing gear designs that reduce bycatch.

CONCLUSIONS:

The SLUTH workshop brought together a multilateral consortium of diverse stakeholders interested in maintaining healthy leatherback sea turtle populations while supporting viable U.S. swordfish fisheries. Stakeholders include the fishing industry, scientists, fisheries managers, and policy makers with the goal of including NGO's in future efforts. A prime concern of workshop participants was the possibility that the management measures, while detrimentally impacting west coast swordfish fisheries, may have resulted in an overall increase in turtle take due to a transfer effect to foreign fleets. The goal of the workshop was to explore how to couple adaptive fisheries management schemes with a holistic approach to leatherback sea turtle conservation, to the benefit of both leatherback populations and the U.S. fishing industry. Having an active, well managed and regulated U.S. fishery provides leverage to promote Pacific-wide sea turtle conservation. Such a fishery also provides an incentive to develop innovative bycatch reduction gear and alternative methodologies that can be exported to other countries whose fishing fleets interact with leatherback turtles.

Throughout the workshop, the group identified scientific, economic, and policy data gaps and strategies needed to develop a more adaptive management scheme for domestic swordfish fisheries while achieving low bycatch of leatherback sea turtles and advancing Pacific-wide conservation efforts. Central to achieving the above goal is gathering additional information on the habitats of both swordfish and leatherbacks, respectively, to allow for the possibility of predictive modeling, as well as identifying methods to maximize the selectivity of fishing gear and minimize the ecological footprint of U.S. fleets while maintaining economic viability and U.S. supply. Any mechanisms or management schemes identified and proven successful can then be exported internationally.

When possible, the economic and policy implications of the current management regime need to be quantified. This approach will help identify the most efficient options for domestic and international fisheries management and turtle conservation. The SLUTH workshop was the first step in moving forward in these efforts and will be a foundation for seeking funding and support for a multi-year and multi-faceted effort. This effort incorporates ecosystem considerations into the management of U.S. fisheries and protected species.

ACKNOWLEDGEMENTS:

The collaborative and productive nature of the workshop is a testament to the efforts put forth by all the workshop participants. We thank them for their valuable time and input. The content of the workshop report represents the combined contributions of a large group of people who all deserve recognition and thanks including Suzanne Kohin, Tomo Eguchi, Elizabeth Petras, Heidi Hermsmeyer, and Yonat Swimmer. We also thank Steve Foltz, Scott Aalbers, Peter Flournoy, Pete Dupuy, Jeremiah O'Brien, Kathy Fosmark, Bill Sutton, Jim Lecky, Roger Hewitt, Anne Allen, Russ Vetter, Lisa Ballance, Jeffrey Seminoff, Chris Yates, Heidi Taylor, Mark Helvey, Siri Hakala, Adam Bailey and Alvin Katekaru for their valuable comments and editorial assistance.

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Appendix A:

List of workshop participants

SLUTH Attendance List

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APPENDIX B:
SLUTH Workshop Agenda

May 28: 9:00 a.m. - 3:00 p.m.

Opening Remarks – Peter Dutton (SWFSC), Mark Helvey (SWR)

Introduction - Peter Flournoy, Facilitator
Housekeeping

- finalize agenda
- workshop schedule

Presentations

- Overview and Current Status of the Swordfish Fishery off the West Coast
  - Craig Heberer (SWR) – Summary of West Coast DGN, Harpoon, and Longline fisheries for swordfish
  - Oscar Sosa Nishizaki - Description of swordfish fisheries off Northern Baja, Mexico
  - Tina Fahy (SWR) – History of protected resources management related to West Coast swordfish fisheries, including recent leatherback Critical Habitat petition
  - Suzy Kohin (SWFSC) – Overview of swordfish stock status
  - Kathy Fosmark et al. – Fishers perspective (topic TBA)
- Oceanography of the California Current
  - Stephen Bograd (SWFSC)
- Jellyfish biology and distribution
  - Jennifer Purcell (Western Washington University) - Insights from jellyfish biology and distribution
- Gear innovations and fishing practices
  - Jeremiah O'Brien - Swordfish fishing practices and insights on habitat
  - Darin Mauer - Dynamics of spotting swordfish
- Past, Present, and Future Swordfish Research off the West Coast
  - Heidi Dewar - Swordfish vertical habitat use
  - Chugey Sepulveda - Fine scale habitat use

May 29: 8:30 a.m. – 5:00 p.m.

Presentations (cont.)

- Past, Present, and Future Leatherback Research off the West Coast
  - Scott Benson (SWFSC)
- Tools for Adaptive Management and Predictive Modeling
  - Steven Bograd (SWFSC) – PIFSC TurtleWatch Program
  - Tomo Eguchi (SWFSC) – Predictive modeling to minimize protective species fisheries interactions

Plenary Discussion

Open discussion. Review and elaboration of objectives and questions posed for the three working groups.

Working Groups (Divide into working groups to address topics)

- Reduction of encounter rates
  Step 1: Identify habitat overlap
  WG1: Habitat
  - Identify most pressing questions - is there spatial or temporal separation in habitat use of swordfish and leatherbacks?
  - Identify best methods, tools, experimental design, location, time, potential for data mining and the potential for dove-tailing with existing programs.
  - What is the role of fishermen/cooperative projects?

  Step 2: Developing strategies for adaptive management
  WG2: Predictive Modeling
  - Identify most pressing questions-what do fishers need? What do fisheries managers need?
  - What is needed for implementation?
    - Timing
    - Method
  - Role of fishermen/cooperative projects?

- Reduction of entrapment:
  WG3: Gear modification, both drift net and longline
  - What gear modifications exist that might be applicable?
  - What new innovative ideas are out there?
  - Logistics to develop and or test new or old methods
    - Is there a role for behavioral studies? What questions exist?
    - If so what studies could help understand and mitigate entanglement?
  - How do we move forward?
    - Role of fishermen/cooperative projects?

- Economics:
  Based on comments during the meeting it was clear that some discussion of economic options and considerations would be useful so this was added as a working group.

Reconvene Plenary Discussion - outcomes of Working Groups

Next Steps

- Research and Data Needs
- Outcome of workshop – development of cooperative research proposals
- Drafting workshop proceedings

Concluding Remarks

<u>APPENDIX C:</u>
Brief report from LUTH cruise.

Telemetry studies have revealed that endangered Western Pacific leatherback turtles (*Dermochelys coriacea*) associate with dynamic offshore oceanographic features (e.g., fronts) within a former part of the range of the California drift gillnet fishery. This fishery targeted primarily swordfish and was subject to a time/area closure in 2001 because of leatherback bycatch. To better understand the overlap of leatherbacks and swordfish and to support the development of new mitigation approaches, a multidisciplinary survey was conducted during August-September 2008 in this region. The Leatherback Use of Temperate Habitat (LUTH) survey, a collaborative 'process-oriented' ecosystem investigation sponsored by NOAA - Southwest Fisheries Science Center, involved oceanographic and prey sampling aboard the NOAA Ship *David Starr Jordan*. Components of the research included studies of swordfish habitat, near real-time satellite oceanography, and aerial surveys of leatherback turtles and their jellyfish prey. In addition, electronic tagging data were collected from leatherback turtles tagged at California foraging grounds and at Indonesian nesting beaches during summer 2007. The objectives of LUTH were: 1) to conduct an ecosystem assessment in offshore waters of central California, including traditional swordfish fishing grounds; 2) to identify leatherback foraging areas via shipboard oceanographic and prey sampling, aerial surveys, and satellite telemetry; 3) to identify swordfish habitat and to fish for and satellite tag swordfish; and 4) to determine how areas used by leatherbacks may overlap with swordfish habitat.

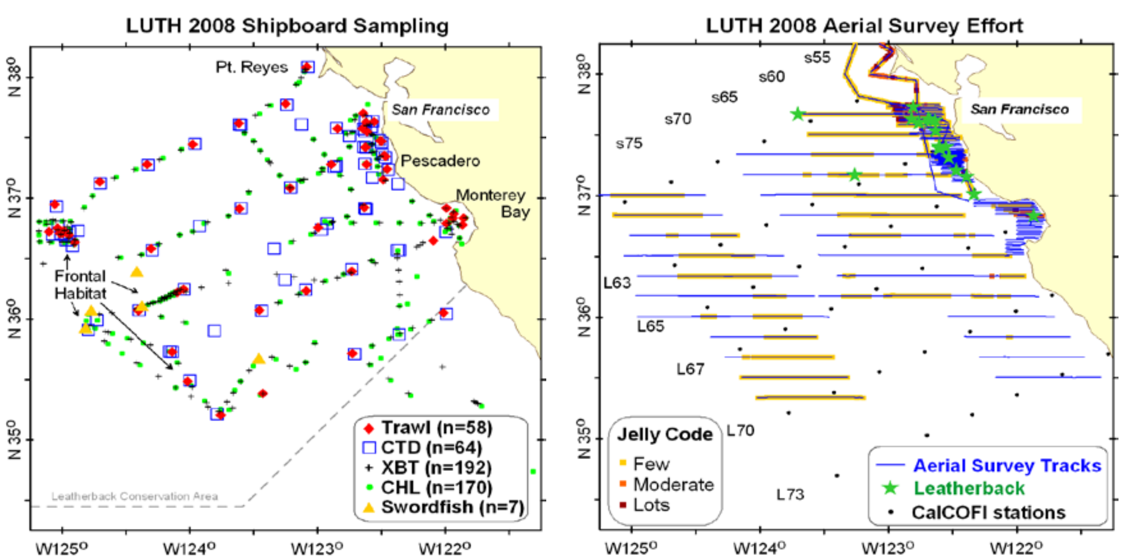


Figure C1. Cumulative plots of data collected during LUTH 2008 shipboard sampling and aerial survey efforts off the central coast of California. Swordfish include those either caught or observed.

The cruise was divided into two 14-day legs, and sampling was dynamic as features of interest were encountered. Daily satellite images from our land-based team helped guide the location of targeted sampling, and the aerial survey team documented turtles, jellyfish, marine mammals, and other species. During the first week, the team completed several CalCOFI (California Cooperative Oceanic Fisheries Investigations) stations and four night-time sets to catch swordfish for telemetry studies (Fig. C1). Four swordfish were caught and two were biologically sampled. During the second week, a detailed assessment of prey, oceanographic conditions, and the foraging behavior of three leatherbacks was completed in an important near-shore foraging area off San Francisco, as a comparison to offshore habitats. Weeks three and four yielded opportunities to conduct extensive sampling of an offshore frontal region and to complete a detailed sampling grid within the target study area (Fig. C1).

Preliminary results of the cruise indicate that the offshore frontal regions contain aggregations of large jellyfish that could provide foraging opportunities for migrating leatherbacks; however, offshore jellyfish aggregations were significantly less than those found in neritic waters. Jellyfish and jelly predators such as ocean sunfish (*Mola mola*) were consistently found on the cold-water side of these fronts, while the swordfish were seen and captured on the warm-water side. Several novel sampling techniques, including optical plankton analysis (AC-S) and a multibeam acoustic prey assessment were tested during this cruise and the results appear promising. Most significantly, the multidisciplinary approach that combined diverse sampling techniques in an adaptive sampling framework yielded many new insights into ecosystem processes and how species such as leatherbacks utilize the dynamic marine environment. The data will be analyzed during the coming year and results will provide a new foundation for developing conservation and management strategies to protect and recover leatherback turtles.

APPENDIX D:

Comparison of catch of the major finfish species observed in the California-based drift gillnet and shallow set longline fisheries.

Catch of the major finfish species for all observed CA-based shallow set longline sets, October 2001 through February 2004. N = 469.

Species	Total Obsvr Catch	Catch per 100 SWO	SWO Catch per 100 Finfish
Blue shark	5,575	74.2	135
Albacore tuna	460	6.1	1,633
Shortfin mako shark	249	3.3	3,017
Bigeye tuna	223	3.0	3,369
Pelagic stingray	125	1.7	6,010
Dorado	65	0.9	11,557
Common mola	51	0.7	14,729
Opah	36	0.5	20,867
Unidentified mako shark	33	0.4	22,764
Yellowfin tuna	18	0.2	41,733
Striped marlin	12	0.2	62,600
Billfish, Unidentified	12	0.2	62,600
Bluefin tuna	11	0.1	68,291
Skipjack tuna	10	0.1	75,120
Bigeye thresher shark	8	0.1	93,900
Blue marlin	4	0.1	187,800
Swordfish	7,512		

Catch of the major finfish species for all observed drift gillnet sets 1990 through January 2008. N= 7,891.

Species	Total Obsvr Catch	Catch per 100 SWO	SWO Catch per 100 Finfish
Common mola	49,691	298.5	33
Blue shark	21,692	130.3	77
Albacore tuna	16,564	99.5	100
Skipjack tuna	9,550	57.4	174
Shortfin mako shark	7,183	43.2	232
Pacific mackerel	6,210	37.3	268
Common thresher shark	5,945	35.7	280
Opah	4,548	27.3	366
Bluefin tuna	3,744	22.5	445
Bullet mackerel	3,020	18.1	551
Pacific bonito	941	5.7	1,769
Louvar	748	4.5	2,225
Bigeye thresher shark	607	3.6	2,742
Yellowfin tuna	512	3.1	3,251
Striped marlin	397	2.4	4,193
Pelagic thresher shark	77	0.5	21,618
Blue marlin	52	0.3	32,012
Bigeye tuna	20	0.1	83,230
Swordfish	16,646		

Agenda Item D.1.b
Supplemental NMFS Powerpoint (Squires)
April 2009

Report on SLUTH Workshop

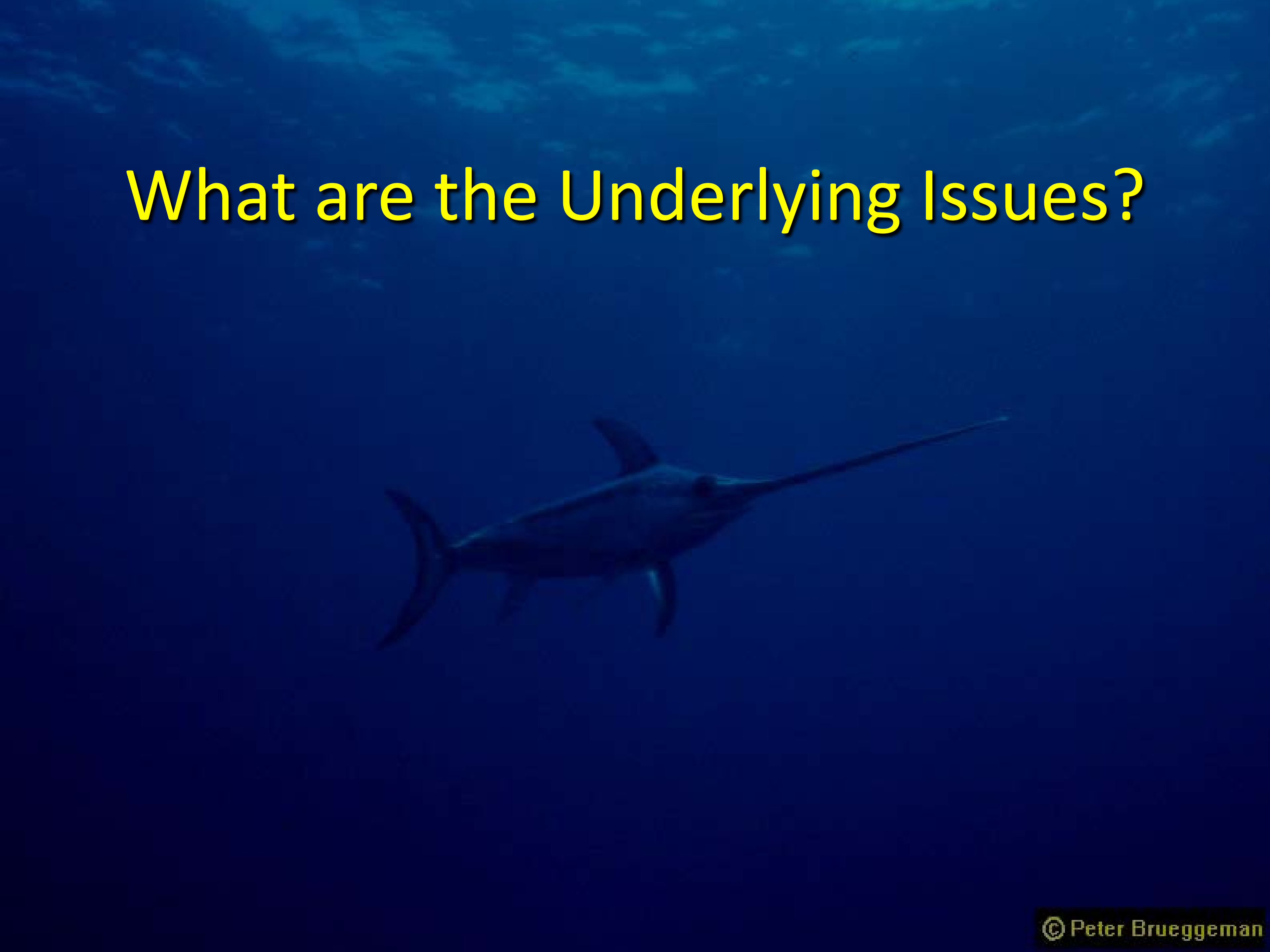
Workshop May 28-29, 2008

Swordfish and Leatherback Use of Temperate Habitat

What is SLUTH?

- Proposed inter-disciplinary research program to improve scientific knowledge for fisheries management and leatherback conservation.
- First in a series of workshops to identify elements necessary for this research program.
- Establish broad-based and cooperative research process.
  - Includes scientists, managers, industry, NGOs

What are the Underlying Issues?



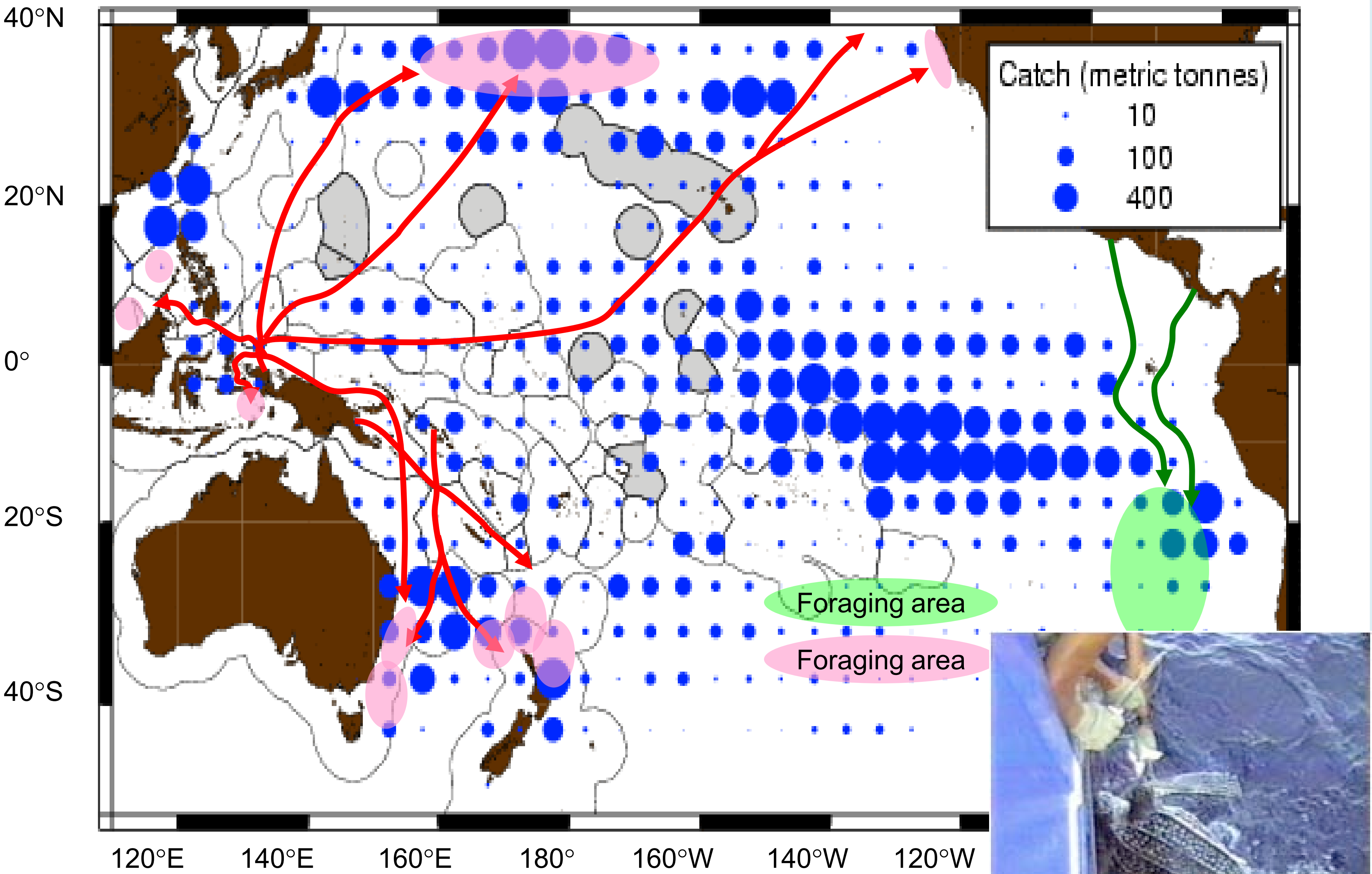
Population Status

- Pacific leatherback populations are endangered and declining
- Multiple sources of mortality include
  - Nesting site threats
  - Coastal fisheries around Pacific
  - High seas fisheries from multiple nations across Pacific

Transboundary & International Issues

- Leatherbacks are transboundary
- Nest in Western Pacific but migrate to multiple foraging areas around Pacific
  - Includes U.S. West Coast
- Interact with multiple fishing fleets throughout their migration
- Minimal conservation measures around Pacific

Distribution of longline catches of swordfish in the Pacific reported for 2004 and movements of western and eastern Pacific leatherback turtles 2005-2008

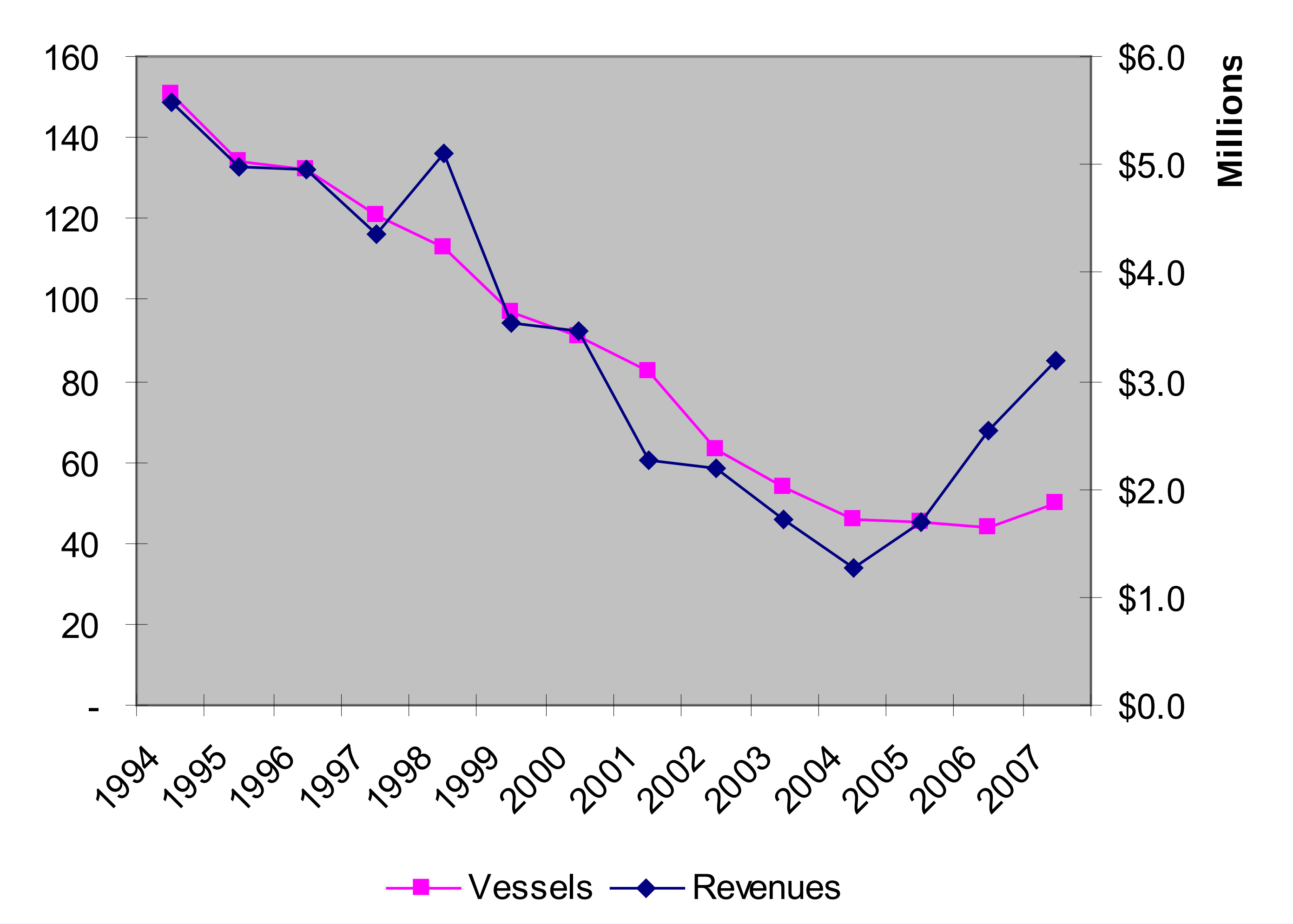


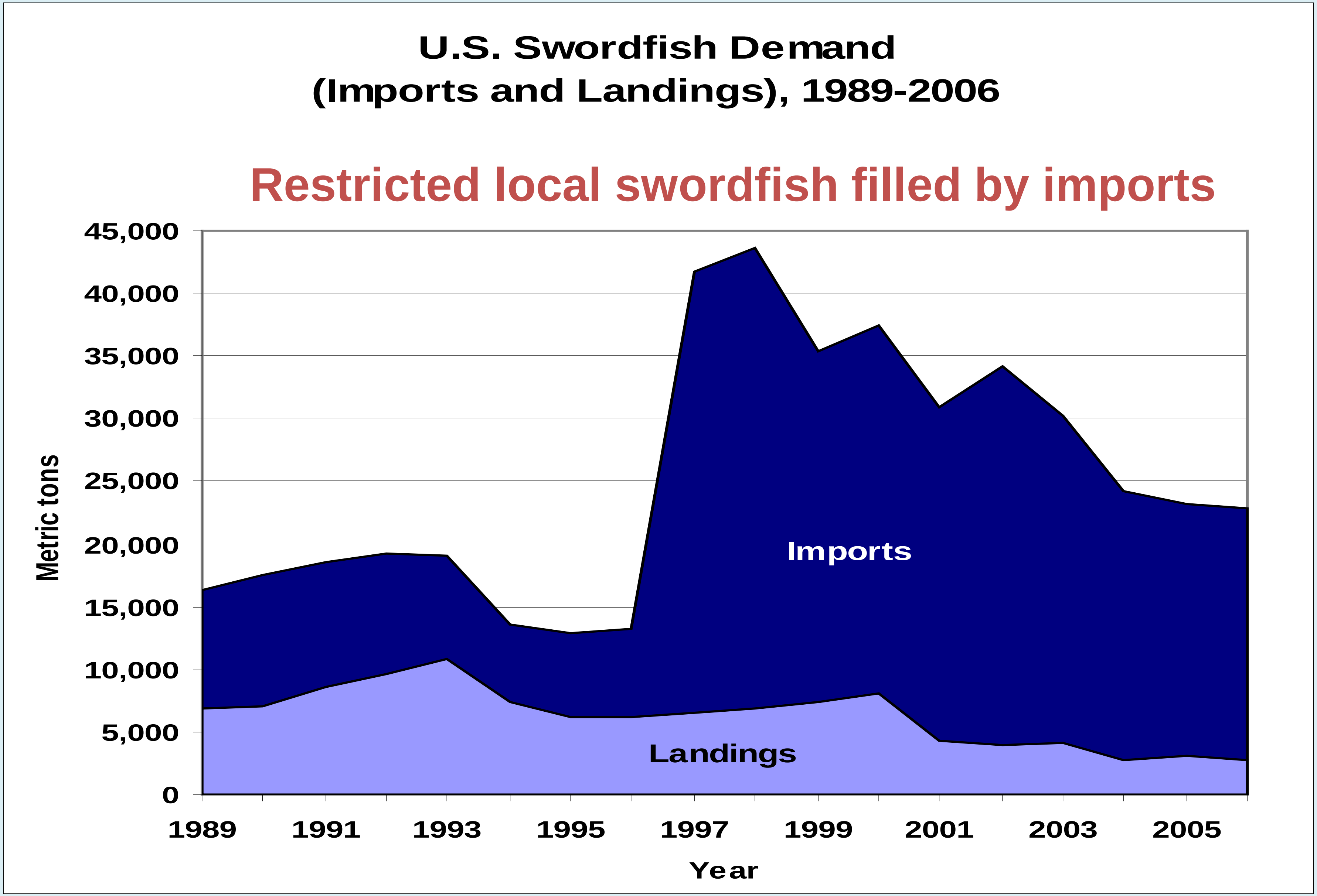
Source: Benson et al. unpublished; Shillinger 2008, modified from PFMC 2009.

U.S. West Coast Swordfish Fishery

- Declining revenue
- Declining vessel numbers
- Impact not just on fishers
  - 1) Includes processors, ports, service industries
  - 2) Reduced availability of fresh, locally caught product for consumers

Active West Coast DGN Vessels and Nominal Revenues




U.S. Swordfish Demand
(Imports and Landings), 1989-2006
Restricted local swordfish filled by imports
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Metric tons
Imports
Landings
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year

U.S. Conservation

- U.S. has taken the lead on conservation measures
- Endangered Species Act
- Magnuson-Stevens Act
- Marine Mammal Protection Act
- U.S.-type conservation is rare in the Pacific

SLUTH Research Recommendations

Inter-disciplinary research program to improve scientific knowledge for fisheries management and leatherback conservation

Science Research Elements

- Two Ways to Minimize Bycatch Mortality:
- 1. Fish where there are no turtles
- 2. Change gear, bait, and practices
- What are environmental costs of swordfish consumption in the U.S.?
  - Both domestic and foreign sources

Reduce Encounter Rates

- Is there separation between sea turtles and swordfish that allows more fine-tuned management?
- Requires Knowing:
- What are the spatial and temporal patterns in habitat use for swordfish and sea turtles?
- Vertical or horizontal separation
- Ecosystem and life history context
- Foraging areas, migration patterns, oceanographic influences on movements

Reduce Encounter Rates

- Explore feasibility of model-based adaptive management
  - Real-time response by fishers to dynamic environment
  - E.g. a web-based tool to predict probability of turtle encounters by area

Minimize Entanglement and Entrapment

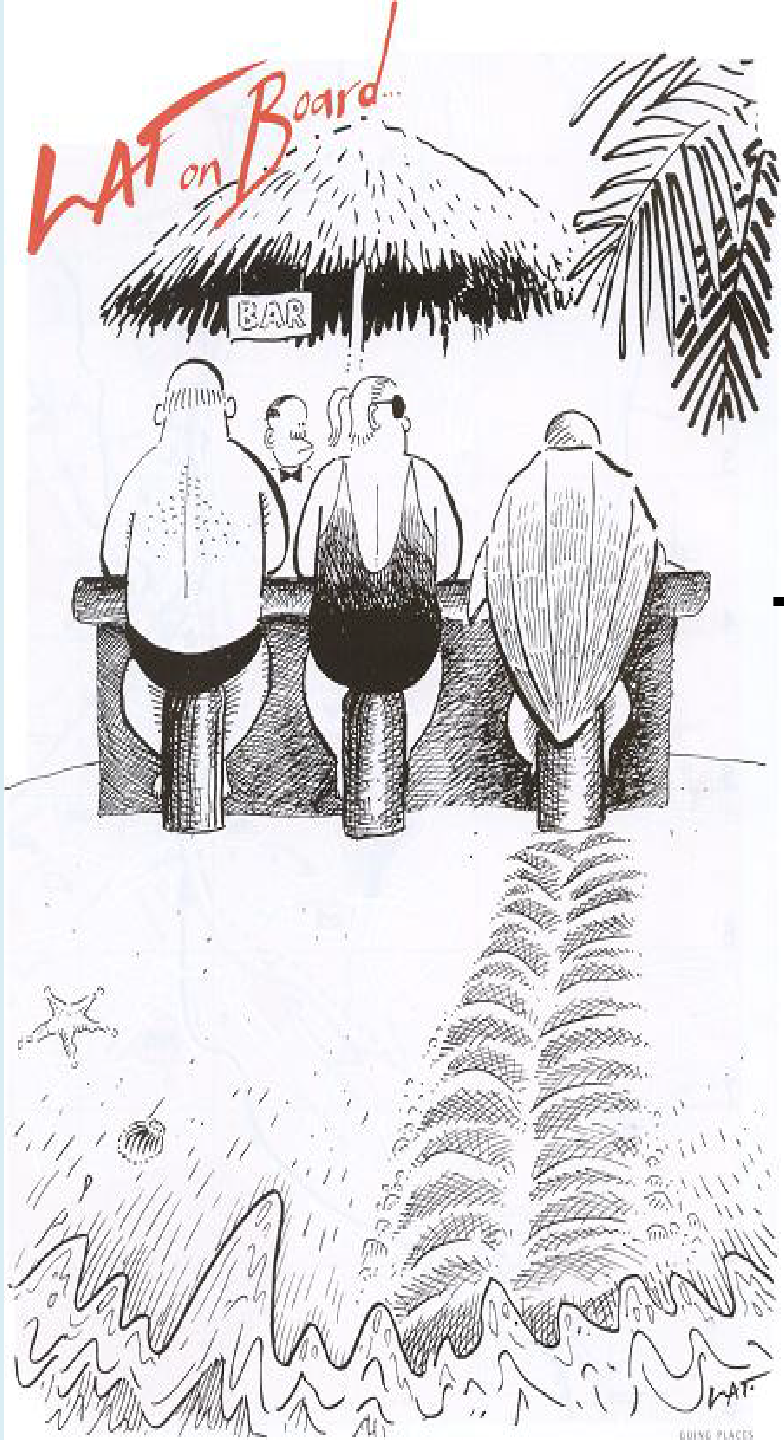
- Are there gear and/or operational modifications that can potentially minimize bycatch?

SLUTH and Sustainable Fishing

- SLUTH spearheads scientifically based leatherback population recovery.
- Allows U.S. fishers to be at the forefront of global sustainable fisheries.
- Export lessons learned to rest of the world.

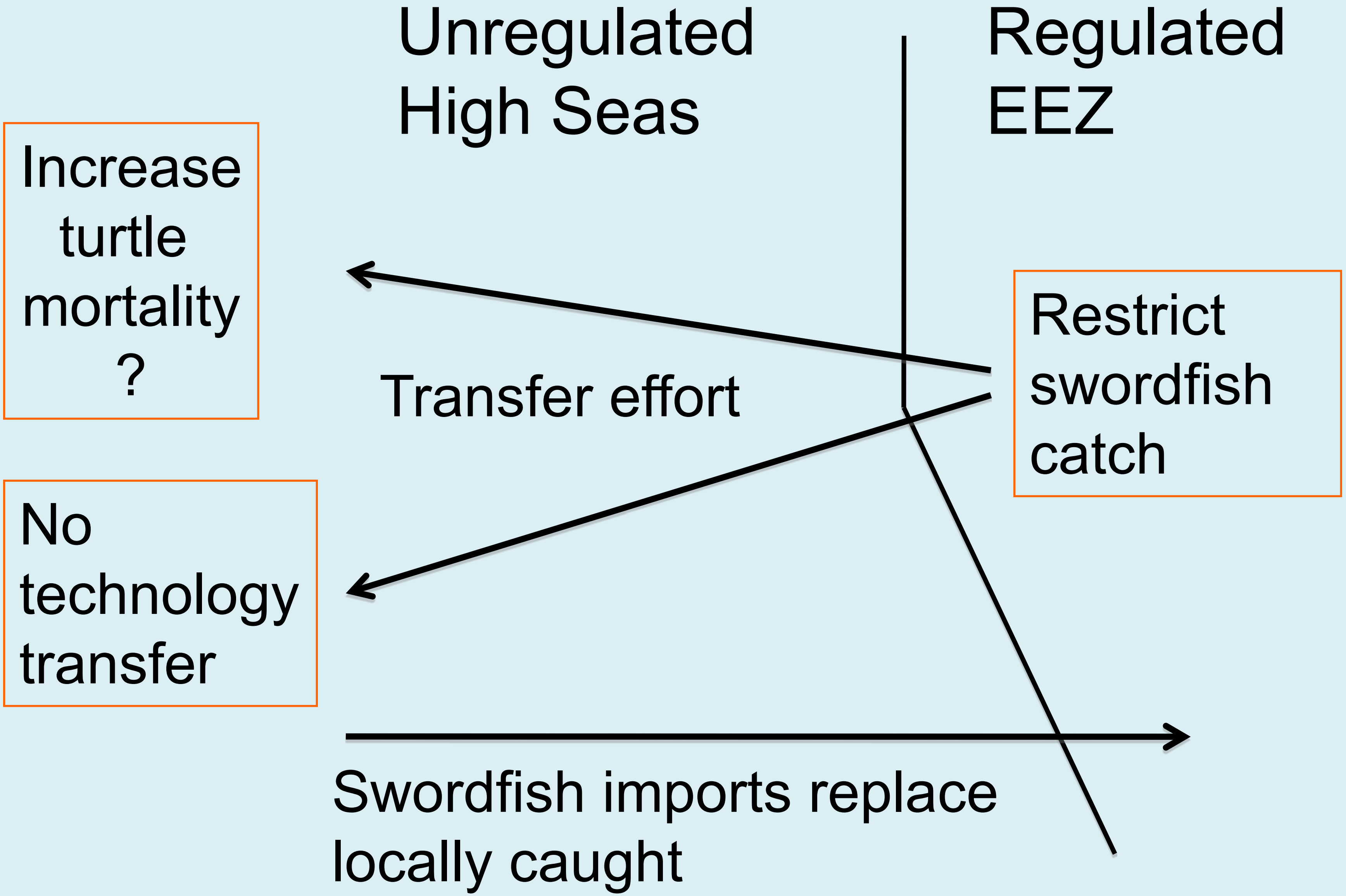
Economic Research Questions

- Transfer effects hypothesis
- Demand and import analysis
- Spillover effects onto other species & ecosystems
- Least-cost conservation alternatives
  - Orders of magnitude difference between nesting site and at-sea protection
- Economic viability of alternative gears and bycatch reduction measures



Thank You!

Transfer Effects Hypothesis



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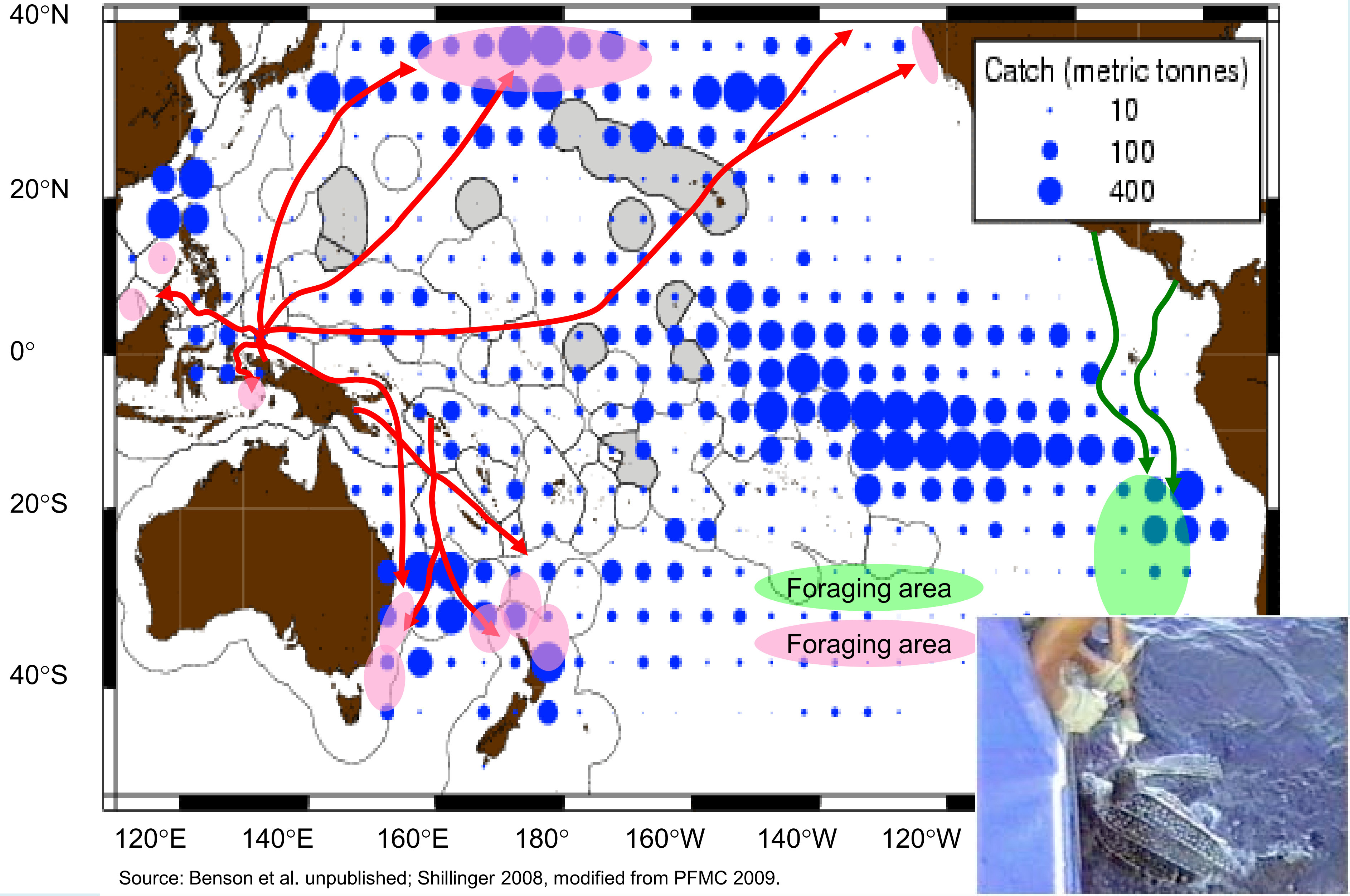
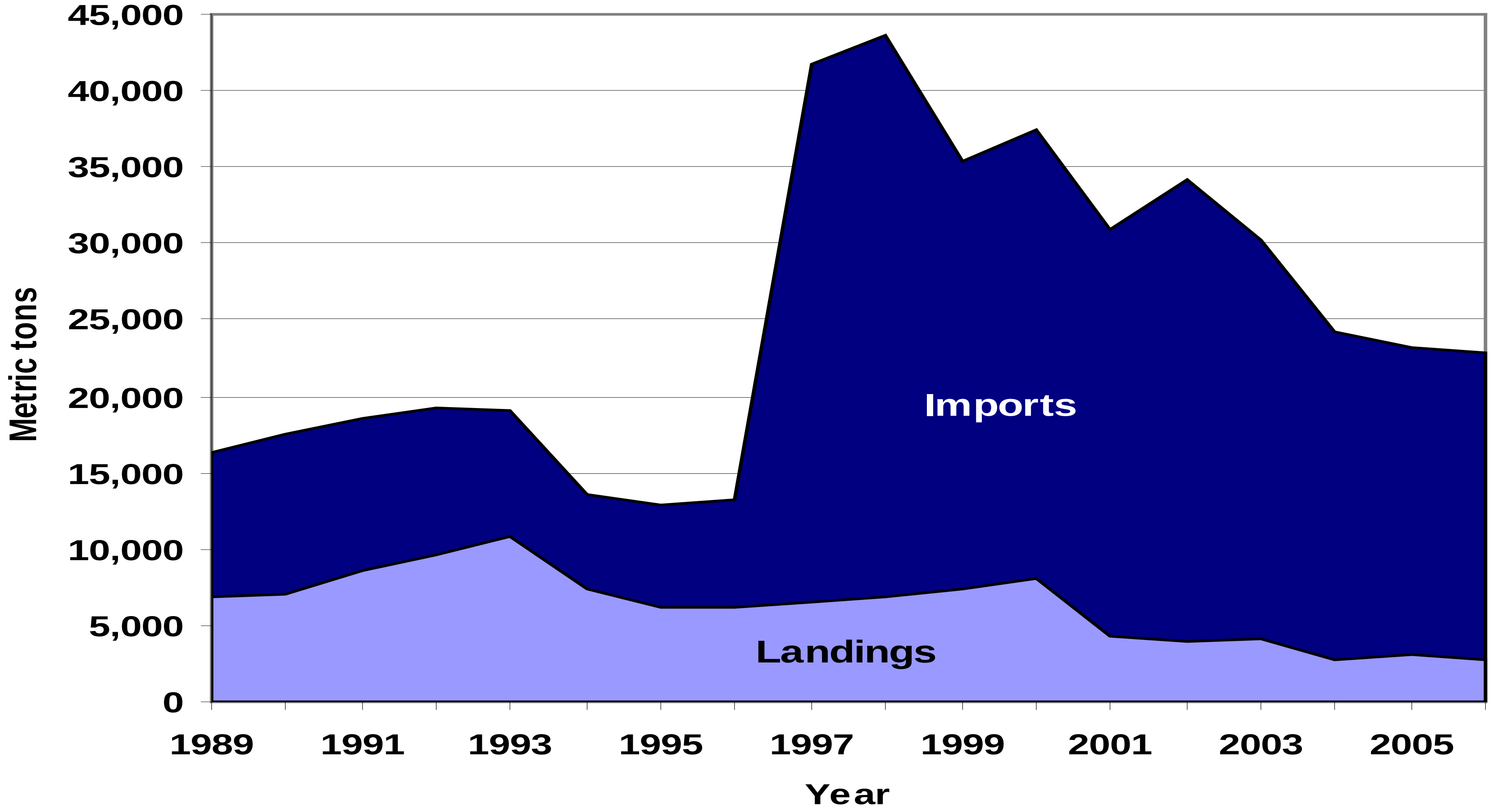


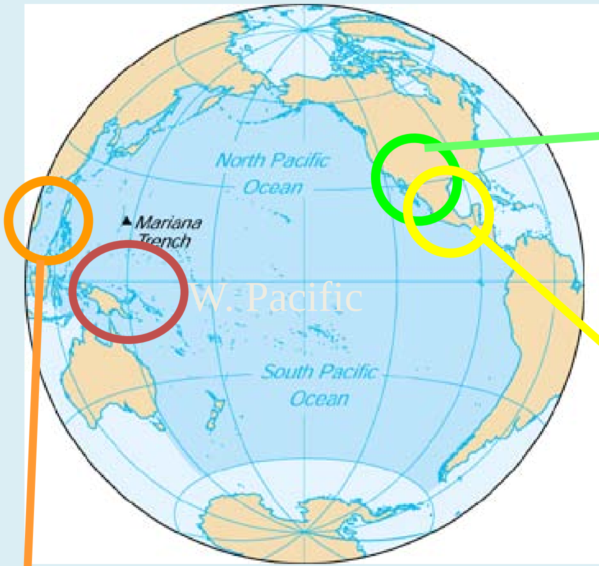
Source: Benson et al. unpublished; Shillinger 2008, modified from PFMC 2009.

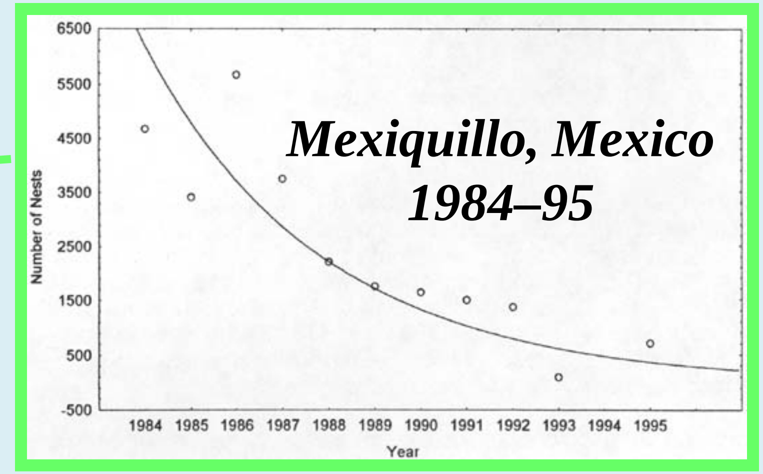
U.S. Swordfish Demand (Imports and Landings), 1989-2006

Reduced local swordfish filled by imports

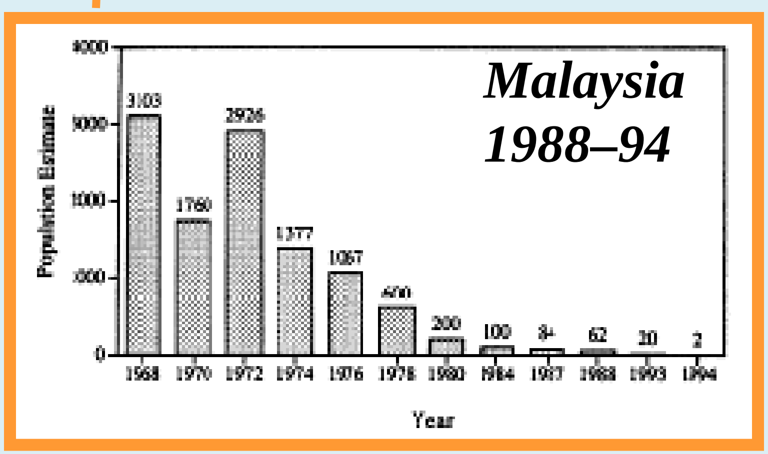


Decline of Pacific Leatherback Turtles

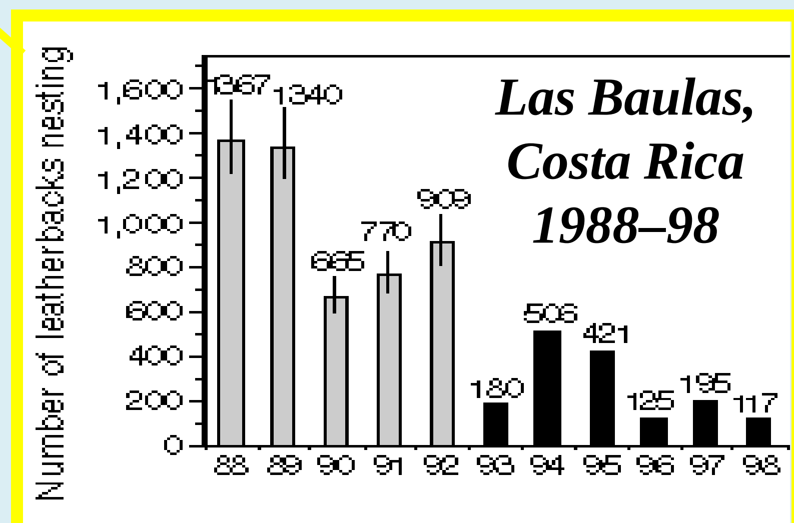




Source: Sarti et al. 1996

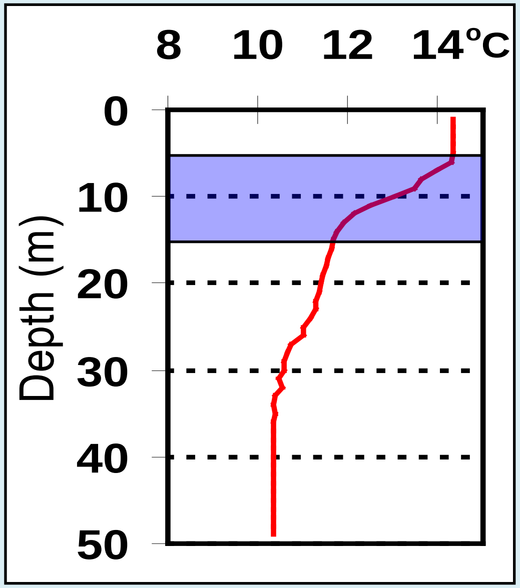


Source: Spotila et al. 1996



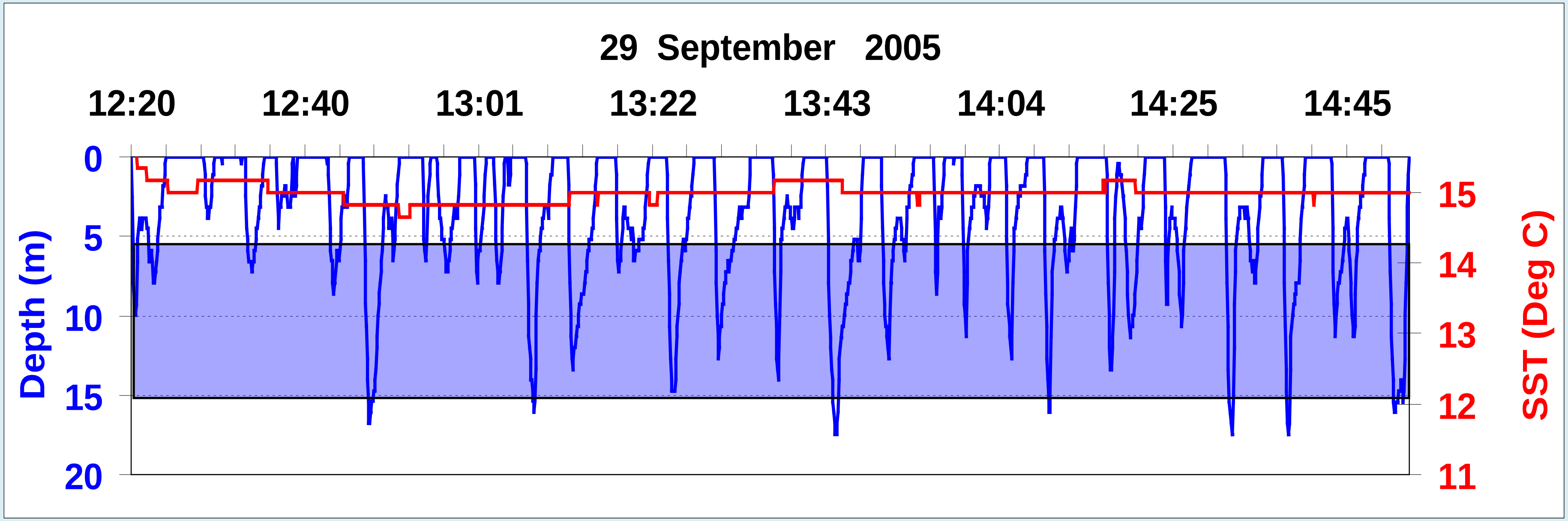
Source: Spotila et al. 2000

Foraging behavior

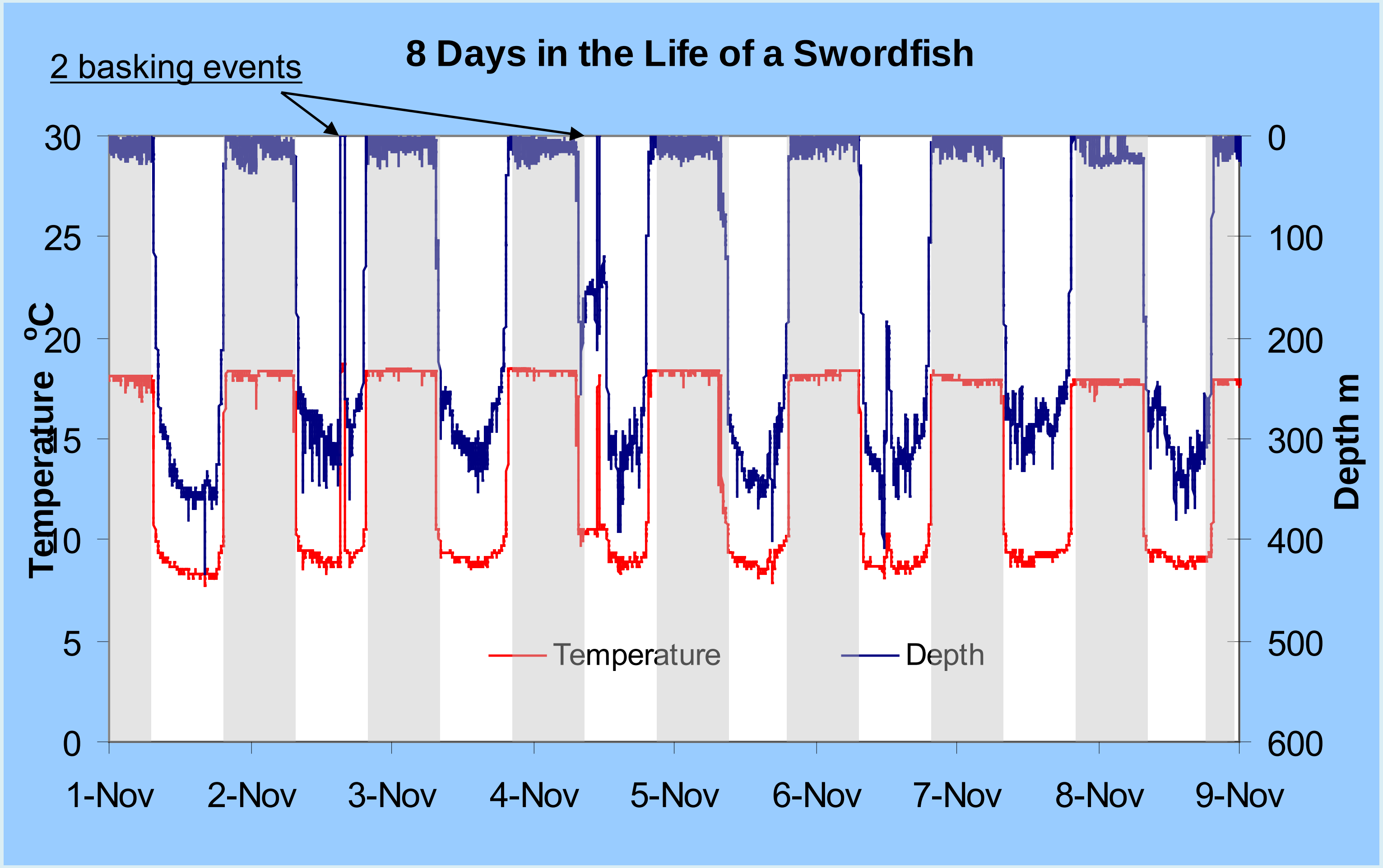


CTD profile

Leatherback dive profile
→ Foraging within thermocline



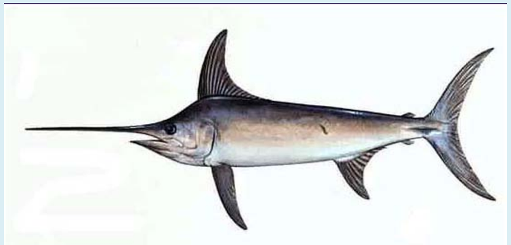
Southern California Bight



Shaded Bars denote night time. Note the diel vertical behavior and the infrequent basking events.

It is only during basking that swordfish are accessible to the harpoon fleet. Swordfish are taken in surface waters by the DGN fleet at night.

Final Remarks



- SLUTH is a science-based research process to address information gaps and inform public policy
- Contributes to
  - healthy U.S. swordfish fishery,
  - the recovery of leatherback populations,
  - the supply of fresh, locally caught fish.
- First step in an on-going, inclusive scientific research process

HIGHLY MIGRATORY SPECIES REPORT ON THE NMFS REPORT

The Highly Migratory Species Advisory Subpanel (HMSAS) welcomes the data that would be gathered by the proposed Marine Recreational Information Program (MRIP) albacore project. This project is supported by the recreational fisheries people, who would be happy to aid in the collection of effort data. We hope that caution will be used in the interpretation of the results due to the small geographic size of the fishing area and the effects oceanographic conditions might have on the data.

The presentation of the White Paper on albacore management options has been delayed. If there is a time schedule to discuss various albacore management measures (we are unaware that there is one), we would ask the Council not to allow this six-month delay in the presentation of the draft report to compress the time within which the HMSAS and Highly Migratory Species Management Team have to discuss the draft report and its recommendations. The HMSAS would also like to emphasize that it is important to schedule time for the HMSAS to meet and discuss the White Paper while it is in its draft form before it is submitted to the Council. If the White Paper is to be submitted to the Council, this should be done after the close of the 2009 albacore troll and baitboat fishing season, perhaps at the November Council meeting.

PFMC
04/04/09

FISHERY MANAGEMENT PLAN (FMP) AMENDMENT 2- HIGH SEAS SHALLOW-SET LONGLINE

In September 2008 the Council adopted a revised set of alternatives to amend the Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species (HMS FMP) to authorize a West Coast based shallow-set longline (SSLL) fishery seaward of the Exclusive Economic Zone (EEZ) in the North Pacific Ocean. Use of traditional SSLL gear is currently not authorized under the HMS FMP and is prohibited on the high seas east of 150° W. longitude by Endangered Species Act (ESA) regulations because, as originally proposed in the HMS FMP, this type of fishing without sufficient mitigation measures was determined likely to jeopardize the continued existence of loggerhead sea turtles, which are listed as threatened under the ESA. The fishery authorized through Amendment 2 to the HMS FMP would incorporate the use of innovative longline gear and methodologies and be subject to a range of restrictions and mitigation measures designed to minimize the likelihood of the action jeopardizing the continued existence of any species listed under the ESA.

Attachment 1 is a preliminary Draft Supplemental Environmental Impact Statement analyzing the alternatives adopted by the Council. There are four alternatives including No Action. Alternative 2 would establish a limited entry fishery with no more than 20 permits. Alternative 3 would establish a limited entry program with anyone having made at least one swordfish landing on the West Coast, 2005-2007, qualifying. Alternative 4 would establish an open access fishery with no new permit requirement. Under all of the action alternatives, the new gear requirements, use of circle hooks and mackerel-type bait, would be required to reduce the incidental take of sea turtles. In addition, under the action alternatives the fishery would be subject to incidental take limits ("sea turtle caps"), which would be set consistent with the findings of a consultation on the proposed action pursuant to section 7 of the ESA. If, during the fishing year, turtle takes reach any of the limits (likely set for loggerhead and leatherback sea turtles) the fishery would close for the remainder of the year. Alternatives 3 and 4 would prohibit fishing west of 140° W. longitude. Alternative 2 contains three options related to an area closure: no area closure, prohibiting the fishery west of 150° W. longitude, and prohibiting the fishery west of 140° W. longitude.

As noted, if an action alternative is selected, it would be subject to a section 7 consultation to determine whether the proposed action jeopardizes the continued existence of any ESA-listed species. If such a jeopardy determination were to be made, National Marine Fisheries Service (NMFS) is required under the ESA to include Reasonable and Prudent Alternatives (RPAs) that specify additional measures necessary to avoid jeopardy. In developing these RPAs the Protected Resources Division (Consulting Agency) would confer with the Sustainable Fisheries Division (Action Agency) on the measures to be included. The Council would likely want to discuss various possible measures with the Federal Action Agency (Sustainable Fisheries Division) for their consideration in this process. The Council may wish to discuss with NMFS how such a process would unfold in a way to allow Council input, if necessary.

Previously, the Council requested NMFS conduct a simultaneous ESA section 7 consultation of this proposed action and the Western Pacific Fishery Management Council's (WPFMC's) Pelagics FMP Amendment 18, which proposed to lift the current fishing effort limit on the Hawaii SSLL fishery and increase the interaction limits (turtle caps) applicable to that fishery accordingly. However, a biological opinion was completed for Pelagics FMP Amendment 18 on October 15, 2008. In response to the biological opinion, at their October 2008 meeting the WPFMC reexamined their previous vote on an increase in the leatherback sea turtle interaction limit from 16 to 19 and decided to recommend keeping the current limit of 16 leatherbacks. The 60-day public comment period during Secretarial Review of Amendment 18 was announced on March 18, 2009 (see Attachment 2).

Council Action:

Adopt a preferred alternative to amend the HMS FMP to authorize a West Coast based SSLL fishery seaward of the EEZ in the North Pacific Ocean.

Seek guidance from NMFS on a process to allow Council input, if appropriate, in response to findings in the biological opinion for the proposed action.

Reference Materials:

1. Agenda Item D.2.a, Attachment 1: Amendment 2 to the Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species: Authorize a Shallow-set Longline Fishery Seaward of the EEZ; Preliminary Draft Supplemental Environmental Impact Statement
2. Agenda Item D.2.a, Attachment 2: Notice of Availability of WPFMC Pelagics FMP Amendment 18 for Public Comment (74 FR 11518)

Agenda Order:

a. Agenda Item Overview — Kit Dahl
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. **Council Action:** Adopt Final Preferred Alternative

PFMC
03/19/09

Agenda Item D.2.a
Attachment 1
April 2009

AMENDMENT 2 TO THE FISHERY MANAGEMENT PLAN FOR U.S. WEST COAST FISHERIES FOR HIGHLY MIGRATORY SPECIES: AUTHORIZE A SHALLOW-SET LONGLINE FISHERY SEAWARD OF THE EEZ

PRELIMINARY DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

PREPARED BY:

PACIFIC FISHERY MANAGEMENT COUNCIL
PORTLAND, OREGON

❖

DEPARTMENT OF COMMERCE
NATIONAL MARINE FISHERIES SERVICE
SOUTHWEST REGION
LONG BEACH, CALIFORNIA

SOUTHWEST FISHERIES SCIENCE CENTER
LA JOLLA, CALIFORNIA

MARCH 2009

Printed: Thursday, March 19, 2009 | G:\!PFMC\MEETING\2009\April\HMS\D2_Att1_Amd2_master_090224.doc

This document is published by the Pacific Fishery Management Council pursuant to National Oceanic and Atmospheric Administration Award Number NA05NMF4410008.

Executive Summary

This document provides background information about, and analysis of, a proposed amendment (Amendment 2) to the *Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species* (HMS FMP) to authorize a fishery targeting swordfish (*Xiphias gladius*) seaward of the exclusive economic zone (EEZ) off Washington, Oregon, and California, which is currently prohibited. Management of the proposed longline fishery would be covered by the 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 HMS 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 of U.S. fisheries in the EEZ or on the high seas beyond the EEZ for vessels making landings at U.S. ports. The EEZ extends from the outer boundary of state waters at 3 nautical miles (nmi) to a distance of 200 nmi from shore. In addition to addressing MSA mandates, this document is a supplemental environmental impact statement (SEIS), pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended.

The Proposed Action

The proposed action is to amend the HMS FMP to authorize a West Coast based shallow-set longline (SSLL) fishery seaward of the EEZ in the North Pacific Ocean. Use of traditional SSLL gear is currently not authorized under the HMS FMP and is prohibited on the high seas east of 150° W. longitude by Endangered Species Act (ESA) regulations, because, as originally proposed in the HMS FMP, this type of fishing without sufficient mitigation measures was determined likely to jeopardize the continued existence of loggerhead sea turtles, which are listed as threatened under the ESA (NMFS 2004a). The fishery authorized through Amendment 2 to the HMS FMP would incorporate the use of innovative longline gear and methodologies (described in more detail in Chapter 2) and be subject to a range of restrictions and mitigation measures designed to minimize the likelihood of the action jeopardizing the continued existence of any species listed under the ESA. Other restrictions and mitigation measures could also be applied to minimize the take of seabirds, consistent with other applicable law. Impacts to non-ESA-listed marine mammals will also be evaluated and mitigated to the extent practicable, consistent with the Marine Mammal Protection Act (MMPA).

The Alternatives

The Council initially adopted a detailed range of alternatives for analysis at their March 2008 meeting and further refined them at their September 2008 meeting. There are four alternatives, including No Action, which are described below.

Alternative 1: No Action

Unless possessing both a Hawaii longline limited access permit (pursuant to the Western Pacific Fishery Management Council Pelagics FMP; 50 CFR 660.21) and a PFMC HMS FMP permit, swordfish caught with shallow-set longline gear on the high seas cannot be landed on the West Coast. Otherwise, no more than 10 swordfish can be possessed or landed on the West Coast when using other forms of longline gear (i.e., deep-set longline gear to target tunas on the high seas). Regulations pursuant to the HMS FMP prohibit landings of swordfish caught with shallow-set longline gear west of 150° W. longitude. ESA regulations prohibit such landings of swordfish caught east of 150° W. longitude. As indicated, these regulations are applicable to vessels fishing under a PFMC HMS FMP permit; they are not applicable to vessels registered to a Hawaii longline limited access permit. Under No Action this regulatory framework would remain in effect.

Alternative 2: West Coast Limited Entry Program for a SSLL Fishery Seaward of the West Coast EEZ

Sea Turtle Mitigation Measures

The fishery would be subject to the following measures to mitigate potential impacts to ESA-listed loggerhead and leatherback sea turtles:

- In addition to the current HMS FMP prohibition on pelagic longline fishing in the West Coast EEZ, options to prohibit fishing either (1) west of 150° W. longitude or (2) west of 140° W. longitude. An option of no westward area closure is also included.
- Gear restrictions, consistent with those currently applicable to Hawaii longline limited access permit holders fishing with SSLL gear. These include the requirement to use large 18/0 circle hooks with up to a 10° offset and mackerel-type bait, and for skippers to attend a workshop presented by NMFS Protected Resources Division (PRD). These workshops are aimed at raising fishermen's awareness of the proper methods for avoiding, handling, and de-hooking protected species.
- All participating vessels must carry an at-sea observer when fishing (100 percent observer coverage requirement).
- Take caps for loggerhead and leatherback sea turtles would be established, at sufficiently low levels so that the proposed action is not found to jeopardize the continued existence of these ESA-listed species. Take caps would be renewed annually and the fishery would be closed until the end of the fishing year (April 1-March 31) if either cap were ever reached during the fishing year. The fishery would re-open at the start of the next fishing year.

Limited Entry

Participation in the fishery would be limited to 20 permits or less. A vessel would have to be registered to one of these West Coast SSLL limited entry permits to fish with SSLL gear and land more than 10 swordfish per trip on the West Coast. This alternative includes four options for determining eligibility to receive a permit. Under all the options having made at least one swordfish landings 2001-2007 would be required to qualify for the permits. The options include additional criteria focusing on past participation in the West Coast SSLL and drift gillnet (DGN) fisheries. Permit transfer would be restricted in the first 1 or 2 years after they are issued. Simultaneous use of the new West Coast SSLL limited entry permit and a Hawaii longline limited entry permit would be prohibited.

Alternative 3: A Limited Entry Program with No Cap on the Number of Permits

This alternative includes the sea turtle mitigation measures listed above for Alternative 2 except that the fishery would be closed west of 140° W. longitude. Any person having made at least one commercial fishery swordfish landing on the West Coast during the years 2005-2007 would qualify for a permit.

Alternative 4: Open Access

Under this alternative participation in the fishery would not be limited by permit.

The management framework would contain the following provisions:

- The fishery is closed west of 140° W. longitude.

- Owners of a Hawaii longline limited access permit would not qualify for participation in this fishery.
- The sea turtle take mitigation measures listed under Alternative 2 (gear requirements, 100 percent observer coverage, take caps, etc.) would apply.

Summary of the Impacts of the Alternatives

Finfish

- The North Pacifc swordfish stock is not subject to overfishing or in an overfished state. Alternative 2 (limited entry) could increase total catch across all foreign and domestic fisheries by as much as 10 percent. The stock-wide increase in catch under Alternatives 3 and 4 (unconstrained fishery) could be as high as 15 percent.

- For nontarget stocks there are conservation concerns for bigeye tuna (overfishing occurring and stock overfished), yellowfin tuna (overfishing may be occurring) striped marlin (stock size low compared to historic levels), and albacore tuna (current fishing effort high). Under all the alternatives the increase in catch would be very small in comparison to stock-wide catch.

Sea Turtles

- Estimated take and mortality in the proposed fishery, under the different alternatives and options, was compared to guidance issued by NMFS when partially disapproving the HMS FMP in 2004 (see Section 1.2), which directed the Council to consider a proposed fishery "that would limit sea turtle mortality to low levels approximating those that had previously been found in the drift gillnet fishery not to result in jeopardy to any listed sea turtles." Under Alternative 2, a fishery closed west of 140° W. longitude with up to 20 permits (vessels) has estimated mortality levels of two loggerhead and two leatherback sea turtles, which may be consistent with this guidance. A fishery closed west of 150° W. longitude or without an area closure results in higher takes than with the 140° W. closure. With either the 150° W. closure or no area closure a fishery with 10 permits (vessels) or fewer is estimated to result in a similar number of loggerhead and leatherback mortalities. Unconstrained fisheries under Alternatives 3 and 4 have a higher risk of jeopardizing the continued existence of ESA-listed sea turtles.

- Under Alternative 2, a fishery with 20 permits (vessels) risks substantial detrimental population level impacts for loggerhead and leatherback sea turtles. A fishery with fewer permits reduces this risk.

Marine Mammals

- The analysis identifies marine mammal species occurring in the action area, species that have been observed taken in the Hawaii and West Coast SSLL fisheries, and assesses the likelihood of species being taken in the proposed fishery. A fishery as proposed under Alternative 2 with 20 permits is likely to have a comparable level of marine mammal takes to what has been observed in the Hawaii SSLL fishery, estimated at 5-10 marine mammals annually. Based on observed takes in the Hawaii SSLL fishery, and recognizing the different geographic area in which a West Coast SSLL fishery is likely to operate, the species most likely to be taken are Risso's dolphins and bottlenose dolphins. These species commonly depredate longlines, ingesting bait and hooks, which leads to serious injury.

- Strategic marine mammal stocks occurring in the action area, which include ESA-listed species, are also noted. Two of these species, humpback and short-finned pilot whales, have been observed taken in the Hawaii SSLL fishery and have a distribution that includes the area within which a West Coast fishery is likely to operate.

- Under Alternative 2, a fishery with fewer than 20 permits (vessels) would reduce the risk of substantial adverse impacts to marine mammals stocks. Alternatives 3 and 4 would present an increased risk.

Seabirds

- Two seabird species, black-footed albatross and Laysan albatross, have been observed captured in the West Coast and Hawaii SSLL fisheries. The short-tailed albatross, listed as endangered under the ESA, occurs in the action area. The USFWS has conducted a 12-month status review based on a petition to list the black-footed albatross as threatened or endangered under the ESA. A decision is pending.

- A BO prepared for the HMS FMP by the USFWS estimated one short-tailed albatross take per year in HMS fisheries, including the SSLL fishery proposed (but subsequently prohibited) in the HMS FMP. This BO concluded that the one annual take would no jeopardize the continued existence of the species. A fishery with fewer than 20 permits (vessels) is not likely to present a greater risk to the short-tailed albatross than the fishery originally proposed in the HMS FMP.

- Although not specified in the alternatives, seabird mitigation measures comparable to those currently in place for the Hawaii SSLL fishery are likely to be required for the proposed fishery. These mitigation measures have been shown to substantially reduce seabird takes compared to the fishery as it operated without such measures.

- Capture rates in the historical West Coast SSLL fishery, adjusted based on research on the effect of mitigation measures in the Hawaii SSLL fishery, were used to estimate potential captures under the alternatives. Under Alternative 2 a fishery with 20 permits (vessels) is estimated to result in 47 black-footed albatrosses and 15 Laysan albatrosses being captured. Under Alternatives 3 and 4, 153 black-footed albatrosses and 4 Laysan albatrosses are estimated to be captured.

Socioeconomic Impacts

- An economic viability analysis was prepared, which estimated financial and economic profit under different scenarios representing sets of constraints on the proposed fishery (area closures, take caps, observer coverage). According to the analysis, a fishery under Alternative 2 with up to 15 vessels would be economically viable, defined as having a positive expected economic profit, under most scenarios analyzed. The exceptions are the case with the fishing area restricted to east of 140° W. longitude and the case with observer coverage limited to 300 sets. Higher levels of viability (economic profit) are estimated for a fishery with fewer numbers of participants.

- Total expected ex-vessel revenue ranges from about $1.4 to $3.6 million depending on the number of vessels and fishery constraints. This level of ex-vessel revenue is substantial compared to region-wide HMS commercial ex-vessel revenue, which was $2.9 million in 2008 in Southern California according to PacFIN landings information. The high end of the range represents about 6 percent of ex-vessel revenues from all fisheries in the region. This gives an indication of the effect on regional personal income. The proposed fishery may not result in any increase in employment if it principally results from vessels and fishing effort shifting from existing fisheries.

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List of Figures

List of Tables

List of Acronyms

AMSY- Average Maximum Sustainable Yield
AIDCP- Agreement on International Dolphin Conservation Program
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 Party Fishing Vessels
CPUE- Catch Per Unit of Effort
CZMA- Coastal Zone Management Act
DGN- Drift Gillnet
DML- Dolphin Mortality Limit
DSEIS- Drat Supplemental Environmental Impact Statement
DSLL- Deep-set Longline
EA- Environmental Assessment
EEZ- Exclusive Economic Zone
EFH- Essential Fish Habitat
EFP- Exempted Fishing Permit
EIS- Environmental Impact Statement
ENSO- El Niño / Southern Oscillation

EO- Executive Order
EPO- Eastern Pacific Ocean
ESA- Endangered Species Act
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- Highly Migratory Species Fishery Management Plan
HMSAS- Highly Migratory Species Advisory Subpanel
HMSMT- Highly Migratory Species Management Team
IATTC- Inter-American Tropical Tuna Commission
IPCC- Intergovernmental Panel on Climate Change
ISC- International Scientific Committee
ITS- Incidental Take Statement
IUCN- World Conservation Union
IWC- International Whaling Commission
LOF- List of Fisheries
MCSST- Multi-Channel Sea Surface Temperature
MAP- Marine Mammal Authorization Program
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
NOI- Notice of Intent
NPTZ- North Pacific Transition Zone
NWHI- Northwestern Hawaiian Islands
OY- Optimum Yield
PacFIN- Pacific Fisheries Information Network
PIFSC- NMFS Pacific Islands Fisheries Science Center
PIRO- NMFS Pacific Islands Regional Office
PBR- Potential Biological Removal
PDO- Pacific Decadal Oscillation
Pelagics FMP- WPFMC Pelagics Fishery Management Plan
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
SEIS- Supplemental Environmental Impact Statement
SSLL-Shallow-set Longline
STFZ- Subtropical Frontal Zone
SWFSC- NMFS Southwest Fisheries Science Center

USFWS- United States Fish and Wildlife Service
WPFMC- West 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 the course of a federal action (e.g., fishing under an FMP).

Incidental Take Statement: a requirement under 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.

CHAPTER 1 INTRODUCTION

1.1 Organization of the Document

This document provides background information about, and analysis of, a proposed amendment (Amendment 2) to the *Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species* (HMS FMP) to authorize a fishery targeting swordfish (*Xiphias gladius*) seaward of the exclusive economic zone (EEZ) off Washington, Oregon, and California, which is currently prohibited. Management of the proposed longline fishery would be covered by the 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 HMS 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 of U.S. fisheries in the EEZ or on the high seas beyond the EEZ for vessels making landings at U.S. ports. The EEZ extends from the outer boundary of state waters at 3 nautical miles (nmi) to a distance of 200 nmi from shore. The action must also comply with other applicable law, summarized below and enumerated in Chapter 6.

In addition to addressing MSA mandates, this document is a supplemental environmental impact statement (SEIS), pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended. According to NEPA (Section 102(2)(C)), any "major Federal action significantly affecting the quality of the human environment" must be evaluated in an environmental impact statement (EIS). Based on a preliminary determination by Council and NMFS staff, implementing the proposed action may have significant impacts. Therefore, rather than preparing an environmental assessment (EA), which provides "sufficient evidence and analysis for determining whether to prepare an environmental impact statement," NMFS and the Council have decided to proceed directly to preparation of an SEIS.[1] This document is organized so that it contains the analyses required under NEPA and other applicable law (see Chapter 6).

Federal regulations (40 CFR 1502.9) require agencies to prepare and circulate a draft EIS (DEIS, DSEIS), which "must fulfill and satisfy to the fullest extent possible the requirements established for final statements in Section 102(2)(C) of the Act" (i.e., NEPA). Federal regulations (40 CFR 1506.10(c)) and agency guidelines NOAA Administrative Order 216-6, Section 5.01.b.1(i)) stipulate a minimum 45-

[1] An agency may prepare an SEIS if substantial changes are made to a proposed action, new information about the environment or environmental concerns becomes available, or if the agency believes doing so will further the purposes of NEPA (40 CFR 1502.9(c)). This SEIS supplements the EIS for the HMS FMP.

day public comment period on a DEIS. At the end of this period, a final EIS (FEIS, FSEIS) is prepared, public comments are addressed, and the document is revised accordingly. After the FSEIS is completed, a 30-day waiting period ensues before the responsible official may sign a record of decision (ROD) and implement the proposed action. (Depending on the action, the responsible official is either the Regional Administrator or the Assistant Administrator for Fisheries.)

The evaluation in this document of adverse impacts to species listed under the Endangered Species Act (ESA) is intended to be consistent with evaluation of the action required by section 7 of the ESA. However, the analysis in this document does not replace the required consultations with NMFS's Protected Resources Division (PRD) and the U.S. Fish and Wildlife Service (FWS) to determine whether the proposed action may jeopardize the continued existence of any federally-listed species.

Environmental impact analyses have four essential components: 1) a description of the purpose and need for the proposed action; 2) a set of alternatives that represent different ways of accomplishing the proposed action; 3) a description of the human environment affected by the proposed action; and 4) 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, 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 in six main chapters:

- The remainder of Chapter 1 describes the purpose and need for the proposed action and considerations that went into the development of this SEIS.

- Chapter 2 outlines different alternatives that have been considered to address the purpose and need. The Council will choose a preferred alternative from among these alternatives.

- 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 (7-9) list those who contributed to this SEIS, information on SEIS distribution, and the references cited.

1.2 The Proposed Action and Why the Council and NMFS are Considering an FMP Amendment

The proposed action is to amend the HMS FMP to authorize a West Coast based shallow-set longline (SSLL) fishery seaward of the EEZ in the North Pacific Ocean. Use of SSLL gear is currently not authorized under the HMS FMP and is prohibited on the high seas east of 150° W. longitude by Endangered Species Act (ESA) regulations, because, as originally proposed in the HMS FMP, a fishery employing the type of SSLL gear then in use, without sufficient mitigation measures, was determined likely to jeopardize the continued existence of loggerhead sea turtles, which are listed as threatened under the ESA (NMFS 2004a). The fishery authorized through Amendment 2 to the HMS FMP would incorporate the use of innovative longline gear and methodologies, described in more detail below, and will be subject to a range of restrictions and mitigation measures designed to minimize the likelihood of the action jeopardizing the continued existence of any species listed under the ESA. Other restrictions and mitigation measures could also be applied to minimize the take of seabirds and other species of concern, consistent with other applicable law. Impacts to non-ESA-listed marine mammals will also be evaluated and mitigated to the extent practicable, consistent with the Marine Mammal Protection Act (MMPA).

The HMS FMP, as submitted to NMFS for approval by the Council in August 2003, would have authorized a West Coast-based SSLL fishery on the high seas outside the EEZ and east of 150° W longitude and north of the equator; however, on February 4, 2004, NMFS informed the Council that it had approved the HMS FMP with the exception of the provision that would have allowed SSLL fishing by West Coast-based vessels targeting swordfish east of 150° W. longitude. The disapproval was based on the ESA section 7 consultation for the HMS FMP, which concluded that allowing shallow sets for swordfish with traditional gear and no effort limits east of 150° W. longitude would appreciably reduce the likelihood of survival and recovery of threatened loggerhead sea turtles (i.e., jeopardize their continued existence). At about the same time, the Hawaii-based shallow-set longline fishery, which had been shut down by court order, was re-opened (it had been closed due to a jeopardy opinion written in 2001) due to the adoption of sea turtle take mitigation measures like those that are proposed under Amendment 2. Hawaii-permitted vessels may currently fish in the entire north Pacific, including seaward of the U.S. West Coast EEZ and east of 150° W. longitude and land in Hawaii or U.S. West Coast ports if in compliance with existing state and Federal requirements, including possession of a valid HMS FMP permit.

Section 204(a)(3) of the MSA requires NMFS, if an FMP is disapproved in part or in whole, to advise the Council of actions it can take to address the disapproved FMP provisions. In the aforementioned February 4, 2004, letter NMFS indicated to the Council that alternative gear and bait options (e.g., circle hooks and mackerel-type bait[2]) being tested in the U.S. Atlantic pelagic longline swordfish fishery had proven successful in significantly reducing sea turtle interactions and consequent injury to and mortality of sea turtles. NMFS advised the Council that possible use of alternative gear and bait requirements, effort limits, time/area limits, turtle take limits, or other measures that would limit sea turtle mortality to low levels by any future west-coast-based SSLL fishery might provide the necessary conservation and management measures to operate a fishery without jeopardizing the continued existence of ESA-listed sea turtles. The February 4, 2004, letter from the NMFS SWR Regional Administrator concludes by stating:

> I believe [the information discussed in this letter] will be very useful to the Council in considering adjustments to its fishery management regime that can allow fishing without jeopardizing any ESA-listed species. NOAA Fisheries' action on the Western Pacific Council's proposal has implications for potential approvability of similar approaches for the West Coast longline fishery. I recommend that the Council direct its management team to review this information and to begin developing and analyzing alternative sets of comparable conservation and management measures under which the longline fishery off the West Coast might be able to target swordfish with low levels of marine turtle takes. This could include consideration of limited longline fishing for swordfish with effort limits, gear and bait requirements, time/area

2 The term "mackerel-type bait" is used throughout this document to refer to mackerel and similar fish species used for bait.

limits, turtle take limits, or other measures that would limit sea turtle mortality to low levels approximating those that had previously been found in the drift gillnet fishery not to result in jeopardy to any listed sea turtles.

Since that time, the alternate gear and bait modifications have proven successful in existing domestic (e.g., western Atlantic Ocean and Hawaii-based) and foreign (e.g., Italy, Brazil, Ecuador, and Uruguay) shallow-set longline fisheries in reducing sea turtle interactions[3] and mortalities[4] as compared to traditional J-hooks and squid (*Illex* spp.) bait while maintaining an economically viable fishery (Boggs and Swimmer 2007; Gilman, *et al.* 2006; Largacha, *et al.* 2005; Lewison and Crowder 2007; Watson and Kerstetter 2006; Watson, *et al.* 2005). In the Hawaii-based SSLL swordfish fishery, the overall marine turtle interactions have been reduced by 89 percent, and there has been a significant increase in the proportion of turtles released alive after removal of all terminal tackle, which may increase the likelihood of turtles surviving post-hooking mortality (Gilman and Kobayashi 2007). As a result of these successful gear innovations, NMFS recommended at the April 2007 Council meeting that the Council revisit the disapproved portion of the HMS FMP.

The proposed action is intended to allow for an economically viable shallow-set longline fishery to be reestablished, supplying fresh fish to West Coast markets while complying with ESA requirements to avoid taking ESA-listed species. Establishing a management framework under the HMS FMP would allow the Council to control design and implementation of the program, and enables West Coast stakeholders to be more involved in the process, compared to the current situation where only Hawaii-permitted vessels may make landings on the West Coast using SSLL gear. The management framework must mitigate adverse impacts as prescribed by applicable law, particularly the ESA, thereby completing the part of the HMS FMP that was disapproved. Qualification for participation in any such fishery must also be considered, because NMFS recommended considering effort limits. To the degree that effort is limited, for example through a limited access privilege program (LAPP), several factors may be used to consider future participation in any authorized fishery, including: 1) participation in the historical longline fishery that existed until April 2004; 2) recent history of landing swordfish on the West Coast in terms of total amount at both the individual level and for gear types as a whole; 3) suitability of vessels for operating in a longline fishery outside the EEZ; and 4) opportunities to shift fishing effort away from gear types with higher adverse environmental impacts than shallow-set longline gear.

By responding to the charge laid out in NMFS's letter, the action would also help to carry out the goals and objectives embodies the HMS FMP, which include:

- 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 highly migratory species based in ports in the area of the Pacific Council's jurisdiction, and give due consideration for traditional participants in the fisheries.

- Manage the fisheries to prevent adverse impacts on any protected species covered by MMPA and the Migratory Bird Treaty Act (MBTA) and promote the recovery of any species listed

[3] "Interactions" are defined as hooking, entanglement, or a combination of both in the fishing gear.
[4] Mortalities are defined here as turtles that were either observed or estimated to have suffered mortality as a result of interaction with fishing gear.

under the ESA to the extent practicable.

In implementing the action the following goals and objectives need to be taken into account:

- Promote and actively contribute to international efforts for the long-term conservation and sustainable use of highly migratory species fisheries that are utilized by west-coast-based fishermen, while recognizing these fishery resources contribute to the food supply, economy, and health of the nation.
- Implement harvest strategies which achieve optimum yield for long-term sustainable harvest levels.
- Promote inter-regional collaboration in management of fisheries for species which occur in the Pacific Council's managed area and other Councils' areas.
- Minimize inconsistencies among Federal and state regulations for highly migratory species fisheries.
- Minimize bycatch and avoid discard and implement measures to adequately account for total bycatch and discard mortalities.
- Prevent overfishing and rebuild overfished stocks, working with international organizations as necessary.
- Promote effective monitoring and enforcement.

1.3 The Action Area

Figure 1-1 shows the action area for the proposed action compared to that for the Hawaii SSLL fishery as defined in the biological opinion for Amendment 18 to the Pelagics FMP (NMFS 2008).[5] Definition of the action area is based on observed sets in the historic (pre-2004) West Coast fishery, as shown in the figure. In the alternatives described in Chapter 2 there are three options for prohibiting fishing in westward areas, in order to reduce impacts to ESA-listed sea turtles. These are no area closure, prohibiting fishing west of 150° W. longitude (consistent with the SSLL prohibition currently in the HMS FMP), and prohibiting fishing west of 140° W. longitude. In addition, longline fishing is already prohibited inside the West Coast EEZ as indicated in the figure. Depending on which area closure option is chosen, the action area for the proposed action could be smaller than identified in the figure. Federal regulations covering the Hawaii pelagic longline fishery prohibit fishing within 50 nmi of the Hawaiian Islands. If a West Coast fishery were authorized with no westward restriction on the area of operation, then conforming regulations prohibiting fishing by West Coast longline vessels around the Hawaiian Islands would likely be adopted. Even if the fishery were authorized without a westward limit on fishing, it seems unlikely that much if any fishing from the West Coast would occur in the western portion of this action area because of the costs involved in venturing so far to fish in that area.

5 This amendment, currently under Secretarial Review, would allow the level of fishing effort in the current Hawaii SSLL fishery to expand.

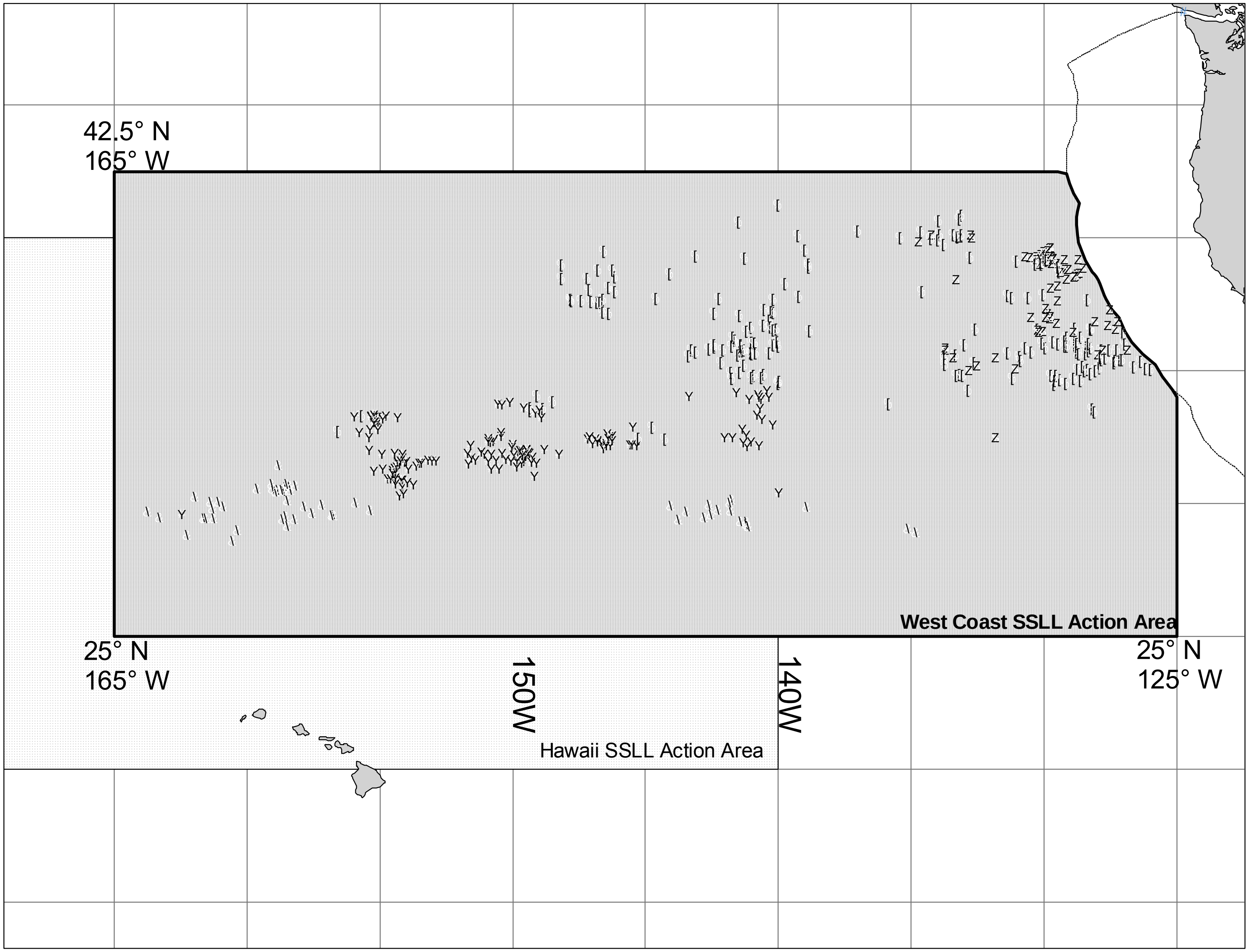

Figure 1-1. Action area of proposed West Coast SSLL fishery and Hawaii SSLL fishery.

1.4 Background

The November 2007 final environmental assessment prepared by NMFS and the Council for Issuance of an Exempted Fishing Permit to Fish with Longline Gear in the West Coast Exclusive Economic Zone describes the management history of the West Coast SSLL fishery (NMFS and PFMC 2007). This description is incorporated by reference and summarized below.

A significant California-based SSLL fishery began in 1993 with the arrival of vessels from the Gulf of Mexico. An active pelagic longline fishery based out of Hawaii already existed at that time. However, in 1991 the Western Pacific Fishery Management Council (WPFMC) implemented a moratorium on new entrants followed by a license limitation (limited entry) program in 1994, because the fishery had rapidly expanded in the late 1980s and early 1990s and they were concerned about the negative effects of gear and market competition. This limited the ability of the Gulf longliners to enter that fishery. At the same time California state law prohibited landing fish caught with pelagic longline gear in the West Coast EEZ in California ports. By 1994, 31 vessels comprised this California-based fishery, fishing the grounds beyond the EEZ, and landing swordfish and tunas in 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 California fishery declined from its peak in the mid-1990s because the Gulf vessels either acquired the permits necessary to enter the Hawaii fishery or returned to the Gulf. But the fishery demonstrated that swordfish were seasonally available, in the fall and winter, farther east than the Hawaii fleet had traditionally operated.

As a result of the verdict in the case *Center for Marine Conservation vs. NMFS* (D. Haw. Civ. No. 99-00152 DAE), restrictions were imposed in 2001 to protect loggerhead sea turtles from being taken, effectively eliminating the Hawaii swordfish fishery. At that time, some Hawaiian longline permit holders deregistered their vessels from the permit, and proceeded to fish from California ports, as was their custom during this time of year.

A West Coast longline fishery operated between 2001 and 2004 based mainly on the activities of these deregistered Hawaiian vessels. In 2004, two events occurred that caused the West Coast fishery to close and the Hawaii fishery to reopen. As discussed above, the implementation of the HMS FMP effectively closed the West Coast fishery. At almost the same time, in response to litigation (*Hawaii Longline Association v. NMFS*, No. 1:01cv00765:CKK (D.D.C.)), the Hawaii fishery was proposed to be reopened with a variety of gear and effort restrictions to reduce impacts on sea turtles. This action was analyzed by NMFS and found to not jeopardize ESA listed sea turtles and the fishery re-opened via an amendment to the Hawaii pelagics FMP in April 2004.

This history of West Coast longline landings of fish caught outside the EEZ reflects this history of participation (see Figure 1-2). Since 1991 West Coast pelagic longline landings of swordfish 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. Swordfish landings have declined since that time and have been negligible since April 2004 when the West Coast SSLL fishery closed.

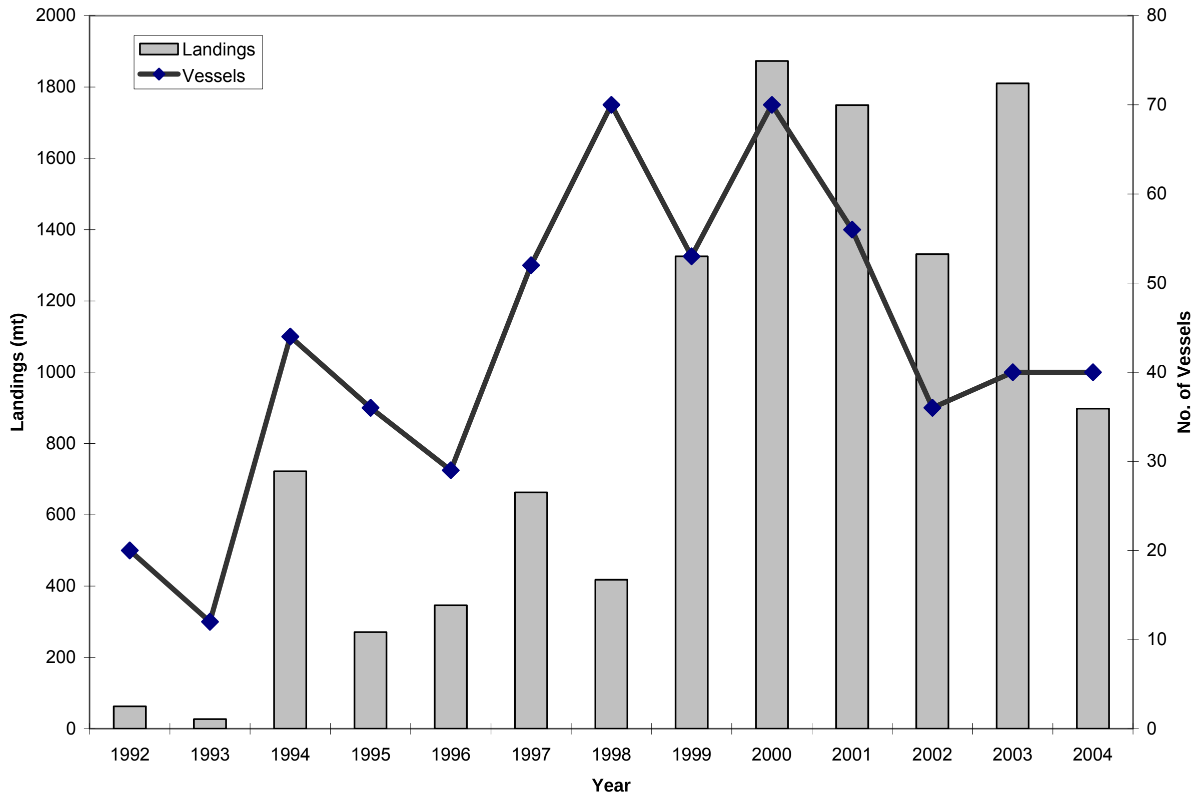

Figure 1-2. Number of vessels and landings (mt), pelagic longline, 1992-2004. Number of vessels computed based on commercial HMS landings with pelagic longline gear identified on the landing tickets. (Source: PFMC 2008)

The Hawaii SSLL fishery has operated as a "model fishery" since reopening in 2004 with gear regulations requiring the use of large (18/0) circle hooks with up to a 10° offset and mackerel-type bait. This gear has been demonstrated to substantially reduce the incidental take of sea turtles in comparison to traditional SSLL gear employing J-hooks and squid bait. In addition, the fishery operates under caps that limit the number of sea turtle interactions with fishing gear in any one year to 16 leatherbacks and 17 loggerheads. If the fishery reaches the cap for either sea turtle species, it is closed for the remainder of the year. These limits are based on the biological opinion prepared for the fishery when it reopened (NMFS 2004b), which determined that this interaction rate would not cause jeopardy to ESA listed species that are likely to be affected by the fishery. Table 1-1 shows the annual takes in the fishery since 2004.[6] The fishery closed very early in 2006 because the loggerhead take limit had been reached; in the other years the caps have not been reached and the fishery remained open for the entire year. The fishery has also been subject to an effort limit of 2,120 sets per year. The Hawaii SSLL fishery is subject to 100 percent observer coverage, which allows monitoring of takes and strict enforcement of the take caps.

[6] The ESA defines take "…to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" with respect to listed species. Thus a take is not necessarily equivalent to a mortality. NMFS has developed guidelines (NMFS 2006) for determining mortality rates in pelagic longline fisheries based on the nature of the interaction (e.g., hook location).

Table 1-1. Annual takes of leatherback and loggerhead sea turtles in the Hawaii SSLL fishery, 2004-2008. (Source: NMFS 2009)

	Leatherback Takes	Loggerhead Takes
Annual Limit	**16**	**17**
2004*	1	1
2005	8	12
2006	1	17**
2007	5	15
2008	2	0

*The fishery reopened on April 12, 2004
**Interaction limit reached; fishery closed on March 20, 2006.

In 2006 the Pacific Islands Fisheries Science Center (PIFSC) established the TurtleWatch Program based in part on research showing that in the area of the Hawaii-based SSLL fishery loggerhead sea turtles prefer waters below 65.5° Fahrenheit (Howell, *et al.* 2008). As a no-cost service to fishermen, the TurtleWatch Program produces and disseminates up-to-date sea surface temperature maps for the Hawaii fishery's area of operation (28°-37° N. latitude and 140°-173° W. longitude). This can help fishing vessels avoid areas where loggerheads may be more abundant if fishermen follow the recommendations of the TurtleWatch Program.

At their June 2008 meeting the WPFMC took action to expand their fishery and identified a preliminary preferred alternative that would eliminate the current 2,120 set overall limit on the SSLL component of their pelagic longline fishery. A draft SEIS was released on August 12, 2008 (WPFMC 2008). Based on a biological opinion prepared for the proposed action (NMFS 2008), the WPFMC took final action on October 17, 2008, recommending take caps for leatherback and loggerhead sea turtles that reflect projected effort levels without the set limit. They recommended maintaining the current cap level for leatherback sea turtles at 16 while increasing the take cap for loggerhead sea turtles to 46. The biological opinion found that these interaction levels would not cause jeopardy to ESA-listed species.

In summary, a small, economically viable SSLL fishery existed on the West Coast before it was closed in 2004. The historical range of this fishery overlaped with that operated out of Hawaii and managed by the WPFMC in terms of area of operation, although the west-coast-based fishery tended to occur farther east (see Figure 1-1). Since 2004 the Hawaii fishery has demonstrated that the switch to circle hooks and mackerel-type bait can result in substantial reductions in sea turtle interactions in an area overlapping the likely area of operation for the proposed West Coast fishery (see Section 1.3). Take caps add an additional layer of precaution. Because takes at these cap levels have been determined not to cause jeopardy, takes at levels below the caps would not trigger the requirement to reinitiate a Section 7 consultation under the ESA. In 2006, when the loggerhead cap was met, the fishery was closed for the rest of the year, consistent with the regulations for that fishery, so there was no need to re-initiate consultation.

1.5 Council Decision-making and the Scoping Process

Public involvement is an important part of the scoping process. According to NEPA regulations (40 CFR 1501.7) scoping is "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to the proposed action." Public scoping is designed to provide interested citizens, government officials, and tribes an opportunity to help define the range of issues and alternatives that should be evaluated in the EIS. The Council process, which is based on stakeholder involvement and allows for public participation and public comment, has been the principal mechanism for public scoping in developing the proposed action for Amendment 2 and the related range of alternatives. The public has had and will continue to have the opportunity to comment on the proposal during Council, subcommittee, and advisory body meetings.

On August 7, 2008, NMFS published a notice of intent (NOI) to prepare an SEIS on Amendment 2 to the HMS FMP (73 FR 45965). In addition to the Council process, the NOI also announced a 30-day period during which NMFS would accept written scoping comments, pursuant to agency guidance (NAO 216-6 §5.02d.2). In seeking scoping comments the NOI briefly described the alternatives adopted by the Council in March 2008 and described public scoping opportunities available through the Council process. In addition to submitting comments to NMFS, three of these comment letters were also submitted to the Council at its September 2008 meeting. NMFS also independently considers the comments received in providing input on the development of the SEIS.

A scoping report was drafted and distributed at the November 2008 Council meeting.[7] This scoping report is incorporated by reference. It describes the Council scoping process, during which the alternatives were developed, summarizes the written scoping comments received by NMFS, and describes how these comments will be addressed in development of the SEIS.

Since April 2007, the proposal has been discussed at four Council meetings. The Council initially identified the range of alternatives at their September 2007 meeting; they adopted a more detailed specification of the alternatives at their March 2008 meeting; and they made further refinements and additions at their September 2008 meeting. Substantial work on developing the proposal has been carried out by two committees that advise the Council on HMS-related matters, the Highly Migratory Species Management Team (HMSMT), composed of state and Federal agency resource managers and scientists, and the Highly Migratory Species Advisory Subpanel (HMSAS), composed of representatives from different West Coast HMS stakeholder groups. They have held five meetings to discuss the proposal and make recommendations to the Council. Briefing materials and meeting minutes from these meetings are available on the Council web site.[8]

1.6 Determining the Scope of the Analysis

Staff began work on this SEIS 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). This evaluation used a "scoping matrix" based on the 16 factors enumerated in NOAA NEPA guidance (NAO 216-6 §6.01), which reproduces the factors defining "significant" listed at 40 CFR 1508.27, and NAO 216-6 §6.02, specific guidance on fishery management actions, in order to screen for potentially significant impacts and to determine the scope of the analysis. In conjunction with internal scoping, comments received through public scoping, both at Council meetings and through the NOI, were also considered in determining the scope of the analysis.

[7] Available on the Council's website at http://www.pcouncil.org/bb/2008/1108/IR_6_SUP_1108.pdf.
[8] http://www.pcouncil.org/hms/hmsactivities.html

CHAPTER 2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1 Description of the Alternatives

The Council initially adopted a detailed range of alternatives for analysis at their March 2008 meeting. At their September 2008 meeting they modified the alternatives to clarify their components and to add requirements on permit transfer and simultaneous use of a limited entry permit proposed under Alternative 2 and a Hawaii longline limited entry permit. They also added Alternative 3, which proposes a limited entry program with a much higher cap on the number of permits.

2.1.1 Alternative 1: No Action

Unless possessing both a Hawaii longline limited access permit (pursuant to the WPFMC Pelagics FMP; 50 CFR 660.21) and a PFMC HMS FMP permit, swordfish caught with shallow-set longline gear on the high seas cannot be landed on the West Coast. Otherwise, no more than 10 swordfish can be possessed or landed on the West Coast when using other forms of longline gear (i.e., deep-set longline gear to target tunas on the high seas). Regulations pursuant to the HMS FMP prohibit landings of swordfish caught with shallow-set longline gear west of 150° W. longitude. ESA regulations prohibit such landings of swordfish caught east of 150° W. longitude. As indicated, these regulations are applicable to vessels fishing under a PFMC HMS FMP permit; they are not applicable to vessels registered to a Hawaii longline limited access permit. Under No Action this regulatory framework would remain in effect.

2.1.2 Alternative 2: West Coast Limited Entry Program for a SSLL Fishery Seaward of the West Coast EEZ

2.1.2.1 *Sea Turtle Take Mitigation Measures*

Area Closure Options

In addition to the current closure of the West Coast EEZ, the fishery is only permitted:

Option 1: East of 150° W. longitude
Option 2: East of 140° W. longitude

Option 3: No area closure west of the current prohibition on pelagic longline fishing in the West Coast EEZ.

Gear Restrictions and Other Mitigation Measures

The fishery would be subject to the following measures to mitigate potential impacts to ESA-listed loggerhead and leatherback sea turtles:

- Gear restrictions, consistent with those currently applicable to Hawaii longline limited access permit holders fishing with SSLL gear. These include the requirement to use large 18/0 circle hooks with up to a 10° offset[9] and mackerel-type bait, and for skippers to attend a workshop presented by NMFS Protected Resources Division (PRD). These workshops are aimed at raising fishermen's awareness of the proper methods for avoiding, handling, and de-hooking protected species.
- All participating vessels must carry a NMFS-certified at-sea observer when fishing (100 percent observer coverage).
- Take caps for loggerhead and leatherback sea turtles would be established, at sufficiently low levels so that the proposed action is not found to jeopardize the continued existence of these or any other ESA-listed species. These take caps would be based on the anticipated take amounts estimated in the biological opinion that will be completed for this proposed action. There could be several different ways to decide on these cap levels:
  1. The Council could recommend take caps as part of the preferred alternative, based on informal consultation with NMFS PRD.
  2. After selecting a preliminary preferred alternative, consultation with NMFS would begin and a draft biological opinion would be prepared, which would include recommendations to reduce impacts on ESA-listed species, particularly if the draft analysis suggests that the action may jeopardize a species. The Council could then take subsequent final action to modify the take cap levels, if necessary, based on a review of the draft biological opinion.
  3. If the estimated take of turtles under the final preferred alternative, including the effect of turtle take caps proposed by the Council, is determined to cause jeopardy, a Reasonable and Prudent Alternative in the biological opinion would require changes to the fishery or reducing the caps sufficiently to avoid jeopardy. This would be the least attractive approach, because the changes required under the RPA may not be consistent with the goals of the Council. Preferably, the Council's preferred alternative would result in a no jeopardy finding without the application of a Reasonable and Prudent Alternative.

  Take caps would be renewed annually and the fishery would be closed until the end of the fishing year (April 1-March 31) if either cap were ever reached during the fishing year. The fishery would re-open at the start of the next fishing year.

2.1.2.2 *Limited Entry Program*

Number of Permits

The Council proposed that any authorized fishery not exceed a maximum annual fishing effort of 1 million to 1.5 million hooks. The actual level of fishing effort would be a function of the number of permits allocated under the proposed limited entry program. A maximum of 20 permits would be issued.

For the purpose of analysis the following options are included:

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9 This differs from the regulations for the Hawaii fishery, which specified a 10° offset. However, that was a mistake; generally, less of an offset would reduce the likelihood of hooking.

Option 1: 20 permits
Option 2: 15 permits
Option 3: 10 permits
Option 4: 5 permits

The environmental and socioeconomic impacts of this range of permits are analyzed in Chapter 4. The analysis is intended to help the Council determine an environmentally sustainable and economically viable number of permits that could be issued, based on an estimate of the amount of fishing effort one vessel (permit) would expend in a year.

Recent Participation Requirement

In order to qualify for a permit the applicant[10] would need to have made at least one swordfish landing on the West Coast in any year from 2001 to 2007, inclusive.

Limit on Permit Transfer

At the start of the program, after permits have been initially distributed, the permit holder cannot transfer the permit for a specified length of time, as follows:

Option 1: In the first year after initial receipt permit transfer is prohibited
Option 2: In the first 2 years after initial receipt permit transfer is prohibited

In addition, to transfer the permit, the permit holder must make a specified number of landings (**options**: 0-5) in the specified time period (1 or 2 years after initial receipt) in order to be eligible to transfer the permit.

2.1.2.3 *Simultaneous Use of a West Coast SSLL Permit and a Hawaii Longline Limited Access Permit Prohibited*

In any given calendar year a person cannot not exercise / utilize both a West Coast SSLL permit and a Hawaii longline limited access permit to fish for swordfish on the high seas.

Qualification Criteria

Applicants would first be screened according to the recent participation requirement ((i.e., at least one swordfish landing on the West Coast in any year from 2001 to 2007, inclusive). Then a ranking of qualified applicants to receive limited entry permits would be based on one of the following options. Under each option, applicants would be ranked in decreasing order according to the applicable formula, and permits would be issued based on this rank order up to the maximum authorized number of permits.

<u>Qualification Option 1</u>

Applicants are ranked sequentially based on their total swordfish landings on the West Coast, 1996-2007, caught with (1) pelagic longline gear and with (2) drift gillnet gear, combined. Pelagic longline landings are attributed to the person owning the vessel in 2007. Drift gillnet (DGN) landings are attributed to the person owning the California DGN permit or Oregon DGN developmental fishery permit in 2007.[11]

[10] The alternatives do not specify the process for issuing the permits. As discussed in Section 2.2.3.1, the process could require potential qualifiers to apply for a permit, which is typical for limited entry programs. For that reason, potential qualifiers are referred to as applicants in the text.

[11] No Oregon developmental fishery permits were issued for DGN gear or longline gear in 2007.

Permits are issued up to the maximum number authorized in rank order according to combined landings.

Qualification Option 2

A point system for individuals based on the following criteria:

1. Possessed a DGN permit in 2007.
2. Possessed a DGN permit in 2007 and made landings of swordfish on the West Coast using pelagic longline gear in 2007.
3. Possessed a DGN permit in 2007 and made swordfish landings 1996-2007 using any gear.
4. Number of years owning a DGN permit.

The scoring system is as follows:

1. One point would be awarded to each individual possessing a DGN permit in 2007 (Q_1 = 1 if a DGN permit holder, 0 otherwise).
2. One point would be awarded to each individual possessing a DGN permit in 2007 who made landings of swordfish on the West Coast using pelagic longline gear in 2007 (Q_2 = 1 if this condition is met, 0 otherwise).
3. For applicants possessing a DGN permit in 2007 who made West Coast swordfish landings between 1996 and 2007 using any gear, a point would be awarded for each year the applicant made at least one West Coast swordfish landing during this period (Q_3 = 0–7).
4. A point would be awarded for each year the applicant owned a DGN permit (Q_4 = number of years of DGN permit ownership).

The ranking is based on a formula (F_2) calculated for an applicant as the sum of the first three point amounts plus a weighted multiple of the fourth criterion. Different values for this weighting factor (w_1) will cause the scoring to place relatively more or less value on length of permit ownership.

The resulting formula is:

$F_2 = Q_1 + Q_2 + Q_3 + w_1 * Q_4$

Ties will be broken by using the total amount of swordfish landings, 1996-2007.

Permits are issued up to the maximum number authorized in rank order according to the scoring system.

Qualification Option 3

A point system for SSLL based on the following criteria:

- The number of years in which at least one swordfish landing was made on the West Coast 1996-2007 with pelagic longline gear.
- The number of swordfish landings on the West Coast made 1996-2007 with pelagic longline gear.

The scoring system is as follows:

1. The sum of the number of years in which at least one swordfish landing was made on the West Coast 1996-2006 with SSLL gear (S_1)
2. A weighted multiple of the tonnage of swordfish landings on the West Coast made 1996-2006 with SSLL gear (S_2):

   $F_3 = S_1 + w_2 * S_2$

with a weight w_2 chosen to make S_1 and w_2*S_2 of comparable magnitudes.

Permits are issued up to the maximum number authorized in rank order according to the scoring system.

Qualification Option 4

A scoring system based on a weighted sum of the previous three ranking systems is used.

The resulting formula is:

$$F_4 = F_1 + v_1*F_2 + v_2*F_3$$

Weights v_1 and v_2 are chosen to make F_1, v_1*F_2, and v_2*F_3 of comparable magnitudes.

Permits are issued up to the maximum number authorized in rank order according to the scoring system.

2.1.3 Alternative 3: A Limited Entry Program with No Cap on the Number of Permits

Any person having made at least one commercial fishery swordfish landing on the West Coast during the years 2005-07 would qualify for a permit.

The management framework would contain the following provisions:

- The fishery is closed west of 140° W. longitude.
- The sea turtle take mitigation measures listed under Alternative 2 (e.g., gear requirements, take caps) would apply.
- Effort would be constrained by the available observer pool under a mandatory 100 percent observer coverage requirement.

2.1.4 Alternative 4: Open Access

Under this alternative no new permit requirement would be established, aside from the current general HMS FMP permit. Participation in the fishery would not be limited by special permit.

The management framework would contain the following provisions:

- For analysis overall fishing effort is estimated within a range of 1 million to 1.5 million hooks annually.[12]
- The fishery is closed west of 140° W. longitude.
- Owners of a Hawaii longline limited access permit would not qualify for participation in this fishery.
- The sea turtle take mitigation measures listed under Alternative 2 (e.g., gear requirements, take caps) would apply.
- Effort would be constrained by the available observer pool under a mandatory 100 percent observer coverage requirement.

[12] As discussed in Chapter 4, an estimate of annual fishing effort for the open access fishery was arrived at independently. This value, used in the analysis, is 1.8 million hooks.

2.2 Performance of Features of the Alternatives

This section provides more detailed explanation of how the various features of the alternatives described above might perform if adopted into a management program. The performance of these features are unlikely to have environmental consequences. For example, the details of a limited entry permit program are unlikely to have a discernable environmental effect, considered separately from the issue of the number of permits that will be issued. The number of permits will determine aggregate fishing effort, which does have differential environmental effects. Sea turtle mitigation measures are intended to reduce impacts and are required under all the alternatives. While the potential environmental effects of applying these measures are discussed in the Chapter 4 environmental impact analysis, this section reviews information on the efficacy of these measures and how they would function.

2.2.1 Permit Qualification

Alternative 2 includes four different options for determining the pool of individuals that would potentially qualify for permits. Appendix A contains a more detailed evaluation and comparison of these options and a short summary is provided here.

To varying degrees the options evaluate landings from or participation in the west-coast-based SSLL and DGN swordfish fisheries. Data for this evaluation were derived from the Pacific Fisheries Information Network (PacFIN) and the California Department of Fish and Game (CDFG) Commercial Fisheries Information System (CFIS). It should be emphasized that as part of the program implementation, any data used to determine qualification for a limited entry permit will have to be verified; thus the evaluation provided here may not exactly match results after such verification (see Section 2.2.3.1). In total, there are 92 vessels with longline landings of swordfish from 1996-2007, but only 42 of these vessels meet the recent landings requirement. There are 174 DGN permit holders that made landings from 1996-2007, but only 83 meet the recent landings requirement.

As described above, Option 4 combines the scores from the other three qualification options. This offers another way of looking at the overlap in individuals between the first three options. As discussed in Appendix A, one of the problems with comparing the options, and developing a scoring system for Option 4, is that Options 1 and 3 are based on landings by vessels while Option 2 is based on landings associated with a permit. This means that DGN permit holders under Options 2 have to be matched with vessels owners under Options 1 and 3. This complicated because a DGN permit may have been registered to more than one vessel. Also, it is not always possible to match an owners's name in the vessel documentation information with a DGN permit holder's name, because, for example, a vessel owner may be a company name while DGN permits are registered to indviduals. With these types of caveats in mind, Figure A-1 is a Venn diagram indicating the number of qualifying permits/vessels that overlap among each of the first three options. Adding together the numbers contained in one circle will give the total number in the qualification pool for that option (e.g., for Option 1, 31 + 39 + 6 + 36 = 112). It can be seen that no individual only qualifies under Option 3 (they all also qualify under Option 1 or all three options). Likewise, there is no overlap between Options 2 and 3. Comparing this with Table A-9, it can be seen that the six individuals who are in all three qualification pools also are all in the top 20 under the scoring system used for Option 4.

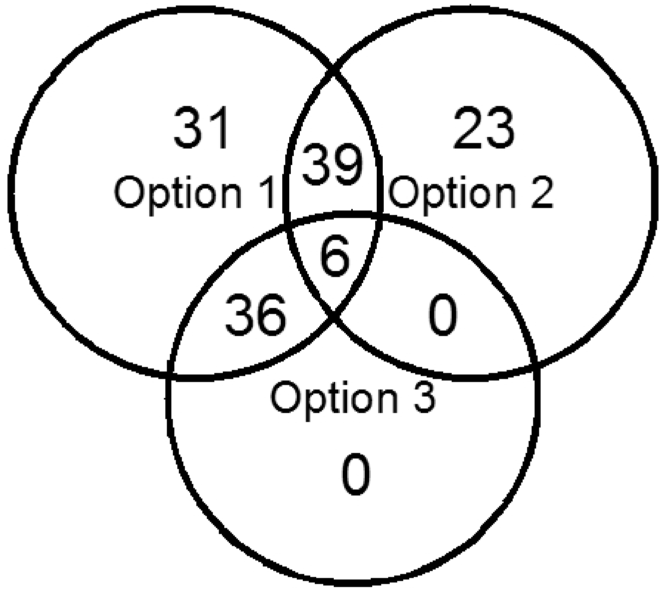


Figure 2-1. Overlap between options based on Option 4 evaluation.

In terms of fishery participation, of the top 20 ranked vessels under Option 1 four only participated in the longline fishery, nine only participated in the DGN fishery and seven participated in both fisheries. For Option 2 none only participated in the longline fishery, 15 only participated in the DGN fishery and 5 participated in both fisheries. For Option 3, 11 only participated in the DGN fishery, none participated only in the DGN fishery, and 9 participated in both fisheries. For Option 4, three only participated in the longline fishery, eight participated only in the DGN fishery, and nine participated in both fisheries. Overall, it can be seen Option 2 tends to favor DGN fishery participants and Option 3 tends to favor longline fishery participants. Options 1 and 4 are more balanced in terms of fishery participation.

Under Alternative 3, the open access fishery, any individual who made at least one swordfish landing from 2005 to 2007 would qualify for a limited entry permit. According to CDFG records, 98 individuals would qualify. Table A-5 shows the types of gear used to make these landings and the number of individuals who used each gear type. Because an individual may have used more than one gear type, the total is greater than 98.

Table 2-1. Number of individuals and gear types used to make swordfish landings, 2005-2007.

Gear Type	Number
Hook and line	3
Vertical hook and line	1
Longline, set	5
Troll, albacore	1
Harpoon/spear	45
Diving	1
Gillnet, drift	55
Gillnet, set	4
TOTAL	114

2.2.2 Permit Transfer Restriction

The permit transfer restriction feature of Alternative 2 prohibits permit transfer for the first 1 or 2 years after issuance, depending on which option is chosen, and could require a minimum number of landings to gain transferability, with options ranging from no landing requirements up to five landings per year. This is intended to prevent someone who is not actively fishing from obtaining a permit and then immediately selling it. The minimum landings requirement is intended to encourage participation in the fishery. However, it is possible that someone with no intention to fish would receive a permit, not fish, and then be unable to transfer the permit to someone who desires to use it. Acquiring the gear and refitting a vessel, for someone not already participating in longline fishing, would represent a substantial capital investment. They would thus be motivated to fish to recover this investment. However, if at the end of 1 or 2 years they are unsuccessful, selling the permit might be a means of recovering some of the initial capital investment. It may be advisable to add a sunset clause to this feature so that if a minimum number of landings is required, but no landings are made during the first 1 or 2 years, the permit is taken away from the individual and reissued to the next eligible applicant on the qualification list not already owning a permit (determined by one of the options discussed above).

There are two sources of information that give an indication of the typical number of landings made in the historical West Coast fishery. First, the landings information in qualification Option 3 could be used to determine an average number of landings per year. Looking at all 42 vessels in the qualification pool, the average was 3.8 landings per year from 1996-2007. For the vessels ranked in the top 20, the average was 6.25 landings per year.

Another way of assessing typical annual landings is to review longline vessel log books compiled by NMFS. From 2002-2004, NMFS monitored longline vessels activity in Southern California ports, to document when vessels were not in port, and when they were carrying an observer. From this information it is possible to calculate a typical trip length and number of trips made by a vessel in a year (the West Coast fishery did not operate year round; most of these trips occurred from August to April). These data were analyzed to determine the average number of trips per vessel and to estimate average trip length and time in port between trips.

First, the number trips each vessel made in a season was calculated and averaged for the two monitoring periods (September 8, 2002-May 17, 2003 and July 27, 2003-April 3, 2004). It should be noted that several vessels are shown leaving port before the end of the second period but not returning. This is due to the fact that the second period ended when the West Coast fishery closed and the Hawaii fishery reopened, so it is likely that these vessels returned to Hawaii. These departures were counted as a trip in deriving averages. The average number of trips in the first and second periods was 4.2 and 3.8, respectively.

Second, the number of potential trips was calculated by looking at the number of days a vessel was out of port and in port between trips and dividing the sum of those values into the length of the monitoring period. Because there were outlier values (i.e., unusually long or short trips and port stays) both an average with outliers thrown out and an average of the middle two quartiles of values were derived. These averages were close, so rounded values of 38 days at sea and 10 days in port were used. Both monitoring periods were 251 days long, resulting in 5.2 potential trips in a season.

The landings requirement options (1-5) fit reasonably well with the activity of the historical fishery. Few vessels are likely to meet a requirement at the high end (i.e., 5 trips) especially if those qualifying have little experience with longline fishing outside the EEZ. Two to three landings per year is the median of the range of historical activity. Depending on the value of permits, requiring a single landing could lead to strategic behavior whereby a vessel is minimally outfitted to make a single, short trip solely to meet the requirement.

2.2.3 Prohibition on Simultaneous Use of a Hawaii Limited Access Permit

Alternative 2 includes a restriction that in any given calendar year a person (or business entity) cannot not exercise / utilize both a West Coast SSLL permit and a Hawaii longline limited access permit to fish for swordfish. This is meant to prevent a Hawaii permit holder from obtaining one of the West Coast limited entry permits and registering another vessel to it and fishing both simultaneously. As described under the No Action alternative, Hawaii permitted vessels can currently land swordfish on the West Coast, even if using SSLL gear, as long as they obtain, among other requirements, a general HMS permit. Table 2-11 shows the number of vessels / permit holders in each option ranked in the top 20 (in rank increments of five) that currently possess a Hawaii permit.

Table 2-11. Number of individuals ranked in the top 20 (in rank increments of five) that possess a Hawaii limited access permit.

Option	1-5	6-10	11-15	16-20	Total
Option 1	4	1	4	0	9
Option 2	1	0	0	0	1
Option 3	3	5	3	4	15

As might be expected, a large number of the vessels qualifying under Option 1 (combined SSLL and DGN landings) and Option 3 (SSLL landings only) are registered to a Hawaii permit while only one permit holder under Option 2 owns a vessel with a Hawaii permit. It is difficult to predict how ownership of a Hawaii-registered vessel would affect use of a West Coast permit. The transfer restrictions discussed above, especially if a landings requirement is included, would diminish the ease of realizing a gain from selling the permit. This could diminish interest in initially receiving the permit. On the other hand, it can be difficult to monitor actual control of vessels and permits. A Hawaii permit holder could transfer that permit to a family member (such as a spouse) or trusted confident in order to exercise the West Coast permit, at least during the initial 2 years during which landings may be required to secure transferability. They could then either sell the permit or continue the arrangement to use both permits simultaneously. In order to prevent this from happening ownership and control would have to be defined (e.g., what level of partial ownership, in a partnership for example, would be sufficient to prevent simultaneous use of the two permits) and a system of verification and monitoring established. This could add substantially to administrative costs.

2.2.3.1 *Application, Issuance, and Appeals Process for Permits*

Alternatives 2 and 3 do not describe the process for application and issuance of limited entry permits, or a mechanism to appeal decisions on permit issuance. The qualification options under Alternative 2 use a combination of landings and permit information to rank applicants for permit issuance. The data sources used in any of the qualification options, such as the PacFIN commercial landings fishticket receipts and permit records, would need some level of verification. Provisions to notify potential qualifiers and allow them to cross-check agency data with their personal records may be warranted. If there are discrepancies between applicants' records and agency data, rules would have to be established to determine which information, or combination of sources, to use. An appeals process could also be established to adjudicate disputes over permit issuance.

A limited entry program was established in 1993 under the Council's groundfish FMP. This program required potential qualifiers to apply to NMFS within 6 months of the start of the program to receive a permit. While recognizing that NMFS issues permits and therefore appeals would be made to the Regional Administrator, a Limited Entry Permit Issuance Review Board was established to advise the Council and the Regional Administrator on appeals. (Sections 11.6 and 11.7 in the groundfish FMP describe the appeals board and the permit issuance process.)

The Council may wish to specify how permits would be issued and establish an appeals process. Like the groundfish limited entry permit system, permit issuance should probably be based on application, so it would be incumbent on those who think they may qualify to affirm that they want to be considered for a permit. Requiring application would help to ensure that those receiving permits would actually use them.

2.2.4 Sea Turtle Bycatch Mitigation Measures

2.2.4.1 *Gear Modifications*

Pelagic longline fishing has been used worldwide since the 19^{th} century; however, it has dramatically increased since the 1950s and ranges from small-scale domestic artisanal fisheries to modern mechanized industrialized fleets from distant water-fishing nations. Pelagic longline fishing gear consists of a 600-1,200 pound test monofilament mainline strung horizontally across 15 to 150 km of ocean, supported at regular intervals by vertical float lines connected to surface floats (Beverly and Chapman 2007). Descending from the main line are branch lines, each ending in a single, baited hook. Between 700 and 1,300 hooks are deployed per set. The main line droops in a curve from one float line to the next and usually bears some 2–25 branch lines between floats (Figure 2-2). To target swordfish, longline gear is set at a shallower depth (less than 100 meters) than its counterpart "deep-set" longling gear (which is usually set between 300 and 400 meters to target tuna). Pelagic longline gear does not touch the seafloor and therefore does not directly damage physical habitat. The mainline takes 3–7 hours to deploy and then left to drift (unattached) for 7–12 hours with radio buoys attached to facilitate gear recovery. Retrieval typically requires 7–10 hours depending on the length of mainline and the number of hooks deployed. Fishing occurs primarily during the night, targeting the full moon time period, and gear is typically deployed near thermal fronts (temperature breaks) or eddies when more swordfish are available in surface waters. Shallow-set longline gear is generally deployed at sunset and hauled back at sunrise. A typical longline vessel carries a crew of six, including the captain, although some of the smaller vessels operate with a four-man crew. Fishing trips can last about three weeks depending on the amount of ice the vessel can carry to keep the fish cold. Most vessels do not have a built-in refrigeration system, which limits their trip length. The fish are iced and sold predominantly in the "fresh fish market." Detailed background information on longline fishing can be found in Beverly and Chapman (2007).

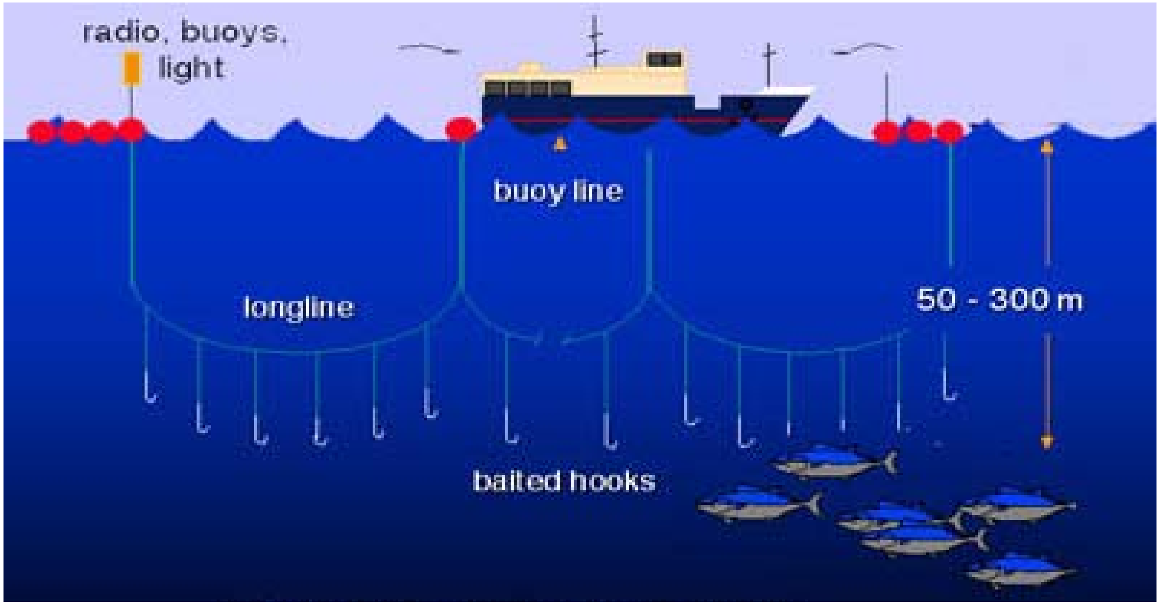


Figure 2-2. Typical setup of longline gear; baited hooks would be set at a depth of less than 100 m to target swordfish. (Source: PIFSC)

With technological and operational modifications, this gear is now being considered a selective fishing gear, which is gear that has undergone innovative gear-based and operational solutions to protect many organisms while still allowing target species to be caught (Kennelly and Broadhurst 2002). A variety of studies have been conducted in different fisheries around the world on the efficacy of using circle hooks and fish bait to reduce incidental captures and post hooking mortalities of sea turtles compared to traditional gear that consists of using squid (*Illex* spp.) and J-hooks. The predominant hook type used historically in U.S. pelagic longline fisheries for swordfish was the 9/0 J-hook with 20-25º offset, and the predominant bait was squid (Hoey and Moore 1999). Offset hooks are hooks with the point bent sideways (usually 18-20º) in relation to the shank (Figure 2–3 in Watson, *et al.* 2005). Mackerel bait has proven to be effective in reducing the interaction rate of sea turtles, most likely due to the fact that sea turtles primarily prey on squid, and fish bait tends to come free of the hook while being progressively eaten by the turtle in small bites, while squid bait holds much more firmly to the hook and tends to result in turtles gulping down the hook with the entire squid (Gilman, *et al.* 2006).

Recent studies have also shown that circle hooks with no offset or minor offset (10º offset or less) cause less physical damage to fish and certain species of sea turtles compared to J-hooks, because of the tendency of circle hooks to engage fish and sea turtles in the mouth rather than in the pharynx, esophagus, or stomach; in addition, circle hooks minimize foul hooking (externally hooked) and bleeding (Piovano, *et al.* 2008; Prince, *et al.* 2002; Skomal, *et al.* 2002). Furthermore, by rotating when set, circle hooks may increase mouth-hooking as opposed to ingestion, an effect demonstrated in fish (Cooke and Suski 2004).

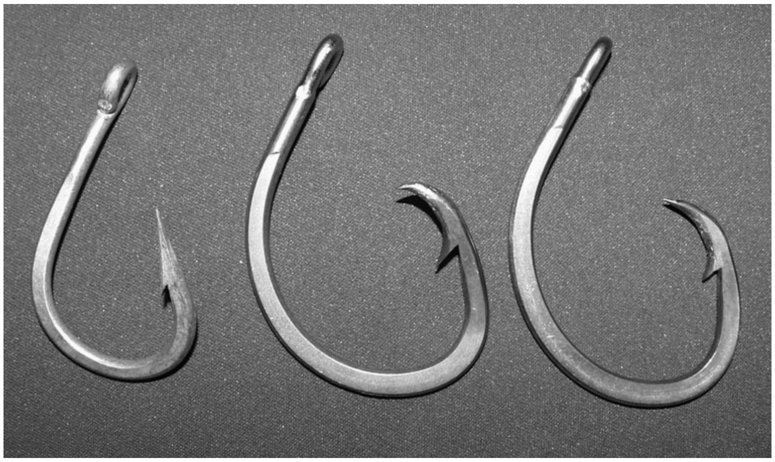
Watson, *et al*. (2005) investigated the effectiveness of using 18/0 circle hooks and mackerel bait as compared with 9/0 J-hooks and squid bait in the Atlantic pelagic longline fishery to evaluate whether these gear modifications reduced sea turtle interactions while maintaining swordfish catch rates. Circle hooks used in combination with mackerel bait resulted in a significant reduction in the capture[13] rate of

[13] "Capture" refers to those interactions that result in a turtle being restrained by the fishing gear until it is observed by the crew or observer.

loggerheads (*Caretta caretta*) and leatherbacks (*Dermochelys coriacea*), with no negative impact on the primary target species catch rate. Loggerhead and leatherback catch rates were reduced by 90 percent and 66 percent, respectively, and swordfish catch rate was increased by 30 percent (Watson, *et al.* 2005). In addition, these modifications in fishing methods significantly reduced the post-hooking mortality of sea turtles, swordfish, and blue shark (*Prionace glauca*), and did not negatively impact the primary target species catch rate (Watson, *et al.* 2005). With respect to loggerhead sea turtles, circle hooks resulted in a significant change in hooking location. Of the 80 loggerheads that were taken using J-hooks, nearly 70 percent swallowed the hook. In contrast, only 3 of the 11 loggerheads (27.3 percent) caught on circle hooks swallowed the hooks; most were hooked in the mouth, where the hooks could be removed more safely. With respect to leatherbacks, the change in hooking location was not as pronounced; however, the sample size was too small to statistically evaluate the interaction of bait and hook type on the hooking location. Fishermen have also reported that a larger percentage of swordfish are alive and active when being hauled in when using circle hooks, as compared to J-hooks, and that the quality of the fish is better (presumably because they are more likely to be caught in the mouth and stay alive longer after being hooked) (Watson, *et al.* 2005). In addition, undersized swordfish that are discarded likely have a higher probability of surviving the interaction with circle hooks (Watson, *et al.* 2005). In regards to blue shark, mackerel bait reduced the catch of blue sharks on both 18/0 circle hooks by an estimated 31 percent. Blue sharks were more frequently hooked in the gut with 9/0 J-hooks compared with 18/0 circle hooks; however, circle hook offset also resulted in a greater gut hooking, but still less than that with J-hooks (Watson, *et al.* 2005).

Read (2007) reviews the large study conducted in the Northeast Distant Statistical Sampling Area in the 2001-2003 time period, referred to as the NED study (results originally reported in Watson, *et al.* 2005), as well as similar studies conducted in the Azores, Gulf of Mexico, and Ecuador. Read concludes that these studies on balance demonstrate that circle hooks both reduce sea turtle catch rates and bycatch mortality. The studies under review indicate that changes in target species catch rates are variable; swordfish catch rates appear to remain the same or increase slightly while tuna and small pelagics (e.g., mahi mahi) catch rates are reduced.

Boggs and Swimmer (2007) prepared a report reviewing other studies on circle hooks conducted from 2005 to 2007 in the Italian Mediterranean (also see Piovano, *et al.* 2008), Uruguay, and Indonesia, and also the ongoing Hawaii SSLL fishery as it has operated since reopening in 2004. Key findings relevant to the proposed action are that the use of circle hooks results in substantial reductions in bycatch and bycatch mortality of hardshell sea turtles (e.g., loggerheads) both because the catch rate is reduced and hooks are less frequently deeply ingested by these turtles. Leatherbacks, which seldom bite baited hooks, are also less frequently caught, and their interactions are due to being snagged and subsequently entangled.



Source: Watson, *et al*. 2005.

Figure 2-3. Comparison of hook designs; from left to right: 9/0 J-hook with 25° offset, 18/0 circle hook with 10° offset, and 18/0 circle hook with 0° offset.

A report by Gilman and Kobayashi (2007), updates information in a previous, peer reviewed paper (Gilman, *et al.* 2007). They found that overall turtle interaction rates (or catch rates) in the Hawaii SSLL fishery were reduced by 89 percent: 90 percent for loggerheads and 85 percent for leatherbacks, after the 2004 regulations were implemented that required the use of 18/0 circle hooks with a 10° offset and mackerel-type bait. Furthermore, there was a significant reduction in the proportion of turtles that swallowed hooks into the esophagus or deeper (deeply hooked, versus being hooked in the mouth or body or entangled) in the post-regulations period. Before large circle hooks and mackerel-type bait were required in the fishery, 53 percent of sea turtles (111 of 211) were deeply hooked, while only 12 percent of captured sea turtles (6 of 51) were deeply hooked in the post-regulations period. As noted above, this likely reduces bycatch mortality. A paper currently in press (Swimmer, *et al.* 2008) reports on the deployment of pop-up satellite archival tags on incidentally-caught loggerhead sea turtles in the Hawaii fishery in order to assess post-release mortality. The study found direct (post-hooking) mortality to be about 15 percent.

Boggs and Swimmer (2007) also cite a study conducted in Spain comparing the use of squid to mackerel bait, demonstrating that switching bait alone can significantly reduce sea turtle capture rates. In his review of the NED experiment Read also finds that the use of mackerel bait on J-hooks resulted in a significant reduction in sea turtle bycatch rates. Combined with the use of large circle hooks, using mackerel-type bait may result in additional reductions in incidental capture in comparison to J-hooks baited with squid. Gilman, *et al*. (2007) found a 36 percent reduction in blue shark catch-per-unit-effort (CPUE) in the Hawaii fishery, which they attribute to the use of mackerel-type bait. (Blue sharks are discarded because their flesh deteriorates quickly after they die, making them unmarketable.) According to the authors, this is consistent with findings in other studies where direct comparison of the bait types was possible. Since blue sharks are a major bycatch species in the SSLL fishery, and sharks tend to be less fecund compared to target swordfish and tunas, reduced catch rates could provide an added conservation benefit for this species.

Boggs and Swimmer (2007, p. 5) also note that “[o]ffset hooks are not a bycatch mitigation tool, but rather a convenience to fisherman that may not increase capture rate or injury to sea turtles.” The offset (e.g., 10°) refers to the bend angle of the hook point in relation to the hook shank. The offset facilitates certain types of baiting operations. As discussed above, regulations would limit the offset to 10° or less rather than specifying an exact 10° offset.

NMFS also produced a memorandum[14] that summarized the actual number of sea turtles that were captured in the Hawaii-based shallow-set longline fishery from when the fishery resumed in late 2004 to the end of 2007, and provided an estimate of mortality resulting from these interactions. The actual number of sea turtles captured in the fishery was determined with 100 percent observer coverage from 2004-2007. All turtles captured in the fishery during this period were released (or escaped) alive with various injuries and release conditions. During 2004-2007, the fishery captured a total of 45 loggerheads, 16 leatherbacks, 1 olive ridley, and no green or hawksbill sea turtles. The total estimated mortality was 9.21 loggerheads (20.5 percent), 3.56 leatherbacks (22.3 percent), and 0.01 olive ridleys (mortality rate not calculated due to one sample). It is important to note that these estimates do not reflect the reproductive cost of the mortalities to the species as a whole or to individual subpopulations (e.g., they do not take into account the sex, size, or age class of the turtles).

In concluding his review, Read (2007) advocates for field testing of circle hooks "in a rigorous experiment" before they are employed in any fishery because of the "variation in fishing practices and in the complex dynamics of turtle capture." In line with this recommendation, the proposed fishery will operate in an area and with requirements very similar to the current Hawaii SSLL fishery, which has provided an ongoing test of these requirements. Because of these similarities, it is reasonable to expect that a West Coast fishery would experience generally similar patterns of incidental capture of sea turtles and other protected species. (Expected takes will be explored further in the impact analysis in Chapter 4.) Initial implementation of a comparatively small fishery (for example, by establishing a limited entry program with a minimal number of permits) would allow for information collection and possibly changing the management regime in response.

The action alternatives would impose gear requirements consistent with those currently applicable to Hawaii longline limited access permit holders fishing with SSLL gear. The Biological Opinion conducted for Pelagics FMP Amendment 18 (NMFS 2008) lists the current shallow-set regulations. The regulations, as they would be modified under Amendment 18, are summarized below to indicate the likely regulatory requirements for a West Coast fishery:

Fishing Permits and Certificates:

- Hawaii Longline Limited Entry Permit. (Under Alternative 2 or 3 of Amendment 2 a new West Coast limited entry permit would be required, and using both a Hawaii and a West Coast limited entry permit simultaneously would be prohibited.)
- Marine Mammal Authorization Program Certificate.
- High Seas Fishing Compliance Act Permit, for vessel fishing on the high seas.
- Protected Species Workshop Certificate.
- Western Pacific Receiving Vessel Permit, if applicable. (No provisions in the alternatives deal with the permitting of at-sea transfer.)
- State of Hawaii Commercial Marine License. (Under the alternatives for Amendment 2, a general HMS FMP permit and California general commercial fishing permit would be required.)

Reporting, Monitoring, and Gear Identification:

- Logbook for recording catch, effort and other data.
- Transshipping Logbook, if applicable.
- Marine Mammal Authorization Program (MMAP) Mortality/Injury Reporting Form.
- Vessel Monitoring System (VMS).

[14] Memorandum dated February 1, 2008 from Chris Yates and Alvin Katekaru, Assistant Regional Administrators, Pacific Islands Regional Office, to William Robinson, Regional Administrator, Pacific Islands Regional Office, in regards to observed captures and estimated mortality of sea turtles in the HI shallow-set longline fishery, 2004-2007.

- Vessel Identification.
- Gear Identification.

Notification Requirement and Observer Placement:
- Notify the PIRO Observer Program contractor at least 72 hours before departure on a fishing trip to declare the trip type (shallow-set or deep-set). (For the West Coast SSLL fishery under Amendment 2 the NMFS SWR Observer Program would coordinate observer coverage.)
- All longline fishing trips are required to have a fisheries observer on board if requested by the Regional Administrator; NMFS policy is to place observers on board every shallow-set longline trip.
- Fisheries observer guidelines must be followed.

Prohibited Areas in Hawaii:
- (These requirements would be applicable only if there is no western area restriction. Generally, pelagic longline fishing is prohibited within 50 nmi of the Hawaiian Islands.)

Protected Species Workshop:
- Each year, longline vessel owners and operators must attend a Protected Species Workshop, and receive a Protected Species Workshop (PSW) certificate.
- A valid PSW certificate is required to renew a Hawaii longline limited entry permit.
- The operator of a longline vessel must have a valid PSW certificate on board the vessel while fishing.

Sea Turtle and Seabird Handling and Mitigation Measures:
- Longline vessel owners/operators are required to adhere to the regulations for the safe handling and release of sea turtles and seabirds presented in the PSWs.
- Longline vessel owners/operators must have on board the vessel and use all required turtle handling/dehooking gear specified in the regulations.
- Longline vessel owners/operators can choose between side-setting or stern-setting to reduce seabird interactions:
- Side-setting requirements:
  - Mainline deployed as far forward as possible.
  - If line shooter is used, mount as far forward as possible, and at least 1 m forward of the stern.
  - Branchlines must have 45 g weight within 1 m of hook.
  - When seabirds are present, deploy gear so hooks remain submerged.
  - Deploy a bird curtain.
- Stern-setting requirements:
  - When seabirds are present, discharge offal while setting or hauling on opposite side of the vessel.
  - Retain sufficient offal between sets.
  - Remove all hooks from offal before discharge.
  - Use swordfish liver and head for offal. The swordfish bill must be removed, and the head split in half vertically.
- When using basket-style gear, ensure mainline is set slack (seabird measure).
- Use completely thawed bait, and dye all bait to match NOAA Fisheries-issued color control card (seabird measure).
- Maintain at least 2 cans of blue dye on board (seabird measure).
- Deploy set ≥1 hour after sunset, complete deployment before sunrise (seabird measure).
- When shallow-set longline fishing north of the Equator:
  - Use 18/0 or larger circle hooks with up to a 10° offset.
  - Use mackerel-type bait.

- Marine Mammal Handling and Release:
  - Longline vessel owners/operators must follow the marine mammal handling guidelines provided at the PSW.
  - Submit the MMPA Mortality/Injury Reporting Form to NOAA Fisheries to report injuries or mortalities of marine mammals.
- Shark Finning and Landings[15]
  - Shark fins, including the tail, cannot be removed from sharks and the carcass disposed at sea.
  - Shark fins can be removed if the corresponding carcass is kept. Shark fins can only be sold if the fins and corresponding carcass are weighted at the same time after returning to port.
  - Shark fins received from another vessel must be accompanied by the corresponding carcass.
  - The total weight of shark fins landed may not exceed 5 percent of the total dressed weight of shark carcasses on board or landed from the vessel.
  - NOAA Fisheries must be granted access to shark fin records.

2.2.4.2 *Incidental Take Caps*

The description of the alternatives above lays out several different ways of determining the value of incidental take caps. Take caps would be based on (although not necessarily equal to) the Incidental Take Statement (ITS) in the biological opinion (BO) prepared for the proposed action. The ITS exempts from ESA section 9 take prohibitions the takes of ESA-listed species that are incidental to the agency's action. Any takes resulting from the action (in this case the SSLL fishery) must comply with the reasonable and prudent measures and terms and conditions of the ITS. The ITS includes an estimate of take anticipated from the proposed action. Where the data are available the take estimate is usually based on previous takes by the same type of activity. For example, the BO recently completed for Amendment 18 to the Pelagics FMP (lifting effort limits on the Hawaii SSLL fishery) used data on the interaction rate experienced in the fishery to date and an estimate of the amount of effort that would be expended in the fishery if the current limit on total sets were to be lifted. It is possible to require a take cap (called an interaction limit in the Amendment 18 BO) lower than the take level estimated solely on the effort and interaction rate data. In the case of Amendment 18, for example, it was estimated that the expanded fishery would take 19 leatherback sea turtles, but as a term and condition, the ITS required that the interaction rate remain at the current level of 16 leatherbacks in order to avoid an increase in "harm" to the western Pacific leatherback population. (The BO concluded, however, that even a take of 19 leatherbacks would not jeopardize the continued existence of the population).

The foregoing discussion suggests that a take cap could be different from the initial estimate of take based on effort and take rates, as long as the BO concludes that the proposed action will not cause jeopardy. This suggests a tradeoff between the size of the fishery authorized and the take caps. For example, the preferred alternative could include a limited entry program with a certain number of permits. Based on the estimate of fishing effort associated with that many vessels, an amount of take would be estimated. If this level of take would cause harm to a turtle population (but not jeopardy), a lower take cap could be imposed as a precautionary measure to limit take at a lower level. This would result in a tradeoff between greater potential fishing opportunity, in terms of the number of permits issued, against the higher risk that the take caps would be reached, which would cause the fishery to immediately close.

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[15] In California it is unlawful to sell, purchase, deliver for commercial purposes, or possess on any commercial fishing vessel, any shark fin or shark tail that has been removed from the carcass before landing the fish. However, thresher shark tails and fins may be retained if there is a corresponding carcass to match each tail and fin (FGC §7704).

It may be advisable for the Council to use a two-step decision process to choose a preferred alternative. First, the Council would choose a preliminary preferred alternative sufficient to trigger preparation of the draft BO. At a subsequent meeting the Council would review the findings in the draft BO and choose its final preferred alternative, which could involve modifying the preliminary preferred alternative if necessary to be consistent with the conclusions in the draft BO. (For example, if the draft BO concluded that the action was likely to jeopardize an ESA listed species, the Council could use this guidance to revise their preferred alternative in a way that would lower the anticipated takes to a level that would not cause jeopardy).

2.2.4.3 *Identification of Hotspots*

The NMFS PIFSC, Ecosystems and Oceanography Division released TurtleWatch to fishermen and managers in electronic and paper formats on December 26, 2006, to assist in decision making during the first quarter of 2007. TurtleWatch provides up-to-date information on the preferred thermal habitat of loggerhead sea turtles in the Pacific Ocean north of the Hawaii Islands (Pacific Islands Fisheries Science Center 2008a). A composite image of sea surface temperature and ocean currents is regularly posted to the program website (see Figure 2-4. for an example of this image). Previous research at the PIFSC indicates that within the region of the map image loggerhead sea turtles' preferred habitat is in waters cooler than 65.5° F, making that contour an indication of the southern boundary. The map image delineates the 65.5° F temperature contour. This data product is intended to help fishermen avoid areas where interaction rates may be higher.

As can be seen in Figure 2-4, the map currently extends to 140° E. longitude and therefore does not encompass areas likely to be fished by the proposed West Coast fishery. Also, it is not clear that the 65.5° F temperature contour pertains as a habitat boundary in regions further east because the research underlying TurtleWatch was conducted in the area north of Hawaii.

Extension of the TurtleWatch program eastward to the likely area of operation for the proposed West Coast fishery is not included as a mitigation measure in the alternatives, because it is not a regulatory measure but a discretionary program activity. However, program expansion could be proposed as an additional mitigation measure, although this would substantially increase program costs because the required data are not gathered east of the current TurtleWatch coverage area. Furthermore, no research has been conducted on how loggerheads (and leatherbacks) interact with thermal fronts in this more easterly region (potentially influenced by California Current).

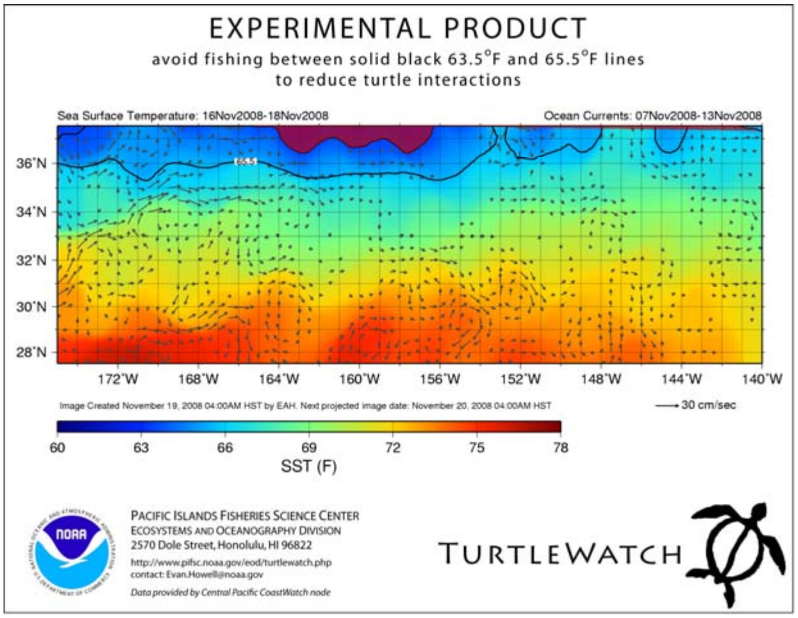

Figure 2-4. Example of TurtleWatch image (accessed November 19, 2008).

2.2.5 At-Sea Observer Coverage

The alternatives would require 100 percent observer coverage of all vessels participating in the fishery. Full observer coverage is needed in order to make sure that the turtle take caps are effective. Protected species takes are a relatively rare occurrence, so even without take caps very high levels of coverage are needed to determine the actual level of takes. Typically NMFS provides and pays for observers, although the observers are usually employed and supervised by a third party contractor. Currently, NMFS SWR has a limited budget for observers so the requirement for 100 percent coverage combined with this limitation could be a greater constraint to participation than license limitation. At this time the SWR Observer Program has funding for approximately 300 days of at-sea observer time across all the fisheries under SWR management. Assuming that about one quarter of observer time would be spent transiting to and from the fishing grounds and about one set can be made per day when actively fishing, this would limit fishing effort to the neighborhood of 225 sets per year (assuming that all observer time was allocated to this fishery, which is unlikely). This represents a relatively small level of effort (less than 200,000 hooks) compared to the historical West Coast SSLL fishery, which has been estimated to have annually set about 1.5 million hooks. The Council could recommend a management framework that would allow fishery participants to pay the observer costs by using a third party contractor approved by NMFS. For example, in the at-sea portion of the Council-managed Pacific whiting fishery industry pays for onboard observers. The Council is currently proposing that industry pay for observer costs in other segments of the groundfish limited entry trawl fishery under the groundfish trawl rationalization program.

2.2.6 Hawaii Permit Owners Prohibited from Open Access Fishery

Alternative 4, the open access alternative, includes a provision that owners of a Hawaii longline limited access permit would not qualify for participation in the West Coast open access fishery. Since participation is not restricted by a new permit, the only mechanism available to restrict participation would be limiting possession of a general HMS permit, which is currently required of any vessel landing HMS on the West Coast. This restriction could be implemented by prohibiting the simultaneous possession of both a Hawaii longline limited access permit and a West Coast general HMS permit. This would not prohibit Hawaii permitted vessels from fishing on the high seas but would prevent them from landing their catch on the West Coast. The issues discussed above in Section 2.2.3 of defining, determining, and monitoring ownership or control would also apply in this case.

2.3 Summary of the Impacts of the Alternatives

2.3.1 Finfish

- The North Pacifc swordfish stock is not subject to overfishing or in an overfished state. Alternative 2 (limited entry) could increase total catch across all foreign and domestic fisheries by as much as 10 percent. The stock-wide increase in catch under Alternatives 3 and 4 (unconstrained fishery) could be as high as 15 percent.

- For nontarget stocks there are conservation concerns for bigeye tuna (overfishing occurring and stock overfished), yellowfin tuna (overfishing may be occurring) striped marlin (stock size low compared to historic levels), and albacore tuna (current fishing effort high). Under all the alternatives the increase in catch would be very small in comparison to stock-wide catch.

2.3.2 Sea Turtles

- The analysis estimated levels of loggerhead and leatherback sea turtle take based on observer data from the West Coast and Hawaii fisheries, 2001-2004. During that time period the fisheries used J-hooks and squid bait so the take rates in these fisheries were adjusted to reflect the use of circle hooks and mackerel bait required under the action alternatives. Constraining the fishery east of 150° or 140° W. longitude and limiting the number of vessels participating in the fishery would result in lower takes of loggerhead sea turtles. For leatherback sea turtles, the analysis shows that the area closures have less of an effect because the historical take observations of leatherback sea turtles occurred east of 150° W.

- Estimated take and mortality in the proposed fishery, under the different alternatives and options, was compared to guidance issued by NMFS when partially disapproving the HMS FMP in 2004 (see Section 1.2), which directed the Council to consider a proposed fishery "that would limit sea turtle mortality to low levels approximating those that had previously been found in the drift gillnet fishery not to result in jeopardy to any listed sea turtles." Under Alternative 2, a fishery closed west of 140° W. longitude with up to 20 permits (vessels) has estimated mortality levels of two loggerhead and two leatherback sea turtles, which may be consistent with this guidance. A fishery closed west of 150° W. longitude or without an area closure results in higher takes than with the 140° W. closure. With either the 150° W. closure or no area closure a fishery with 10 permits (vessels) or fewer is estimated to result in a similar number of loggerhead and leatherback mortalities. Unconstrained fisheries under Alternatives 3 and 4 have a higher risk of jeopardizing the continued existence of ESA-listed sea turtles.

- Under Alternative 2, a fishery with 20 permits (vessels) risks substantial detrimental population level impacts for loggerhead and leatherback sea turtles. A fishery with fewer permits reduces this risk.

2.3.3 Marine Mammals

- The analysis identifies marine mammal species occurring in the action area, species that have been observed taken in the Hawaii and West Coast SSLL fisheries, and assesses the likelihood of species being taken in the proposed fishery. A fishery as proposed under Alternative 2 with 20 permits is likely to have a comparable level of marine mammal takes to what has been observed in the Hawaii SSLL fishery, estimated at 5-10 marine mammals annually. Based on observed takes in the Hawaii SSLL fishery, and recognizing the different geographic area in which a West Coast SSLL fishery is likely to operate, the species most likely to be taken are Risso's dolphins and bottlenose dolphins. These species commonly depredate longlines, ingesting bait and hooks, which leads to serious injury.

- Strategic marine mammal stocks occurring in the action area, which include ESA-listed species, are also noted. Two of these species, humpback and short-finned pilot whales, have been observed taken in the Hawaii SSLL fishery and have a distribution that includes the area within which a West Coast fishery is likely to operate.

- Under Alternative 2, a fishery with fewer than 20 permits (vessels) would reduce the risk of substantial adverse impacts to marine mammals stocks. Alternatives 3 and 4 would present an increased risk.

2.3.4 Seabirds

- Two seabird species, black-footed albatross and Laysan albatross, have been observed captured in the West Coast and Hawaii SSLL fisheries. The short-tailed albatross, listed as endangered under the ESA, occurs in the action area. The USFWS has conducted a 12-month status review based on a petition to list the black-footed albatross as threatened or endangered under the ESA. A decision is pending.

- A BO prepared for the HMS FMP by the USFWS estimated one short-tailed albatross take per year in HMS fisheries, including the SSLL fishery proposed (but subsequently prohibited) in the HMS FMP. This BO concluded that the one annual take would no jeopardize the continued existence of the species. A fishery with fewer than 20 permits (vessels) is not likely to present a greater risk to the short-tailed albatross than the fishery originally proposed in the HMS FMP.

- Although not specified in the alternatives, seabird mitigation measures comparable to those currently in place for the Hawaii SSLL fishery are likely to be required for the proposed fishery. These mitigation measures have been shown to substantially reduce seabird takes compared to the fishery as it operated without such measures.

- Capture rates in the historical West Coast SSLL fishery, adjusted based on research on the effect of mitigation measures in the Hawaii SSLL fishery, were used to estimate potential captures under the alternatives. Under Alternative 2 a fishery with 20 permits (vessels) is estimated to result in 47 black-footed albatrosses and 15 Laysan albatrosses being captured. Under Alternatives 3 and 4, 153 black-footed albatrosses and 4 Laysan albatrosses are estimated to be captured.

2.3.5 Socioeconomic Impacts

- An economic viability analysis was prepared, which estimated financial and economic profit under different scenarios representing sets of constraints on the proposed fishery (area closures, take caps, observer coverage). According to the analysis, a fishery under Alternative 2 with up to 15 vessels would be economically viable, defined as having a positive expected economic profit, under most scenarios analyzed. The exceptions are the case with the fishing area restricted to east of 140° W. longitude and the case with observer coverage limited to 300 sets. Higher levels of viability (economic profit) are estimated for a fishery with fewer numbers of participants.

- Total expected ex-vessel revenue ranges from about $1.4 to $3.6 million depending on the number of vessels and fishery constraints. This level of ex-vessel revenue is substantial compared to region-wide HMS commercial ex-vessel revenue, which was $2.9 million in 2008 in Southern California according to PacFIN landings information. The high end of the range represents about 6 percent of ex-vessel revenues from all fisheries in the region. This gives an indication of the effect on regional personal income. The proposed fishery may not result in any increase in employment if it principally results from vessels and fishing effort shifting from existing fisheries.

CHAPTER 3 AFFECTED ENVIRONMENT

3.1 Pelagic Environment

A 2007 environmental assessment evaluating a proposed exempted fishing permit to allow a single vessel to fish with SSLL gear in the West Coast EEZ (NMFS and PFMC 2007; NMFS and PFMC 2008) and the Pelagics FMP Amendment 18 EIS (WPFMC 2008) provide information relevant to the proposed action evaluated in this EIS. Information on the pelagic environment is incorporated by reference and summarized below.

3.1.1 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 the SSLL fishery, occur widely in the Pacific, and tolerate a wide range of water temperature (5°-27° 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° C sea surface temperature (SST) isotherm and 34.8 isohaline (line of equal salinity) while the SSTF can be identified by the 20° C isotherm and 35.0 isohaline and 24.8 isopycnal (line of equal density) (Seki, *et al*. 2002). The SAFZ is approximated by the 8° isobath and 33.0 isohaline.

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° C water and decreased at higher temperatures. Increasing SST frontal energy had a positive effect on swordfish CPUE.

Figure 3-1 plots average sea surface temperature (SST), September 2002-March 2003, against the location of observed SSLL sets during the fourth and first quarters, 2001-2004, in order to show the location of the oceanic fronts discussed above. (The SST image was matched to an image output of observed SSLL sets from ArcView GIS by manual “rubbersheeting” in OpenOffice Draw.) The 17° and 20° C isotherms are approximated by dashed lines to show the location of the STFZ. (A second image with the temperature bands constrained between 17° and 20° C was used to define these lines, which were then copied to the figure.) The circle symbols are sets made during the first quarter and the square symbols are sets made during the fourth quarter. It can be seen that first quarter sets tended to be in the transition zone between the STFZ and SAFZ and farther east while first quarter sets were within the STFZ and further west.

In the North Pacific higher chlorophyll concentrations are found moving north away from the equator. Figure 3-2 shows average chlorophyll a concentrations in February and August 2008 to depict seasonal variation The boxes in the two figures show the approximate location of the STFZ. Chlorophyll concentrations are somewhat higher in this region during the winter period. Chlorophyll concentrations area higher in the SAFZ, located at 30°-45° N. latitude. A chlorophyll front occurs between the low surface chlorophyll subtropical gyre and the high surface chlorophyll subarctic gyre, which migrates north-south seasonally. Since chlorophyll is an indication of primary production areas of higher concentration would generally indicate areas of higher potential productivity.

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° C isotherm and the second with the 20° 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 to large pelagics, such as blue whales. They cite satellite telemetry data from four blue whales to show individual whale movements overlapped frontal features.

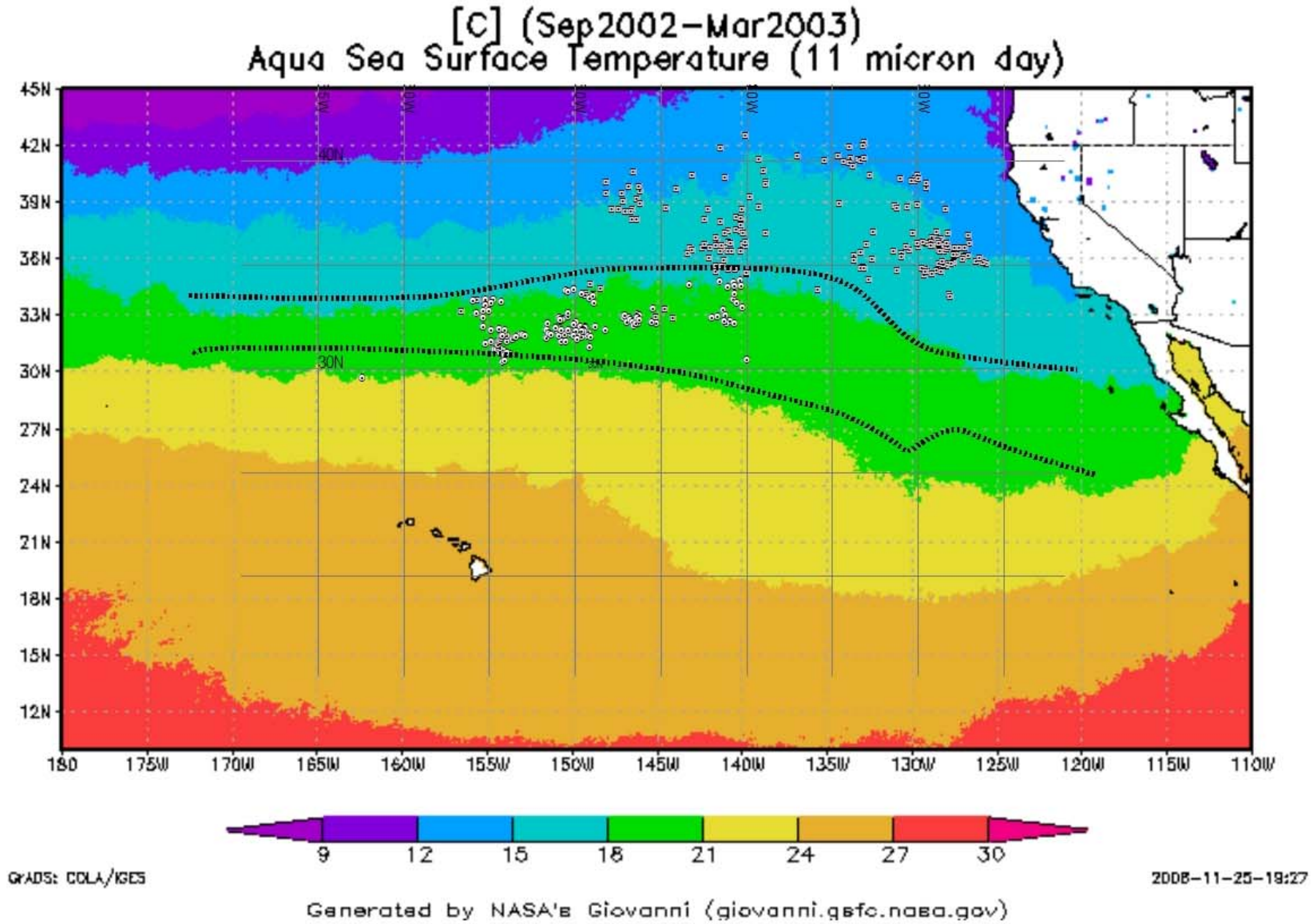

Figure 3-1. Sea surface temperature, September 2002-March 2003 and observed SSLL sets, September 2002-March 2003.

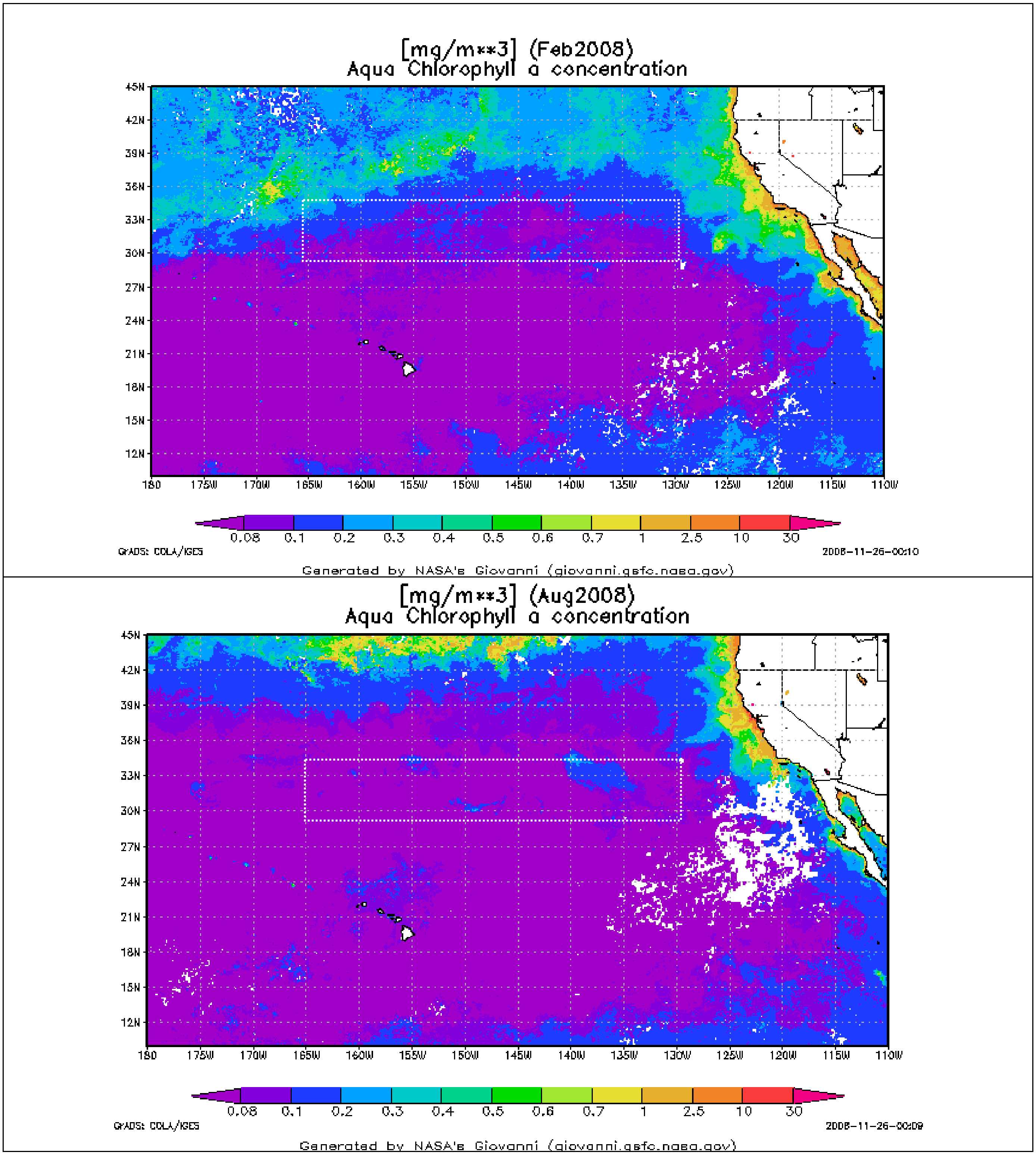

Figure 3-2. Chlorophyll concentrations in Eastern Pacific, February 2008 (top) and August 2008 (bottom).

3.1.2 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 a SSLL fishery. 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. 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. Table 3-1 is an extract from the NOAA Climate Prediction Center's historical record of El Niño events, the Oceanic El Niño Index (ONI), based on a 3-month running mean of ERSST.v3 SST anomalies in the Niño 3.4 region (5°N-5°S, 120°-170°W), based on the 1971-2000 base period (Climate Prediction Center 2008). Note that the September 2002-March 2003 period depicted in Figure 3-1 is one of positive anomalies.

Table 3-1. Cold and warm periods based on the Oceanic El Niño Index.

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
1996	**-0.8**	**-0.7**	**-0.5**	-0.3	-0.2	-0.2	-0.1	-0.2	-0.1	-0.2	-0.3	-0.4
1997	-0.4	-0.3	-0.1	0.3	**0.8**	**1.3**	**1.7**	**2**	**2.2**	**2.4**	**2.5**	**2.5**
1998	**2.3**	**2**	**1.4**	**1.1**	0.4	-0.1	**-0.7**	**-1**	**-1.1**	**-1.2**	**-1.4**	**-1.5**
1999	**-1.5**	**-1.2**	**-0.9**	**-0.8**	**-0.8**	**-0.8**	**-0.9**	**-1**	**-1**	**-1.2**	**-1.4**	**-1.7**
2000	**-1.7**	**-1.4**	**-1**	**-0.8**	**-0.6**	**-0.6**	-0.4	-0.4	-0.4	**-0.5**	**-0.7**	**-0.7**
2001	**-0.7**	**-0.5**	-0.4	-0.3	-0.1	0.1	0.1	0	0	-0.1	-0.1	-0.2
2002	-0.1	0.1	0.2	0.4	**0.6**	**0.8**	**0.9**	**0.9**	**1.1**	**1.3**	**1.5**	**1.4**
2003	**1.2**	**0.9**	**0.5**	0.1	-0.1	0	0.3	0.4	0.5	0.5	0.6	0.4
2004	0.4	0.2	0.2	0.2	0.3	0.4	**0.7**	**0.8**	**0.9**	**0.8**	**0.8**	**0.8**
2005	**0.6**	**0.5**	0.4	0.5	0.5	0.5	0.5	0.3	0.2	-0.1	-0.4	-0.8
2006	-0.8	-0.6	-0.3	-0.1	0.2	0.3	0.4	**0.5**	**0.7**	**0.9**	**1.2**	**1.1**
2007	**0.8**	0.4	0.1	-0.1	0	-0.1	-0.2	**-0.5**	**-0.8**	**-1.1**	**-1.2**	**-1.4**
2008	**-1.5**	**-1.4**	**-1.1**	**-0.7**	**-0.5**	-0.4	-0.1	0	0			

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 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 fishermen (Francis, *et al.* 1998; MacCall 2005).

3.1.3 Climate Change

The Intergovernmental Panel on Climate Change (IPCC) in their 2007 report found substantial evidence that changes in marine ecosystems are associated with rising water temperatures and associated changes in ice cover, salinity, dissolved oxygen, and currents (IPCC 2007). They also found that anthropogenic carbon has led to increased ocean acidification, although observed effects on the marine environment are as yet undocumented.

Seasonal movements of large pelagics, such as swordfish, in the North Pacific Transition Zone (NPTZ) appear to be related in shifts in primary production, as indicated by changes in chlorophyll concentration. Polovina, *et al.* (2008) found that low chlorophyll waters within the region have been expanding consistent with global warming. This could affect productivity of stocks of large pelagic fish and other animals.

3.2 Finfish

Finfish species that have been historically caught in the SSLL fishery are described in the Pelagics Amendment 18 EIS (WPFMC 2008) and the SSLL exempted fishing permit EA (NMFS and PFMC 2007). The information in these documents is incorporated by reference and summarized in this section.

3.2.1 Target Species: North Pacific Swordfish

3.2.1.1 *Biology and Life History Characteristics*

Broadbill swordfish (*Xiphias gladias*) have wide distribution throughout the world’s tropical, subtropical, and temperate seas. They tolerate temperatures of 5°-27° C, preferring regions with SSTs above 13° C. Tagging data indicate a general movement in the North Pacific from west to east. Several semi-independent stocks may occur in the Pacific. Adults feed opportunistically on squid, fish, and crustaceans. In the North Pacific spawning occurs between May and August in the upper mixed layer from the surface to 75 m. There is little information about the distribution of larval and juvenile swordfish, although larval fish are reportedly abundant between 35° N. and 25° S latitudes in the Pacific. In the North Pacific, female swordfish reach maturity at between 5 and 6 years and 150-180 cm lower-jaw-fork-length. Maximum ages differ between the sexes with estimates for males ranging from 9 to 14 years and for females from 15 to 32 years.

Swordfish exhibit a general diurnal pattern of vertical movement, remaining at depth during the day and rising to near the surface at night, although telemetry experiments and the existence of the Southern California harpoon fishery indicate occasional excursions to surface waters during daytime (a behavior known as basking). As mentioned in Section 3.1.1, swordfish tend to concentrate in frontal zones along with their preferred forage.

3.2.1.2 *Stock Status*

The North Pacific swordfish stock was last assessed in 2004 by the International Scientific Committee for Tuna and Tuna-like Species (ISC). The assessment (ISC 2004), based on CPUE indices from Japanese longline vessels, showed declining trends mainly driven by declines in the northwest portion of the study area (north of 10° N latitude and west of 170° E longitude). The last stock assessment conducted by the IATTC for swordfish in the Eastern Pacific Ocean (Hinton, *et al.* 2004) did not find a trend of declining abundance, based on standardized CPUE data from longline fisheries. Catches were reported as being fairly stable and CPUE greater than that corresponding to MSY. The assessment concluded that catch and effort were not of a magnitude to "cause significant responses" in the Eastern Pacific populations.

The ISC Billfish Working Group is currently preparing for the next assessment, scheduled for 2009. It has identified four possible stock structure scenarios for the North Pacific have been identified, based on the existence of either a single stock or two stocks and different distributional patterns(BillWG 2008).

3.2.2 Nontarget Species

A wide range of other species is caught in SSLL fisheries, albeit many in small numbers. Table 3-2 shows observed catch and CPUE in the pre-2004 California and Hawaii-based SSLL fisheries.[16] This table reproduces information in Table 3-4 in the SSLL EFP EA (NMFS and PFMC 2007) but the California and Hawaii columns have been sorted separately according to descending CPUE. Observed swordfish catch accounted for 46.8 percent of the California fishery's catch (in numbers of fish) while the proportion is 32.4 percent in the Hawaii fishery. The top 10 species ranked by CPUE accounted for 97.6 percent and 93.9 percent of the catch respectively. In both fisheries blue sharks, which are not retained, were the second most commonly caught species, accounting for around a third of the catch. Other common incidentally caught species include other sharks, albacore, bigeye tuna, striped marlin, and other species such as dorado, escolar, and oilfish.

No controlled experiments have been conducted in the Hawaii fishery to determine if the use of circle hooks and mackerel bait results in different CPUEs for finfish in comparison to J-hooks and squid bait. A simple statistical comparison (Student's t-test) of pooled pre-2004 West Coast observer data (J-hooks, squid bait) and post-2004 Hawaii observer data (circle hooks, mackerel bait) found no significant difference in swordfish CPUE on a per set basis (HMSMT 2008). However, considering that there are various other factors which could affect CPUE independently of the gear, such as the time and location of fishing and other operational characteristics of the fisheries, the conclusion is not definitive. As noted in Section 2.2.4.1, Gilman, *et al.* (2007) found a 36 percent reduction in blue shark CPUE when comparing the fishery before and after the adoption of circle hooks and mackerel bait; they attributed this reduction to the bait change. Table 3-3 compares the CPUE of vessels fishing with J-hooks prior to 2004 compared to catch rates for those vessels fishing with circle hooks in the reopened fishery. Although not a side-by-side comparison temporally and spatially, thus introducing other factors that may affect catch rates, it gives an idea of the change in catch rates between the gear types. Note that the reduction in blue shark CPUE is consistent with the findings reported by Gilman, *et al* (2007).

[16] As discussed elsewhere, J-hooks and squid bait were used in the pre-2004 fisheries; the Hawaii fishery has used circle hooks and mackerel bait since reopening in 2004.

Table 3-4 summarizes data presented in Table 12 in the Pelagics Amendment 18 EIS (WPFMC 2008, pp. 73-74) on species caught and retained in the Hawaii SSLL fishery, 2004-2007. The rows are sorted according to the proportion of the total observed catch. There are 18 species for which more than 50 percent are retained. Of these 18 species, swordfish accounts for 40 percent of the total catch; the remaining 17 species account for 20 percent of the total catch. The proportion retained depends somewhat on their commercial value and the condition of fish when brought aboard the vessel. Table 12 also includes estimates of the number of fish released alive versus released dead, which represents a minimum estimate of bycatch mortality (recognizing that there may be additional post-release mortality). This proxy for a minimum bycatch mortality rate is shown in the last column in Table 3-4; the average discard rate is 34 percent.

Table 3-2. Catch and CPUE in the Hawaii and West Coast SSLL fisheries, pre-2004. (CPUE is number of fish per 1,000 hooks.)

	CA-based SSLL			HI-based SSLL	
	Total Observed Catch	CPUE		Total Observed Catch	CPUE
Swordfish	7,512	21.53	Swordfish	56,995	16.65
Blue shark	5,575	15.98	Blue shark	53,947	15.76
Unid sharks	998	2.86	Dorado	18,793	5.49
Albacore tuna	460	1.32	Albacore tuna	11,108	3.25
Shortfin mako shark	249	0.71	Bigeye tuna	6,085	1.78
Longnose Lancetfish	235	0.67	Longnose Lancetfish	4,509	1.32
Bigeye tuna	223	0.64	Escolar	4,472	1.31
Escolar	194	0.56	Remora	4,397	1.29
Pelagic stingray	125	0.36	Striped marlin	2,747	0.80
Oilfish	86	0.25	Shortfin mako shark	2,313	0.68
Dorado	65	0.19	Pelagic stingray	2,259	0.66
Common Mola	51	0.15	Snake mackerel	1,632	0.48
Opah	36	0.10	Yellowfin tuna	1,575	0.46
Unid. fish	34	0.10	Oilfish	935	0.27
Unid mako sharks	33	0.10	Blue Marlin	633	0.19
Pacific Pomfret	30	0.09	Oceanic White-tip shark	559	0.16
Snake mackerel	29	0.08	Unid sharks	471	0.14
Remora	21	0.06	Shortbill spearfish	435	0.13
Yellowfin tuna	18	0.05	Wahoo	412	0.12
Striped marlin	12	0.03	Sickle Pomfret	365	0.11
Unid billfishes	12	0.03	Unid. fish	288	0.08
Pacific Bluefin tuna	11	0.03	Skipjack tuna	249	0.07
Skipjack tuna	10	0.03	Opah	232	0.07
Bigeye thresher shark	8	0.02	Common Mola	157	0.05
Wahoo	7	0.02	Unid mako sharks	123	0.04
Unid. tunas and mackerels	5	0.01	Bigeye thresher shark	116	0.03
Blue Marlin	4	0.01	Unid. tunas and mackerels	107	0.03
Black Marlin	1	0.00	Unid billfishes	66	0.02
Oceanic White-tip shark	0	0.00	Pacific Bluefin tuna	60	0.02
Shortbill spearfish	0	0.00	Pacific Pomfret	58	0.02
Sickle Pomfret	0	0.00	Unid thresher sharks	23	0.01
Unid thresher sharks	0	0.00	Black Marlin	7	0.00
Pelagic thresher shark	0	0.00	Pelagic thresher shark	6	0.00

Table 3-3. Observed catch and CPUE on vessels using circle hooks and mackerel bait in comparison to sets by those vessels not using circle hooks and using mixed bait. CPUE is number of fish per 1,000 hooks. (Source: Table 3-5 NMFS 2007.)

	Circle Hook SSLL Trips		Non-circle Hook SSLL Trips		Percent Change
	Total Observed Catch	CPUE	Total Observed Catch	CPUE	Associated with Circle Hooks
Swordfish	36,595	17.156	20,167	15.637	9.7%
Blue shark	26,965	12.641	26,532	20.572	-38.6%
Dorado	7,467	3.501	11,319	8.776	-60.1%
Escolar	3,539	1.659	913	0.708	134.3%
Bigeye tuna	3,342	1.567	2,741	2.125	-26.3%
Longnose lancetfish	2,702	1.267	1,786	1.385	-8.5%
Albacore	2,255	1.057	8,651	6.708	-84.2%
Shortfin mako shark	1,867	0.875	399	0.309	183.2%
Striped marlin	1,810	0.849	936	0.726	16.9%
Remora	920	0.431	3,474	2.694	-84.0%
Snake mackerel	685	0.321	946	0.733	-56.2%
Oilfish	488	0.229	443	0.343	-33.2%
Blue marlin	389	0.182	244	0.189	-3.7%
Oceanic whitetip shark	352	0.165	207	0.16	3.1%
Yellowfin tuna	348	0.163	1,227	0.951	-82.9%
Sickle pomfret	285	0.134	76	0.059	127.1%
Shortbill spearfish	245	0.115	190	0.147	-21.8%
Pelagic stingray	202	0.095	2,035	1.578	-94.0%
Opah	176	0.083	51	0.04	107.5%
Wahoo	159	0.075	253	0.196	-61.7%
Skipjack tuna	140	0.066	107	0.083	-20.5%
Unid mako shark	115	0.054	7	0.005	980.0%
Bigeye thresher shark	52	0.024	64	0.05	-52.0%
Unid. fish	49	0.023	3	0.002	1050.0%
Unid billfishes	38	0.018	28	0.022	-18.2%
Tunas and mackerels	32	0.015	75	0.058	-74.1%
Common Mola	21	0.01	134	0.104	-90.4%
Unid thresher shark	12	0.006	10	0.008	-25.0%
Pelagic thresher shark	3	0.001	3	0.002	-50.0%
Pacific Bluefin tuna	1	0	59	0.046	--
Unid shark	0	0	705	0.547	--
Black marlin	1	0	8	0.006	--
Pacific pomfret	0	0	58	0.045	--

Table 3-4. Observed finfish catches and retention rate in the Hawaii based shallow-set fishery, 2004-2007. (Adapted from Table 12 in WPFMC 2008).

Species	Total number caught 2004-2007	Percent retained	Percent of total caught	Average percent discarded dead
Swordfish	57,769	89.2%	40.376%	66.36%
Blue Shark	42,856	0.0%	29.953%	5.91%
Mahimahi	9,712	82.7%	6.788%	16.03%
Escolar	6,264	71.1%	4.378%	39.99%
Longnose Lancetfish	5,683	0.0%	3.972%	93.14%
Bigeye Tuna	4,723	91.8%	3.301%	35.75%
Albacore	3,827	62.8%	2.675%	43.04%
Shortfin Mako (Mackerel Shark)	2,902	10.8%	2.028%	21.10%
Striped Marlin	2,144	85.1%	1.498%	23.13%
Snake Mackerel	1,086	11.1%	0.759%	61.66%
Remora	923	0.8%	0.645%	9.39%
Oilfish	783	10.5%	0.547%	26.25%
Yellowfin Tuna	493	91.7%	0.345%	36.59%
Oceanic Whitetip Shark	450	2.0%	0.315%	6.80%
Indo-Pacific Blue Marlin	440	84.3%	0.308%	24.64%
Sickle Pomfret	389	93.3%	0.272%	53.85%
Cartilaginous Fishes	360	0.0%	0.252%	15.83%
Pelagic Stingray	303	12.5%	0.212%	30.94%
Shortbill Spearfish	301	66.1%	0.210%	45.10%
Opah (Moonfish)	253	64.0%	0.177%	26.37%
Wahoo	250	96.4%	0.175%	77.78%
Brama Pomfrets Nei	229	50.7%	0.160%	56.64%
Skipjack Tuna	189	87.3%	0.132%	79.17%
Mako Sharks	125	0.0%	0.087%	23.20%
Bigeye Thresher Shark	95	15.8%	0.066%	23.75%
Bony Fishes Nei	73	5.5%	0.051%	57.97%
Sandbar Shark	51	3.9%	0.036%	2.04%
Billfishes	43	2.3%	0.030%	28.57%
Silky Shark	42	2.4%	0.029%	9.76%
Tunas And Mackerels	41	2.4%	0.029%	77.50%
Ocean Sunfish (Common Mola)	38	0.0%	0.027%	2.63%
Knifetail Pomfret	26	3.9%	0.018%	44.00%
Pelagic Puffer	25	0.0%	0.017%	16.00%
Crocodile Shark	23	0.0%	0.016%	21.74%
Salmon Shark	22	0.0%	0.015%	81.82%
Brilliant Pomfret	19	36.8%	0.013%	58.33%
Thresher Sharks	16	0.0%	0.011%	18.75%
Great Barracuda	15	80.0%	0.010%	33.33%
Longfin Mako	13	7.7%	0.009%	16.67%

Table 3-4 (cont.)

Species	Total number caught 2004-2007	Percent retained	Percent of total caught	Average percent discarded dead
Tiger Shark	11	0.0%	0.008%	9.09%
Thresher Shark	10	10.0%	0.007%	22.22%
Cookie Cutter Shark	8	37.5%	0.006%	60.00%
Galapagos Shark	6	0.0%	0.004%	16.67%
Pelagic Thresher Shark	6	0.0%	0.004%	33.33%
Smooth Hammerhead Shark	6	0.0%	0.004%	66.67%
Mobulas Nei	5	40.0%	0.003%	0.00%
Manta	5	0.0%	0.003%	40.00%
Omosudid (Hammerjaw)	5	0.0%	0.003%	80.00%
Tapertail Ribbonfish	4	25.0%	0.003%	66.67%
Driftfish	3	33.3%	0.002%	100.00%
Roudi Escolar	3	0.0%	0.002%	66.67%
Pacific Bluefin Tuna	2	100.0%	0.001%	0.00%
Louvar	2	50.0%	0.001%	0.00%
Black Marlin	1	100.0%	0.001%	0.00%
Bignose Shark	1	0.0%	0.001%	0.00%
Black Mackerel	1	0.0%	0.001%	0.00%
Slender Mola	1	0.0%	0.001%	0.00%
White Shark	1	0.0%	0.001%	0.00%

3.2.2.1 *Characteristics, Catch, and Stock Status of Major Nontarget Species*

The SSLL EFP EA (NMFS and PFMC 2007) comprehensively discusses the status of major nontarget finfish species. In that document major nontarget species are distinguished from minor based on a CPUE greater than 0.05 animals per 1,000 hooks. That discussion is incorporated by reference and summarized below. Detailed descriptions of the life history of many of these stocks also may be found in the Pelagics Amendment 18 EIS (WPFMC 2008).

Major nontarget tunas

North Pacific albacore (*Thunnus alalunga*): Stock status of North Pacific albacore is reviewed at 1- to 2-year intervals by the ISC Albacore Working Group with participating members from the United States, Mexico, Canada, Japan, and Taiwan. The latest assessment was completed in December 2006 (ISC 2007) and finalized by the ISC in July 2007. North Pacific albacore is considered a single Pacific-wide stock. Spawning stock biomass is currently at historically high levels but fishing mortality is high relative to most commonly used reference points, leading to a concern that overfishing could occur. Both the IATTC and WCPFC have passed resolutions calling on nations not to increase fishing effort on this stock. U.S. fisheries account for roughly 15 percent of total catch, mostly from the West Coast based troll fishery. Observed catch of albacore in the former west coast based SSLL fishery and the current HI based SSL fishery represent less than 3 percent of the total observed catch in numbers of fish (from Tables 3-2 and 3-4).

Pacific bluefin (*T. orientalis*): There is likely a single stock in the North Pacific. Fishing mortality likely exceeds the rate predicted to produce maximum yield per recruit (F_{MAX}) (ISC 2008). In 2008 the WCPFC considered a conservation and management measure calling on nations to not increase fishing effort on this stock but did not adopt it. U.S. West Coast fisheries account for 2-3 percent of total catch, mostly by purse seine vessels. Observed catch of Pacific bluefin in the former west coast based SSLL fishery and the current HI based SSL fishery represent less than 0.1 percent of the total observed catch in numbers of fish (from Tables 3-2 and 3-4).

Skipjack (*Katsuwomus pelamis*): The IATTC regularly conducts analyses to assess the Eastern Pacific skipjack stock. The most recent analyses (Maunder 2009) examined eight data- and model-based indicators of skipjack stock status. While the results demonstrated that fishing effort is high and the average weight of exploited skipjack is declining, there still appears to be no adverse consequences and no conservation concern for this stock. This species is a major target of purse seine fisheries, but the U.S. accounts for a negligible proportion of the catch. Observed catch of skipjack tuna in the former west coast based SSLL fishery and the current HI based SSL fishery represent less than 0.2 percent of the total observed catch in numbers of fish (from Tables 3-2 and 3-4).

Yellowfin (*T. albacares*): The latest IATTC assessment for yellowfin tuna (Maunder and Aires-da-Silva 2009) assumes a single Eastern Pacific stock, although it is likely the stock is continuous throughout the Pacific. Results of the base-case assessment demonstrated that fishing effort and spawning stock biomass are both near levels corresponding to AMSY with a slight improvement over the previous assessment. Based in part on previous stock assessment results from the IATTC, NMFS declared that overfishing is occurring on this stock. In accordance with the MSA, in March 2007 the Council provided recommendations to NMFS and Congress on measures to end overfishing on this stock. Such measures would have to be implemented through the IATTC. To date the IATTC has been unsuccessful in adopting conservation measures to end overfishing on this stock. In the Eastern Pacific, Latin American purse seine fleets and Asian longline fleets account for the bulk of the catch. U.S. West Coast fisheries account for less than 1 percent of total catch. Observed catch of yellowfin tuna in the former west coast based SSLL fishery and the current HI based SSL fishery represent less than 0.4 percent of the observed catch in numbers of fish (from Tables 3-2 and 3-4).

Bigeye (*T. obesus*): The IATTC assesses the Eastern Pacific bigeye stock every 1-2 years. The most recent base-case assessment (Aires-da-Silva and Maunder 2009) demonstrated that current spawning stock size is below that corresponding to AMSY and the level of fishing effort is above that at AMSY. If a stock-recruitment relationship is assumed in the stock assessment model, the outlook is even more pessimistic, and it appears that overfishing is occurring with this bigeye tuna stock. Based on earlier IATTC assessments, NMFS declared the stock subject to overfishing in 2004.

Since the MSA had not yet been amended to add §304(i), which created the aforementioned reporting requirement for internationally-managed stocks, the Council was obligated to amend the HMS FMP per §304(e) of the MSA. The amendment was approved by NMFS in 2006; it incorporated Section 4.5.1 into the FMP describing the Council's strategy for ending overfishing. As with other internationally-managed stocks, the strategy principally relies on making recommendations, through the U.S. delegations to the IATTC and WCPFC, on measures that would end overfishing. As noted above, the IATTC has so far been unable to adopt such conservation and management measures. Purse seine fisheries setting on floating objects (i.e., fish aggregation devices, FADs) are a principal source of overfishing on both this stock and yellowfin, because they catch large number of fish below the critical size (the size that maximizes yield per recruit). West coast fisheries catch less than 1 percent of the EPO catch. One West Coast based longline vessel fishes with deep sets in order to target tropical tunas, including bigeye. The western Pacific bigeye stock (occurring west of 150° W. longitude) is a target in the deep-set segment of the Hawaii longline fishery. In 2007 reported Hawaii landings (which includes other local fisheries) were 5,839 mt, 2.6 percent of the Pacific-wide catch in that year of 225,066 mt (Pacific Islands Fisheries Science Center 2008b; Williams and Terawasi 2008).

Major nontarget sharks

Blue shark (*Prionace glauca*): As discussed above, blue shark is the most common bycatch species in Pacific longline fisheries; observer data discussed above (see Table 3-2) indicate that it comprises about a third of the U.S. Pacific SSLL catch. International longline fisheries (Japan, Korea, Taiwan) also catch large numbers of blue sharks. Blue shark is considered undesirable bycatch because the flesh ammoniates without complex processing; it is rarely retained. In the past they were finned in U.S. longline fisheries but landing shark fins without the accompanying carcass is now prohibited by Federal law (codified MSA §307(1)(P), 16 USC 1857). In the Hawaii fishery about 66 percent of blue sharks are reported released by cutting the branch line, which likely results in high survival rates (WPFMC 2008, p. 65). Although a formal stock assessment of the entire stock in the North Pacific has not been conducted due to data limitations, analyses based data from the Japan longline fisheries in the central and western Pacific have been conducted (Kleiber, *et al.* 2001; Sibert, *et al.* 2006). Based on those results, it appears that blue sharks in the North Pacific are neither subject to overfishing or approaching an overfished state.

Shortfin mako shark (*Isurus oxyrinchus*): This species is an important component of the incidental catch in the SSLL fishery with modest retention rates (see Table 3-2 and Table 3-4). They are also an important part of the landed catch in the California DGN fishery and an important recreational species in Southern California. West Coast recreational catch in recent years is estimated to range from 2,000 to 6,000 fish annually; many are released. The HMS FMP adopted a harvest guideline of 150 mt for this species; preliminary calculations based on the DGN catch off the US west coast at the time of the FMP adoption suggested that the population size was above MSY. Stock status throughout the north Pacific is unknown, although trends from a small-scale fishery-independent survey in Southern California suggest that the regional population may be declining. The IUCN lists this species as "Near Threatened."[17]

Common thresher shark (*Alopias vulpinus*): The common thresher shark predominantly inhabits coastal waters and is rarely encountered in oceanic waters off the US west coast. In the northeast Pacific, the stock likely ranges from Canada to the tip of Baja California, Mexico. The West Coast DGN fishery accounts for most U.S. Pacific commercial landings, along with set nets and small-mesh drift nets in California. They are not commonly caught in the SSLL fishery. The thresher shark is also a popular recreational species in Southern California. In 2008 the Council considered additional recreational management measures for thresher sharks because of concerns that total harvest was approaching the 340 mt harvest guideline in the FMP. The HMSMT estimated that total commercial and recreational harvest averaged 209 mt, 2005-2007 (Agenda Item E.3.a Attachment 1, November 2008). After reviewing the available catch data the Council concluded that additional measures are not needed presently but recommended improved catch monitoring and the NMFS SWFSC plans to conduct a new stock assessment in the near futre. The California DGN fishery led to local population depletion in the mid-1980s but subsequent management restrictions appear to have resulted in recovery with estimates of local stock size exceeding MSY based on the 1981-1999 DGN fishery data (PFMC 2003). Stock status throughout the Eastern Pacific is unknown. The thresher shark is considered a "data deficient" species by the IUCN.

Major nontarget billfish

Striped Marlin (*Tetrapturus audax*): Striped marlin is incidentally caught in Pacific longline fisheries. However, California regulations incorporated into the HMS FMP prohibit commercial landing of striped marlin. The most recent ISC assessment of striped marlin was completed in 2006. In 2007 the ISC

[17] http://www.iucnredlist.org

evaluated the status of hypothesized striped marlin stock spanning the entire North Pacific. Although biological uncertainties made it difficult to reach a conclusion, model runs suggest the current stock is 6 to 16 percent of the 1952 level, indicating the stock is depleted. In 2007 and 2008 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." However, a 2003 IATTC assessment which assumed a separate EPO stock found that the current biomass was greater than the biomass that would produce AMSY. The IATTC is planning a new assessment of the EPO stock in 2009.

Other major nontarget finfish

Dorado (*Coryphaena hippurus*): Of commercially valuable species, this is the most commonly-caught incidental species in longline fisheries. Most landings in Hawaii are made by the commercial troll fishery; the longline fleet and commercial hook-and-line vessels also make landings. On the West Coast reported commercial landings were 2 mt. The dorado (or in Hawaii, mahimahi) is also a valuable recreational species. According to Table 3-2, mahimahi (dorado) was the third most common species caught in the historical Hawaii SSLL fishery; however, the catch rate is lower with circle hooks (Table 3-3). It appears that the historical West Coast fishery, possibly because it operated farther east, has a lower catch rate of dorado. There is relatively little information on the status of the stock and no stock assessment has been made. However, dorado is believed to be a fast-growing and highly productive species capable of quickly rebounding from exploitation.

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). The population status of pelagic stingray in the Pacific is unknown.

Escolar (*Lepidocybium flavobrunneum*): Research in the Southwestern Atlantic Ocean suggests that the black escolar and tunas and swordfish have similar trophic and reproductive behavior since their seasonal catch pattern was similar to the target species (Milessi and Defeo 2002). It is a fairly common bycatch species in both the historical West Coast fishery and the Hawaii fishery (Table 3-2). The use of circle hooks appears to increase CPUE for this species substantially (Table 3-4). The population status of escolar in the North Pacific is unknown

Common mola (*Mola mola*): Very little is known about the habitat preferences and behavior of the common mola, or ocean sunfish. They are thought to associate with frontal and stratified water masses rather than cooler, mixed water (Cartamil and Lowe 2004; Sims and Southall 2002). Table 3-4 shows that ocean sunfish have been caught in moderate numbers in the Hawaii SSLL fishery; 38 were caught 2004-2007. All but one were discarded alive. The population status of common mola in the North Pacific is unknown.

Pacific pomfret (*Brama japonica*): This species has a subtropical to boreal distribution; the southern limit of their distribution is about 20° N. latitude (SST ≥ 70° F) and as far north as the Gulf of Alaska, Aleutian Islands, and Sea of Japan. They have been a large component in Alaskan net fisheries; in the squid fisheries in 1990 and 1991 the catches were 1,329 million and 82 million fish respectively. They appear to have been a somewhat less common bycatch species in the pre-2004 Hawaii SSLL fishery in comparison to the West Coast fishery (Table 3-2); however, the catch rate apparently decreased with the use of circle hooks (Table 3-3). The population status of Pacific pomfret is unknown.

3.2.3 Prohibited Species

The HMS FMP identifies nine prohibited species, listed in Table 3-5, which may not be retained if caught. They must be released immediately, unless other provisions for their disposition are established such as retention for scientific study, by permit. The SSLL EFP EA (NMFS and PFMC 2007) describes the characteristics and status of those species. Those descriptions are incorporated by reference. Given the area of operation and operational characteristics of the SSLL fishery, it is extremely unlikely that any of the salmon species or Pacific halibut would be caught in the fishery and they have never been observed caught in the SSLL fishery. Of the other species, one great white shark was observed caught on February 10, 1997, in the historical West Coast SSLL fishery; it was retained for sale. One basking shark was observed caught in the in the Hawaii SSLL fishery on December 3, 2003; it was discarded dead. According to Table 3-4, a white shark was caught in the 2004-2007 period in the Hawaii SSLL fishery; it is recorded as being released alive.

Table 3-5. 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*

3.2.4 Actions and Trends Affecting Finfish Species

Fishing mortality is the primary human-induced action affecting North Pacific swordfish and major nontarget species stocks. The aforementioned SSLL EFP EA (NMFS and PFMC 2007) contains an exhaustive review of various sources of fishing mortality as does the Pelagics Amendment 18 EIS (WPFMC 2008). The SSLL EFP EA describes the following fisheries having effects on finfish species that would be caught in the proposed SSLL fishery:

- Southern California experimental drift longline fishery for sharks, 1988-1991
- California-based deep-set tuna longline fishery, 2005-present
- California- and Hawaii-based shallow-set longline swordfish fishery, 1994-present
- Distant water foreign longline fisheries
- California/Oregon swordfish/thresher shark DGN fishery
- West coast harpoon fishery for swordfish
- West coast recreational HMS fisheries, including the commercial passenger fishing vessel (CPFV) and private boat fleets

- California small mesh set net fishery
- California small mesh DGN fishery
- U.S. purse seine fishery
- HMS albacore troll and baitboat fleet
- Trawl and pot fisheries and other non-HMS fisheries
- Illegal, unreported, and unregulated (IUU) fleets

This information is incorporated by reference and a summary of domestic and international fisheries with swordfish catches is provided below.

In the short to medium term human-induced habitat alteration or destruction that would contribute to changes in natural mortality is negligible because of this species' pelagic existence. However, as discussed above, climate change could alter primary productivity in the North Pacific swordfish habitat zone, which may reduce stock production over the long term.

3.2.4.1 *Domestic Fisheries*

Current U.S. commercial fisheries for swordfish in the North Pacific include the California DGN fishery, the West Coast harpoon fishery, and the Hawaii pelagic longline fishery (descriptions of these fisheries may be found in Section 3.6.1). As discussed elsewhere, a West Coast SSLL swordfish fishery existed up until 2004 when it was closed. One West Coast longline vessel currently targets tuna using deep-set gear and may land small amounts of swordfish incidentally.[18] Small amounts of U.S. catch are reported from the South Pacific, ranging from 3 to 30 mt 2003-2006 (WPFMC 2008). This reflects landings by the small longline fleet based in American Samoa. Figure 3-3 shows reported Hawaii and West Coast landings, 1997-2007 (Source: PFMC 2008; WPFMC 2008). The Hawaii landings principally come from the longline fishery with small amounts landed in nearshore troll and handline fisheries around the main Hawaiian Islands. West coast landings have accounted for 19-29 percent of total landings for the 1997-2000 period, 71-87 percent in the 2001-2004 period when the Hawaii SSLL fishery was closed, and 8-13 percent in the 2005-2007 period when the West Coast SSLL fishery was closed. West coast landings were 67 percent of the total in 2004, the transition year when the Hawaii fishery reopened and the West Coast fishery closed in the April-May time period. It can be seen from the figure that Hawaii longline landings have been smaller in the period subsequent to reopening due to fishing effort limit of 2,120 sets annually placed on the fishery. However, if Pelagics FMP Amendment 18 is implemented the number of allowable sets would be increased to approximately 9,925 sets per year, a level commensurate with the condition of the North Pacific swordfish stock. If realized, this effort increase is estimated to increase catches in that fishery by 7,784 mt per year from the current range of 850-1,637 mt (WPFMC 2008).

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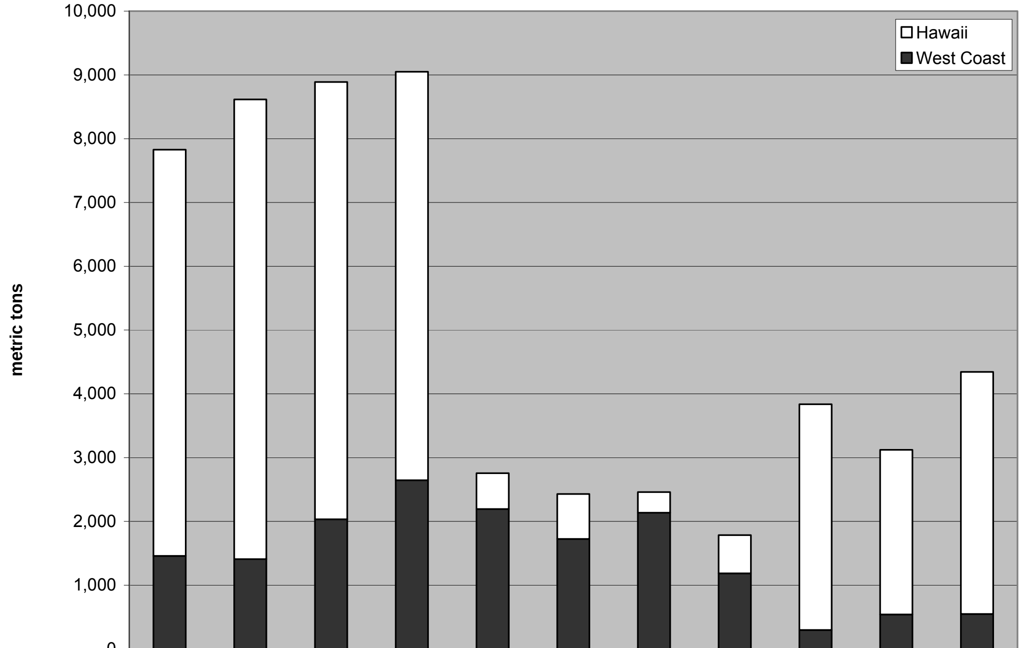
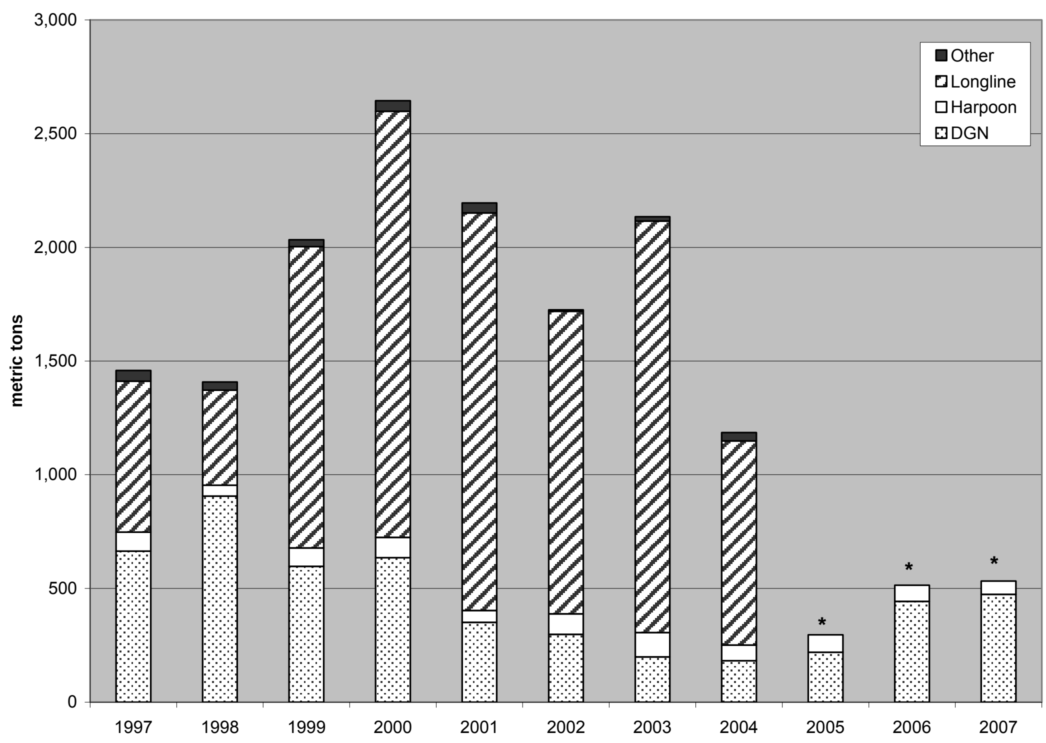
[18] Regulations allow up to 10 incidentally-caught swordfish to be landed for each trip when using deep-set gear.



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Hawaii	6,368	7,208	6,855	6,404	562	703	324	598	3,539	2,583	3,796
West Coast	1,459	1,408	2,033	2,645	2,195	1,725	2,135	1,186	297	540	549

year

Figure 3-3. Hawaii and West Coast swordfish landings, 1997-2007.



* Longline and other landings excluded for confidentiality.

Figure 3-4. West coast landings by fishery, 1997-2007.

Figure 3-4 breaks out West Coast landings by fishery for the same time period. (Note that for data confidentiality reasons longline landings are not reported from 2005 onward. The "other" category was derived from subtracting the sum of swordfish landings from DGN, harpoon, and longline fisheries from total swordfish landings.) Longline landings as a proportion of total west landings increased during the period up to 2004; since then they have been negligible.

Swordfish are rarely caught in West Coast recreational fisheries. The HMS SAFE (PFMC 2008) does not report any swordfish landings by private vessels and occasional catches of one or two fish in a year by the CPFV fleet. The Pelagics FMP Amendment 18 EIS describes West Coast recreational catches; billfish club records show catches of about six fish per year among Southern California clubs. Catches were higher in the 1970s when catches averaged 30 fish per year. Catches outside Southern California are extremely rare on the West Coast.

In 2008 the Council recommended that NMFS approve an EFP application that would authorize one vessel to fish with SSLL gear in the West Coast EEZ, which is currently prohibited under the HMS FMP (NMFS and PFMC 2007; NMFS and PFMC 2008). The EFP would limit fishing to a maximum of four trips during one fishing season between September 1st and December 31st in either 2008 or 2009 and no more than 14 sets per trip. If NMFS issues the EFP this activity could occur in 2009.

3.2.4.2 *Foreign Fisheries*

Across all nationalities, foreign fisheries catch much larger amounts of swordfish than domestic fisheries, and operate throughout the Pacific. As can be seen in Figure 3-5 one center of abundance is the area north and northwest of Hawaii. Table 3-6 reproduces a table estimating total annual North Pacific swordfish catches by nation and fishery produced by the ISC's Billfish Working Group. Catch by nation in 2004, the last year for which a complete estimate is available, is shown in Figure 3-6. It can be seen that Japan accounted for the largest proportion of the catch at 65 percent; U.S. catches were 10 percent. However, U.S. catches were at a low point in that year so the proportion is likely somewhat greater on average.

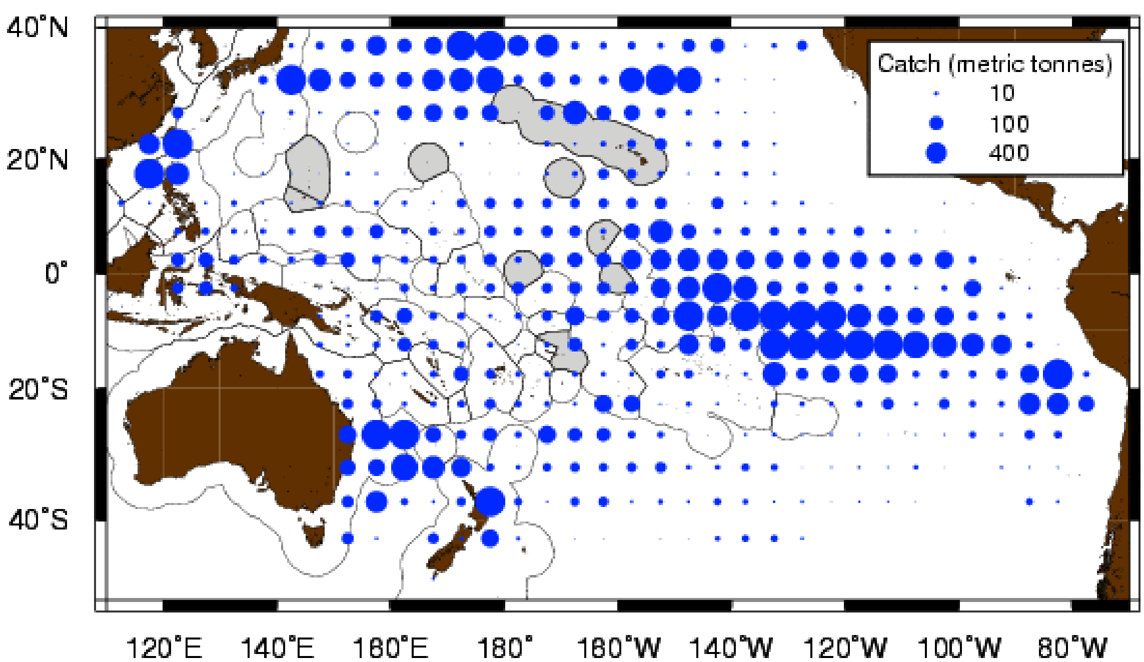


Figure 3-5. Distribution of longline catches of swordfish in the Pacific reported for 2004. (Source: WPFMC 2006, Figure 9)

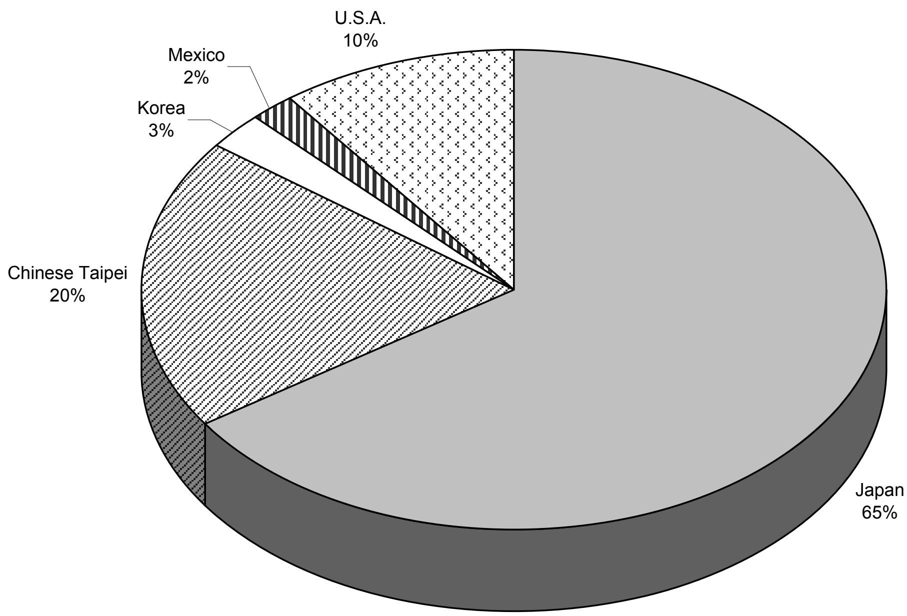


Figure 3-6. North Pacific swordfish catches by nation, 2004.

Table 3-6. North Pacific swordfish catch compiled by the ISC Billfish Working Group. (Source: BillWG 2008)

Table 2. Swordfish catches (in metric tons) by fisheries, 1952-2005. Blank indicates no effort. - indicates data not available. 0 indicates less than 1 metric ton. Provisional estimates in ( ).

Year	Japan: Distant-water and Offshore Longline[2]	Japan: Coastal Longline	Japan: Driftnet	Japan: Harpoon[3]	Japan: Other Bait Fishing	Japan: Trapnet	Japan: Other[4]	Japan: Total	Chinese Taipei[5]: Distant-water Longline	Chinese Taipei: Offshore Longline	Chinese Taipei: Offshore Gillnet	Chinese Taipei: Offshore Others	Chinese Taipei: Coastal Harpoon	Chinese Taipei: Coastal Setnet	Chinese Taipei: Coastal Gillnet & other net	Chinese Taipei: Coastal Longline	Chinese Taipei: Coastal Others	Chinese Taipei: Other	Chinese Taipei: Total	Korea: Longline	Korea: High-seas Drift Gillnet	Korea: Total	Mexico: All Gears	United States[6]: Hawaii Longline	United States: California Longline	United States: California Gill Net	United States: California Harpoon	United States: California Unknown[7]	United States: Total	Grand Total
1952	8,890	152	0	2,569	6	68	6	11,691	-	-									-	-			-	-	-	-	-	-	-	11,691
1953	10,796	77	0	1,407	20	21	87	12,408	-	-									-	-			-	-	-	-	-	-	-	12,408
1954	12,563	96	0	813	104	18	17	13,611	-	-									-	-			-	-	-	-	-	-	-	13,611
1955	13,064	29	0	821	119	37	41	14,111	-	-									-	-			-	-	-	-	-	-	-	14,111
1956	14,596	10	0	775	66	31	7	15,485	-	-									-	-			-	-	-	-	-	-	-	15,485
1957	14,268	37	0	858	59	18	11	15,251	-	-									-	-			-	-	-	-	-	-	-	15,251
1958	18,525	42	0	1,069	46	31	21	19,734	-	-									-	-			-	-	-	-	-	-	-	19,734
1959	17,236	66	0	891	34	31	10	18,268	-	427								91	518	-			-	-	-	-	-	-	-	18,786
1960	20,058	51	1	1,191	23	67	7	21,400	-	520								127	647	-			-	-	-	-	-	-	-	22,047
1961	19,715	51	2	1,335	19	15	11	21,147	-	318								73	391	-			-	-	-	-	-	-	-	21,538
1962	10,607	78	0	1,371	26	15	18	12,115	-	494								62	556	-			-	-	-	-	-	-	-	12,671
1963	10,322	98	0	747	43	17	16	11,243	-	343								18	361	-			-	-	-	-	-	-	-	11,604
1964	7,669	91	4	1,006	42	17	28	8,858	-	358								10	368	-			-	-	-	-	-	-	-	9,226
1965	8,742	119	0	1,908	26	14	182	10,991	-	331								27	358	-			-	-	-	-	-	-	-	11,349
1966	9,866	113	0	1,728	41	11	4	11,764	-	489								31	520	-			-	-	-	-	-	-	-	12,284
1967	10,883	184	0	891	33	12	5	12,008	-	646								35	681	-			-	-	-	-	-	-	-	12,689
1968	9,810	236	0	1,539	41	14	9	11,649	-	763								12	775	-			-	-	-	-	-	-	-	12,424
1969	9,416	296	0	1,557	42	11	5	11,327	0	843								7	850	-			-	-	-	-	-	-	-	12,177
1970	7,324	427	0	1,748	38	9	1	9,545	-	904								5	909	-			-	5	-	-	812	10	827	11,281
1971	7,037	350	1	473	17	37	0	7,915	-	992								3	995	-			-	1	-	-	99	3	103	9,013
1972	6,796	531	55	282	20	1	1	7,686	-	862								11	873	-			2	0	-	-	171	4	175	8,736
1973	7,123	414	720	121	27	23	2	8,430	-	860								119	979	-			4	0	-	-	399	4	403	9,816
1974	5,983	654	1,304	190	27	16	1	8,175	1	880								136	1,017	-			6	0	-	-	406	22	428	9,626
1975	7,031	620	2,672	205	58	18	2	10,606	29	899								153	1,081	-			-	0	-	-	557	13	570	12,257
1976	8,054	750	3,488	313	170	14	1	12,790	23	613								194	830	-			-	0	-	-	42	13	55	13,675
1977	8,383	880	2,344	201	71	7	1	11,887	36	542								141	719	-			-	17	-	-	318	19	354	12,960
1978	8,001	1,031	2,475	130	110	22	1	11,770	-	546								12	558	-			-	9	-	-	1,699	13	1,721	14,049
1979	8,602	1,038	983	161	45	15	1	10,845	7	661								33	701	-			7	7	-	-	329	57	393	11,946
1980	6,005	849	1,746	398	30	15	1	9,045	10	603								76	689	-			380	5	-	180	588	82	793	10,907
1981	7,039	727	1,848	129	59	10	0	9,812	2	656								25	683	-			1,575	3	0	473	271	2	749	12,819
1982	6,064	874	1,257	195	58	7	0	8,546	1	855								49	905	-			1,365	5	0	945	156	10	1,116	11,932
1983	7,692	999	1,033	166	30	9	2	9,931	0	783								166	949	-			120	5	0	1,693	58	7	1,763	12,763
1984	7,177	1,177	1,053	117	98	13	0	9,635	-	733								264	997	-			47	3	12	2,647	104	75	2,841	13,520
1985	9,335	999	1,133	191	69	10	0	11,737	-	566								259	825	-			18	2	0	2,990	305	104	3,401	15,981
1986	8,721	1,037	1,264	123	47	9	0	11,201	-	456								211	667	-			422	2	0	2,069	291	109	2,471	14,761
1987	9,495	860	1,051	87	45	11	0	11,549	3	1,328								190	1,521	-			550	24	0	1,529	235	31	1,819	15,439
1988	8,574	678	1,234	173	19	8	0	10,688	-	777								263	1,040	-			813	24	0	1,376	198	84	1,682	14,001
1989	6,690	752	1,596	362	21	10	0	9,431	50	1,491								38	1,579	-			690	218	0	1,243	62	56	1,579	13,279
1990	5,833	690	1,074	128	13	4	0	7,742	143	1,309								154	1,806	-			2,650	2,436	0	1,131	64	43	3,674	15,872
1991	4,809	807	498	153	20	5	0	6,292	40	1,390								180	1,610	-			861	4,508	27	944	20	44	5,543	14,306
1992	7,234	1,181	887	381	16	6	0	9,705	21	1,473								243	1,737	-			1,160	5,700	62	1,356	75	47	7,240	19,842
1993	8,298	1,394	292	309	43	4	1	10,341	54	1,174								310	1,538	-			812	5,909	27	1,412	168	161	7,677	20,368
1994	7,366	1,357	421	308	37	4	0	9,493	-	1,155								219	1,374	-			581	3,176	631	792	157	24	4,780	16,228
1995	6,422	1,387	561	440	17	7	0	8,834	50	1,135								225	1,410	-			437	2,713	268	771	97	29	3,878	14,559
1996	6,916	1,067	428	633	9	4	0	9,057	9	701	2	-	19	10	-	-	-		741	12		12	439	2,502	346	761	81	15	3,705	13,954
1997	7,002	1,214	365	396	11	5	0	8,993	15	1,358	1	1	27	8	-	24	-		1,434	246		246	2,365	2,881	512	708	84	11	4,196	17,234
1998	6,233	1,190	471	535	9	2	0	8,441	20	1,178	8	-	17	15	1	-	-		1,239	123		123	3,603	3,263	418	931	48	19	4,679	18,085
1999	5,557	1,049	724	461	2	5	0	7,798	70	1,385	4	-	51	5	1	-	-		1,516	104		104	1,136	3,100	1,229	606	81	27	5,043	15,597
2000	6,180	1,121	808	539	7	5	1	8,661	325	1,531	5	-	74	5	1	1	-		1,942	181		181	2,216	2,949	1,885	646	90	9	5,579	18,559
2001	6,932	908	732	255	5	15	0	8,848	1,039	1,691	17	-	64	8	1	1	-		2,821	349		349	780	220	1,749	375	52	5	2,401	15,199
2002	6,230	965	1,164	222	8	11	0	8,600	1,633	1,557	7	1	1	16	1	1	-		3,217	350		350	465	204	1,320	302	90	3	1,919	14,551
2003	5,352	1,039	1,198	167	10	4	0	7,770	1,084	2,196	3	-	-	8	-	-	-		3,291	311		311	671	147	1,812	216	107	0	2,282	14,325
2004	(6,165)	1,454	1,339	33	33	23	1	(9,048)	884	1,828	5	-	-	7	1	-	3		2,728	(350)		(350)	270.1	213	898	169	62	37	1,379	(13,775.1)
2005	(6,972)							(6,972)	437	1,813	1	-	-	5	2	-	18		2,276	(407)		(407)	234.5	1,475		220	76	0	1,771	(11,660.5)
2006																							347.2	1,175		444	71	2	1,692	2,039
2007																								1,444		484	58	0	1,986	1,986
2008																														

[1] Catch data are currently unavailable for Republic of Korea, Philippines, and some other countries catching swordfish in the North 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] Contrains 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.
[6] Estimated round weight of retained catch. Does not include discards.
[7] Unknown includes pole and line, purse seine, troll and troll/handline, half ring, and unspecified gears.

(shaded) only one vessel fished so combined with Hawaii longline

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3.3 Sea Turtles

The most up to date description of the characteristics and status of the sea turtle stocks taken in the Hawaii SSLL fishery, and likely to be taken in a West Coast SSLL fishery, may be found in the biological opinion (BO) prepared for Pelagics FMP Amendment 18 (NMFS 2008). Information on the status and baseline condition of sea turtles in the BO is incorporated by reference and summarized here. According to Table 3 in the BO, in the period from October 2004 to March 2008, 45 loggerheads, 17 leatherbacks, 2 olive Ridleys, and 1 green sea turtle have been taken in the Hawaii SSLL fishery. This gives an indication of the relative frequency of such interactions; loggerhead and leatherback sea turtles are more frequently taken while olive Ridley and green turtles takes are very infrequent. The action area identified in the BO, based on the area of operation of the Hawaii SSLL fishery, is 180°–140° W. longitude and 20°–40° N latitude (See Figure 1-1). Depending on the area closure option chosen (see Section 2.1.2.1), the area of operation for a West Coast SSLL fishery could be immediately to the east of this area (east of 140° W. longitude) or overlap with Hawaii SSLL fishery action area. Therefore, the proposed action is likely to affect the same or a very similar set of protected species, including the four sea turtles species mentioned above, as have been identified for the Hawaii SSLL fishery.

3.3.1 Loggerhead Sea Turtles (Carretta carretta)

3.3.1.1 *Status and Characteristics*

Loggerhead sea turtles are listed as globally threatened under the ESA; however, status varies among distinct populations. While most populations are decreasing, some are increasing. There is insufficient information to determine the status and trends for the species as a whole. Based on genetic sampling in the Hawaii SSLL fishery, members of the North Pacific loggerhead population are taken in this fishery. North Pacific loggerheads nest exclusively in Japan. Monitoring of loggerhead nesting in Japan began in the 1950s; since 1990 all known nesting beaches have been monitored. In the 1990-2008 period the number of nests per year has ranged from 2,064 to 6,638, although the 2008 total may exceed 10,000 once monitoring data are fully tallied and verified. Estimating total population size is difficult, but Lewison, *et al.* (2004) estimated the 2000 Pacific (North and South combined) population at 335,000 for both sexes and all age classes. They estimated that about 20 percent of the population was susceptible to the Hawaii longline fleet. Snover (2008) estimated the total adult female (North Pacific) population at 2,915 for the 2005-2007 period. Nesting data suggest that the population declined by 50 to 90 percent in the second half of the twentieth century. From 1999 to 2005 the number of nests more than doubled, then declined from that peak in 2006 and 2007.

The Hawaii SSLL fishery interacts primarily with juvenile loggerheads, although adults have been observed taken. Adults forage primarily in neritic zones (coastal waters) rather than oceanic zones, except for migration across the oceanic zone to reach nesting beaches. In the oceanic zone in the North Pacific juveniles congregate at the Transition Zone Chlorophyll Front, the boundary between vertically stratified low chlorophyll water and cool, mixed high chlorophyll water (see Section 3.1.1), which is also favored habitat for swordfish. Tagging studies show that juveniles are shallow divers, foraging at the same depths as SSLL gear (<100 m). Loggerheads grow slowly, reaching sexual maturity at 25 to 37 years old. The mean generation time is estimated to be 33 years. Loggerheads range across the entire North Pacific; migration of juveniles and adults from and to nearshore areas and open ocean habitats may result in individual loggerheads being exposed to longline fishing over a substantial part of their lifespan.

3.3.1.2 *Actions and Trends Affecting the Population*

The BO (NMFS 2008) identifies fishery bycatch, habitat alteration, hunting, and anthropogenic climate change as the major threats to loggerheads.

Incidental capture in fisheries is identified as the most serious of these threats. The range of fisheries taking loggerheads include longline, gillnet, set gillnet, bottom trawl, dredge, and trap net fisheries both on the high seas and in coastal areas. Fisheries with known high bycatch include gillnet and longline fisheries operating in "hotspots" off Baja Mexico, bottom trawl fisheries in Australia and New Zealand, high seas pelagic longline fisheries that continue to use J-hooks and squid bait, and coastal fisheries in Japan that use trap or pound nets. Pound and gillnet fisheries in coastal areas of Japan near nesting beaches have reportedly declined or disappeared in recent years. The principal domestic fishery taking loggerheads in the North Pacific is the Hawaii SSLL fishery. As discussed elsewhere, this fishery substantially reduced its interaction and mortality rates with loggerhead sea turtles through the adoption of circle hooks and mackerel-type bait, among other measures, and interaction rates are low compared to almost all other longline fisheries (see Table 3-7). The Incidental Take Statement (ITS) in the Amendment 18 BO (NMFS 2008) estimates that 46 logghergead sea turtles would be taken annually (calendar year) in the expanded Hawaii SSLL fishery resulting in an estimated 10 mortalities, equivalent to an estimated 3 adult female mortalities. This is an expansion of the ITS for the current fishery of 17 loggerhead takes resulting in an estimated 3 mortalities (NMFS 2004b).

Table 3-7. Estimated sea turtle bycatch ratios per 190 mt of fish for longline fisheries operating in the central and western Pacific. (Adapted from Figure 7 in NMFS 2008)

Fishery	Catch Ratio
China tuna	19.0
Taiwan tuna	13.7
Australia swordfish	9.5
Japan tuna	4.7
Hawaii swordfish	3.7
Hawaii tuna	1.0

Observer records show a total of 56 loggerheads taken in the West Coast SSLL fishery in observed sets from October 17, 2001, to February 9, 2004. As noted elsewhere, the fishery at that time used J-hooks and squid bait. Table 3-8 summarizes additional information on the observed takes with respect to condition of the sea turtles upon release and hooking location. The BO conducted for the HMS FMP (NMFS 2004a) estimated that between 131 and 200 loggerheads would be taken annually in HMS FMP fisheries, with five taken in the DGN fishery and one taken in the albacore surface hook-and-line fishery. This suggests a take of 125 to 194 loggerheads in the SSLL longline fishery (the BO does not specify an estimate for this fishery, so these numbers are derived by subtracting the estimated takes from the other fisheries). Of the total 131-200 loggerheads, the BO estimated that 37 to 92 would die as a result of being taken (since mortality rates vary by gear type, it is not possible to specify what proportion of these mortalities were due to the SSLL fishery, although it is likely to be fairly proportional to the large fraction of takes attributed to the SSLL fishery above). Based on this level of take and mortality NMFS concluded that the shallow-set component of the pelagic longline fishery was likely to cause jeopardy to the loggerhead population and the fishery was closed as a result.

Because of limited reporting, estimating turtle interactions in foreign longline fisheries in the Pacific is difficult. Lewison, *et al.* (2004) estimated 2,600-6,000 loggerhead sea turtles were killed by pelagic longlining in the Pacific in 2000. Beverly and Chapman (2007) arrived at a lower estimate of approximately 20 percent of the Lewison, *et al.* estimate, or 520-1,200 loggerheads killed annually.

Table 3-8. Condition and hook location of loggerhead sea turtles observed taken in the West Coast SSLL fishery, 2001-2004.

Hook Location	Condition on Release: Dead	Condition on Release: Injured	Total
1. Ingested	1	27	28
2. Head/Beak	1	21	22
3. Flipper	0	4	4
4. Carapace/Plastron	0	0	0
5. Unknown	0	2	2
Total	2	54	56

Habitat destruction occurs in coastal areas and particularly beaches where loggerheads nest. Nesting beaches can be damaged or destroyed through coastal armoring projects, intended to protect adjacent development from shoreline retreat. Beaches seaward of the armor (seawalls, rip rap, etc.) are likely to erode at a faster rate because of increased wave energy focused in front of the armoring. The beach can be completely lost or become completely intertidal, such that nests are drowned at high tide. Beach armoring has occurred at nesting beaches in Japan. Coastal development has indirect effects, such as increasing ambient nighttime light, which can disorient emerging hatchlings, and increased presence of people on the beach. Vehicular and foot traffic on the beach can destroy nests.

Hunting of loggerheads for their meat, shells, and eggs has declined but still occurs in some areas. In Japan, a 1973 law prohibited such harvests on Yakushima Island, the principal nesting area, and a similar law passed in 1988 covers most of the other nesting beaches in Japan. This may account for the increase in nesting turtles in the 2001-2005 period since loggerheads mature in about 29 years. In the South Pacific, nesting beaches in Australia are protected but harvest of nesting females may be common in New Caledonia. Feral foxes in Australia and feral dogs in New Caledonia feed on loggerhead eggs, elevating natural mortality.

Anthropogenic climate change affects loggerheads because nest chamber temperature affects the sex of hatchlings; warmer nests produce females while cooler ones produce males. Elevated average temperature can thus skew the sex ratio in the population. Sea level rise is likely to hasten inundation of beaches, especially if coastal development prohibits shoreline retreat. As mentioned in Section 3.1.3 increases in ocean temperature may reduce productivity in the preferred open ocean habitat of loggerheads.

Measures in place intended to reduce the adverse impacts of human activities on sea turtles include:

- Employment of gear modifications, such as the use of circle hooks and mackerel-type bait.
- Protection of nesting beaches. The WPFMC has been working with the Sea Turtle Association of Japan to foster activities such as nighttime patrolling of beaches, nest relocation, protecting nests from predators, and cooling nests. The Sea Turtle Association of Japan has developed techniques that lead to a 60 percent rate of hatchling success for relocated nests (an improvement over nearly zero survival for inundated nests). This has lead to the survival of nearly 100,000 hatchlings in the 2004-2007 period that would have otherwise died.
- International agreements can lead to domestic arrangements for sea turtle conservation. Relevant international agreements include the Food and Agriculture Organization’s Technical Consultation on Sea Turtle-Fishery Interactions, the Inter-American Convention for the Protection and Conservation of Sea Turtles, and the Convention on International Trade in Endangered Species.

Such agreements have supported community-based initiatives to protect nesting beaches and reduce fishery impacts in foraging areas. Both the IATTC (in 2007) and WCPFC (in 2008) have adopted measures calling on members to reduce sea turtle bycatch by adopting appropriate mitigation measures in their fisheries, such as circle hooks and fish bait for longline fisheries.

3.3.2 Leatherback Sea Turtles (Dermochelys coriacea)

3.3.2.1 *Status and Characteristics*

The leatherback sea turtle is listed as endangered globally although discrete populations in different areas vary in their status. Leatherbacks have a very wide distribution, occurring from subpolar regions to the equator. Nesting occurs on tropical coastlines but members of the species travel long distances when foraging. In the Pacific Ocean there are two leatherback populations, one in the eastern Pacific and the other in the western Pacific. The western Pacific population primarily nests on beaches in Papua New Guinea, Papua Indonesia (Iryan Jaya), the Solomon Islands, and Vanuatu. The eastern Pacific population nests on beaches in Mexico and Costa Rica. Eighteen leatherbacks taken in the Hawaii SSLL fishery have been sampled for genetic analysis; all are part of the western Pacific population. Genetic analysis of leatherbacks taken in the California/Oregon DGN fishery reveal that all of these individuals also originated from the western Pacific population. However, one individual taken by the Hawaii deep-set longline fishery at 6° N. latitude (south of action area of the SSLL fishery and the proposed action) was from the eastern Pacific population. Tagging studies have found that members of the western Pacific population migrate across the Pacific through the oceanic region south of Hawaii to forage in the neritic zone off of California and Oregon. Those migrating northeast towards North American waters nest during the northern hemisphere summer (June-August) while winter nesting (November-March) animals migrate southeast towards Australian and New Zealand waters (Benson, *et al.* 2007b; Benson, *et al.* 2007a). The Amendment 18 BO (NMFS 2008) reports that eastern Pacific leatherbacks migrate south to foraging areas off of South America (Shillinger, *et al.* 2008) and are not known to migrate through the Hawaii SSLL fishery action area (although extending further eastward, the action area for the West Coast SSLL fishery is in the same latitudinal range). Thus it is likely that any leatherbacks that would be taken in the proposed West Coast SSLL fishery would be adults from the western Pacific population and unlikely that they would originate from the eastern Pacific population.

The Amendment 18 BO (NMFS 2008) estimates the adult female component of the western Pacific population at 3,987, within the 2,110–5,735 range for breeding females estimated by Dutton, *et al.* (2007). Lewison, *et al.* (2004) estimated that the total Pacific population vulnerable to longline fishing was 32,000 in 2000. But this estimate would include the eastern Pacific population vulnerable to fisheries in the southeast Pacific.

The single largest nesting site for the western Pacific population is at Jamursba-Medi, Papua Indonesia. During the 1999-2007 period the estimated average number of nests at this beach was 2,733 (Dutton, *et al.* 2007). Reliable nesting data have only been collected since the early 1990s, so it is hard to estimate population trends before that time. Anecdotal reports suggest that nesting was in decline in the decade before nest counts began in 1993. Annual nest count data suggest a decline in nests when comparing the 1993-1997 period to the 1999-2007 period (no data are available for 1998), although there is a lot of year-to-year variability in nest numbers (see Figure 3-7). Furthermore, the apparent decline between these two periods is largely attributable to the high nest count in 1996. The trend within the 1999-2007 period, while fluctuating, appears to be stable or declining slightly. These estimates are presented in the Pelagics FMP Amendment 18 BO and derived from Hitipeuw, *et al.* (2007); however, a Japanese researcher reported nest counts 31-38 percent lower than these estimates (NMFS 2008; Suganuma 2005).

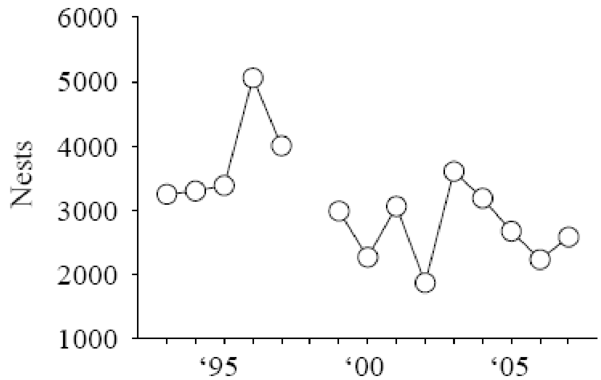

Figure 3-7. Leatherback nest counts, Jamursba-Medi, Papua Indonesia, 1993-2007. (Source: NMFS 2008)

Dutton, *et al.* (2007) reported 27 other nesting sites in the western Pacific, accounting for about 62 percent of total leatherback nesting in the 1999-2006 period. After Jamursba-Medi, the next largest site is nearby Warmon, accounting for about 30 percent of all western Pacific nesting. Figure 3-8 shows nest counts at Warmon for the 2002-2007 period; nesting has been variable with fewer nests counted in the last two years. Other nesting beaches are found in Papua New Guinea, the Solomon Islands, and Vanuatu. Anecdotal information from all these sites suggests that nesting numbers have declined at these locations in recent years (NMFS 2008).

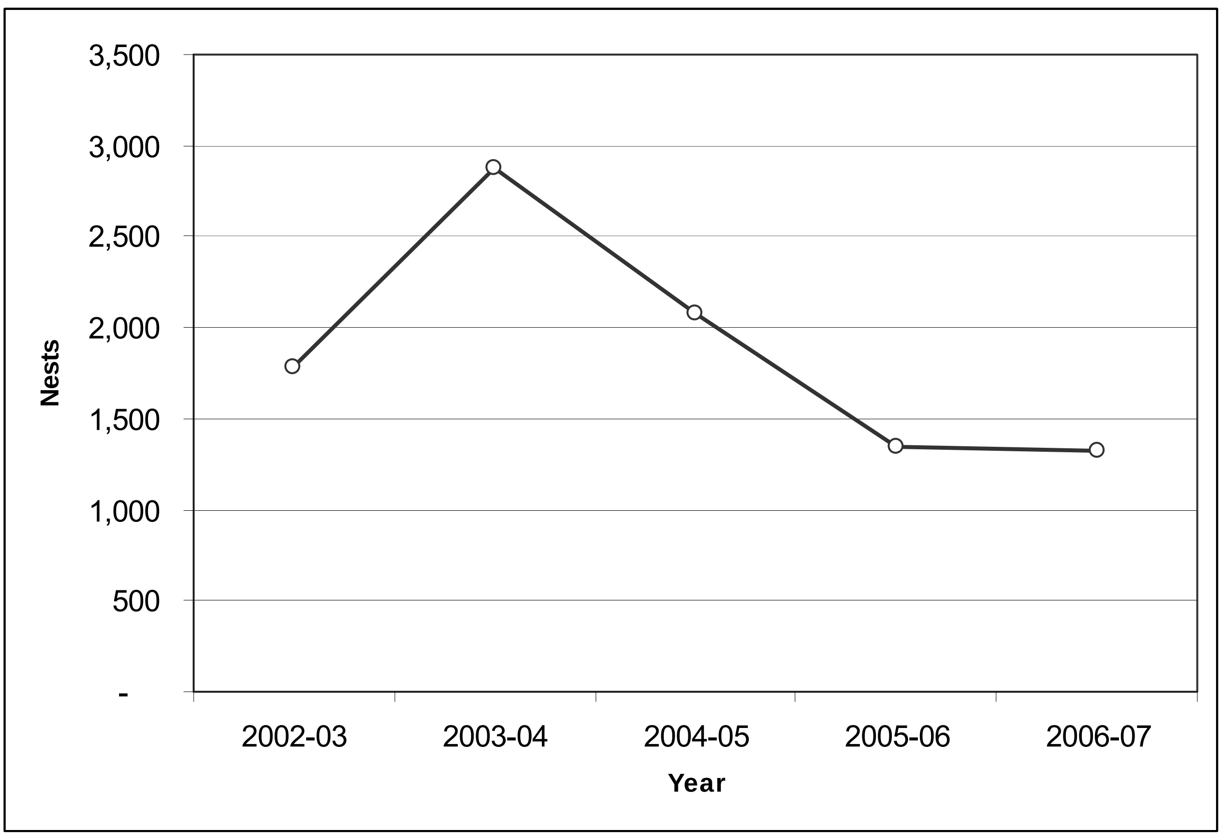

Figure 3-8. Nest counts at Warmon, 2002-2007. (Source: NMFS 2008)

Leatherbacks are known to dive to depths deeper than 1,000 m, but usually feed in surface waters with most dives at depths of 80 m or less. They typically feed on jellyfish, tunicates, and siphonophores.

These prey have high water content and low nutritive value; nonetheless leatherbacks grow to large size in comparison to other sea turtle species. Because they feed in surface waters they tend to be vulnerable to SSLL fisheries, but because of their preferred prey they do not typically ingest hooks baited with fish; instead they are usually entangled in branchlines.

3.3.2.2 *Actions and Trends Affecting the Leatherback Population*

The Amendment 18 BO lists a similar set of threats for leatherbacks as identified for loggerheads: fisheries bycatch, alteration of nesting habitat, direct harvest and predation, and climate change.

In the eastern Pacific, longline and gillnet fisheries operating off the West Coast of South America report high leatherback bycatch. The component of the western Pacific population migrating to Australian and New Zealand waters may be subject to high bycatch in fisheries there.

Prior to its closure and subsequent reopening with modified gear, the Hawaii SSLL fishery had higher interaction rates with leatherback sea turtles. Since reopening in 2004 the interaction rate for leatherbacks has been reduced by 85 percent from previous levels (Gilman and Kobayashi 2007). The Amendment 18 BO ITS estimated that 19 leatherbacks would be taken in the fishery annually, resulting in 5 mortalities and 3 adult female mortalities. However, as a Reasonable and Prudent Measure under the BO's Terms and Conditions, the leatherback take would be capped at 16 takes annually, which is the level in the ITS for the current fishery (NMFS 2004b). This is estimated to result in four mortalities, two of which would be adult females.

Data from observed sets from October 17, 2001, to February 9, 2004, in the West Coast SSLL fishery record a total of three leatherback takes during that period. Two were recorded as hooked on the flipper and one on the carapace/plastron; all were released alive but injured with some gear remaining attached. The HMS FMP BO (NMFS 2004a) estimated that 26 to 60 leatherbacks would be taken in HMS FMP fisheries annually. It estimated that three would be taken annually in the DGN fishery and one in the albacore troll fishery. This suggests that the estimated take in the SSLL fishery was 22 to 56. The BO estimated that 5 to 27 leatherbacks were killed annually due to interaction with the SSLL fishery.

Other pelagic longline fisheries in the Pacific continue to use J-hooks and squid bait resulting in higher interaction and post-hooking mortality rates. Lewison, *et al.* (2004) estimated that pelagic longline fisheries in the Pacific killed 1,000–1,300 leatherbacks in 2000. However, Beverly and Chapman (2007) reexamined the data and arrived at an estimate 20 percent of that made by Lewison, *et al.*, (2004) or 200–640 juvenile and adult leatherbacks killed annually.

The other trends identified for leatherbacks have effects similar to those described for loggerheads. Loss of nesting habitat is mainly due to human activity, including alteration of the shoreline, coastal development, and human activity on beaches. Harvest of leatherbacks for their meat and eggs has resulted in the extirpation of nesting populations in Malaysia and Mexico. Egg collection continues throughout the species' range and predation is a major problem for both western and eastern Pacific leatherbacks. Global warming elevates nest chamber temperature, also altering sex ratios towards more females. Climate change induced sea level rise results in a faster pace of beach inundation, which may be exacerbated by attempts to armor retreating shorelines to protect coastal development. Global warming may increase abundance of jellyfish, an important prey species. Because of their wide geographic range it is hard to predict the long-term effects on leatherbacks of global warming

3.3.3 Olive Ridley (Lepidochelys olivacea), Green (Chelonia mydas), and Hawksbill (Eretmochelys imbricate) Sea Turtles

3.3.3.1 *Status and Characteristics*

Olive ridleys are the most abundant sea turtle species, nesting in the tens of thousands to more than a million in aggregations (called *arribadas*) on the West Coasts of Mexico and Costa Rica and the east coast of India. Smaller *arribadas* and solitary nesters are found elsewhere throughout tropical to warm temperate areas with the exception of the western Pacific and eastern Indian Oceans. Global population structure is poorly understood; in the Pacific, eastern and western populations are thought to be separate. The eastern Pacific population is thought to be increasing. However, the part of the population nesting in Mexico is listed as endangered under the ESA; all other populations are listed as threatened (NMFS 2008). Olive ridleys are similar to loggerheads in that adults and juveniles spend most of their time in the oceanic zone. They forage for soft-bodied invertebrates in the deep-scattering layer. They are less susceptible to take in North Pacific SSLL swordfish fisheries both because they forage at greater depths (>100 m) than where the gear is deployed and generally occur in warmer, tropical waters. Since 2004 through the second quarter of 2008, three olive ridleys have been recorded as taken and released injured in the Hawaii SSLL fishery (Pacific Islands Regional Office 2008; WPFMC 2008). One olive ridley was observed taken in the historic West Coast SSLL fishery, 2001-2004.

Green turtles occur in the Atlantic, Indian, and Pacific Oceans; Mediterranean Sea; and Southeast Asian waters. In the Pacific, western, central, and eastern Pacific populations are recognized. The central Pacific population occurs around island groups, including Hawaii where the population is increasing. However, other components of the central Pacific population may be declining, such as those occurring in the Federated States of Micronesia and Marshall Islands (Snover, *et al.* 2007). The part of the eastern Pacific population nesting on Mexico's West Coast is listed as endangered under the ESA. The western Atlantic population nesting outside Florida is also listed as endangered; all other populations are listed as threatened (NMFS 2008). Green turtles spend their early development phase in the oceanic zone and recruit to coastal areas at carapace length less than 40 cm. Adults forage on sea grass and algae in coastal areas. Green turtles may migrate long distances between coastal foraging areas and nesting areas; for example, in Hawaii, turtles inhabiting the Main Hawaiian Islands migrate to French Frigate Shoals in the Northwest Hawaiian Islands to nest. Because of their life history, interactions between the Hawaii SSLL fishery and green turtles are rare. (Longline fishing is prohibited within 50 nmi of the Hawaiian Islands, so even turtles migrating to nesting sites do not occur in the action area for that fishery.) Juveniles would be expected to occur in the action area for that fishery (and for the proposed action) but the reason for the very low interaction rate is not known. One green turtle was observed taken in the Hawaii SSLL fishery from 2004 through the second quarter of 2008 (Pacific Islands Regional Office 2008; WPFMC 2008). No green turtles were observed taken in the historic West Coast SSLL fishery.

Hawksbill turtles occur in the Caribbean and Atlantic, Indian and Pacific Oceans. While some subpopulations in the Atlantic and Caribbean may be increasing, elsewhere populations are declining. The species is listed as endangered under the ESA. Similar to green sea turtles, hawksbills spend part of their juvenile phase in the oceanic zone; adults forage on coral reefs. In the Pacific they are not known to make trans-oceanic migrations between foraging, breeding, and nesting areas. Although juvenile hawksbills may occur in the action area, they are not known to have interacted with domestic longline fisheries. No incidental takes of this species have been recorded in Hawaii longline fisheries or the historic West Coast fishery (recognizing that the Hawaii deep-set and historic West Coast fisheries have not been subject to 100 percent observer coverage).

3.3.3.2 *Actions and Trends Affecting the Olive Ridley, Green, and Hawksbill Populations*

Threats to these species are similar to those described for loggerheads and leatherbacks above, including: fisheries bycatch (olive ridleys, greens), alteration of nesting and foraging habitat (greens and hawksbills), direct harvest (all three species), and climate change (all three species).

Olive ridleys are taken in a variety of fisheries including longline, gillnet, bottom trawl, dredge, and trap fisheries. Fisheries near the *arribadas* can cause especially high mortality. The shrimp trawl fishery off Central America is thought to kill tens of thousands annually. Developing longline fisheries in this region may pose an even greater threat (Frazier, *et al.* 2007). Green turtles are particularly susceptible to nearshore artisanal fisheries, which use a wide range of gear types. Foreign and domestic deep-set longline fisheries also interact with this species. Takes in the deep-set fishery have a higher mortality rate because turtles captured on the gear do not have the opportunity to reach the surface to breathe; in the Hawaii SSLL fishery branch lines must be long enough to allow the sea turtles to reach the surface to breathe.

Alteration or destruction of nesting habitat is similar as to what has been described previously. Coastal development and shoreline armoring often results in the degradation or destruction of nesting beaches. Green and hawksbill sea turtles also forage in nearshore habitats that are more vulnerable to damage from human activities.

Olive ridleys were intensively harvested for meat and leather from the 1950s through the 1970s on the West Coasts of Central and South America, leading to the extirpation of some of the largest *arribadas*. Globally, harvest of adults has since declined but egg harvest likely continues in some areas. Globally direct harvest of green turtles has declined but still occurs in some areas. In Mexico illegal harvests of green turtles is still prevalent. In Southeast Asia green turtle harvests supply the curio trade. Hawksbills have been harvested heavily for their beautiful shells, called “tortoiseshell.” Until 1992 Japan imported a large amount of tortoiseshell, stopping to comply with Convention on International Trade in Endangered Species (CITES). However, trade continues in Latin America and Southeast Asia. Hawksbill eggs are also harvested in Southeast Asia.

3.4 Marine Mammals

Table 3-9 lists marine mammals occurring in the action area and notes which species have been observed taken in the Hawaii or West Coast SSLL fisheries. Seven of these species, shown in boldface in the table, are listed as endangered under the ESA. As discussed in Section 1.3, the action area is defined as waters westward of the West Coast EEZ to 165° W. longitude and between 25° and 42° 30’ N. latitude, although area closure options could limit the westward extent of the fishery. Most of the observed takes in the Hawaii SSLL fishery occurred west of 150° W. longitude; depending on their distribution some species may be less common in the area east of 150° W. longitude. This list was compiled by evaluating those species listed in the 2007 SSLL EFP EA (NMFS and PFMC 2007) and the Amendment 18 EIS (WPFMC 2008). Those documents relied on information from marine mammal stock assessment reports (SARs) prepared annually by NMFS and required under the Marine Mammal Protection Act (MMPA). Distribution information in the recent Pacific and North Pacific Stock Assessment Reviews (Angliss and Allen 2007; Carretta, *et al.* 2007; Carretta, *et al.* 2008) was also consulted to distinguish those species occurring primarily in coastal areas and thus not in the action area. It should be noted that the SARs focus on populations occurring in the U.S. EEZ, in this case the EEZs around Hawaii and off the West Coast, although the species in question usually have a wider distribution.

As shown in Table 3-9, 12 marine mammal species that been observed taken in the Hawaii or West Coast SSLL fisheries. Six of these species are identified in the 2009 List of Fisheries (73 FR 73032) as marine mammals incidentally killed or injured in the Hawaii and historical West Coast SSLL fisheries. Information on observed interactions is derived from Forney and Kobayashi (Forney and Kobayashi 2007), the Amendment 18 EIS (WPFMC 2008), and 2001-2004 observer data from the West Coast SSLL fishery. Table 3-10 shows the number and types of marine mammals takes based on information reported in Forney and Kobayashi (Forney and Kobayashi 2007) and the Amendment 18 EIS (WPFMC 2008) (updated through the end of 2008 based on the annual observer report available from NMFS PIRO). Forney and Kobayashi report takes by set type, distinguishing tuna sets, swordfish sets, and swordfish-style sets, which are sets where information on gear deployment (number of hooks between floats) shows a similarity to swordfish sets but swordfish were not targeted. In Table 3-10 for 1994-2005 takes for both swordfish and swordfish-style sets are reported, on the premise that the way the gear is set rather than the stated target species, will influence interactions with marine mammals.

The information in Table 3-10 shows that Risso's dolphins are the most commonly taken marine mammal. This species has been observed taken in the SSLL fisheries east of 150° W. longitude, based on the reported location of takes in the Hawaii SSLL fishery and the fact that one Risso's dolphin was reported released injured in the West Coast SSLL fishery. Both of the bottlenose dolphin takes reported by Forney and Kobayashi occurred east of 150° W. longitude. This species also has the second most number of observed takes. Two other species were taken in the Hawaii SSLL fishery east of 150° W. longitude: one short-finned pilot whale and one common dolphin.

The EIS for the 2004 regulatory amendment authorizing the current Hawaii SSLL fishery (WPFMC 2004) described three ESA-listed marine mammal species as potentially affected by the Hawaii fishery: humpback whales, sperm whales, and the Hawaiian monk seal. As shown in Table 3-10, there were two observed interactions with humpback whales and one interaction with a sperm whale in the Hawaii SSLL fishery, 1994-2008. The two humpback whales were reported seriously injured; the humpback whale was reported not seriously injured.

Evidence from the early 1990s suggests interactions between Hawaiian monk seals and longline fisheries, based on sighting of animals with hooks and other non-natural injuries. Implementation of a Protected Species Zone around the Hawaiian Islands, where longline fishing is prohibited, is believed to have prevented any such interactions with the Hawaii fishery and no interactions have been observed. The HMS FMP EIS (PFMC 2003) describes preliminary, unedited information from state logbooks for the West Coast SSLL fishery, August 1995-December 1999, that reported one monk seal and one unidentified sea lion taken and released. However, the logbook reports are of questionable validity since the information was recorded by the skipper, who likely had little or no training in marine mammal identification. Monk seals are likely confined to waters within the Protected Species Zone.[19] The 2007 SAR describes the California sea lion as principally a coastal species.

[19] As discussed in Section 1.3, the fishery could only occur in the area around the Hawaiian Islands if no westward area closure option were adopted. Even without a westward area closure, the operational characteristics of a West Coast fishery makes it unlikely that much fishing would occur in the vicinity of the Hawaiian Islands.

Table 3-9. Marine mammals occurring in the action area and those observed taken in the Hawaii or West Coast SSLL fisheries. Information source for observations is indicated, see footnote for symbols. Endangered species highlighted in boldface.

Common Name	Latin Name	Observed Taken (Source)*
Baird's beaked whale	*Berardius bairdii*	
Blue whale (Endangered)	*Balaenoptera musculus*	
Bottlenose dolphin	*Tursiops truncatus*	F, A (e)
Bryde's whale	*Balaenoptera edeni*	F, A
California sea lion	*Zalophus californicus*	W
Common dolphin, short beaked	*Delphinus delphis*	F (e)
Cuvier's beaked whale	*Ziphius cavirostris*	
Dall's porpoise	*Phocoenoides dalli*	
Dwarf sperm whale	*Kogia sima*	
False killer whale	*Pseudorca crassidens*	F, A
Fin whale (Endangered)	*Balaenoptera physalus*	
Fraser's Dolphin	*Lagenodelphis hosei*	
Hawaiian monk seal (Endangered)	*Monachus schauinslandi*	
Humpback whale (Endangered)	*Megaptera novaeangliae*	A
Killer whale (Eastern North Pacific Offshore & Hawaiian stocks)	*Orcinus orca*	
Longman's beaked whale	*Indopacetus pacificus*	
Melon-headed whale	*Peponocephala electra*	
Mesoplodont beaked whales**	*Mesoplodon spp.*	
Minke Whale	*Balaenoptera acutorostrata*	
North Pacific right whale (Endangered)	*Eubalaena japonica*	
Northern elephant seal	*Mirounga angustirostris*	
Northern fur seal:	*Callorhinus ursinus*	
Northern right whale dolphin	*Lissodelphis borealis*	
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	
Pantropical spotted dolphin	*Stenella attenuata*	
Pilot whale, short-finned	*Globicephala macrorhynchus*	F (e)
Pygmy killer whale	*Feresa attenuata*	
Pygmy sperm whale	*Kogia breviceps*	A
Risso's dolphin	*Grampus griseus*	F, A, W (e)
Rough-toothed dolphin	*Steno bredanensis*	
Sei whale (Endangered)	*Balaenoptera borealis*	
Sperm whale (Endangered)	*Physeter macrocephalus*	F
Spinner dolphin	*Stenella longirostris*	F
Striped dolphin	*Stenella coeruleoalba*	A

* F: Forney and Kobayashi, 2007; A: Amendment 18 EIS; W: 2001-2004 West Coast observer data; (e): Take reported east of 150° W. longitude in Forney and Kobayashi, 2007

**The 2007 SAR designates all Mesoplodont beaked whales as one stock in the EEZ waters off the coasts of CA/OR/WA, because these species are rarely observed and hard to distinguish. They are the Hubbs' beaked whale (*M. carlhubbsi*), gingko-toothed whale (*M ginkgodens*), Stejneger's beaked whale (*M. stejnegeri*), Blainville's beaked whale (*M. densirostris*), pygmy beaked whale or lesser beaked whale (*M. peruvinius*), and Perrin's beaked whale (*M. perrini*). A Hawaiian stock of the Blaineville's beaked whale is listed separately in the SARs.

Table 3-10. Marine mammal takes in the Hawaii SSLL fishery, 1994-2008 by species killed (D), seriously injured (S,) and not seriously injured (N). Sources: 1994-2005: Forney and Kobayashi, 2007; 2006-2008: Amendment 18 EIS as updated through 2008 by annual observer report.

	1994-2005			2006-2008			Total		
	D	S	N	D	S	N	D	S	N
Bottlenose dolphin		2			4			6	
Bryde's whale			1						1
Common dolphin, short-beaked			1						1
False killer whale		2			1			3	
Humpback whale					2			2	
Pilot whale,short-finned	1	1					1	1	
Pygmy sperm whale					1			1	
Risso's dolphin		8		1	7		1	15	
Sperm whale			1						1
Spinner dolphin			2						2
Striped dolphin					1			1	
Unidentified		3	2					3	2

3.4.1 Stock Status and Actions and Trends Affecting Marine Mammal Species

The Amendment 18 EIS and the 2007 SSLL EFP EA (NMFS and PFMC 2007; WPFMC 2008) provide information on marine mammals occurring in the action area. This information is incorporated by reference. Information on the stock status and characteristics of those marine mammals identified as potentially affected by the proposed action, and the other five ESA-listed species occurring in the action area, is summarized below.

The MMPA defines a strategic stock as a marine mammal stock: (1) for which the level of direct human-caused mortality exceeds the potential biological removal (PBR) level; (2) which, based on the best available scientific information, is declining and is likely to be listed as a threatened species under the ESA within the foreseeable future; or (3) which is listed as a threatened or endangered species under the ESA, or as depleted under the MMPA. PBR, as defined by the MMPA, means the maximum number of animals, not including natural mortality, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (OSP).[20] NMFS regulations define a Category I fishery as a fishery that has frequent incidental mortality and serious injury of marine mammals, a Category II fishery as a fishery that has occasional incidental mortality and serious injury of marine mammals, and a Category III fishery as a fishery that has a remote likelihood of, or no known incidental mortality and serious injury of marine mammals. The Hawaii SSLL fishery is listed as a Category II fishery in the 2009 List of Fisheries (73 FR 73032). The 2009 List of Fisheries lists the California pelagic longline fishery (which includes the currently open deep-set compont) as Category II. The MMPA also establishes a zero mortality rate goal defined as total fishery mortality and serious injury less than 10 percent of the calculated PBR for a stock. The MMPA establishes a goal of maintaining populations at or returning them to optimal sustainable population (OSP). It also prohibits marine mammal takes except when authorized by the Secretary of Commerce (additional retrictions apply to ESA-listed species). Vessel owners participating in Category I or II fisheries must register with NMFS and obtain authorization. However, this requirement has been integrated with other

[20] The MMPA defines OSP as “the number of animals which will result in the maximum productivity of a population or species, considering the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element.”

permitting requirements for relevant fisheries so that vessel owners need not separately apply for authorization.

3.4.1.1 *Information on Marine Mammals Species Observed Taken in the Hawaii and West Coast SSLL Fisheries*

This section provides brief summaries for those species that have been observed taken in the Hawaii and West Coast SSLL fisheries. As noted above, the proposed West Coast SSLL fishery is likely to operate farther to the east of the Hawaii fishery (especially if either of the area closure options are chosen), so not all of the species are likely to be affected by the proposed fishery. Table 3-11 shows summary information from the draft 2008 SAR for key stock characteristics, including the estimated population size, the minimum population size estimate, PBR, and serious injury/mortality estimates.

Bottlenose Dolphin

Bottlenose dolphins are distributed world-wide in tropical and warm-temperate waters. In many areas separate coastal and offshore stocks are found. The SARs include information on both a CA/OR/WA stock and a Hawaii stock. Neither stock is designated strategic.

The 2008 draft SAR (Carretta, *et al.* 2008) updates information for both a coastal and offshore stock for the CA/OR/WA region. Information on the offshore stock is provided here, since the proposed fishery would more likely interact with this stock. The minimum population estimate for the CA/OR/WA offshore stock is an average of 2,706 for the 2001-2005 period. There is no information on population trends. The PBR for this stock is 27 animals per year (Carretta, *et al.* 2008). Fishery mortality for the CA/OR/WA offshore stock is within the zero mortality rate goal (<10 percent of PBR).

The 2008 draft SAR identifies only the DGN fishery as a source of mortality on the West Coast. However, estimated annual mortality for the fishery, 2002-2006 is zero. One stranded animal with its flukes cut off was documented in California in 2004, suggesting an interaction with an entangling net fishery. The aforementioned Mexican driftnet fishery is another potential source of mortality. The 2008 draft SAR also mentions the squid purse seine fishery because bottlenose dolphins are known to associate with Risso's dolphins, for which mortality in this fishery has been documented.

The 2007 SAR (Carretta, *et al.* 2007) provides un-updated information on the Hawaii stock. Distribution information suggests that the Hawaii stock is separate from those found elsewhere in the eastern Tropical Pacific. Bottlenose dolphins are common throughout Hawaii waters. The SARs do not distinguish between offshore and coastal stocks in this region. The PBR for this stock is 1.4 animals per year (Carretta, *et al.* 2007). Insufficient information is available to determine whether the fishery mortality of the Hawaii stock (0.8 animals annually within the Hawaii EEZ) is below this threshold.

In Hawaii, inshore gillnets and float lines from trap and line gear may cause some mortality or serious injury. Other local fisheries with likely interactions include various handline fisheries. The Hawaii longline fishery has had observed interactions with bottlenose dolphins; recent SSLL fishery interactions are documented above. For the 1994-2002 period the interaction rate based on observed sets was 0.16 animals per 1,000 sets (three animals in 18,353 observed sets).

Bryde's whale

Bryde's whales occur in tropical and warm temperate waters worldwide. Historical sighting data suggest they are relatively common around the Hawaiian Islands; there is no evidence to suggest a separate stock in Hawaiian waters. The SARs distinguished between populations found in Hawaiian waters and the Eastern Tropical Pacific, covering the West Coast EEZ, but in the 2008 draft SAR the Eastern Tropical Pacific stock was not maintained as a separate stock because this species is rarely observed in the Eastern Tropical Pacific. The PBR for the Hawaii stock is 3.7 animals per year.

Historically this species was a target of Japanese and Soviet whaling. Pelagic whaling for Bryde's whales ended after the 1979 season and coastal whaling ended in 1987. No interactions with the Hawaii longline fishery (both shallow- and deep-set components) were observed during the 1994-2002 period (observer coverage ranged from 4 to 25 percent of total effort). As indicated in Table 3-10, one interaction was observed in the Hawaii SSLL fishery. This occurred in 2005. Takes in other fisheries have not been documented, but the SAR (Carretta, *et al.* 2007) identifies gillnet, lobster trap, and longline fisheries as having the potential for entangling Bryde's whales. There is insufficient information to determine trends in abundance, nor total fishing-related mortality/serious injury. Therefore, it cannot be determined whether the zero mortality rate goal is being met. The Hawaii stock is not designated as strategic.

False Killer Whale

The draft 2008 SAR distinguishes three false killer whale stocks in U.S. EEZ waters, based on genetic sampling. The Hawaii Insular Stock inhabits waters within 25-75 miles of the islands, approximating the Protected Species Zone (longline closed area); the Pelagic Stock comprises the population outside of this zone. A third stock is identified based on genetic samples from animals around Palmyra Atoll (which lies approximately 1,000 miles south of Hawaii). From 1994 to 2006 24 false killer whales were observed hooked or entangled in the Hawaii deep-set longline fishery with approximately 4-34 percent of effort observed. None have been observed caught in the Hawaii SSLL fishery until the interaction in 2008, probably because the fishery operates to the north of the main distribution of this species (WPFMC 2008). The Hawaii Pelagic Stock is designated strategic because estimated annual mortality and serious injury exceeds PBR (see Table 3-11) (Carretta, *et al.* 2008). The SAR does not identify other fisheries responsible for serious injury or mortality for these stocks.

Humpback Whale

There is substantial evidence that several different humpback whale stocks exist in the Pacific Ocean. The SARs (Angliss and Allen 2007; Carretta, *et al.* 2008) recognize three stocks, the eastern Pacific (CA/OR/WA) stock that migrates between West Coast waters and coastal areas off of Mexico and Central America, a central North Pacific stock that migrates between Hawaii and northern British Columbia and Southeast Alaska waters, and a western North Pacific stock that migrates between Japan and waters around the Aleutian Islands and Kodiak Archipelago. There are likely additional biologically separate populations; for example, mixing between the population in British Columbia and CA/OR/WA waters is limited. The total North Pacific population of humpbacks was recently estimated at between 18,000 and 20,000 animals (Calambokidis, *et al.* 2008), a much higher estimate than reported in the 2008 SAR (Carretta, *et al.* 2008) of a total North Pacific population exceeding 6,000 animals.

Humpback whales migrate between feeding grounds at higher latitudes during summer months and breeding areas in subtropical and tropical waters during the winter. Figure 3-9 is taken from Calambokidis, *et al.* (2008) and shows migration patterns between sumer feeding and winter breeding areas in terms of sequential resightings of the same animal. Over half the population winters in Hawaiian waters (central North Pacific stock) and Mexican waters (eastern Pacific stock) (Calambokidis, *et al.* 2008). Whales at these two breeding areas show fewer genetic differences than those found at the California and Alaska feeding areas and individual whales move between these two winter breeding areas (Baker, *et al.* 1990; Baker 1992), although the level of interchange is relatively low (Calambokidis, *et al.* 2008). The draft SAR includes an estimate of the pre-1905 population at 15,000, declining to 1,200 by 1966 (Johnson and Wolman 1984; Rice 1978). The population has been generally increasing with some variability in the trend.

The CA/OR/WA stock feeds off the West Coast and winters off of Mexico and Central America. The Pacific SAR reports the minimum population estimate for CA/OR/WA stock is 1,250 and the PBR is 2.5 animals per year (see Table 3-11 for additional SAR statistics). Annual serious injury and mortality due to fisheries for the CA/OR/WA stock may exceed 10 percent of PBR, the zero mortality threshold.

Hawaii is the primary breeding ground for the central north Pacific stock, but individual whales photographed in the Revillagigedo Archipelago (off Mexico) have also been seen in the Southeast Alaska, Prince William Sound, Kodiak, and eastern Aluteans (Angliss and Allen 2007) suggesting some movement between these areas. According to the SAR the minimum population estimate for this stock is 3,698.

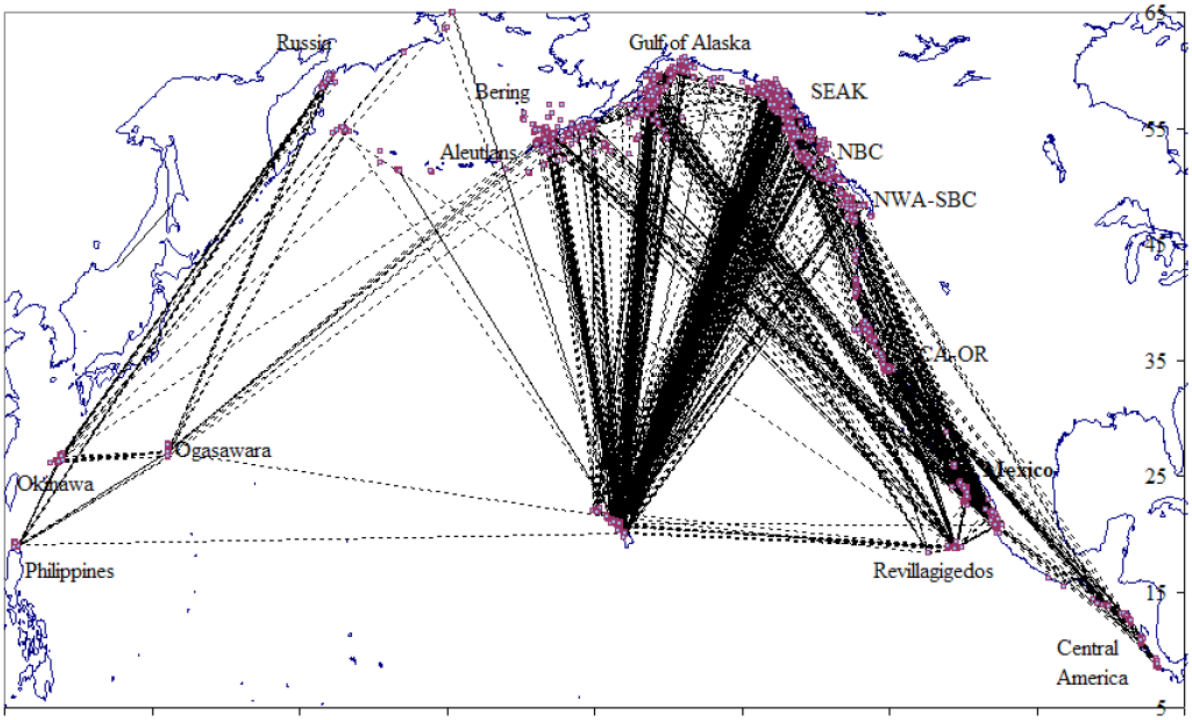

Figure 3-9. Interchange of humpback whales between winter breeding areas and summer feeding areas. Lines connect sequential resightings of the same individual. (Source: Calambokidis, *et al.* 2008)

Humpback whales were listed as endangered under the ESA in 1973. As a result, under the MMPA they are automatically categorized as depleted and a strategic stock. The Amendment 18 BO (NMFS 2008) provides information on humpback whales, because they are an ESA-listed species determined to be potentially adversely affected by that proposed action. Humpback whales are most likely to interact with SSLL fisheries during migrations, especially since they tend to make shallow dives (<600 ft) during that time. Most mating and calving occurs in Hawaiian waters from December to April so migrations would occur in the months preceding and following this time period. When in waters close to the Hawaiian Islands humpbacks are less likely to interact with the SSLL fishery because longline fishing is prohibited within a zone around the Hawaiian Islands varying from 50 to 75 nmi (as noted above, should a West Coast fishery be authorized west of 150° W. longitude, complementary regulations would likely be established for that fishery).

Directed harvest of humpback whales has been prohibited by international agreement since 1966. This is probably the main reason for the apparent substantial increase in the North Pacific population since that time. Fishery-related impacts to humpback whales primarily relate to gear entanglement. Because of their size it is rare for whales to become immobilized or immediately drown from entanglement. But trailing gear can increase the risk of starvation, infection, or other forms of trauma. Reports of entanglements have increased in the last couple of years, which may indicate an increasing trend (NMFS 2008). A total of 14 humpback whales were reported entangled in fishing gear off California and Oregon, 2002-2006 (Carretta, *et al.* 2008). These entanglements were with gillnet and trap/pot gear.

Other actions affecting humpback whales include ship strikes, potential harassment from whale-watching operations, undersea noise, and global climate change (NMFS 2008). Ship strikes are likely the greatest direct source of human-induced mortality. Humpbacks are very vulnerable to ship strikes because their distribution overlaps with major shipping routes and they spend a lot of time near the surface. It is estimated that an average of five humpback whales per year were struck in Alaska waters, 2001-2005. In Hawaii 12 ship strikes were reported in 2008. The Amendment 18 BO does not provide an estimate of what proportion of these strikes may have resulted in death. Ship strikes were implicated in the deths of four humpback whales, 1993-2000, off the West Coast (Carretta, *et al.* 2008). There is likely additional unobserved mortality due to ship strikes. Due to a recent Supreme Court decision attention has focused on the effects of U.S. Navy Sonar training exercises on marine mammals (Liptak 2008), but other sound sources, such as ship and aircraft noise may affect whales that use vocalization in various social and other behavioral contexts. Global climate change, by increasing sea temperatures, may change the distribution of favored foraging and breeding areas.

Pygmy Sperm Whale

Pygmy sperm whales are common worldwide in tropical and warm-temperate waters. They are rarely observed in the West Coast EEZ but surveys recorded sightings in seas adjacent to the outer EEZ boundary (Carretta, *et al.* 2008), which is likely to be an area where more fishing effort would be concentrated in a West Coast SSLL fishery. In Hawaii pygmy sperm whales have been found stranded but sightings are uncommon (Carretta, *et al.* 2007). No interactions have been observed in fisheries except for the one animal in 2008. As with other species, the SARs reference gillnet fisheries as a possible source of injury or mortality. One pygmy sperm whale stranded on the West Coast in 2002 with evidence of a gunshot wound; the SAR concluded that this shooting likely resulted from an interaction with an entangling net fishery, leading to the estimate of average human caused mortality of 0.2 per year (Carretta, *et al.* 2007). The SAR also identifies anthropogenic sound, and specifically military sonar, as causing an unknown level of harm. The 2008 draft SAR does not include an estimate of PBR for the CA/OR/WA stock due to insufficient data; past estimates have ranged from 1 to 28 animals per year. Neither stock is classed as strategic.

Risso's Dolphin

Risso's dolphins are found in tropical and warm-temperate waters worldwide. The SARs list both a West Coast (CA/OR/WA) stock and a Hawaii stock. The current minimum population estimate for the CA/OR/WA stock is 10,054 animals (Carretta, *et al.* 2008).[21] There is no reported trend in abundance, based on surveys between 1991 and 2005. The PBR is calculated as 80 animals per year for the stock.

[21] The SARs periodically update status information for selected stocks. The most recent available data in the SARs are cited here.

The minimum population estimate for the Hawaii stock is 1,426 in 2002 (Carretta, *et al.* 2007). The PBR for this stock is 14 animals per year. Neither stock is designated as strategic.

The 2008 draft SAR lists four West Coast fisheries with possible incidental mortality and injury to Risso's dolphins: the CA/OR DGN fishery, the SSLL fishery (currently closed and subject of the proposed action), the deep-set longline fishery, and the market squid purse seine fishery. Drift gillnet fisheries in both California and Mexico account for the largest source of mortality/injury in the region, although the California fishery had no observed takes in 2005 and 2006. The historical West Coast SSLL fishery had one observed Risso's dolphin take in 2003, as mentioned above while the deep-set fishery comprising one vessel currently has had no observed takes. The squid purse seine fishery is included because of historical evidence that Risso's dolphins were intentionally killed in this fishery to protect gear and catch. Three animals were found stranded with evidence of gunshot wounds; the SAR suggests that the squid purse seine fishery is implicated based on past behavior. However, no interactions have been documented from observed sets, 2004-2006. The 2007 SAR describes interactions with the Hawaii longline fishery for the period 1998-2002; this includes both shallow-set and deep-set components of the fishery. The SAR estimates average annual mortality of serious injury for the period at 8.2 for the Hawaii fishery.

Short-beaked Common Dolphin

Short-beaked common dolphins are the most abundant cetacean off California and are distributed up to at least 300 nmi from shore. 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 CA/OR/WA short-beaked stock is 397,733 (Coefficient of Variance (CV) =0.18) animals, with a minimum population estimate of 338,708 animals and an estimated PBR of 3,387 animals per year. The estimated mean annual take (serious injury and mortality) for short-beaked common dolphins in U.S. commercial fisheries is 77 (CV=0.23) animals, based on information from 1997–2001. The SAR identifies the DGN fishery, large mesh set gillnet fishery, and squid purse seine fishery as sources of mortality for this stock. This stock is not classified as strategic under the MMPA (Carretta, *et al.* 2008).

Short-finned Pilot Whale

Short-finned pilot whales are found in all oceans, primarily in tropical and warm temperate waters. The SAR distinguishes separate CA/OR/WA and Hawaii stocks of short-finned pilot whales. Although once common off California, since the strong El Niño event in 1982-1983 they virtually disappeared from the West Coast region (Carretta, *et al.* 2007). Animals found in theWest Coast EEZ are morphologically distinct from those found farther south in the Eastern Tropical Pacific. Abundance in the West Coast EEZ is variable and influenced by oceanographic conditions. This means that the population estimate in the SAR, which is for the West Coast EEZ only, is probably not representative of the population as a whole. This estimate for 2001-2005 is 245 (C=0.97) (Carretta, *et al.* 2008). Fishery related serious injury / mortality is estimated at one animal per year. The stock is classified as strategic.

Short-finned pilot whales are commonly sighted around the Hawaiian Islands. This stock appears morphologically similar to the Japanese "southern form." Genetic analysis indicates that the stock around the Hawaiian Islands is reproductively isolated from those found in the eastern Pacific Ocean. The principal source of fishery-related serious injury / mortality indentified in the SAR is the Hawaii pelagic longline fishery. An estimated 3.6 animals are subject to fishery-related serious injury / mortality outside the Hawaii EEZ and an additional 0.6 inside the Johnston Atoll EEZ. The stock is not designated strategic but there is insufficient information to fully assess the status of the stock (Carretta, *et al.* 2007).

Sperm Whale

Sperm whales are found in all the world's oceans and are widely distributed in the North Pacific. During winter months the majority of the population is thought to reside south of 40° N. latitude (Gosho, *et al.* 1984; Miyashita, *et al.* 1995; Rice 1974; Rice 1989). The IWC identifies two North Pacific stocks, one in the east and the other in the west. The SARs divide the population into three stocks, CA/OR/WA, Hawaii, and Alaska, for the purposes of reporting (Carretta, *et al.* 2008). Because the sperm whale is listed as endangered under the ESA both stocks are designated strategic. As with other whales, the IWC agreed in 1982 that there should be a moratorium on directed harvest (whaling) from the 1985-1986 season onward. No directed harvest of sperm whales has occurred since that time. Table 3-11 provides population estimates for the designated stocks within the U.S. EEZ. The SAR cites a 1993 estimate of the North Pacific population of 22,700 with a 95 percent confidence interval estimate of 14,800-36,400 (Wade and Gerrodette 1993). (Barlow 2006) estimated sperm whale abundance in the U.S. EEZ waters surrounding Hawaii as 6,900 (CV=0.81). There are no available estimates for sperm whales in Alaskan waters and no recent estimates of abundance for the entire North Pacific. Using (Whitehead 2002) global average of sperm whale density (1.40 per 1,000 km^2), the North Pacific would have approximately 112,000 sperm whales. Given that the densities in 3 of 5 study areas are higher than Whitehead's average, this could be considered a conservative estimate.

As noted above, one sperm whale was observed entangled in the Hawaii longline fishery during the 1994-2002 period; no interactions have been observed in the SSLL fishery since it reopened in 2004. The SARs identify gillnet fisheries as another of serious injury or mortality. Anthropogenic noise is identified as a possible non-fishery source of harm (Carretta, *et al.* 2007; Richardson, *et al.* 1995).

Striped Dolphin

As shown in Table 3-10, one striped dolphin was observed caught and released injured in the Hawaii SSLL fishery in 2008. Table 3-11 provides population information from the SARs for these stocks. The PBR for the stocks are 132 for the CA/OR/WA stock and 71 for the Hawaii stock. No trend in population abundance can be confirmed. The SARs identify gillnet fisheries as a potential source of mortality for these animals although interactions have not been observed in West Coast or Hawaii fisheries. The estimate of 0.2 animals subject to serious injury or mortality for the CA/OR/WA stock is due to evidence of trauma, possibly related to a fishery interaction, observed on a stranded animal in Oregon in 2006. Neither stock is designated strategic and the zero mortality rate goal is considered met for the CA/OR/WA stock (Carretta, *et al.* 2008); not enough information is available to make the determination for the Hawaii stock (Carretta, *et al.* 2007).

3.4.1.2 *Other ESA-listed Marine Mammals occurring in the Action Area*

Four other whale species and the Hawaiian monk sea are listed as endangered under the ESA and occur in the action area. Based on the lack of past observed interactions it is unlikely that these species would be affected by the proposed action. The Amendment 18 BO (NMFS 2008) identified these species as unlikely to be adversely affected by that proposed action. Since the current proposed action involves the same target species and gear type and a similar regulatory framework, it is reasonable to conclude that adverse effects from this action are also unlikely. The Amendment 18 EIS (WPFMC 2008) describes the population characteristics of these species; this information is incorporated by reference and summarized below.

The IWC recognizes only one stock of blue whales in the North Pacific (eastern North Pacific stock), but some evidence suggests that there may be as many as five separate stocks (Carretta, *et al.* 2007). The SARs identify both Eastern North Pacific and Hawaiian stocks. Since blue whales are listed as endangered under the ESA both stocks are automatically considered as a depleted and strategic stock under the MMPA. Insufficient information is available to determine whether the total fishery mortality and serious injury for blue whales is insignificant and approaching zero mortality and serious injury rate. Increasing levels of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for blue whales (Reeves, *et al.* 1998). Blue whales have been protected in the North Pacific by the IWC since 1996, although some illegal whaling reportedly occurred after that date (Doroshenko 2000). The annual serious injury / incidental mortality rate for the Eastern North Pacific Stock is 0.6, due to ship strikes (Carretta, *et al.* 2008). Although gillnet and longline fisheries are discussed as a potential source of serious injury / mortality, no interactions have been observed and it is estimated to be zero. No PBR can be calculated for the Hawaii Stock; it is 1.0 for the Eastern North Pacific Stock.

The IWC recognizes two fin whale stocks in the North Pacific, one in the East China Sea and the other occupying the rest of the North Pacific Ocean. The SARs identify three stocks for reporting purposes: CA/OR/WA, Hawaii, and Alaska. This suggests wide distribution although they appear scarce in the Eastern Tropical Pacific (Carretta, *et al.* 2008). No interactions have been observed recently in U.S. fisheries. Ship strikes appear to be the primary source of human-caused mortality.

The Hawaiian monk seal is endemic to the Hawaiian Archipelago and Johnston Island (located approximately 700 miles southwest of Hawaii). They mainly occur in the Northwestern Hawaiian Islands (NWHI) with the largest colony on French Frigate Shoals. The population appears never to have been large and has been in decline since at least the 1950s. The current population estimate is 1,247 animals. The 2007 SAR (Carretta, *et al.* 2007) provides the following information on impacts to the population. Although there is past evidence of fishery interactions, including seals observed with hook injuries or entangled in gear, the establishment of the Protected Species Zone and more recently designation of the Northwest Hawaiian Islands Marine National Monument has reduced interactions to near zero. However, fishery interactions continue to be a concern in the Main Hawaiian Islands, principally from state-managed nearshore fisheries. As a result, while the serious injury / mortality rate is unknown, it is not considered insignificant and approaching a rate of zero (the zero mortality rate goal). Entanglement in marine debris is the other main human-caused source of injury and mortality. Human modification of physical habitat in the NWHI and changes in prey availability are also implicated in population decline. The prey availability issue has been linked to competition with fisheries (the lobster and bottomfish fisheries in the NWHI) but there is no definitive evidence of such a link. Conversely, the population in the Main Hawaiian Islands appears to be increasing and the excellent condition of pups weaned on these islands suggests that prey is not a limiting factor. An increasing population in the Main Hawaiian Islands is likely to result in more adverse interactions with humans.

The North Pacific right whale was separately listed as endangered under the ESA in 2008. The population had previously been considered part of a single species occurring in both the North Atlantic and North Pacific. However, genetic evidence led to a taxonomic revision distinguishing the North Pacific population as a different species (*E. japonica*) from the North Atlantic population (*E. glacialis*). (A third species, *E. australis*, occurs in the Southern Ocean.) The 2008 Draft Alaska SAR provides information on the stock (Angliss and Allen 2007). They generally occur north of 35° N. latitude but occasionally as far south as 20° N. Since the action area is defined from 25° N. to 42° 30' N. latitude, the Northern right whale range partially overlaps with it. Currently there is no reliable estimate of the stock size, although a review of sighting records suggest that it is a few hundred (Brownell, *et al.* 2001). Since the right whale is listed as endangered, it is considered depleted and a strategic stock under the ESA. An estimate of PBR and population trends is not known, but because of historically whaling the stock is thought to be well below OSP, or pre-whaling abundance. Current human-caused injury and mortality appears to be minimal (Angliss and Allen 2007). However, the stock has shown little signs of recovery, perhaps because of illegal Soviet whaling in the 1960s (Brownell, *et al.* 2001). Right whales may be the most endangered whale species worldwide. Potential oil and gas development in the U.S. portion of the Bering Sea EEZ is cited as a potential human impact on the population (Angliss and Allen 2007).

The IWC recognizes only one stock of sei whales in the North Pacific (the eastern North Pacific stock) for management purposes, although there is evidence that more than one stock exists. Sei whales are distributed in temperate waters in all oceans, and are not usually associated with coastal features. In the North Pacific Ocean, the summer range extends from southern California to the Gulf of Alaska and across the North Pacific south of the Aleutian Islands, extending into the Bering Sea in the deep southwestern Aleutian Basin (Carretta, *et al.* 2007). Sei whales are thought to have been reduced to 20 percent of their pre-whaling abundance in the North Pacific, estimated at between 7,260 and 12,620 animals (Tillman 1977). On the West Coast the only fishery identified as potentially taking sei whales is the DGN fishery, although the estimated take is zero (Carretta, *et al.* 2008). Longline fisheries are also identified as a potential source of takes (Carretta, *et al.* 2007). However, no interactions with Hawaii longline fisheries have been observed since 1994. Total fishing mortality is estimated at zero, and the zero mortality and serious injury rate goal is considered met, although the North Pacific stock is automatically listed as depleted and strategic under the MMPA because of its ESA listing. Ship strikes are another potential source of human-caused serious injury and mortality.

Table 3-11. Summary information from Stock Assessment Reports for marine mammal species that have been observed taken in the Hawaii or West Coast SSLL fisheries. (Source: Carretta, *et al.* 2008, Appendix 3.)

Species	Stock	N est	N min	PBR	Total Injury/Mortality	Fishery Injury/Mortality	Strategic Status	SAR Last Revised
Bottlenose dolphin	CA/OR/WA	323	250	2.4	0.2	0.2	N	2008
	Hawaii	3,263	2,046	20	≥0.2	≥0.2	N	2006
Bryde's whale	Hawaii	493	373	3.7	Unknown	Unknown	N	2004
California sea lion	U.S.	238,000	141,842	8,511	≥232	≥159	N	2007
Common dolphin, short beak	CA/OR/WA	392,733	338,708	3,387	77	77	N	2008
False killer whale	Hawaii Pelagic	484	249	2.2	5.7	5.7	Y	2008
	Palmyra Atoll	1,329	806	7.2	1.2	1.2	N	2008
	Hawaii Insular	123	76	0.8	0	0	N	2008
Humpback whale	CA/OR/WA	1,391	1,250	2.5	≥2.6	≥2.6	Y	2008
	Cent. N. Pacific	4,005	3,698	12.9	5.0	3.2	Y	2007
	Hawaii	2,351	1,426	14	Unknown	Unknown	N	2004
Pilot whale, short-finned	CA/OR/WA	245	123	0.98	1	1	Y	2008
	Hawaii	430	250	2.5	Unknown	Unknown	N	2004
Pygmy sperm whale	CA/OR/WA	Unknown	Unknown	Und	≥0.2	≥0.2	N	2008
	Hawaii	7,251	4,082	69	Unknown	Unknown	N	2004
Risso's dolphin	CA/OR/WA	11,621	10,054	80	4.9	4.9	N	2008
Sperm whale	CA/OR/WA	2,853	2,326	9.3	0.2	0.2	Y	2008
	Hawaii	7,082	5,531	11	0	0	Y	2004
Striped dolphin	CA/OR/WA	17,925	13,251	132	0	0	N	2008
	Hawaii	10,385	7,078	71	Unknown	Unknown	N	2004

3.5 Seabirds

Two species of albatross, the Laysan (*Phoebastria immutabilis*) and the black-footed (*P. nigripes*) have been observed caught in both the Hawaii and historical West Coast SSLL fisheries. The short-tailed albatross (*P. albatrus*) is listed as endangered under the ESA and occurs in the action area, but none have been observed taken in the two longline fisheries. These are the only albatross species that occur in the northern hemisphere. The Amendment 18 EIS (WPFMC 2008) describes the status of these species; this information is incorporated by reference and summarized below. The Recovery Plan for short-tailed albatross (USFWS 2008) was also consulted for information on their status and distribution. The Biological Opinion completed for the HMS FMP (USFWS 2004) concluded that "the [U.S. Fish & Wildlife] Service does not anticipated the number of short-tailed albatross killed or injured per year to exceed one" in the West Coast pelagic longline fishery. That conclusion was based on an assumed level of effort (for both deep-set and shallow-set components) of approximately 1,000,000 hooks and a fishery constrained to east of 150° W. longitude.

Table 3-12 reports observed interactions with non-listed seabirds in the West Coast SSLL fishery. Of the 72 black-footed albatross that interacted with the gear, 65 were released dead; all 7 of the Laysan albatrosses were released dead. Table 3-13 shows similar data from the Hawaii SSLL fishery. It can be seen that the interaction rates are different in the two fisheries, with the West Coast fishery having a comparatively higher rate for black-footed albatross and a lower rate for Laysan. The USFWS Biological Opinion recommends that NMFS investigate whether the use of circle hooks would reduce the mortality rate for seabirds. The data presented in the tables below suggest that they do; the mortality rate upon release for both species combined in the West Coast fishery was 91 percent while it is only 41 percent in the Hawaii fishery using circle hooks. The effect of other seabird mitigation measures is discussed below (see page 76).

Table 3-12. Observed seabird interactions in the historic West Coast longline fishery.

Species Name	Year 2001	2002	2003	2004	Total	Interaction Rate (per set)
Black-footed albatross	1	35	34	2	72	0.154
Laysan albatross	2	3	2		7	0.013
No. sets observed	22	153	228	66	469	

Table 3-13. Observed interactions in the Hawaii SSLL fishery (Adapted from Table 27 in WPFMC 2008).

	Year 2004	2005	2006	2007	2008*	Total	Interaction Rate (per set)
Black-footed albatross, released injured	0	3	0	6	2	11	0.005
Black-footed albatross, released dead	0	4	3	2	9	18	
Laysan Albatross, released injured/	1	44	5	33	22	105	0.027
Laysan albatross, released dead	0	18	3	6	11	38	
No. of sets	135	1,645	850	1,497	1,151	5,278	

*Through second quarter

3.5.1 Short-tailed Albatross

The short-tailed albatross has the smallest population of any of the albatross species, because it was extensively hunted to near extinction in the late 19th and early 20th centuries. Some five million short-tailed albatross are thought to have been harvested for their feathers between 1885 and 1903 (USFWS 2008). In 1949 the species was thought to be extinct, because no breeding pairs were observed on Torishima Island, Japan, the main nesting site for the species. Beginning in 1950 breeding pairs were again observed at Torishima and the population has been steadily increasing since that time, but it is currently estimated at only 2,717 birds (USFWS 2008). Historically, the species bred at a number of islands in the northwest Pacific, but today, aside from Torishima there is only a secondary breeding site at Minami-kojima in the Senkaku Islands of Japan (Figure 3-10). About four-fifths of the breeding population nests in a single colony at Tsubamezaki, Torishima. Torishima is an active volcano overdue for an eruption, so there has been some concern that the population could be extirpated if a volcanic eruption occurred. Tsubamezaki is located on a fluvial outwash plain of the volcano's caldera. A second breeding colony comprising 36 pairs has formed at Hatsunezki on the northwest side of the island and is experiencing rapid growth. Over time this could reduce the risk of losing most of the breeding population to an eruption. Historically, the species may have bred at Midway Atoll in the NWHI and they have been observed at Midway since the 1930s, but without successful nesting having been documented. Breeding occurs from August to December

Like other albatross species, short-tailed albatrosses spend much of their time on the open ocean. Currently, their range comprises much of the North Pacific north of about 20° N. latitude (Figure 3-10). Their diet mainly consists of squid, shrimp, and fish found in the pelagic environment. Recent satellite tagging work has confirmed their preference for areas of upwelling and high productivity along shelf breaks. They are thus more heavily concentrated in waters off the Pacific Rim from Japan, the Aleutian Islands and Bering Sea, Southeast Alaska, British Columbia, and the U.S. West Coast. Although the distribution is concentrated in these areas, as noted above, short-tailed albatrosses have been consistently observed in the NWHI. Use of open ocean, or abyssal, regions may principally represent periods of transit between foraging and breeding sites. It is estimated that they spend less than 20 percent of their time over waters greater than 3,000 m deep (Suryan, *et al.* 2007). Thus, the functional range of the species is likely considerably more restricted than the broad region shown in Figure 3-10, with the species predominantly occurring north of 30° N. latitude.

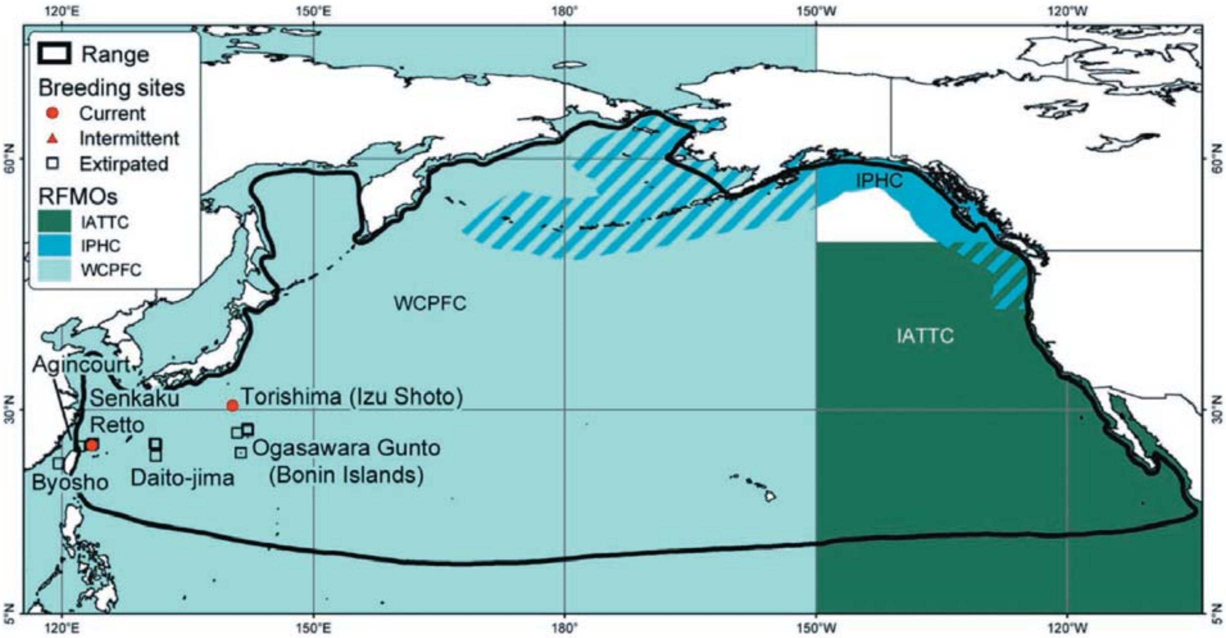

Figure 3-10. Range and breeding sites of the short-tailed albatross (Source: USFWS 2008).

3.5.2 Black-footed Albatross

The NWHI is the primary breeding site for the black-footed albatross; they also breed on three offshore islands in Japan. It is estimated that 62,437 breeding pairs nested in the NWHI in 2006-2007 while about 2,000 breeding pairs nest on the Japan islands. Breeding begins in late October or November and continues through December. Breeding pairs mate for life. Breeding and foraging may occur simultaneously. The breeding distribution is concentrated around and to the northeast of the Hawaiian Islands while non-breeding black-footed albatrosses are concentrated around 40° N. latitude, around the Aleutian Islands, and off the West Coast of North America (see Figures 21 and 22 in WPFMC 2008). Like the other albatrosses, they feed on squid, shrimp, and fish found in the pelagic environment. They commonly forage at night. The population has declined due to hunting for eggs and feathers during the 20th century. In 2000 the population was estimated to be 278,000 birds (Audubon Society 2009). The IUCN provides an estimate of the breeding population in the 2006-2007 season of 129,000 individuals. The IUCN lists this species on its Red List as "Endangered" because of predictions of rapid population decline over the next three generations (IUCN 2008b). However, the Amendment 18 EIS cites information that the population is stable or increasing (Naughton, *et al.* 2008, cited in WPFMC 2008). On October 27, 2007, the USFWS announced a finding on a petition to list the black-footed albatross as threatened or endangered under the ESA, initiating a 12-month status review (57 FR 57278). The finding concluded that there was sufficient evidence of adverse effects of fishery-related mortality and the effects of ingesting contaminants such as organochloride compounds and heavy metals, as claimed in the petition, to initiate a status review. A decision is pending.

3.5.3 Laysan Albatross

The Laysan is the most abundant albatross species. Ninety-nine percent of all breeding occurs in the NWHI. The population is estimated at about 1,180,000 mature individuals (IUCN 2008a). Other small breeding sites are found on islands off Japan and Mexico. This species has a range similar to the other two albatross species described above. The distribution of the breeding population is concentrated around and north of the Hawaiian Islands while the non-breeding population is concentrated from about 35° N. latitude north to the Aleutian Islands (see Figures 23 and 24 in WPFMC 2008). The largest breeding colony, at Midway Atoll, saw a 39 percent increase between 2001 and the 2006-2007 breeding season (WPFMC 2008). The IUCN lists the Laysan albatross as "Vulnerable" on its Red List, because of projected rapid future population decline (IUCN 2008a). However, they note recent data indicating a population rebound, suggesting that declines observed in the 1990s and early 2000s could have been due to conditions affecting the number of birds returning to breed rather than the size of the overall population. If increasing trends continue the IUCN may down-list the species to "Near Threatened."

3.5.4 Actions and Trends Affecting Seabird Populations

All three albatross species were subject to extensive past harvest for their feathers, resulting in substantial population declines. This activity ceased with the protection of nesting sites in the early to middle part of the last century. Currently, the major source of human-induced mortality for these birds is incidental capture in pelagic fisheries. Historically, the high seas drift net fishery had a high level of incidental capture. North Pacific longline fisheries continue to take large number of birds, although as discussed below, mitigation measures have been introduced in U.S. fisheries that have substantially reduced seabird catch. Foreign longline fisheries, particularly the large Japanese fleet, may continue to be a large source of mortality. Other threats include plastic ingestion, which reduces the nutritional content of the diet, and impacts associated with breeding sites. For the short-tailed albatross, the threat of volcanic eruption destroying their primary breeding site was mentioned above. Historically, military activities in the NWHI produced numerous impacts, including habitat destruction and alteration and aircraft bird strikes.

The NWHI were originally protected as a National Wildlife Refuge and surrounding state waters were protected as a marine refuge by the State of Hawaii. A coordinated management structure was established with the designation of the Papahānaumokuākea Marine National Monument in 2006, with the USFWS, NOAA, and the Hawaii Department of Land and Natural Resources having joint responsibilities. The WPFMC instituted a 50 nmi Protected Species Zone around the Hawaiian Islands where pelagic longlining is prohibited. Taken together, these measures reduce the impact of fishing, and other human activities, in and around the major breeding site for black-footed and Laysan albatrosses. Short-tailed albatrosses are also known to occur there.

Under a framework established by the Food and Agriculture Organization of the United Nations, NMFS has prepared a National Plan of Action (NPOA) for reducing seabird incidental catch (NMFS 2001). It outlines a strategy for collecting data, developing mitigation measures, and proposed time frames for implementing mitigation measures where needed.

A variety of regulations intended to reduce seabirds incidental catch are applicable to Hawaii pelagic longline fisheries (50 CFR 665.35); similar regulations apply to West Coast pelagic longine fisheries (50 CFR 660.712(c)). Mitigation measures are also required in Alaskan bottom longline fisheries. The Hawaii pelagic longline fishery regulations either require side-setting and use of a bird curtain aft of the line shooter or the use of weighted branchlines, discharging offal or bait on the opposite side of the vessel from where line setting or hauling operations are occurring, and use of thawed, blue-dyed bait. Gilman, *et al.* (2008) used a Poisson General Additive Model (GAM) to evaluate the effects of these mitigation measures. They found a significant reduction in seabird take rates when comparing observed sets in the Hawaii longline fishery targeting tuna (deep-setting) from the pre- and post-regulation period (before and after June 10, 2001, when seabird mitigation regulations first came into effect, although current regulations date from January 18, 2006), amounting to a 76 percent overall reduction. Modeling to account for the effects of the time of day when setting began, season, and geographic location, resulted in a statistically significant 67 percent reduction accountable to the use of mitigation measures.

Significant differences in catch rates by season, time of setting, and geographic location (independent of each of the other factors) were also found, suggesting other operational restrictions that could be used to mitigate seabird catch. For example, they found that sets initiated before 7:00 a.m. resulted in a catch rate 69 percent lower than sets initiated later in the day. They suggest that avoiding setting during dawn and dusk periods, when albatrosses actively forage, is a key factor. Catch rates were also higher in the first half of the year in comparison to the second half.

3.6 Socioeconomic Environment

3.6.1 Historical and Current Swordfish Fisheries

Both the HMS FMP (WPFMC 2004) and the annual HMS SAFE (stock assessment / fishery evaluation) (PFMC 2008) describe West Coast HMS fisheries and provide data on landings and revenue by fishery and year. This information is incorporated by reference in the descriptions below.

3.6.1.1 *West Coast SSLL Fishery*

Section 1.3 summarizes the development and regulatory history of the West Coast SSLL fishery. The fishery was closed on April 12, 2004, with the implementation of regulations pursuant to the ESA (69 FR 11540). The West Coast fishery had several different components. First, in terms of fishing strategy, two types of trips can be distinguished based on catch composition: trips where swordfish was targeted exclusively and “mixed trips” where both tunas and swordfish were targeted. Unpublished logbook data provided by the SWFSC (personal communication, John Childers, November 21, 2008) shows that on a per set basis between 1994 and 2004, 49 percent of sets occurred on trips targeting swordfish, the remainder occurred during mixed trips. Second, West Coast landings included those made by Hawaii-based and permitted vessels as well as vessels based on the West Coast. The West Coast fishery occurred the first and fourth quarters of each year. This seasonality was due to the availability of swordfish in waters closer to West Coast EEZ during this time of the year. Hawaii vessels, following the fish, would make landings on the West Coast based on the relative transit distance from the fishing grounds to the West Coast or Hawaii. In other words, when fishing occurred closer to the West Coast than Hawaii, it was more cost effective to land the fish on the West Coast. The data used to evaluate the limited entry options, discussed in Chapter 2, give an indication of the large role Hawaii-permitted vessels played in this fishery. Under limited entry Option 3 (permit qualification based on longline landings), 46 vessels meet the basic requirement of having made at least one swordfish landing with pelagic longline gear during the 1996-2007 period. Of these, 35, or 76 percent, had a Hawaii limited entry permit.

The 2008 HMS SAFE (Table 4-43) provides data on the number of HMS pelagic longline vessels making landings on the West Coast; between 1996 and 2004 the numbers varied from 29 to 70 vessels and averaged 48 vessels.

Table 4-13 in the HMS SAFE shows historical landings by species in the West Coast pelagic longline fishery. Figure 3-11 shows the average annual landings by species in percent terms for the 1994-2004 period. Swordfish comprised the majority of landings at 88 percent, followed by tunas at 7 percent. Table 4-25 in the HMS SAFE shows ex-vessel revenue for the fishery in real (2007) dollars; average annual revenue for the 1994-2004 period was $5,229,402.

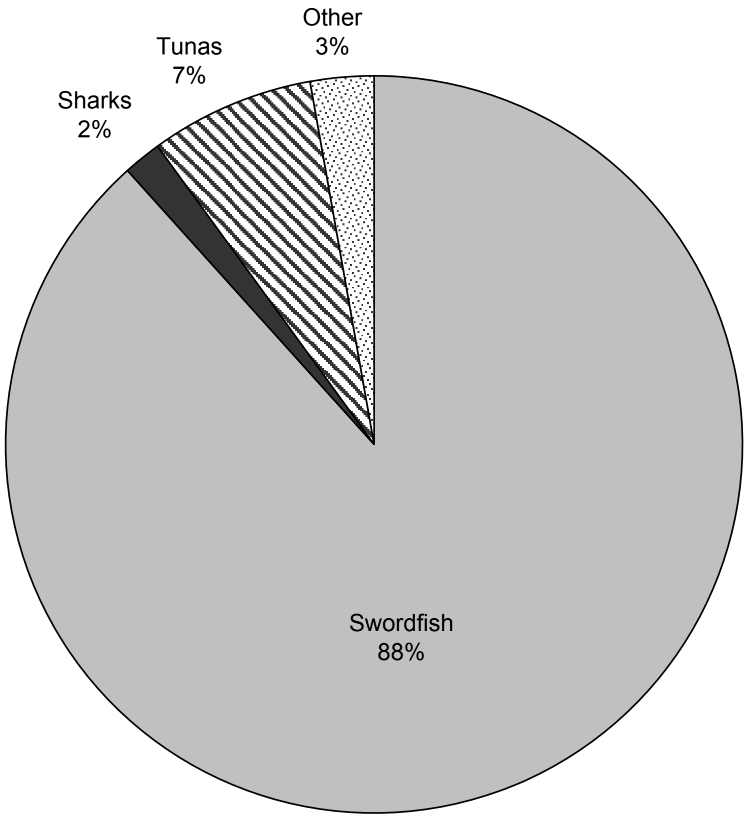

Figure 3-11. Average pelagic longline landings by species, percent, 1994-2004

3.6.1.2 *Hawaii Longline Fishery*

The Amendment 18 EIS (WPFMC 2008) provides a detailed description of the Hawaii longline fishery; this information is incorporated by reference and summarized here. Although longline fishing in Hawaii dates back to the early part of the 20th century, the fishery didn't begin to expand until the 1980s. The late 1980s and early 1990s saw an influx of vessels from the Atlantic and Gulf States. This fleet introduced new technologies, such as the use of monofilament mainlines and the use of hydraulic reels. The expanding fleet also began to target swordfish in addition to tunas. From 1987 to 1990 the fleet expanded from 37 to 138 vessels, leading to the imposition of a moratorium on new participation, which then led to the development of the current limited entry program by the WPFMC. Before the shallow-set segment of the fishery effectively closed in 2001 due to sea turtle impacts, fishermen were free to target tunas and swordfish at any time so that so-called mixed trips comprised an identifiable segment of the fishery. With reopening of the fishery in 2004 mixed trips were prohibited and vessel operators had to declare when they were going on a swordfish (SSLL) or tuna (DSLL) trip. Fishing effort has been limited to 2,120 sets annually by a system of tradable set certificates; every set must be covered by such a certificate. Figure 3-12 shows the annual number of trips annually by type. It can be seen that mixed trips were an important component of the fishery, especially during the 1990s. Tuna trips have always comprised a large proportion of total trips, and since 2001 the vast majority of trips have targeted tuna.

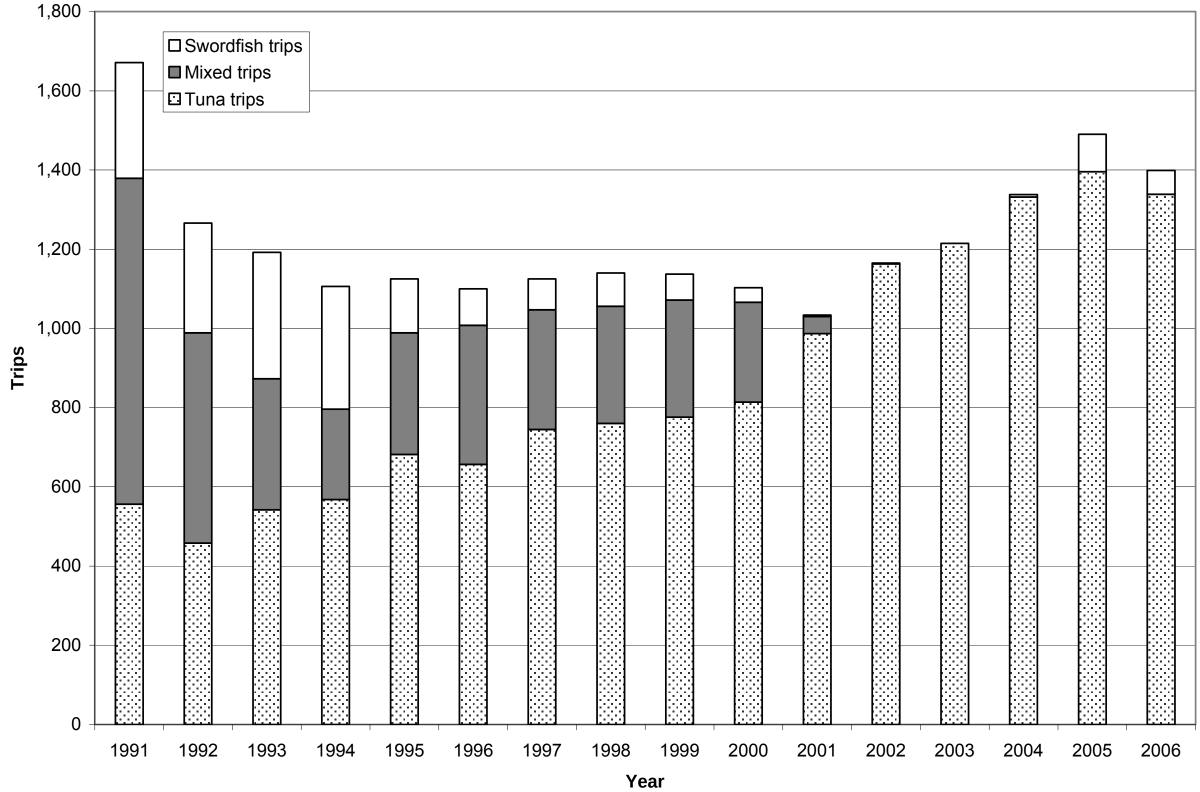

Figure 3-12. Annual number of trips by type in the Hawaii pelagic longline fishery. (Source: WPFMC 2006, p. 178.)

There are 164 permits outstanding in the limited entry program, but actual participation has been around 120 vessels. Of these, about 30 vessels have participated in the Hawaii SSLL fishery since it reopened in 2004. Figure 3-13 shows the trend in swordfish landings in Hawaii; the vast majority of these landings come from the pelagic longline fleet. It can be seen that landings were much higher in the 1990s. The preferred alternative under Pelagics FMP Amendment 18 would lift the current 2,120 set limit on the fishery and allow effort to increase to a level comparable to harvest at MSY levels for the North Pacific swordfish stock; this is estimated at 9,925 sets per year. However, the current 2,120 set limit has not been reached. This may be due in part to the effect of various regulatory constraints (such as sea turtle take caps) on fishermen's behavior.

According to the WPFMC's most recent Annual Report (WPFMC 2006), commercial landings of swordfish in Hawaii generated $8.236 million in exvessel revenue in 2005 and $5.233 million in 2006.

Figure 3-13. Swordfish landings in the Hawaii pelagic longline fishery. (Source:WPFMC 2006, p. 167.)

3.6.1.3 *California DGN fishery*

The following description is excerpted from the 2008 HMS SAFE (PFMC 2008, pp. 11-13).

California's swordfish fishery transformed from primarily a harpoon fishery to a drift gillnet fishery in the early 1980s and landings soared to a historical high of 2,371 mt by 1985. The drift gillnet fishery is a limited entry program, managed with gear, season, and area closures. A limited entry program was established in 1980 and about 150 permits were initially issued. The permit is transferable under very limited conditions and it is linked to an individual fisherman, not a vessel; thus the value of the vessel does not become artificially inflated, allowing permittees to buy new vessels as needed. Since 1984, the number of permits has declined from a high of 251 in 1986 to a low of 86 in 2007; however, only 46 vessels participated in the swordfish fishery in 2007 (Table 3-14). Annual fishing effort has also decreased from a high of 11,243 sets in the 1986 fishing season to 1,043 sets in 2005. Industry representatives attribute the decline in vessel participation and annual effort to regulations implemented to protect threatened and endangered marine mammals, sea turtles, and seabirds. To keep a permit active, current permittees are required to purchase a permit from one consecutive year to the next; however, they are not required to make landings using drift gillnet gear. In addition, a general resident or non-resident commercial fishing license and a current vessel registration are required to catch and land fish caught in drift gillnet gear. A logbook is also required. The HMS FMP requires a Federal permit with a drift gillnet gear endorsement for all U.S. vessels that fish for HMS within the West Coast EEZ and to U.S. vessels that pursue HMS on the high seas (seaward of the EEZ) and land their catch in California, Oregon, and Washington.

Table 3-14. Annual drift gillnet permits issued and number of active vessels, 1981–2007.

Year	Active[1] Vessels	Permits Issued	Year	Active[1] Vessels	Permits Issued
1980	100	*	1994	138	162
1981	118	*	1995	117	185
1982	166	*	1996	111	167
1983	193	*	1997	108	120
1984	214	226	1998	98	148
1985	228	229	1999	84	136
1986	204	251	2000	78	127
1987	185	218	2001	69	114
1988	154	207	2002	50	106
1989	144	189	2003	43	100
1990	134	183	2004	40	96
1991	114	165	2005	42	90
1992	119	149	2006	45	88
1993	123	117	2007	46	86

Source: CDFG License and Revenue Branch (LRB), extracted August 24, 2007.
Additional processing information:
[1]-some vessels only land thresher and/or swordfish from year to year so the highest number of active vessels for both components of the fishery were reported for this gear.
*-actual number of permits issued by LRB not available but the California State Legislature set a cap of 150 in 1982.

Historically, the California drift gillnet fleet has operated within EEZ waters adjacent to the state and as far north as the Columbia River, Oregon, during El Niño years. 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, over 90 percent of the fishing effort occurs August 15 through January 31.

Table 3-15. Annual commercial landings (round mt) and number of deliveries for swordfish landed in California's major port complexes by the drift gillnet fleet, 2006–07.

Port Complex[1]	2006 Landings (mt)[2]	2006 Landings (number)	2007 Landings (mt)[2]	2007 Landings (number)
San Francisco	*	*	0	0
Monterey	*	*	3	7
Morro Bay	5	8	6	19
Santa Barbara	12	75	44	127
Los Angeles	16	34	48	51
San Diego	64	165	65	180
Total	97	282	166	384

Source: California's Commercial Fisheries Information System (CFIS), market receipt data, extracted July 2, 2008, Additional processing information:
[1]- Port Complex: composed of two or more ports within one of the nine geographic statistical reporting areas.
[2]-Landings in pounds are converted to round weight mt by dividing the landed weights by 2000 for ST, and then multiply the conversion factor of 0.9072 for MT. A conversion factor of 1.45 was multiplied by the reported dressed weight to obtain a round weight.
* -Withheld for data confidentiality reasons.

Table 3-16. Monthly commercial landings (round mt) and ex-vessel revenue for swordfish landed in California by the drift gillnet fleet, 2006–07.

	2006		2007	
Month	Landings (mt)[1]	Ex-vessel (dollar)[2]	Landings (mt)[1]	Ex-vessel (dollar)[2]
January	19	32,875	17	36,654
February	3	750	>1	766
March	0	0	>1	674
April	0	0	0	0
May	7	11,155	0	0
June	5	9,601	7	12,418
July	1	2,336	2	3,471
August	2	4,286	6	12,020
September	21	40,899	11	20,661
October	10	18,943	41	75,069
November	14	29,636	50	61,694
December	16	30,703	32	35,353
Total	98	181,184	166	258,780

Source: California's Commercial Fisheries Information System (CFIS), market receipt data, extracted July 2, 2008.
Additional processing information:
[1]-Landings in pounds are converted to round weight mt by dividing the landed weights by 2000 for ST, and then multiplying the conversion factor of 0.9072 for MT. A conversion factor of 1.45 was multiplied by the reported dressed weight to obtain a round weight.
[2]-Ex-vessel revenues are nominal (not adjusted for inflation).
* -Withheld for data confidentiality reasons.

In 2001, NMFS implemented two Pacific sea turtle conservation areas on the West Coast with seasonal drift gillnet restrictions to protect endangered leatherback and loggerhead turtles. The larger of the two closures spans the EPO north of Point Conception, California (34°27' N. latitude) to mid-Oregon (45° N. latitude) and west to 129° W. longitude. Drift gillnet fishing is prohibited annually within this conservation area from August 15 to November 15 to protect leatherbacks sea turtles. A smaller closure was implemented to protect Pacific loggerhead turtles from drift gillnet gear during a forecasted or occurring El Niño event, and is located south of Point Conception, California and west of 120° W. longitude from June 1-August 31 (72 FR 31756). Since 2000, the number of vessels participating in the swordfish fishery has decreased from 69 in 2001 to 38 in 2006.

In 2007, 39 drift gillnet vessels landed 474 mt of swordfish compared to 38 vessels that landed 444 mt in 2006 (Table 3-15). Landings occurred at ports from San Diego to Monterey and the majority occurred from October to December. Over 73 percent of the reported effort occurred in the SCB.

The ex-vessel revenue was nearly $2.4 million in 2007 compared to about $2 million in 2006 (Table 3-16). Most of the swordfish landed in California supports domestic seafood restaurant businesses.

3.6.1.4 *California Harpoon Fishery*

The following description of the harpoon fishery is excerpted from the 2008 HMS SAFE (PFMC 2008, pp. 9-11).

California's harpoon fishery for swordfish developed in the early 1900s. Prior to 1980, harpoon and hook-and-line were the only legal gears for commercially harvesting swordfish. At that time, harpoon gear accounted for the majority of swordfish landings in California ports. In the early 1980s, a limited entry drift gill net fishery was authorized by the State Legislature and soon afterward drift gillnets replaced harpoons as the primary method for catching swordfish, and the number of harpoon permits decreased from a high of 1,223 in 1979 to a low of 23 in 2001. Fishing effort typically occurs in the Southern California Bight (SCB) from May to December, peaking in August, depending on weather conditions and the availability of fish in coastal waters. Some vessel operators work in conjunction with a spotter airplane to increase the search area and to locate swordfish difficult to see from the vessel. This practice tends to increase the catch-per-unit-effort compared to vessels that do not use a spotter plan. To participate in the harpoon fishery a state permit and logbook are required in addition to a general resident or non-resident commercial fishing license and a current CDFG vessel registration. Additionally, the HMS FMP requires a Federal permit with a harpoon gear endorsement for all U.S. vessels that fish for HMS within the West Coast EEZ and to U.S. vessels that pursue HMS on the high seas (seaward of the EEZ) and land their catch in California, Oregon, and Washington.

Table 3-17. Annual commercial landings (round mt) and number of deliveries for swordfish landed in California's major port complexes by the harpoon fleet, 2006–07.

Port Complex[1]	2006 Landings (mt)[2]	2006 Landings (number)	2007 Landings (mt)[2]	2007 Landings (number)
Santa Barbara	*	*	1	13
Los Angeles	38	222	23	208
San Diego	10	89	16	81
Total	48	311	40	302

Source: California's Commercial Fisheries Information System (CFIS), market receipt data, extracted July 2, 2008.
Additional processing information:
[1]- Port Complex: composed of two or more ports within one of the nine geographic statistical reporting areas.
[2]-Landings in pounds are converted to round weight mt by dividing the landed weights by 2000 for ST, and then multiplying the conversion factor of 0.9072 for MT. A conversion factor of 1.45 was multiplied by the reported dressed weight to obtain a round weight.
* -Withheld for data confidentiality reasons.

Table 3-18. Monthly commercial landings (round mt) and ex-vessel revenue (dollars) for swordfish landed in California by the harpoon fleet, 2006–07.

Month	2006 Landings (mt)[1]	2006 Ex-vessel (dollar)[2]	2007 Landings (mt)[1]	2007 Ex-vessel (dollar)[2]
January	*	*	0	0
February	0	0	0	0
March	0	0	0	0
April	0	0	0	0
May	0	0	0	0
June	3	61,289	3	48,212
July	8	135,590	10	155,461
August	6	103,624	20	288,982
September	10	142,071	6	85,261
October	15	170,231	1	16,477
November	6	59,873	*	*
December	*	*	0	0
Total	48	672,678	0	0

Source: California's Commercial Fisheries Information System (CFIS), market receipt data, extracted July 2, 2008.
Additional processing information:

[1]-Landings in pounds are converted to round weight mt by dividing the landed weights by 2000 for ST, and then multiplying the conversion factor of 0.9072 for mt. A conversion factor of 1.45 was multiplied by the reported dressed weight to obtain a round weight.
[2]-Ex-vessel revenues are nominal (not adjusted for inflation).
* -Withheld for data confidentiality reasons.

In 2007, 28 harpoon vessels landed 40 mt of swordfish compared to 23 vessels that landed 49 mt in 2006 (Table 3-17). Fishing effort was concentrated in coastal waters off San Diego and Orange Counties in the SCB, especially from blocks southeast of Santa Catalina and San Clemente Islands. Landings occurred June through November, peaking in August (Table 3-18).

The exvessel revenue for 2007 was $594,393 compared to $679,654 in 2006 (Table 3-18). Because harpoon vessels spend less time on the water and are a low-volume fishery, their catch is often fresher than drift-gillnet-caught fish, so markets tend to pay more for harpooned fish. The average exvessel price-per-pound for harpooned fish was $6.15 compared to $2.89 for drift gillnet caught fish in 2006. Harpooned swordfish support domestic seafood restaurant businesses and is advertised as a bycatch-free fishery, although some mako and thresher shark is taken as well.

3.6.2 West Coast Fishing Communities Affected by the Proposed Action

The SSLL fishery landed fish almost exclusively in Southern California ports. Tables 2-77 through 2-81 in the HMS FMP FEIS list the number of vessels by principal HMS fishery landing in West Coast regions. In the 1994-1999 period between 16 and 27 HMS longline vessels made landings in Southern California each year; in 1998 less than three longline vessels made landings in Central California ports; and no longline vessels are recorded making landings farther north. (The difference in numbers of vessels reported in the HMS SAFE, discussed above, and the HMS FMP FEIS for the period up to 1999 may be an artifact of the methods used to extract the information.) The HMS FMP does not specify which ports are included in the Southern California region, but presumably these are the ports south of Point Conception: Santa Barbara, Ventura, Port Hueneme, San Pedro, Terminal Island, and San Diego.

The Southern California region is characterized by large metropolitan conurbations, around Los Angeles and San Diego, with the densely populated coastal areas of Orange County in between (see Figure 3-14, which shows Southern California counties and U.S. Census Bureau Urbanized Areas). Table 3-19 shows selected demographic characteristics from the U.S. Census Bureau's American Community Survey, which provides annual updates to the decennial census. The five Southern California counties have a combined population of 17 million, 47 percent California's total. The region is ethnically diverse, with non-whites comprising just over half of Los Angeles County's population. Santa Barbara County is the least diverse but still a quarter of the population is non-white. With the exception of Los Angeles, Southern California counties have lower poverty rates, higher employment rates and higher median family income than California or the United States as a whole. With the exception of Ventura County, owner occupied housing is lower than the national average, although higher than that for California as a whole. This probably is a reflection of the urbanized character of the region and comparatively high real estate prices.

Table 3-19. Selected population characteristics of Southern California counties. (Source: U.S. Census Bureau American Community Survey 2007 1-year estimates.)

	Percent white alone		Percent below poverty level		Employment Ratio		Owner occupied housing units		Median Family Income		Total Population
Geography	**Percent**	**Margin of Error**	**Percent**	**Margin of Error**	**Ratio**	**Margin of Error**	**Percent**	**Margin of Error**	**Median**	**Margin of Error**	
Santa Barbara Cty.	74.3	+/-1.7	11.9	+/-1.4	67.3	+/-1.4	53.6	+/-1.6	68,711	+/-2,724	404,197
Ventura Cty.	67.2	+/-1.3	8.5	+/-1.1	70	+/-1.1	67.8	+/-1.3	80,793	+/-2,285	798,364
Los Angeles Cty.	49.9	+/-0.4	14.7	+/-0.3	67.1	+/-0.3	49	+/-0.4	60,264	+/-514	9,878,554
Orange Cty.	61.6	+/-0.7	8.9	+/-0.5	71.2	+/-0.5	62.7	+/-0.6	83,015	+/-1,401	2,997,033
San Diego Cty.	70.1	+/-0.5	11.1	+/-0.5	66.5	+/-0.6	55.9	+/-0.7	71,823	+/-1,214	2,974,859
All California	60.3	+/-0.2	12.4	+/-0.2	67.1	+/-0.2	58	+/-0.2	67,484	+/-375	36,553,215
United States	73.9	+/-0.1	13	+/-0.1	69.1	+/-0.1	67.2	+/-0.1	61,173	+/-101	301,621,159

The margin of error represents the degree of uncertainty for an estimate arising from sampling variability. The margin of error can be interpreted roughly as providing a 90 percent probability that the interval defined by the estimate minus the margin of error and the estimate plus the margin of error (the lower and upper confidence bounds) contains the true value. In addition to sampling variability, the ACS estimates are subject to nonsampling error, which is not represented in the table.

Table 3-20 through Table 3-22 show selected business patterns for the Southern California region. It can be seen that fisheries (included with other industry types under the forestry, fishing and hunting, and agricultural support category) comprise a small portion of overall businesses in the region.

Table 3-20. Number of business establishments by type, Southern California counties. (Source: U.S. Bureau of the Census, 2006 County Business Patterns.)

NAICS code	Industry description	Santa Barbara	Ventura	Los Angeles	Orange	San Diego
0	Total for all sectors	11,432	19,599	249,977	89,587	78,352
11	Forestry, fishing & hunting, & ag support services (113-115)	53	76	118	40	120
21	Mining	44	43	127	55	49
22	Utilities	17	48	243	69	92
23	Construction	1,174	2,094	13,827	7,050	7,209
31-33	Manufacturing	480	937	15,569	5,359	3,183
42	Wholesale trade	461	1,065	23,428	7,626	4,486
44-45	Retail trade	1,599	2,669	30,089	10,056	9,918
48-49	Transportation & warehousing	221	383	6,257	1,318	1,543
51	Information	273	459	9,152	1,599	1,465
52	Finance & insurance	638	1,301	13,442	6,989	5,248
53	Real estate & rental & leasing	685	1,000	13,907	5,492	5,901
54	Professional, scientific, & technical services	1,374	2,538	31,135	13,918	11,933
55	Management of companies & enterprises	57	92	1,255	619	393
56	Administrative & support & waste management & remediation service	632	1,052	10,802	4,602	4,252
61	Educational services	184	246	3,126	1,028	951
62	Health care & social assistance	1,296	2,196	27,211	9,686	7,854
71	Arts, entertainment, & recreation	219	402	10,759	980	1,043
72	Accommodation & food services	1,026	1,467	18,831	6,593	6,322
81	Other services (except public administration)	961	1,453	19,730	6,227	6,094
99	Industries not classified	38	78	969	281	296

Table 3-21. Number of paid employees for pay period including March 12. (Source: U.S. Bureau of the Census, 2006 County Business Patterns.)

NAICS code	Industry description	Santa Barbara	Ventura	Los Angeles	Orange	San Diego
0	Total for all sectors	145,202	273,745	3,895,886	1,478,452	1,205,862
11	Forestry, fishing & hunting, & ag support services (113-115)	e	1,089	785	222	f
21	Mining	1,465	606	2,078	705	514
22	Utilities	348	1,012	14,103	6,516	i
23	Construction	9,745	21,554	162,338	113,078	94,433
31-33	Manufacturing	12,903	38,876	473,532	175,150	104,234
42	Wholesale trade	5,209	17,552	274,941	109,179	63,503
44-45	Retail trade	22,341	40,107	424,457	161,163	156,747
48-49	Transportation & warehousing	2,353	4,534	160,692	29,051	22,858
51	Information	4,701	8,027	218,198	34,348	32,333
52	Finance & insurance	6,017	20,187	207,030	121,994	58,548
53	Real estate & rental & leasing	3,480	4,666	92,764	46,114	35,644
54	Professional, scientific, & technical services	12,121	16,941	354,217	120,518	121,995
55	Management of companies & enterprises	1,823	3,311	83,086	44,939	20,771
56	Administrative & support & waste management & remediation service	11,125	19,382	289,420	133,102	100,557
61	Educational services	3,779	5,258	117,559	26,435	23,107
62	Health care & social assistance	17,785	27,949	439,030	128,122	129,927
71	Arts, entertainment, & recreation	4,249	4,533	75,830	36,902	34,860
72	Accommodation & food services	18,783	27,267	333,797	138,415	143,401
81	Other services (except public administration)	6,544	10,822	170,992	52,222	56,284
99	Industries not classified	b	72	1,037	277	e

Table 3-22. Annual payroll ($1,000). (Source: U.S. Bureau of the Census, 2006 County Business Patterns.)

NAICS code	Industry description	Santa Barbara	Ventura	Los Angeles	Orange	San Diego
0	Total for all sectors	5,662,009	12,339,033	174,873,234	68,418,535	50,977,037
11	Forestry, fishing & hunting, & ag support services (113-115)	D	29,886	19,750	7,119	D
21	Mining	95,784	38,236	140,810	50,815	26,834
22	Utilities	23,035	67,084	1,164,903	529,071	D
23	Construction	423,991	837,500	7,214,846	5,473,493	4,264,156
31-33	Manufacturing	683,229	2,673,152	21,006,299	8,882,143	5,379,550
42	Wholesale trade	271,810	1,245,696	13,448,416	6,983,285	4,785,752
44-45	Retail trade	566,420	1,045,269	11,237,794	4,411,173	4,102,459
48-49	Transportation & warehousing	79,299	170,811	7,112,437	1,188,263	784,148
51	Information	287,210	548,559	15,392,498	2,219,316	2,259,216
52	Finance & insurance	433,468	1,662,658	17,347,808	9,382,095	3,886,575
53	Real estate & rental & leasing	122,889	179,553	4,390,361	2,493,048	1,471,758
54	Professional, scientific, & technical services	747,916	1,109,780	22,448,550	8,371,284	7,840,752
55	Management of companies & enterprises	214,033	210,605	7,716,308	3,661,182	1,494,631
56	Administrative & support & waste management & remediation service	275,690	515,173	7,872,575	3,988,067	3,072,472
61	Educational services	111,026	127,510	3,667,479	675,435	695,311
62	Health care & social assistance	706,059	1,121,030	18,725,206	5,476,044	5,368,711
71	Arts, entertainment, & recreation	128,534	105,365	6,117,173	939,702	982,679
72	Accommodation & food services	305,746	393,027	5,414,189	2,322,126	2,497,257
81	Other services (except public administration)	165,461	256,795	4,403,444	1,355,416	1,462,167
99	Industries not classified	D	1,344	32,388	9,458	D

Symbols:

D Withheld to avoid disclosing data for individual companies; data are included in higher level totals
F Exceeds 100 percent because data include establishments with payroll exceeding revenue
b 20 to 99 employees
e 250 to 499 employees
f 500 to 999 employees
i 5,000 to 9,999 employees

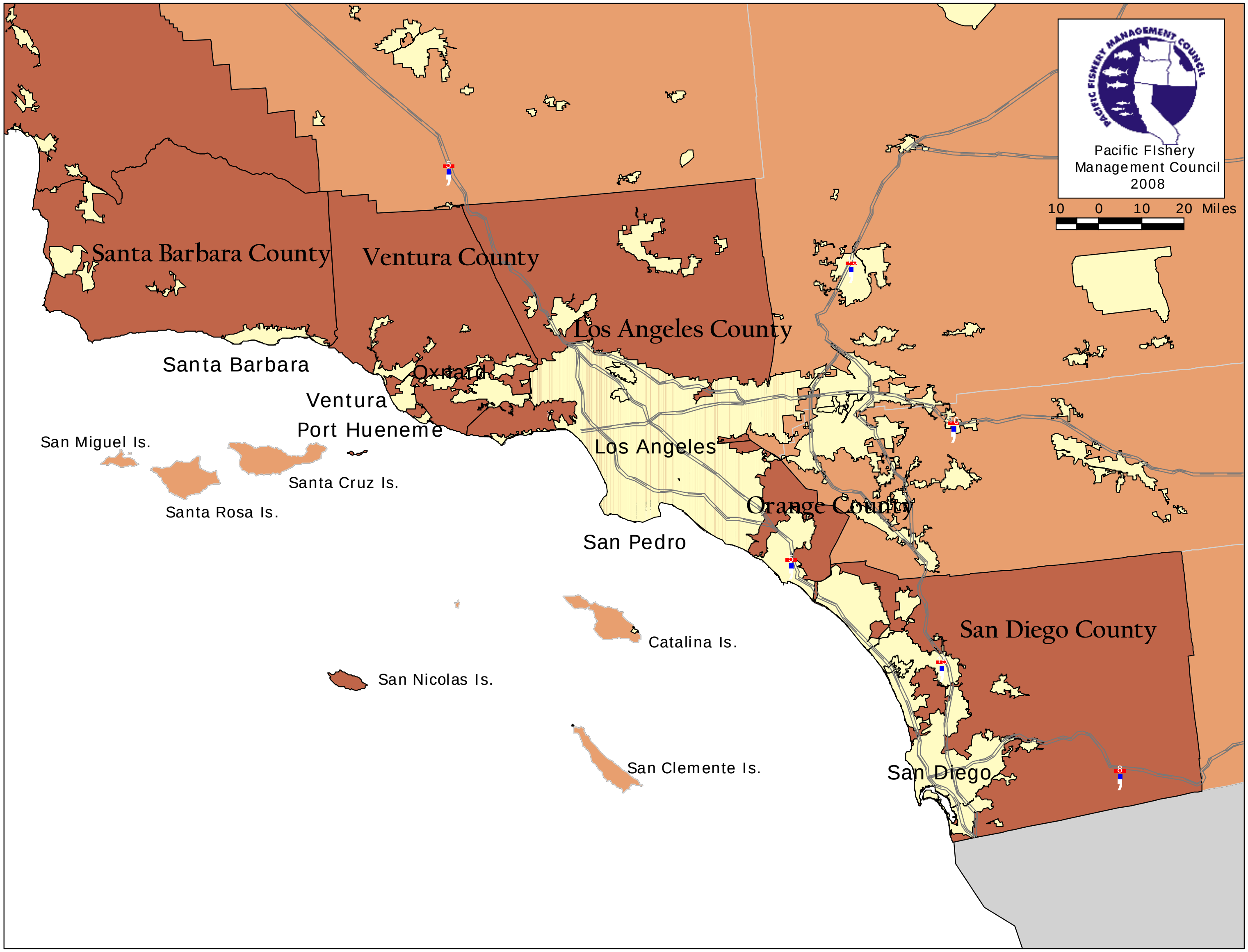

Figure 3-14. Southern California region, showing counties and urbanized areas.

3.6.3 *Actions and Trends Affecting Harvesters and Communities*

The following general economic trends are likely to affect the development of a West Coast SSLL fishery:

- Changes in coastal economies and land use
    - Human population is forcasted to increase in affected fishing communities. Disproportionate population increases would be driven by labor demand and is likely to stimulate infrastructure and private construction but in general growth is more likely in nonfishing economic sectors. In some communities this growth will be due to tourism and recreation-related investment. A British study found fishery-related heritage tourism eclipsing actual fishing in North Sea fishing towns (Brookfield, *et al.* 2005). Another possible growth area is demand for retirement-related infrastructure and services, reflecting an aging population and natural amenities in coastal areas. A report on New England fishing communities found "gentrification" a growing phenomenon (Hall-Arber, *et al.* 2001). According to the report, "[g]entrification … of a fishing community implies a shift in power from the working men and women of the fishing industry to 'those from away,' those in white-collar jobs, or tourist (service) industries, and/or those who do not value the reality of a working waterfront." Growth in these sectors could compete with fishing-related activities for labor and coastal access. In Southern California urban regions (e.g., Terminal Island and San Pedro in Los Angeles County) port infrastructure is well established and much tourism and other amenity-related development has already occurred. This may means that fishing-dependent port infrastructure may be less affected in the future, but pressure to use waterfront areas for higher-value uses could continue in some areas like San Diego.

- Increased demand for protein affecting real prices
    - Global population growth and rising living standards are likely to increase demand for protein sources, including fish. U.S. consumption has shown a modest increase in recent years; per capita consumption of seafood and shellfood increased from 15.6 lb in 2002 to 16.3 lb in 2007.[22] This is likely to lead to an increase in real prices for wild-caught fish. Price increases may be mitigated by lower cost production methods in aquaculture and agriculture. Any such effect on prices will depend on demand elasticity for wild-caught fish (consumer willingness to substitute, degree of product differentiation in the market). Swordfish is less substitutable than other product forms, such as generic "whitefish." In the short term the current global economic downturn is likely to affect demand.

- Changes in relative production costs
    - The real cost of agricultural production is likely to increase because of limits on arable land and inputs (e.g., petroleum-based fertilizer, animal feed); although over the long term this could be mitigated by technological change. Improvements in aquaculture technology, including cost-lowering techniques and an increase in the range of cultured species, could lower real prices for cultured fish. Costs of fishery production are likely to be affected principally by the cost of petroleum-based fuel, since fish harvesting is highly energy intensive. The cost of other inputs (labor, new vessels) is likely to increase, but not disproportionately in comparison to other modes of production. In combination with changes in demand, described above, these factors are likely to affect real prices for wild-caught fish. Overall, real prices are expected to increase.

[22] http://www.st.nmfs.gov/st1/index.html

- Increased consumer awareness affecting purchasing decisions
  - Consumers have been increasingly willing to pay a premium for products and services that can be produced with demonstrably lower environmental impacts (through effective management and monitoring, for example). In fisheries this is evidenced by various consumer awareness and certification programs (Duchene 2004). For example, the Monterey Bay Aquarium sponsors the Seafood Watch seafood guide (http://www.mbayaq.org/cr/SeafoodWatch.asp). The guide has three ratings (best choice, good alternatives, and avoid) and rates fish products by species and fishery. (Seafood Watch currently rates swordfish caught by the Hawaii longline fleet as a good alternative with U.S. or Canadian harpoon or handline caught swordfish best choices.) The Marine Stewardship Council [MSC] (http://www.msc.org/) is a London-based nonprofit that certifies fisheries it determines are environmentally sustainable and well managed. In order to qualify, the fishery is subjected to an extensive review process and products must meet chain of custody requirements. Once certified, products may be labeled with the MSC "eco-label." This allows consumer product discrimination. More and more fisheries have been willing to submit to MSC certification because increasingly consumers are willing to pay a premium for labeled products. This trend could reduce demand (prices) for fish caught by SSLL gear, if consumers perceive it as having substantial adverse effects. The effect depends on the level of consumer discrimination, both between SSLL and other gear types and between SSLL fisheries using gear and methods that reduce impacts from those that don't. Investment in new technology that mitigates adverse impacts, such the sea turtle mitigation measures proposed under the action alternatives, if understood by consumers, could mitigate consumer aversion to swordfish caught with SSLL gear.

CHAPTER 4 ENVIRONMENTAL CONSEQUENCES

4.1 Estimating Total Fishing Effort under the Action Alternatives

The principal quantitative method for estimating impacts uses observer and other data from the West Coast SSLL fishery to estimate the total fishing effort that may be expended in fisheries of different sizes based on the number of permits issued under Alternative 2 (up to 20) or in the unconstrained fishery proposed under Alternatives 3 and 4. The basic formula for computing aggregate effort (E) is as follows:

V x T x S x H = E

Where:

V is the number of vessels participating in the fishery. For Alternative 2 this is equal to the number of permits that would be issued. Since the number of potential qualifiers for a permit under Alternative 3 is large (98) it is assumed to be effectively equivalent to Alternative 4, open access. However, it is further assumed that economic and operational constraints would ultimately limit the number of vessels participating under these alternatives. Data from the HMS FMP EIS (PFMC 2003) on the number of vessels making landings with longline gear 1996-2000 is used as a proxy for an equilibrium level of participation.

T is the average number of trips per year made by an individual vessel. Port monitoring data compiled by NMFS for the periods September 8, 2002-May 17, 2003, and July 27 2003-April 3, 2004, were used to estimate T (see discussion in Section 2.2.2). During these periods NMFS personnel monitored Southern California ports, keeping track of which vessels were in port, when they left port, and when they returned. This information can be used to estimate the number of trips made during a typical fishing year by each vessel.

S is the average number of sets made per trip per vessel, calculated from 2001-2004 West Coast observer data, which is 20.39.

H is the average number of hooks per set, calculated from 2001-2004 West Coast observer data, which is 748.75.

Table 4-1 shows information derived from the NMFS port monitoring program. The number of trips a SSLL vessel might make in a year (or fishing season) was computed in two ways. First, the number of trips was tallied for each vessel by counting each departure and return to port.[23] Second, the duration of each trip and the time period between each trip was computed and averaged. These two values were than added together and divided by the total number of days in the time period to compute the potential number of trips a vessel could make in a season. Although imperfect, this appears to be the best available data to estimate the number of trips a typical SSLL vessel might make in a year, based on observed operational characteristics of the fleet during the 2002-2004 time period.

Table 4-1. Summary of information derived from port monitoring data.

	Sept. 8, 2002-May 17, 2003	July 27, 2003-April 3, 2004
Number of vessels showing departures/arrivals	19	20
Average number of trips per vessel	4.2	3.8
Potential number of trips per vessel	5.2	5.2
Range of trips made by all vessels	2–5	2–5

Based on this information, it is assumed that a typical SSLL vessel will make four trips per fishing year (April 1-March 31). However, it is recognized that the more participation is restricted the more likely those exercising the permits will be more active, "highliner" (top producing) fishermen, who on average would make more trips. Therefore, this value is scaled according to the number of permits that would be issued. The scaling factor is based on information developed for limited entry Option 3, which has a 1996-2004 SSLL landings component in the formula. It is assumed that landings are a proxy for trips. (It should be noted that the average number of landings from the LE option are substantially higher than the average number of trips computed from the port monitoring data, varying from an average of 8 landings per vessel per year for the top 20 ranked vessels to 13 landings per vessel per year for the top 5 ranked vessels. There may be a variety of factors that account for these larger numbers, such as trips where swordfish were not the target but caught incidentally or "split loads" where two or more landings at different ports/processors resulted from one trip.) Therefore, the average number of landings made by the top 20, 15, 10, and 5 vessels was computed from the Option 3 data and then converted to a ratio based on the average number of landings made by the top 20. The average of four trips per year was then multiplied by these ratios for scaling purposes. These fractional values are then rounded up to the next whole number. Table 4-2 reports the results of this computation.

Table 4-2. Scaling factors used to compute the number of trips per year made for different numbers of vessels.

No. of Vessels	Scale Factor	Resulting trips/vessel/per year	Rounded Up Value Used in Effort Estimate
5	1.6	6.4	7
10	1.3	5.2	6
15	1.1	4.4	5
20	1	4	4
30	1	4	4

[23] At the end of the second period some vessels showed port departures but no returns to port. It is assumed that these are Hawaii permitted vessels that originated a trip on the West Coast but then returned to Hawaii because of the regulatory changes opening the Hawaii SSLL fishery and closing the West Coast fishery. These departures were counted as a trip since it is assumed that without the regulatory changes these vessels would have completed a trip on the West Coast.

As noted above, Alternatives 3 and 4 propose essentially unconstrained fisheries, but it is assumed that other operational and economic constraints would come into play to limit the number of participants. To estimate the number of vessels in the fishery for these alternatives, data from 1994-2000, reported in the HMS FMP, were used to make an estimate. During this time period there were no limits on participation in the SSLL fishery. Also, in 2000-2004, because of the closure of the Hawaii fishery, the number of SSLL vessels fishing on the West Coast was probably greater than would be the case now since the Hawaii fishery is again open and those vessels can fish out of Hawaii.[24] The average number of vessels using pelagic longline gear and landing swordfish on the West Coast, 1994-2000, was 28 (see Table 2-65 in PFMC 2003). For the purposes of this analysis this was rounded up to an estimate of 30 vessels fishing with SSLL gear per year under Alternatives 3 and 4. It is assumed that this number of vessels would on average make four tips per year. The resulting annual aggregate effort estimates, using the formula and average set/trip and hook/set values outlined above, are shown in Table 4-3.

Table 4-3. Annual effort estimates for different sized fisheries.

Vessels	Trips/vessel	Effort (hooks)
5	7	534,377
10	6	916,075
15	5	1,145,094
20	4	1,221,434
30	4	1,832,151

The 2001-2004 West Coast observer data is also used to stratify effort data by quarter and area, the areas being east of 140° W. longitude, between 140° and 150° W. longitude, and west of 150° W. longitude. This stratification can be used to evaluate the westward area closure options and take into account seasonal variation in finfish CPUE and sea turtle take rates. It is assumed that constraining the westward boundary of the fishery will not affect the total amount of effort expended; that is, any such restriction would not change behavior in the fishery by, for example, discouraging participation. This assumption may over-estimate the amount of effort that would be expended under these options. To compute the proportion of effort in each stratum the number of observed hooks deployed in that stratum is divided by the total number of hooks deployed in all strata for the particular area restriction option. For example, for a fishery restricted east of 150° W. longitude the number of hooks deployed in quarter 1 east of 140° (704) is divided by the total number of hooks deployed in all quarters east of 150° W. longitude (256,083) to arrive at a proportion of 0.3 percent for the quarter 1 / east of 150° W. stratum. These computations are shown in Table 4-4. Subsequent tables show the resulting effort estimates for fisheries of different sizes with no westward area closure (Table 4-5), closed west of 150° W. longitude (Table 4-6), and closed west of 140° longitude (Table 4-7).

Although these effort estimates are presented as point estimates, the level of unquantified uncertainty around them should be emphasized. Various assumptions have been made, as discussed above, in developing each of the terms in the formula used to arrive at the final estimates. Therefore, in the impact analyses that follow it should be kept in mind that the estimates of catch or protected species take are only a general indication of the possible impacts from a fishery composed of a given number of vessels.

24 These vessels can land swordfish on the west coat under current regulations but would not necessarily qualify to participate in the proposed fishery evaluated in this EIS.

Table 4-4. Stratification of annual fishing effort by quarter and area.

# of Hooks	Quarter				
Area	1	2	3	4	Grand Total
<140	704	3,138	47,884	81,587	133,313
>=140 and <150	50,870	17,255	-	54,645	122,770
>=150	58,630	33,798	-	2,644	95,072
Grand Total	110,204	54,191	47,884	138,876	351,155
Effort distribution - all areas					
<140	0.2%	0.9%	13.6%	23.2%	38.0%
>=140 and <150	14.5%	4.9%	0.0%	15.6%	35.0%
>=150	16.7%	9.6%	0.0%	0.8%	27.1%
Total All Areas	31.4%	15.4%	13.6%	39.5%	100.0%
Seasonal distribution - E of 150					
<140	0.3%	1.2%	18.7%	31.9%	52.1%
>=140 and <150	19.9%	6.7%	0.0%	21.3%	47.9%
Total E of 150	20.1%	8.0%	18.7%	53.2%	100.0%
Effort distribution - E of 140					
Total <140	0.5%	2.4%	35.9%	61.2%	100.0%

Notes:
2001-2004 observer data
<140: east of 140° W. longitude
>=140 and <150: west of 140° W. longitude and east of 150° W. longitude
>150: west of 150° W. longitude

Table 4-5. Effort estimates for a fishery with no westward area closure.

	Quarter				
Area	1	2	3	4	Grand Total
Effort distribution					
<140	0.2%	0.9%	13.6%	23.2%	38.0%
>=140 and <150	14.5%	4.9%	0.0%	15.6%	35.0%
>=150	16.7%	9.6%	0.0%	0.8%	27.1%
Total All Areas	31.4%	15.4%	13.6%	39.5%	100.0%
Effort (# of hooks)					
5 vessels					
<140	1,071	4,775	72,868	124,157	202,872
>=140 and <150	77,412	26,258	-	83,157	186,828
>=150	89,221	51,433	-	4,024	144,678
Total All Areas	167,705	82,466	72,868	211,337	534,377
10 vessels					
<140	1,837	8,186	124,917	212,840	347,780
>=140 and <150	132,707	45,014	-	142,555	320,276
>=150	152,951	88,171	-	6,898	248,019
Total All Areas	287,495	141,371	124,917	362,293	916,075
15 vessels					
<140	2,296	10,233	156,147	266,050	434,725
>=140 and <150	165,884	56,267	-	178,194	400,345
>=150	191,189	110,213	-	8,622	310,024
Total All Areas	359,368	176,713	156,147	452,866	1,145,094
20 vessels					
<140	2,449	10,915	166,556	283,787	463,707
>=140 and <150	176,943	60,019	-	190,073	427,035
>=150	203,935	117,561	-	9,197	330,692
Total All Areas	383,326	188,494	166,556	483,057	1,221,434
30 vessels					
<140	3,673	16,373	249,835	425,680	695,560
>=140 and <150	265,414	90,028	-	285,110	640,552
>=150	305,902	176,341	-	13,795	496,038
Total All Areas	574,989	282,741	249,835	724,585	1,832,151

Table 4-6. Effort estimates for a fishery east of 150° W. longitude.

	1	2	3	4	Grand Total
Effort distribution					
<140	0.3%	1.2%	18.7%	31.9%	52.1%
>=140 and <150	19.9%	6.7%	0.0%	21.3%	47.9%
Total E of 150	20.1%	8.0%	18.7%	53.2%	100.0%
Effort (# of hooks)					
5 vessels					
<140	1,469	6,548	99,921	170,250	278,189
>=140 and <150	106,152	36,007	-	114,030	256,188
Total E of 150	107,621	42,555	99,921	284,280	534,377
10 vessels					
<140	2,518	11,225	171,294	291,858	476,895
>=140 and <150	181,975	61,726	-	195,479	439,180
Total E of 150	184,494	72,951	171,294	487,337	916,075
15 vessels					
<140	3,148	14,032	214,117	364,822	596,119
>=140 and <150	227,469	77,157	-	244,349	548,975
Total E of 150	230,617	91,189	214,117	609,172	1,145,094
20 vessels					
<140	3,358	14,967	228,391	389,144	635,860
>=140 and <150	242,634	82,301	-	260,639	585,574
Total E of 150	245,991	97,268	228,391	649,783	1,221,434
30 vessels					
<140	5,037	22,451	342,587	583,716	953,790
>=140 and <150	363,950	123,451	-	390,959	878,360
Total E of 150	368,987	145,902	342,587	974,675	1,832,151

Table 4-7. Effort estimates for a fishery east of 140° W. longitude.

	Quarter				
	1	2	3	4	Grand Total
Effort distribution					
	0.5%	2.4%	35.9%	61.2%	100.0%
Effort (# of hooks)					
5 vessels	2,822	12,578	191,940	327,037	534,377
10 vessels	4,838	21,563	329,040	560,634	916,075
15 vessels	6,047	26,954	411,300	700,793	1,145,094
20 vessels	6,450	28,751	438,720	747,512	1,221,434
30 vessels	9,675	43,126	658,081	1,121,269	1,832,151

4.2 Finfish

4.2.1 Evaluation Criteria

The EA for the Council-proposed EFP to allow a single vessel to fish with SSLL gear inside the West Coast EEZ (NMFS and PFMC 2007) established four criteria evaluating the direct and indirect impacts of that activity on finfish. These criteria are also used in this SEIS since the proposed action, although on a potentially larger scale and in an adjacent are of the ocean, is likely to result in categorically equivalent impacts. These criteria are:

- 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 the stock conservation objectives described in 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 on target and nontarget finfish are measured quantitatively and qualitatively. For target and major nontarget species the estimated aggregate effort amounts (discussed in Section 4.1) are applied to CPUE estimates derived from observer data from the Hawaii-based SSLL fishery during the 2004-2007 period when circle hooks and mackerel-type bait was in use.

4.2.2 Direct and indirect impacts

4.2.2.1 *Catch Estimates*

Several different sources of reported swordfish catches from the Hawaii SSLL fishery have been used to calculate catch estimates for the action alternatives. First, the swordfish CPUE value reported in Table 3-3, for observed Hawaii SSLL sets after 2004 using circle hooks, was applied to the effort aggregate effort estimate for different numbers of vessels. Second, Hawaii observer data on 4,109 sets made between June 23, 2004, and December 4, 2007, were stratified by quarter and between sets made east and west of 150° W. longitude. The area stratification was applied because of evidence of generally increasing CPUE for sets from east to west. These estimates are then applied to the three area stratifications (east of 140° W., east of 150° W., and all areas) and four quarters as reported in Table 4-5 through Table 4-7. Finally, CPUE estimates reported in the Amendment 18 EIS (see Table 36 in WPFMC 2008) were used. These effort estimates are reported by quarter and in number of fish per set. Although these CPUE estimates are not stratified by area, since the seasonal variation in effort varies among the different area-based catch estimates, the resulting catches are reported by area. For both of these second two estimates per-set CPUEs were converted to a per-hook CPUEs by dividing by 852.16, which is the average hooks/per set derived from Observer Reports posted on the NMFS PIRO website (NMFS PIRO 2008) for 2004-2008. The estimates were then converted from numbers of fish to weight using average weights reported by species in the Amendment 18 EIS (see Table 37 in WPFMC 2008). The results are shown in Table 4-8.

A similar method was used to estimate major nontarget finfish bycatch using quarterly CPUE values reported in Table 36 of the Amendment 18 EIS. As discussed in the previous paragraph, these are reported on a per-set basis by quarter. The same approach was used to estimate catches for different numbers of vessels. The results are reported in Table 4-9. For some species no average weight is reported in the Amendment 18 EIS. In those cases only estimates in numbers of fish caught are reported.

Table 4-8. Estimated swordfish catch (mt) based on CPUE estimates reported in Table 3-3 for circle hook sets, time-area stratified Hawaii observer data, and quarterly CPUE estimates from Amendment 18 EIS.

	CPUE reported in Table 3-3	E of 140° W		E of 150° W		All areas	
		Time & area stratification	Amendment 18 CPUE	Time & area stratification	Amendment 18 CPUE	Time & area stratification	Amendment 18 CPUE
5 vessels	690	468	451	507	514	556	553
10 vessels	1,183	803	773	869	882	953	949
15 vessels	1,479	1,003	966	1,086	1,102	1,192	1,186
20 vessels	1,578	1,070	1,030	1,086	1,102	1,271	1,265
30 vessels	2,367	1,605	1,546	1,737	1,763	1,907	1,898

Table 4-9. Finfish non-target species catch estimates in number of fish and metric tons.

No. fish	5 vessels			10 vessels			15 vessels			20 vessels			30 vessels		
	E140	E150	All	E140	E150	All	E140	E150	All	E140	E150	All	E140	E150	All
Striped marlin	231	212	254	396	364	435	495	455	544	528	485	580	792	728	870
Blue marlin	172	50	61	101	86	105	126	107	131	135	114	140	202	171	209
Bigeye tuna	391	571	639	838	979	1,096	1,047	1,224	1,370	1,117	1,306	1,461	1,676	1,958	2,191
Albacore tuna	1,101	966	842	1,615	1,655	1,443	2,019	2,069	1,804	2,154	2,207	1,924	3,231	3,311	2,886
Yellowfin tuna	169	35	48	38	60	82	48	75	102	51	80	109	77	120	163
Blue shark	4,681	6,966	6,960	11,306	11,942	11,932	14,132	14,928	14,915	15,074	15,923	15,910	22,611	23,885	23,865
Mahimahi	367	1,237	1,318	2,876	2,121	2,260	3,595	2,651	2,825	3,835	2,828	3,013	5,753	4,242	4,520
Opah	258	94	76	174	161	131	218	201	164	232	215	175	348	322	262
Ono	164	19	26	31	32	44	38	40	55	41	43	59	61	65	88
Pomfret	224	79	78	116	135	134	145	169	168	155	180	179	232	270	269
Mako shark	700	627	575	1,068	1,075	985	1,335	1,344	1,232	1,424	1,434	1,314	2,136	2,150	1,971
Oceanic whitetip shark	166	39	45	90	67	77	113	84	96	121	89	103	181	134	154
Oilfishes	448	850	867	1,814	1,457	1,487	2,267	1,821	1,858	2,419	1,943	1,982	3,628	2,914	2,974
Other pelagics	641	432	338	831	741	579	1,038	926	723	1,108	988	771	1,661	1,482	1,157
Other sharks	193	36	34	59	61	58	73	76	73	78	82	78	118	122	117
Other tuna	240	109	81	262	186	139	328	233	174	350	248	186	525	372	279
Shortbilled spearfish	169	24	33	30	41	57	38	51	71	41	54	76	61	81	114
Skipjack tuna	167	13	16	13	22	28	16	27	34	17	29	37	26	43	55
Thresher sharks	171	27	25	61	46	44	76	57	54	81	61	58	121	91	87

Metric Tons	5 vessels			10 vessels			15 vessels			20 vessels			30 vessels		
	E140	E150	All	E140	E150	All	E140	E150	All	E140	E150	All	E140	E150	All
Striped marlin	7.12	6.55	7.83	12.21	11.22	13.42	15.26	14.03	16.77	16.28	14.96	17.89	24.42	22.45	26.83
Blue marlin	12.70	3.69	4.51	7.46	6.33	7.74	9.33	7.91	9.67	9.95	8.44	10.32	14.92	12.66	15.47
Bigeye tuna	15.44	22.54	25.22	33.06	38.64	43.24	41.33	48.30	54.05	44.08	51.52	57.65	66.12	77.28	86.47
Albacore tuna	25.48	22.34	19.47	37.37	38.30	33.38	46.71	47.87	41.73	49.83	51.06	44.51	74.74	76.59	66.77
Yellowfin tuna	4.89	1.02	1.38	1.11	1.74	2.37	1.39	2.18	2.96	1.48	2.32	3.16	2.23	3.49	4.74
Blue shark	212.34	315.99	315.72	512.81	541.70	541.24	641.02	677.12	676.55	683.75	722.26	721.65	1,025.63	1,083.39	1,082.48
Mahimahi	2.33	7.86	8.37	18.27	13.47	14.35	22.83	16.83	17.94	24.35	17.96	19.14	36.53	26.94	28.70
Opah	9.72	3.54	2.88	6.56	6.07	4.93	8.20	7.58	6.16	8.75	8.09	6.57	13.12	12.14	9.86
Ono	2.23	0.26	0.35	0.42	0.44	0.60	0.52	0.55	0.75	0.55	0.59	0.80	0.83	0.88	1.20
Pomfret	1.32	0.46	0.46	0.68	0.80	0.79	0.86	1.00	0.99	0.91	1.06	1.06	1.37	1.59	1.58
Mako shark	56.19	50.36	46.15	85.73	86.32	79.12	107.16	107.91	98.90	114.30	115.10	105.49	171.45	172.65	158.24
Oceanic whitetip shark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oilfishes	3.45	6.55	6.69	13.99	11.24	11.46	17.48	14.04	14.33	18.65	14.98	15.29	27.97	22.47	22.93
Other pelagics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other sharks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other tuna	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shortbilled spearfish	2.38	0.33	0.47	0.43	0.57	0.80	0.54	0.71	1.00	0.57	0.76	1.07	0.86	1.14	1.60
Skipjack tuna	1.21	0.09	0.12	0.09	0.16	0.20	0.12	0.20	0.25	0.13	0.21	0.27	0.19	0.31	0.40
Thresher sharks	15.38	2.40	2.28	5.44	4.11	3.91	6.80	5.13	4.88	7.25	5.48	5.21	10.87	8.21	7.82

No weight estimate provided where no average weight given in Table 37 in Amendment 18 EIS.

4.2.2.2 *Impacts of Alternative 1 (No Action)*

Under the No Action alternative a West Coast SSLL fishery would not be authorized; thus, effects on finfish would be confined to the continuing effects of other fisheries, as described in Section 3.2. As noted, the North Pacific swordfish stock appears stable in response to current levels of fishing mortality. Two nontarget tuna stocks may be subject to overfishing, specifically, bigeye and yellowfin tuna. There is also concern about the status of the North Pacific albacore tuna and striped marlin stocks. Meso-scale and large-scale climate effects, including ENSO, PDO, and global climate change may affect the distribution and productivity of fish stocks over both short and long term scales.

4.2.2.3 *Impacts of Alternative 2 (Limited Entry Program)*

Number of Permits

The number of permits determines how many vessels will participate in the fishery and the expected level of effort. The CPUE value reported in Table 3-3 is substantially higher than the either the CPUE values reported in the Amendment 18 EIS or derived from stratifying the 2001-2004 West Coast observer data, resulting in larger catch estimates. The range of values for swordfish catch in the largest fishery contemplated under this alternative (20 permits/vessels) range from a low of slightly over 1,000 mt to a high of almost 1,600 mt, depending on the CPUE estimate used and whether the fishery is subject to a westward area closure. This is reasonably consistent with the reported swordfish landings from the West Coast pelagic longline fishery from 1996 to 2003, which ranges from 346 to 1,873 mt (See Table 4-13 in PFMC 2008). For a fishery limited to five vessels, estimates of swordfish catch range from 451 to 690 mt.

Similarly, estimates of nontarget tuna catches for a 20-vessel fishery are similar to reported landings for the pre-2004 West Coast pelagic longline fishery. Catches in a 20-vessel fishery are discussed here because that represents the maximum impact of this alternative. Specifying a limited entry program with fewer permits would lessen the impact accordingly. Bigeye tuna landings were 10-103 mt, 1996-2003, while the highest estimated catch for a 20-vessel fishery is 58 mt. Albacore catches were 1-66 mt during that period in the pre-2004 fishery while the maximum 20-vessel catch estimate is 51 mt. Yellowfin catches are generally quite small; in the pre-2004 fishery yellowfin tuna landings were <0.5-4 mt, while the highest estimated catch is 3 mt for a 20-vessel fishery. Skipjack tuna are caught in fairly small numbers with catches for a 20-vessel fishery estimated at a maximum of about 0.3 mt; pelagic longline landings are not separately reported for this species in the HMS SAFE but landings of “other tuna” ranged from <0.5 to 11 mt, 1996-2003.

Blue sharks are the single largest component of bycatch. In a 20-vessel fishery it is estimated that more than 700 mt would be caught annually. (Since this species is not landed, there is no comparable data in the HMS SAFE for the pre-2004 fishery.) However, a large proportion of them will likely survive capture and subsequent release. According to Table 3-4, 6 percent of blue sharks are discarded dead; even allowing for additional post-release mortality the survival rate is likely high. The other shark species caught in substantial numbers is the mako shark, the estimates for a 20-vessel fishery show a maximum of 106 mt. Much smaller numbers were landed in the pre-2004 fishery, 3-5 mt, 1996-2003. According to Table 3-4, the retention rate in the Hawaii SSLL fishery is only 10.8 percent, so a 106 mt catch estimate is reasonably consistent with the range of historical landings. Comon thresher sharks are estimated to be caught in relatively small amounts and are rarely retained in the Hawaii fishery (see Table 3-4). This lack of retention may account for the negligible reported landings in the HMS SAFE.

Striped marlin is the billfish of most concern, both because of the depleted status of the stock and the prohibition on commercial landings in the HMS FMP. For a 20-vessel fishery the maximum catch estimate is 18 mt. According to Table 3-4, the observed discard mortality rate for this species in the Hawaii fishery is 23 percent. Assuming additional post-release mortality, fishing mortality from 18 mt of catch might be in the range of 5-9 mt.

Most other species are caught in relatively small numbers and relative frequency in the catch is probably strongly influenced by fishing area and season. So while Hawaii CPUEs are used in catch estimates, a West Coast fishery deploying a greater proportion of effort farther east may have somewhat different species composition and catch rates than those in the Hawaii fishery. (Comparison of catches in the pre-2004 Hawaii and West Coast fisheries, shown in Table 3-2, suggest these differences.) On the other hand, the use of circle hooks may reduce the CPUE for many of these species, as indicated in Table 3-3, so that a West Coast SSLL fishery with the proposed gear requirements may have lower impacts on many of these species than the pre-2004 fishery did (refer to species discussions in Section 3.2.2).

Area Closure Options

Table 4-8 suggests that constraining the fishery farther east would result in lower swordfish catches for a given number of vessels. However, it should be noted that the catch estimates reflect the interaction between both seasonal and geographic differences in effort and in CPUE. Generally, observer data from the pre-2004 West Coast fishery show more effort was deployed farther east later in the year. For example, the effort distribution for a fishery constrained east of 140° W. longitude shows 61 percent of effort in the fourth quarter, 53 percent for the 150° W. closure, and only 40 percent for the unconstrained fishery. Although the pre-2004 fishery was not constrained by this type of closure, this distribution is related to the availability of target species. So in a constrained fishery one might expect a reasonably similar seasonal pattern in the distribution of effort. The seasonal distribution of effort also interacts with seasonal variability in CPUE when computing catch estimates. While these interactions are reasonable for the target species (fishermen will concentrate effort when and where the swordfish occur) they may skew catch estimates for nontarget species that have different patterns of geographic abundance. For example, looking at the catch estimates for albacore, catches are higher for a fishery constrained east of 150° W. than for an unconstrained fishery. But this is a function of a higher CPUE in the fourth quarter when a higher proportion of effort is projected for the area east of 150° and not necessarily a reflection of the geographic distribution of this species. For this reason any interpretation of the effect of the area closure options on nontarget species catch should be made with caution.

Effects of Other Features of the Alternative

The key conservation features of the alternatives—gear requirements, mandatory observer coverage, and sea turtle take caps—are likely to reduce the amount of fishing effort deployed, and thus catch, for a given number of vessels permitted in the fishery. As discussed previously, the gear requirements (use of circle hooks and mackerel bait) have a negligible to modest downward effect on swordfish CPUE. The effect on nontarget species CPUEs is variable. As discussed in Section 2.2.5, current SWR Observer Program funding would only be sufficient to cover a small proportion of the effort projected for even a fishery of five vessels. NMFS could get additional funding to increase the size of the Observer Program, but that decision is outside the scope of this analysis. Alternatively, the Council could recommend an industry-funded observer program. This could allow greater levels of fishing effort but the cost to revenue ratio would likely limit effort in comparison to the unconstrained effort estimates used here. Likewise, sea turtle take caps increase the likelihood that the fishery will close before the end of the fishing year, because a take cap is reached, limiting the amount of fishing effort. These effects are evaluated in more detail in Section 4.6.

The different options for permit qualification and the restriction on permit transfer will have no or negligible impacts on overall catch within the proposed SSLL fishery, because they only specify who will receive a permit and how they might be transferred. A possible effect could be whether a qualification option favors individuals who have experience in this type of fishery or not. If those with relatively less experience receive permits, their catch rates may be lower, at least in the short term while they gain experience. The restriction on the simultaneous use of a Hawaii limited entry permit could also reduce the actual amount of fishing effort deployed for a given number of permits. For example, a fisherman receiving a West Coast permit and already possessing a Hawaii permit may, for whatever reason, deploy most fishing effort under the Hawaii permit, lessening the actual amount of effort deployed by a vessel registered to the West Coast permit. If an industry funded observer program were established, those holding both a West Coast and Hawaii limited entry permit would likely prefer to fish under the Hawaii permit since observer costs are fully funded for those permit holders. As shown in Table 2-11, permit qualification under Alternative 2, Option 3 would likely result in the most fishermen with Hawaii permit qualifying (in the analysis, 15 out of the top 20)

4.2.2.4 *Impacts of Alternative 3 (Large Limited Entry Program) and Alternative 4 (Open Access)*

As discussed in Chapter 2, it is estimated that as many as 98 individuals would qualify for permits under Alternative 3 while there is no permit requirement under Alternative 4. For the purpose of analysis it is assumed the economic constraints would limit the fishery to 30 vessels. Both alternatives would constrain the fishery to east of 140° W. longitude and include the sea turtle conservation measures required under Alternative 2.

Using the swordfish CPUE reported in Table 3-3 (which is not stratified by time and area) results in a swordfish catch estimate of 2,367 mt. Referring to Table 4-8, swordfish catch for a fishery east of 140° W. longitude is estimated at about 1,600 mt. The effect of constraining the fishery on nontarget tuna catches is variable; albacore catches would be relatively high because of the higher fourth quarter CPUE. Referring to Table 4-9, aside from the overall effect on catch of an increased number of vessels, the effect of constraining fishing east of 140° W. longitude is not discernable.

The mandatory observer coverage requirement and sea turtle caps would have the same effect of reducing actual fishing effort as discussed for Alternative 2. As a result, the actual number of vessels permitted to fish under either of these alternatives may not exceed the number that would be authorized under a limited entry program.

4.2.3 Finfish Cumulative Effects

Section 3.2.4 identifies the range of other domestic and foreign fisheries catching swordfish. In 2007 the Hawaii fisheries landed 3,796 mt of swordfish while West Coast fisheries landed 549 mt (see Figure 3-3). Provisional figures for 2005 for foreign catches of North Pacific swordfish, shown in Table 3-6, total 9,980 mt. As discussed above, it is estimated that a limited entry fishery, depending on the number of permits, would catch as much as 1,600 mt. The HMS SAFE reports stock-wide catches (in the EPO) for swordfish in the 13,000-20,000 mt range (See Table 5-3 in PFMC 2008), suggesting that the maximum impact of a limited fishery (permitting 20 vessels) would represent roughly a 10 percent increase in stockwide catch. The potentially larger fishery forecast under Alternatives 3 and 4 could have a greater incremental effect, although the estimates shown in Table 4-8 suggest that the area constraint east of 140° W. longitude may result in swordfish catches comparable to the largest limited entry fishery proposed.

Of the nontarget species, the incremental effect of the proposed action on bigeye tuna is of greatest concern because the stock has been declared subject to overfishing under Section 304(e) of the MSA. Striped marlin and albacore stocks may be subject to current or potential high levels of depletion so a conservation concern is raised for these stocks as well. For all of these stocks, however, the incremental increase in catch due to the proposed fishery would be small in comparison to stock-wide catches. For bigeye, the range in stock-wide catch reported in the HMS SAFE is 111,000-132,000 mt and for yellowfin 177,000-440,000 mt. For bigeye tuna the proposed fishery is estimated to result in maximum catches of 44 mt (Alternative 2, 20 vessels) and 66 mt (Alternatives 3 and 4, 30 vessels), or an incremental increase in catch under 0.0001 percent. Estimated yellowfin catch is much smaller so the incremental increase is several orders of magnitude smaller. Of these stocks the incremental increase in catch would likely be greatest for striped marlin where stock-wide catches (in the EPO) are in the 1,500-2,200 mt range according to the 2008 HMS SAFE. Striped marlin catches in the proposed fishery could reach a maximum in the 15-25 mt range (20-30 vessels), depending on the alternative chosen, according to the estimates in Table 4-9, or about 1 percent of stock-wide catch. In comparison, the Hawaii fishery retained 18,972 lb or 8.6 mt of striped marlin in 2007 (see Table 10 in WPFMC 2008).

The incremental increase in catches due to the proposed fishery may not be as great as anticipated if participation represents a temporary or permanent transfer of fishing effort out of other fisheries targeting swordfish. This is more apparent under Alternative 2 under qualification options that favor participants in the DGN fishery, the other main West Coast fishery targeting swordfish. Although Alternative 3 proposes a relatively unlimited number of permits (98 estimated to qualify), having made a recent West Coast swordfish landing is a requirement. Many in this pool participate in the DGN or harpoon fishery for swordfish. In the short term at least, it seems unlikely that fishermen would have the necessary capital to purchase and outfit another vessel and use a vessel in both the proposed SSLL fishery and another fishery simultaneously. Although this is a possibility, it is likely that a large proportion of the vessels participating in the proposed SSLL fishery would be shifted over from other fisheries targeting swordfish. The prohibition under Alternative 2 of simultaneous use of a Hawaii permit is likely to have a similar effect.

The effects of climate variability and change on stock productivity could adversely affect the sustainable harvest level (AMSY). Similarly, illegal, unregulated, and unreported (IUU) fisheries could contribute an unknown amount of fishing mortality. As with other internationally managed stocks, U.S. policy has been not to engage in unilateral management but to work through RFMOs to promote needed conservation measures, given U.S. catches generally represent a small fraction of stock-wide catch (as would be the case for the proposed fishery). This has been the case for bigeye, yellowfin and tuna; and if increases in fishing mortality and/or changes in stock productivity necessitated stock conservation measures for swordfish the likely response would be to work through the IATTC and WCPFC to adopt needed conservation measures, which would then be applied to domestic fisheries.

4.2.4 Summary of Finfish Impacts

Risk of Overfishing and Failure to Meet HMS FMP Stock Conservation Objectives

As discussed in Section 3.2.1.2, the most recent stock assessment of North Pacific swordfish did not find that overfishing was occurring or the stock was depleted to a level approaching an overfished condition. The largest fishery contemplated under Alternative 2 could result in as much as a 10 percent increase in EPO stock-wide catch. Based on the catch estimates an unconstrained fishery under Alternative 3 or 4 would represent a larger increase in the neighborhood of 15 percent. The last stock assessment does not provide enough information to determine whether such an increase would raise a conservation concern. A fishery under Alternative 2 with fewer vessels would result in lower catches.

Furthermore, constraints on fishing effort resulting from sea turtle related conservation measures may result in a lower level of realized effort.

As discussed above, the nontarget stocks for which there are conservation concerns are bigeye (overfishing occurring and overfished condition) and yellowfin tuna (may be subject to overfishing) and albacore and striped marlin (concern about current level of fishing mortality and/or stock depletion level). The proposed fishery is estimated to result in no more than a 1 percent increase (for striped marlin) on catches and in most cases a much smaller incremental increase.

Of sharks, blue sharks are the largest bycatch species; under Alternative 2 an estimated maximum of 722 mt could be caught while in an unconstrained fishery (Alternatives 3 and 4) more than 1,000 mt could be caught. According to Table 3-4, 6 percent of blue sharks are discarded dead; even assuming additional post-release mortality, actual fishing mortality would be a small fraction of these values. Available information does not suggest that the blue shark stock is depleted. The HMS FMP includes a 340 mt harvest guideline for the common thresher and a 150 mt harvest guideline for the shortfin mako. A CDFG report submitted at the November 2008 Council meeting (Agenda Item E.3.b, Supplemental CDFG Report) estimated current West Coast thresher shark catches at 229 mt or 68 percent of the harvest guideline. It is estimated that the maximum catch under the proposed fishery (20-30 vessels) would be 7-11 mt, which would not exceed the harvest guideline. Estimated maximum catches of mako shark are relatively large, 114 mt for 20 vessels (Alternative 2 maximum) and 172 mt for 30 vessels east of 140° W. longitude (Alternatives 3 and 4). Catches this high would raise a conservation concern. According to Table 3-4, in the Hawaii fishery, of those makos discarded, 21 percent are discarded dead, so actual catch mortality would likely be lower. Since the proposed fishery would be subject to 100 percent observer coverage, catches could be monitored to determine the risk of the harvest guideline being exceeded.

Of the other species, dorado (mahimahi), a management unit species, would be caught in the largest numbers. According to Table 3-4, in the Hawaii fishery 83 percent are retained so bycatch is relatively low for this species. The stock status of these species is generally unknown but they are considered to be highly productive and resilient.

Elevated Conservation Concern for HMS FMP Prohibited Species

As noted in Section 3.2.3, the only prohibited species recorded as being caught in either the Hawaii or the West Coast SSLL fisheries are the white shark and basking shark. In both cases it has been a very rare occurrence (two white sharks and one basking shark observed caught since 1994). The proposed fishery would likely have a catch incidence less than that previously observed, especially if a fewer number of permits were authorized under the Alternative 2 limited entry program. Bycatch mortality for these species is likely less than 100 percent. The rare incidence of catches does not raise a management concern.

Sufficient Monitoring

All the action alternatives would require 100 percent observer coverage, allowing a very high level of catch monitoring.

4.3 Sea Turtles

4.3.1 Evaluation criteria

As discussed in Section 4.2.1 evaluation criteria used in the EFP EA (NMFS and PFMC 2007) are also applicable for this proposed action. Those criteria have been adapted for use in this EIS; for impacts to sea turtles they are:

- What is the anticipated level of sea turtle take under the alternatives and how do the estimated mortalities compare with the guidance received from the NMFS SWR Regional Adminstrator pursuant to MSA §204(a)(3) (see Section 1.2)?

- At the population level, would the anticipated level of sea turtle take under the alternatives have a measurable and substantially detrimental incremental impact?

4.3.2 Direct and Indirect Impacts

4.3.2.1 *Take and Mortality Estimates*

The fishing effort estimates for different numbers of vessels described in Section 4.1 are also used to estimate sea turtles takes. Take rates for loggerhead and leatherback sea turtles are based on data compiled by Jim Carretta, NMFS SWFSC, using observer data from both the Hawaii and California SSLL fisheries from 2004 and earlier when both fisheries were primarily using J-hooks and sqid bait. NMFS Protected Resources Division provided adjusted CPUE values based on these data to reflect the difference in take rates between J-hooks and squd bait (in use prior to April 2004) and circle hooks with mackerel-type bait. The adjustments made to the CPUE values are a reduction of 90 percent for loggerhead CPUEs (J-hook CPUE x 0.10 = circle hook CPUE) and 85 percent for leatherback CPUEs (J-hook CPUE x 0.15 = circle hook CPUE). These adjusted take rates for the areas east of 150° W. longitude were reported in Attachment 1 to the March 2008 HMSMT Report (Agenda Item C.3.b). That report did not contain an estimate for a fishery without a westward closure (because that option had not been adopted at that time). For this SEIS the underlying data set compiled by Jim Carretta was used to compute the take rates for a fishery with no closure using the same methods. Mortality rates used in the WPFMC Amendment 18 BO (NMFS 2008, Table 10) were applied to arrive at mortality estimates. Those mortality rates are 20.5 percent for loggerheads and 22.9 percent for leatherbacks. Table 4-10 summarizes these estimates. Table 4-11 through Table 4-13 show the estimates for the three area options in more detail, broken down by quarter. In all cases the takes and mortalities are rounded up to the next highest whole number. Potential takes of olive ridley and green turtles are discussed more generally based on information on historical takes reported by Carretta but not stratified by quarter (Carretta 2003). Takes were not observed for hawksbill turtles. The likelihood that a hawksbill would be taken in the proposed fishery is remote because they are uncommon in the action area (see Section 3.3.3).

Table 4-10. Summary of estimated loggerhead and leatherback sea turtle takes and mortalities for fisheries with different numbers of vessels.

Loggerhead Takes and Mortalities:

	E of 140W		E of 150W		No Area Closure	
	Take	Mortality	Take	Mortality	Take	Mortality
5 vessels	4	1	7	2	8	2
10 vessels	6	2	12	3	14	3
15 vessels	7	2	15	4	17	4
20 vessels	8	2	15	4	18	4
30 vessels	11	3	23	5	27	6

Leatherback Takes and Mortalities:

	E of 140W		E of 150W		No Area Closure	
	Take	Mortality	Take	Mortality	Take	Mortality
5 vessels	3	1	3	1	3	1
10 vessels	4	1	5	2	4	1
15 vessels	5	2	6	2	5	2
20 vessels	6	2	6	2	5	2
30 vessels	8	2	9	3	7	2

Table 4-11. Loggerhead and leatherback take and mortality estimates by quarter for a fishery east of 140° W. longitude.

Loggerhead takes

	Quarter					
	1	2	3	4	Total Takes	Mortalities
5 vessels	0.04	-	2.23	0.84	**4**	**1**
10 vessels	0.07	-	3.82	1.44	**6**	**2**
15 vessels	0.09	-	4.77	1.80	**7**	**2**
20 vessels	0.10	-	5.09	1.92	**8**	**2**
30 vessels	0.15	-	7.63	2.88	**11**	**3**
CC take rate	0.015114	-	0.011596	0.002565		

Leatherback takes

	Quarter					
	1	2	3	4	Total Takes	Mortalities
5 vessels	-	-	-	2.28	**3**	**1**
10 vessels	-	-	-	3.90	**4**	**1**
15 vessels	-	-	-	4.88	**5**	**2**
20 vessels	-	-	-	5.20	**6**	**2**
30 vessels	-	-	-	7.80	**8**	**2**
DC take rate	-	-	-	0.006960		

Table 4-12. Loggerhead and leatherback take and mortality estimates by quarter for a fishery east of 150° W. longitude.

Loggerhead takes

	Quarter 1	2	3	4	Total Takes	Mortalities
5 vessels	2.75	1.03	1.16	1.73	**7**	**2**
10 vessels	4.71	1.77	1.99	2.97	**12**	**3**
15 vessels	5.89	2.21	2.48	3.71	**15**	**4**
20 vessels	5.89	2.21	2.48	3.71	**15**	**4**
30 vessels	9.43	3.54	3.97	5.94	**23**	**5**
CC take rate	0.025556	0.024264	0.011596	0.006096		

Leatherback takes

	Quarter 1	2	3	4	Total Takes	Mortalities
5 vessels	-	0.26	-	2.29	**3**	**1**
10 vessels	-	0.44	-	3.93	**5**	**2**
15 vessels	-	0.55	-	4.92	**6**	**2**
20 vessels	-	0.55	-	4.92	**6**	**2**
30 vessels	-	0.89	-	7.86	**9**	**3**
DC take rate	-	0.006066	-	0.008069		

Table 4-13. Loggerhead and leatherback take and mortality estimates by quarter for a fishery with no westward area closure.

Loggerhead takes

	Quarter 1	2	3	4	Total Takes	Mortalities
5 vessels	4.65	0.99	0.84	1.35	**8**	**2**
10 vessels	7.97	1.69	1.45	2.31	**14**	**3**
15 vessels	9.97	2.11	1.81	2.88	**17**	**4**
20 vessels	10.63	2.25	1.93	3.08	**18**	**4**
30 vessels	15.95	3.38	2.90	4.62	**27**	**6**
CC takes rate	0.027739	0.011960	0.011596	0.006369		

Leatherback takes

	Quarter 1	2	3	4	Total Takes	Mortalities
5 vessels	-	0.21	-	1.68	**2**	**1**
10 vessels	-	0.36	-	2.88	**4**	**1**
15 vessels	-	0.45	-	3.61	**5**	**2**
20 vessels	-	0.48	-	3.85	**5**	**2**
30 vessels	-	0.72	-	5.77	**7**	**2**
DC take rate	0.000000	0.002563	0.000000	0.007962		

4.3.2.2 *Impacts of Alternative 1 (No Action)*

As discussed above for finfish, the ongoing impacts due to other sources of direct mortality (fisheries, direct harvest), indirect mortality (e.g., predation by domestic animals), and habitat alteration (e.g., nesting beach inundation) would continue to affect sea turtle populations but no new source of impacts would result from the action.

4.3.2.3 *Impacts of Alternative 2 (Limited Entry)*

The following table summarizes estimated loggerhead and leatherack seat turtle takes and mortalities for the range of permits (vessels) authorized under Alternative 2.

Table 4-14. Summary of estimated loggerhead and leatherback sea turtle takes and mortalities (in parentheses) under Alternative 2.

	Estimated Loggerhead Takes			Estimated Leatherback Takes		
	E. of 140°	E. of 150°	No closure	E. of 140°	E. of 150°	No closure
5 permits (vessels)	4 (1)	7 (2)	8 (2)	3 (1)	3 (1)	3 (1)
10 permits (vessels)	6 (2)	12 (3)	14 (3)	4 (1)	5 (2)	4 (1)
15 permits (vessels)	7 (2)	15 (4)	17 (4)	5 (2)	6 (2)	5 (2)
20 permits (vessels)	8 (2)	15 (4)	18 (4)	6 (2)	6 (2)	5 (2)

Number of Permits

As shown in Table 4-14, constraining the fishery farther to the east and allowing fewer vessels is estimated to result in fewer sea turtle takes. Thus the lowest level of estimated loggerhead take is for 5 vessels constrained to east of 140° W. longitude, with 4 takes, while the highest level of estimated take is for 20 vessels and no area closure, 18 takes. Leatherback takes are estimated at lower levels, ranging from 3 takes and 1 mortality (for 5 vessels) to 6 takes and 2 mortalities (for 20 vessels restricted to east of 150° W. longitude).

Area Closure Options

As noted, constraining the fishery east of 140° W. longitude is estimated to result in fewer loggerhead sea turtle takes in comparison to a fishery closed west of 150° W. (approximately half the number of loggerheads) or a fishery with no westward area closure.

Examination of the more detailed tables, shows the potential variation in takes by quarter. For example, in the estimates for a fishery east of 150° W. longitude, it can be seen that for loggerheads the estimated take rate is highest in the first quarter and for leatherbacks it is highest in the fourth quarter.

However, it should be noted that the statistical analysis performed by the SWFSC and reported to the Council in June 2003 (Carretta 2003) did not find a statistically significant difference in the number of sets with loggerhead or leatherback entanglements between the area east of 150° W. and west of 150° W. longitude.

The most striking difference in the area closure options is level of anticipated takes of loggerheads east of 140° W. compared to the other two area closure options. As can be seen in Table 4-14, for the same levels of effort estimated loggerhead takes approximately double when the fishery is allowed to operated west of 140° W. longitude. This is not unexpected based upon the habitat use of loggerheads in the North Pacific (Polovina, *et al.* 2000; see Polovina, *et al.* 2004).

By comparison, estimated leatherback takes are not substantially different by area. For example, with five vessels, the estimated take of leatherbacks is three takes with one associated mortality whether the fishery is constrained to east of 140° W. or has no area closure.

Effects of Other Features of the Alternatives

As noted, the take estimates are predicated on the use of gear modifications (circle hooks and mackerel-type bait) required under Alternative 2. The alternative would also include sea turtle take caps for leatherback and loggerhead turtles. The use of take caps would establish a specific, definable maximum level of impact (takes) for sea turtles, which would have to be found not to cause jeopardy under the ESA.

As discussed above for finfish impacts, the requirement for 100 percent observer coverage may place a greater limit on participation and effort, depending on the NMFS budget available to fund observer costs. If an industry funded program were established, added costs for fishery participants could affect their willingness to participate.

Impacts to Olive Ridley and Green Turtles

Takes and associated take rate estimates for olive ridley and green turtles are included in the Carretta report (2003). Interactions with these species were relatively rare during the 2001-2004 period for which West Coast observer data are available: Two olive ridleys were taken east of 150° W. and 38 west of 150° W. according the pooled Hawaii and West Coast data reported by Carretta (2003). For green turtles the values are 0 takes east of 150° W. and 13 takes west of 150° W. This translates into a CPUE (take per 1,000 hooks) of 0.025 and 0.004 for olive ridley and 0.009 and 0.0 for green sea turtles. Assuming that the observed reduction in takes accorded to the use of circle hooks and mackerel-type bait is similar for these species to that observed for loggerheads (all are hardshell sea turtles), these values would be reduced by 90 percent. Applying the effort estimates for 20 vessels stratified east and west of 150° W. longitude the resulting take estimates are 1.2 olive ridleys and 0.03 green turtles per year. These are relatively rare events; it can be concluded that even at the highest number of vessels proposed under Alternative 2, few of these species of turtles would be taken. Furthermore, assuming a mortality rate comparable to loggerhead turtles (all are hardshell turtles) total olive ridley and green turtle mortalities would likely be less than one animal in 3-5 years. The application of take caps for loggerheads and leatherbacks would have a further potential constraining effect, which could reduce the number of olive ridley and green turtles that are actually taken.

4.3.2.4 *Impacts of Alternative 3 (Large Limited Entry Program) and Alternative 4 (Open Access)*

As discussed above, a fishery with 30 vessels is used to estimate the impacts under Alternatives 3 and 4. As shown in Table 4-10, since both of these alternatives would restrict the fishery east of 140° W. longitude, the estimated loggerhead take is 11 with 3 mortalities; for leatherbacks it is 8 takes and 2 mortalities. The estimated takes of loggerheads, 11 takes with 3 mortalities, is approximately the same level of effect as 10 vessels (under Alternative 2) fishing east of 150 W. longitude or with no area closure (12 takes and 3 mortalities or 14 takes and 3 mortalities, respectively).

As discussed previously, the requirement for 100 percent observer coverage under these alternatives could place a substantial constraint on the level of effort actually expended. If so, the level of takes would likely be correspondingly lower.

4.3.3 Sea Turtle Cumulative Effects

The proposed fishery would result in an incremental increase in mortality of sea turtles over baseline mortality levels. Sources of baseline mortality were summarized in Section 3.3 for the different sea turtle species and populations. The size of this incremental increase is a function of the size of the fishery authorized (number of vessels or actual fishing effort), the actual interaction rate, and the actual mortality rate (which can only be estimated, even in a fully observed fishery due to uncertainties in the mortality rates of released turtles that are fatigued, injured and/or disoriented). Both the Amendment 18 EIS and associated BO (NMFS 2008; WPFMC 2008) present estimates of the “adult female equivalent” mortality resulting from that proposed action. This supports a risk assessment based on a population assessment conducted by the NMFS Pacific Islands Fisheries Science Center (Snover 2008). That assessment is based on the likelihood that incremental mortality from the proposed action would increase the Susceptibility to Quasi-Extinction (SQE) to an unacceptable level. According to the BO the reason for estimating adult female equivalent mortality is that “females are the only component of the population for which data are available, from counts of adult females on nesting beaches” (NMFS 2008, p. 54). Computing the adult female equivalent mortality requires multiplying the estimated maximum mortality from the proposed action by the female sex ratio by an estimate of the fraction of one adult equivalent represented by each juvenile captured in the fishery. Using the values reported in the Amendment 18 EIS and BO the following calculations can be made for a fishery of 20 vessels (for loggerheads, no area closure, for leatherbacks, closed east of 150° W.), which would represent the maximum impact of Alternative 2:

3.67 loggerhead mortalities x 0.65 female sex ratio x 0.41 adult equivalents = 0.98 adult female equivalent mortality
1.25 leatherback mortalities x 0.65 female sex ratio x 0.85 adult equivalents = 0.69 adult female equivalent mortality

The values reported in Table 4-10 and following tables are rounded up values (the fractional number of takes computed from the stratified effort estimates is rounded up, then the mortality rate is applied to the rounded up take value and the result is rounded up). For these calculations the fractional take value is multiplied by the mortality rate and the resulting fractional value is used.

For leatherbacks, the BO further estimates the impact on the Jamursba-Medi nesting population component since this is the only reliably monitored population for Western Pacific leatherbacks. For the Hawaii fishery they estimate that approximately 69 percent of captured leatherbacks come from this population component. If a West Coast fishery had the same interaction rate with this population component (recognizing that the proposed fishery would likely concentrate effort east of where the Hawaii fishery generally fishes) then 0.47 adult female equivalent mortalities would be attributable to the Jamursba-Medi nesting population component.

The BO reports the conclusion of Snover’s risk assessment for loggerheads: “less than 4 adult female equivalent mortalities would minimize the risk of the proposed action to the North Pacific loggerhead population” (NMFS 2008, p. 57). It is estimated that the Amendment 18 proposed action would result in less than three adult female equivalent mortalities annually for loggerheads. The BO also discusses mitigating factors: likely higher loggerhead nest counts in 2008 and the market transfer effect whereby consumption of U.S. caught swordfish by fisheries with sea turtle conservation measures, in preference to foreign-caught swordfish from fisheries with higher take rates, could have a compensatory effect. Taken together, the combined adult female equivalent mortality for the Amendment 18 proposed action (2.51) and the maximum impact of Alternative 2 (20 vessels), reported above, is 3.49, which is at the threshold of 4 identified in the Amendment 18 BO. Limiting the number of permits under Alternative 2 would reduce this risk. Allowing an unconstrained fishery under Alternatives 3 or 4 substantially increases this risk (in all cases, assuming the absence of other constraining factors, such as observer coverage availability).

For leatherbacks, the conclusion of the risk assessment in the Amendment 18 BO is that three adult females killed annually from the Jamursba-Medi component of the Western Pacific leatherback population is considered a ceiling to minimize extinction risk (NMFS 2008). The Amendment 18 proposed action is estimated to result in 1.66 adult female mortalities; adding to the estimate provided above for this proposed action results in an estimate of 2.13. A similar risk assessment could not be done for the other components of the population (nesting at other sites in Papua Indonesia, Papua New Guinea, the Solomon Islands, and Vanuatu). The BO states that the rest of the population is declining at a greater rate than the Jamursba-Medi component alone and the incremental increase in mortality could have a more adverse impact on these population components.

4.3.4 Summary of Sea Turtle Impacts

What is the Estimated Level of Take and How Does Estimated Mortality Compare to Guidance?

The estimated level of take is summarized in the preceding section on direct and indirect impacts of the alternatives. Under Alternative 2 the highest level of loggerhead take, 18 animals, would occur if the limited entry program authorized 20 permits (the maximum number considered) and there was no westward area closure. The unconstrained fisheries proposed under Alternatives 3 and 4 result in higher takes, using the assumption that on average 30 vessels would participate, although this would be partially mitigated by the constraint of the fishery east of 140° W. longitude under these alternatives. It is estimated that 11 loggerheads and 8 loggerheads would be taken, assuming no other constraints on effort, such as observer availability.

As discussed in Section 1.2, when disapproving the authorization of a SSLL fishery in the HMS FMP the NMFS SWR Regional Administrator recommended that mitigation measures be included "that would limit sea turtle mortality to low levels approximating those that had previously been found in the drift gillnet fishery not to result in jeopardy to any listed sea turtles." The ITS for the HMS FMP (NMFS 2004a, see Table VIII-1) estimated mortality levels for two loggerhead mortalities, two leatherback mortalities, one olive ridley mortality, and one green sea turtle mortality, based on the DGN fishery being the only fishery authorized under the FMP that would have sea turtle takes (recognizing the ESA regulations prohibiting the SSLL fishery).[25] The guidance refers to "low levels approximating"; furthermore, the ESA section 7 consultation for this action will not rest on that previous guidance but instead rely on an assessment of the current status of affected populations of ESA-listed species and analysis of adverse effects of the proposed action. Bearing that in mind, allowing a fishery at or near the highest level contemplated, and without an area closure, is likely inconsistent with this guidance. Authorizing fewer permits and including an area closure (especially the west of 140° W. area closure) is more likely to be consistent with this guidance. Takes of olive ridley and green turtles would likely be very low.

The fisheries contemplated under Alternative 3 and 4, based on an the estimated equilibrium level of participation of 30 vessels and 140° W. area closure feature could result in levels of take somewhat lower than what is estimated for the most unconstrained fishery under Alternative 2. As noted elsewhere, the requirement for 100 percent observer coverage could substantially limit actual fishing effort, consequently reducing the actual level of takes.

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[25] It should be noted, however, that no sea turtle takes have been observed in the DGN fishery since implementation of the Pacific Leatherback Conservation Area in 2001. The DGN fishery is subject to approximately 20 percent observer coverage.

Do Takes Have a Substantially Detrimental Incremental Impact At the Population Level?

The discussion above under cumulative impacts summarizes the population level risk analysis used in the Amendment 18 evaluation. Comparison of estimates of adult female equivalent mortality under this proposed action to the estimates made for the Amendment 18 proposed action suggests that the maximum impact under Alternative 2 (20 permits) would approach or exceed the SQE risk thresholds identified by Snover (2008) for loggerhead and leatherback sea turtles. A fishery with fewer permits authorized would likely be below these thresholds. If the equilibrium level of fishing effort under Alternatives 3 and 4 is close to the estimate (30 vessels) the contribution to SQE risk would be somewhat lower than for the maxiumum level under Alternative 2. However, there would be no limited entry mechanism in place to provide some assurance that fishing effort stays at sufficiently low levels.

4.4 Marine Mammals

4.4.1 Evaluation criteria

Those following criteria are used to evaluate impacts to marine mamamals:

- Does the alternative allow effort in an area where interactions with strategic stocks of marine mammals and/or ESA listed marine mammals would be more probable

- Does the level of effort increase the likelihood of a marine mammal interaction

4.4.2 4.4.2 Direct and Indirect Impacts

4.4.2.1 *Marine Mammals Occurring in the Action Area that May be Affected by the Proposed Action*

Section 3.4 summarized information on marine mammals takes that have been observed taken in the Hawaii and West Coast SSLL fisheries. The proposed fishery would likely occur farther to the east than the Hawaii fishery, especially if the area west of 150° W. or 140° W. longitude is closed to fishing. That makes observed takes in the Hawaii SSLL fishery an imperfect indicator of what marine mammal species may taken in the proposed fishery. Nonetheless, several questions may be applied to this information in order to identify those marine mammals, out of all the species that occur in the action area, that are more likely to interact with the proposed fishery. First, using the information in Forney and Kobayashi (Forney and Kobayashi 2007), what marine mammals were taken east of 150° W. longitude by the Hawaii SSLL fishery? Second, what was the frequency of these actions? Third, is there information in the Stock Assessent Reports that can tell us about the likelihood of an interaction in the proposed fishery? Fourth, what strategic stocks occur in the area where effort in the proposed fishery is likely to be concentrated (i.e., east of 150° W. longitude)?

The following four species were observed taken east of 150° W. longitude in the Hawaii SSLL fishery: bottlenose dolphin, short-beaked common dolphin, shot-finned pilot whale, and the Risso's dolphin (which was also observed taken in the West Coast SSLL fishery). In addition, the 2009 List of Fisheries includes the California sea lion as a species taken in the California pelagic longline fishery. However, as discussed in Section 3.4, this record is based on logbook information and may not be reliable since the California sea lion is considered a coastal species; therefore, it is unlikely they would be encountered in the high seas outside the EEZ.

The Risso's dolphin is the most commonly observed species taken in the Hawaii SSLL fishery, and the only marine mammal species observed taken in the West Coast SSLL fishery (see Table 3-10). Other species for which a take resulting in serious injury or mortality has been observed on more than one occasion are the bottlenose dolphin, the false killer whale, and the humpback whale.

Of the species observed taken in the Hawaii SSLL fishey west of 150° W. longitude only (as reported in Forney and Kobayashi 2007) three species only have a Hawaii stock listed in the SARs (Carretta, *et al.* 2007; Carretta, *et al.* 2008): the Bryde's whale, false killer whale, and spinner dolphin. The remaining species have a wide distribution and/or sightings in waters west of the West Coast EEZ according to the SARs. The description of the Hawaiian Bryde's whale stock notes that the 2007 SARs distinguish an eastern tropical Pacific stock found east of 150° W. longitude and including the Gulf of California and waters off of California. However, the 2008 draft report deletes this stock because the stock rarely enters U.S. waters. Although only a Pacific Islands Region stock complex is defined for false killer whales, the 2008 SAR describes the geographic range as worldwide mainly in the tropical and warm-temperate waters. They are "well known" from the eastern tropical Pacific. The 2007 SAR describes the distribution of spinner dolphins as worldwide in tropical and warm-temparate waters.

Strategic stocks found in the action area include the marine mammal species listed under the ESA, as shown in Table 3-9: the blue whale, fin whale, Hawaiian monk seal, humpback whale, North Pacific right whale, sei whale, and sperm whale. In addition, the Hawaii Pelagic false killer whale stock, the Eastern North Pacific Offshore and Hawaiian killer whale stocks, and the CA/OR/WA short-finned pilot whale stock are listed as strategic because annual mortality and serious injury exceeds PBR.

Two humpback whale interactions were observed in the Hawaii SSLL fishery since reopening in 2004. This may reflect an increasing trend in interactions given that no interactions were observed in the Hawaii pelagic longline fishery 1994-1999 (WPFMC 2004), although this could instead be a function of changing observer coverage levels. The PBR for the Central North Pacific stock of humpback whales that migrates between Hawaii and northern British Columbia and Southeast Alaska waters is 12.9 and total injury/mortality 5.0 (Angliss and Allen 2007). However, as referenced in Section 3.4.1.3, a recent estimate (Calambokidis, *et al.* 2008) puts the North Pacific stock size at 18,000-20,000 animals, much larger than the SAR estimate. Higher abundance could also partly explain any real increase in the interaction rate (if in fact one exists).

Only one sperm whale interaction has been observed in the Hawaii SSLL fishery and that occurred more than a decade ago (WPFMC 2004). According to Forney and Kobayashi, the interaction did not result in serious injury, although it was noted that the animal was hooked in the fluke. (A second interaction occurred during an experimental set and was rated not serious.) Therefore, the likelihood of an interaction in the proposed fishery appears remote.

Based on this information, it is most likely that the proposed fishery would interact with Risso's dolphins and bottlenose dolphins. In addition, consideration should be given for those strategic stocks which occur in the action area and for which there is evidence of past interactions. These include the humpback whale, the sperm whale, the false killer whale, and the short-finned pilot whale. However, the false killer whale appears to have a more westerly distribution based on sightings reported in the SARs. Thus the risk of an interaction in the proposed fishery if effort concentrated farther to the east may be low.

4.4.2.2 *Impacts of Alternative 1 (No Action)*

As discussed above for other environmental components, the ongoing impacts described in Section 3.4 due to other sources of direct mortality (fisheries, ship strikes) and indirect mortality (e.g., stranding) would continue to affect marine mammal populations but no new source of impacts would result from the action.

4.4.2.3 *Impacts of Alternative 2 (Limited Entry)*

Number of Permits

Observed marine mammal takes have been comparatively rare events in the Hawaii and West Coast SSLL fisheries. That makes it difficult to estimate the number of takes of particular species that might occur in the proposed fishery, especially since the geographic distribution of fishing effort in a West Coast fishery would likely differ from that occurring in the Hawaii SSLL fishery. Forney and Kobayashi (2007) report an overall marine mammal take rate for the Hawaii swordfish fishery (based on 1994-2004 observed sets) of 6.51 animals per 1,000 sets. For a fishery with 20 vessels it is estimated that 1,631 sets would occur per year. Applying this level of effort to the rate reported by Forney and Kobayashi results in an estimate of 10.6 marine mammal interactions per year. For the years 2006-2008 effort in the Hawaii SSLL fishery ranged from 850 to 1,497 sets (the fishery closed early in 2006 due to sea turtle interactions, accounting for the low-end value of 850 sets). During this period, noting 100 percent observer coverage, 17 marine mammal interactions were observed (see Table 3-10), or an average of 5.7 interactions per year. The estimate using the take rate and the observed number of takes in the Hawaii fishery, 2006-2008 are reasonably consistent and give an indication of the number of interactions that may occur in the largest fishery proposed under this alternative. It must be noted that using the data from the Hawaii based SSLL may not accurately reflect what may occur under Alternative 2 since historically a large proportion of the fishing effort in the West Coast fishery occurred east of 140 W. (38 percent, see Table 4-5) and east of 150 W. (73 percent), while the majority of fishing effort in the Hawaii SSLL fishery occurs west of 150° W. longitude. Generally, the fewer the number of permits, the lower the likelihood of seriously injuring or killing a marine mammal.

The nature of interactions with longline gear varies with by marine mammal species. Baleen whales would not depredate baited hooks since they feed by straining krill and other zooplankton and small nekton. They may become entangled in the gear and this can lead to serious injury if trailing gear inhibits movement or other behavior. Pinnepeds, dolphins, and toothed whales could depredate bait. Comments included in the record of marine mammals in the Hawaii SSLL fishery (see Table 2 in Forney and Kobayashi 2007) show that most of the interactions, especially for the commonly taken Risso's dolphin and bottlenose dolphin, indicate hook ingestion. The 2007 EFP EA (NMFS and PFMC 2007, p. 73) summarizes information on sperm whale interactions with longline gear. Sperm whales are toothed whales that feed on a variety of cephalopods and fish, raising the possibility that they could depredate longlines. This could be a learned behavior but has not been observed. Both sperm whale interactions noted in Forney and Kobayashi involved entanglement.

Area Closure Options

The area closure options could have a mitigation effect on marine mammal takes depending on the distribution of particular species. The false killer whale stocks identified in the SARs (Carretta, *et al.* 2007; Carretta, *et al.* 2008) are distributed in waters around and to the south of the Hawaiian Islands, based on observed sightings. A review of the Hawaii deep-set and shallow-set longline fishery records (Forney and Kobayashi 2007) shows that takes of this strategic stock of false killer whales occurred primarily west of 150° W. with one take just east of 150° W. longitude. Takes also occurred in the EEZ around the Hawaiian Islands, Johnston Atoll, and Palmyra Atoll. Current regulations prohibit pelagic longline fishing around the main Hawaiian Islands and the NWHI (50 CFR 665.26). Although the fishery data is biased based upon fishing effort, it does provide some information on the distribution of this species. Further, this species is found generally in tropical and warm-temperate waters, which are more prevalent outside the California Current. Prohibiting the fishery west of 150° W or 140° W longitude would likely reduce the likelihood of takes of the false killer whale stocks identified in the SARs.

The Central North Pacific humpback whale migrates between Southeast Alaska and Hawaii. A fishery closed west of 150° W. or 140° W. may overlap less with some migration routes (see Figure 3-9) and would not overlap with wintering grounds around the Hawaiian Islands. The CA/OR/WA stock of humpback whale generally appears to stay within the U.S. West Coast EEZ and therefore would be less likely to occur in the area of the proposed fishery seaward of the EEZ.

Effects of Other Features of the Alternative

Gear requirements are not likely to affect marine mammal take rates, either positively or negatively. As discussed above, baleen whales (humpback whales, Brydes whales; blue, fin, right, and sei whales) are more likely to become entangled in the gear rather than hooking so change in hook type and bait would not have an effect. Sea turtle take caps impose an additional constraint on the fishery, potentially limiting the amount of fishing effort expended if a cap is reached before the end of the season. This could have a secondary effect on the risk of marine mammal takes. As previously noted, the requirement for 100 percent observer coverage may limit fishing effort more than what would be allowed under this alternative. If observer coverage is a greater limiting factor this could further reduce the risk of marine mammal takes.

4.4.2.4 *Impacts of Alternative 3 (Large Limited Entry Program) and Alternative 4 (Open Access)*

These alternatives would effectively not restrict fishing effort, substantially increasing the risk of marine mammal interactions. Both alternatives would close the fishery west of 140° W. longitude. As discussed above, this could decrease the risk of takes from the Hawaii Pelagic false killer whale stock, which is designated strategic. It could also limit the overlap between the action area and the migration route and wintering grounds for the Central North Pacific humpback whale stock.

As previously noted, the requirement for 100 percent observer coverage may by itself limit fishing effort resulting in effort levels below what would otherwise be expected. To the degree that observer coverage is a limiting factor on fishing effort this could reduce the risk of marine mammal takes.

4.4.3 Marine Mammal Cumulative Effects

Section 3.4.1 describes various actions and trends affecting marine mammals. These include other fisheries, other anthropogenic effects, such as ship strikes, and habitat changes, which for affected species occurring in the pelagic environment is mainly a function of climate forcing on the ecosystem (cyclical variability and global warming). The expanded fishery proposed under WPFMC Pelagics FMP Amendment 18 is an important contributory factor, considering the proposed action is likely to affect at least some of the same marine mammal stocks. The effect of other actions may be summarized at the stock level by the estimates of total injury/mortality reported in the SARs (see Table 3-11). Any serious injury/mortality in the proposed fishery would add incrementally to serious injury/mortality resulting from other actions.

4.4.4 Summary of Marine Mammal Impacts

Does the Level of Effort Increase the Likelihood of a Marine Mammal Interaction?

Restricting the fishery to a fewer number of vessels (permits) under Alternative 2 is likely to substantially reduce the risk of interactions. As noted above, NMFS manages fishery interactions with marine mammals by comparing the average annual serious injuries and mortalities to the stock's PBRs. Limiting the effort would reduce the likelihood that serious injuries or mortalities would exceed PBR (aside from strategic stocks where the PBR is currently exceeded).

As discussed above, both sea turtle take caps and the 100 percent observer requirement could constrain fishing effort to levels below what it would be without these measures. This could reduce the risk of marine mammal serious injury/mortality.

Is Fishing Allowed in an Area Where Interactions with Strategic Stocks Would be more Probable?

Closing the fishery west of 150° W. or 140° W. longitude could reduce the likelihood of interactions with stocks distributed farther west. Specifically, the Hawaii Pelagic false killer whale stock and the Central North Pacific humpback whale stocks could be less affected by a fishery that is geographically restricted.

4.5 Seabirds

4.5.1 Evaluation criteria

The following evaluation criteria have been developed for seabirds:

- Would the anticipated level of short-tailed albatross take under the alternatives result in mortalities that would exceed the ITS in the BO for the HMS FMP (USFWS 2004)?

- Would incidental capture of non-ESA-listed seabirds (black-footed albatross, Laysan albatross) substantially contribute to human related mortality sufficient to degrade the status of the species at the population level?

4.5.2 Direct and Indirect Impacts

4.5.2.1 *Information on Incidental Capture in Hawaii and West Coast SSLL Fisheries*

No short-tailed albatross takes have been observed in either the Hawaii SSLL fishery or the historical West Coast SSLL fishery. However, a take is expected to be a very rare event since these birds are uncommon. The BO for the HMS FMP prepared by the USFWS (USFWS 2004) conducted an analysis of potential takes based on a pelagic longline fishery of 1.5 million hooks including deep-set and shallow-set components, as originally proposed in the FMP. They used the following model to estimate takes:

T = N x A x R x E

Where T is the estimated number of takes and:

N is the short-tailed albatross population size, estimated at 1,700 birds at that time (2003);

A is the estimated proportion of the short-tailed albatross population that overlaps with the action area for the West Coast pelagic longline fishery (including deep-set, shallow-set, and mixed-set components), equal to 0.30;

R is the mortality due to the fishery based on the 5-year average of the estimated annual mortality rate of black-footed albatross in the Hawaii longline fishery operating without seabird deterrents, adjusted for drop-off and reduced number of hooks in the West Coast fishery, equal to 0.00083 birds/hook/yr;

E is the proportion of the original estimated mortality to occur as a result of deep-set, shallow-set, or mixed-set operations, estimated at 1.0.

The resulting mortality estimate is 0.41 short-tailed albatross. Although the HMS FMP as approved did not authorize the SSLL fishery, the USFWS found that there was a small risk that other West Coast HMS fisheries could capture a short-tailed albatross and therefore included in the ITS one short-tailed albatross may be taken per year as a result of the fishing activities regulated under the HMS FMP.

Since the USFWS BO includes an analysis based on continuation of the historic West Coast longline fishery, including a shallow-set component, their estimate of short-tailed albatross take can be used as a guide for evaluating the impacts of the proposed action.

Table 4-15 shows a comparison of capture rates for black-footed and Laysan albatross from the data set compiled by Jim Carretta, (see Section 4.3.2.1) and those reported in the Amendment 18 EIS (see Tables 34 and 35 in WPFMC 2008), based on observed Hawaii longline swordfish vessels, 2005-2008. It can be seen that overall the capture rates reported in the Amendment 18 EIS are much lower than the rates from the Carretta data set. This likely reflects the requirement for additional seabird mitigation measures in the Hawaii fishery in recent years. However, probably due to differences in geographic area, for the Hawaii fishery Laysan albatross capture rates are higher than black-footed albatross capture rates while the opposite is true for the rates computed from the Carretta data set. These differences make it difficult to determine what the actual capture rates would be in a West Coast SSLL fishery employing comparable seabird mitigation measures but operating farther to the east than the current Hawaii SSLL fishery.

Table 4-15. Comparison of capture rates of Laysan and black-footed albatross calculated from Carretta data set and those reported in the Amendment 18 EIS (see Tables 34 and 35 in WPFMC 2008).

	Per 1,000 hooks		Per set							
			Q1		Q2		Q3		Q4	
	Carretta	Amd 18	Carretta	Amd 18	Carretta	Amd 18	Carretta	Amd 18	Carretta	Amd 18
Black-foot	0.2052	0.0046	0.2134	0.0037	0.1563	0.0045	0.4590	0.0000	0.1144	0.0000
Laysan	0.0674	0.0283	0.1219	0.0135	0.0164	0.0195	0.0000	0.0000	0.0106	0.0000

The combined capture rate (black-footed plus Laysan albatross) for the recent Hawaii SSLL fishery is 12.1 percent of the comparable value for the fisheries in the Carretta data set ((0.0046 + 0.0283) / (0.2052 + 0.0674)). As discussed in Section 3.5.4, Gilman, *et al.* (2008) detected a 76 percent overall reduction in seabird captures comparing the Hawaii pelagic longline fishery before and after the introduction of mitigation measures; their analysis indicated that 67 percent of this reduction was attributable to the mitigation measures.

4.5.2.2 *Alternative 1 (No Action)*

As discussed above for the other environmental components, the ongoing impacts due to other sources of direct mortality (incidental capture in fisheries) and habitat alteration (primarily at nesting sites) would continue to affect seabird populations but no new impacts would result from the action.

4.5.2.3 *Alternative 2 (Limited Entry)*

Number of Permits

The proposed limited entry fishery under this alternative would increase the risk that a short-tailed albatross would be taken, in comparison to no action. At the largest size contemplated, 20 vessels, it is estimated that about 1.2 million hooks would be fished annually. This is slightly less than the 1.5 million hooks estimated as an annual average effort level for the historical West Coast SSLL fishery. As discussed above, the USFWS calculated 0.46 short-tailed albatross would have been taken annually in the historical fishery if it had been authorized as originally proposed (USFWS 2004). At its largest size the proposed fishery would approach the likelihood of a take that existed for the historical fishery, depending on the current condition of the short-tailed albatross population and factors affecting its distribution. The short-tailed albatross population has increased; the HMS FMP BO used a population estimate of 1,700 while a more recent recovery plan estimates the population at 2,717 (USFWS 2008). This population change increases the probability of an encounter, although it still remains remote. A fishery authorized at a smaller size would reduce the likelihood of an incidental take.

If the capture rates calculated from the Carretta data set are reduced by 67 to 76 percent in line with the findings reported by Gilman, *et al.* (2008), and applied to the aggregate amount of effort estimated for a 20-vessel fishery, the resulting estimates are 61-83 black-footed albatross and 20-28 Laysan albatross captured annually (rounding up fractional values). These estimates do not include unobserved drop-off mortality. The USFWS BO for the HMS FMP used an estimate of the drop-off rate for short-tailed albatross (based on black-footed albatross estimates) of 28 percent, based on work by Gilman, *et al.* (2003). Accounting for drop-off, the high end estimates for a 20-vessel fishery would be 106 black-footed albatross and 34 Laysan albatross. For a five-vessel fishery the corresponding values are 27-37 black-footed albatross and 9-12 Laysan albatross, without accounting for drop-off or upper end estimates of 47 black footed albatross and 15 Laysan when estimated drop-off is added in.

Area Closure Options

Gilman, *et al.* (2008) found that seabird catch rates were higher around the Hawaiian Islands with the highest rates in the north and west of 25° N. latitude and 170° W. longitude. Capture rates generally declined to the east. This is consistent with the distribution of these seabird species, given the importance of the NWHI as habitat. Comparing take rates in the Carretta data set shows a similar pattern (lower rates east of 150° W. compared to west) although no analysis has been done on that data set to determine if the differences are statistically significant. As discussed above, historically more effort was concentrated to the east in the fourth quarter in comparison to other quarters and this is reflected in the modeled seasonal distribution of effort discussed in Section 4.1. Gilman, *et al.* (2008) found that capture rates were lowest in the fourth quarter and highest in the first quarter. This information suggests that constraining the fishery to the east (either east of 150° W. or 140° W. longitude) would reduce seabird impacts.

Effects of Other Features of the Alternative

As discussed above for marine mammals, some of the sea turtle conservation measures could also reduce impacts to seabirds. There is no information suggesting that circle hooks affect seabird capture rates. To the degree that sea turtle take caps limit the actual amount of fishing effort expended during a fishing year, this could reduce the capture of seabirds in comparison to an unconstrained fishery. The requirement for 100 percent observer coverage may also limit the actual amount of fishing effort, because of limits on the number of observers or, if an industry-funded observer program were recommended, the effect of the cost on participation.

The gear substitution effect discussed above for marine mammals could potentially increase the overall impact on seabirds if effort shifted from gear types (such as DGN) with lower seabird capture rates.

4.5.2.4 *Alternative 3 (Large Limited Entry Program) and Alternative 4 (Open Access)*

The fishing effort estimate for an unconstrained fishery is about 1.8 million hooks, or slightly larger than what has been estimated for the historical West Coast fishery. This would increase the risk of short-tailed albatross being taken, potentially to a level above that discussed in the USFWS BO for the HMS FMP (USFWS 2004). Under both these alternatives the fishery would be prohibited west of 140° W. longitude. As discussed above, this could reduce the seabird capture rate both because of the geographic and seasonal distribution of seabirds and how such a limitation could affect the seasonal distribution of fishing effort. Computing the capture rates from the Carretta data set only for sets east of 140° and adjusting them as discussed above, the estimated black-footed albatross captures in this fishery would be 90-124 while for Laysan it would be 2-3. As discussed above, accounting for drop-off would increase the upper bound of these estimates to 153 black-footed and 4 Laysan. These estimates do not account for any effect the area closure would have on the seasonal distribution of effort.

4.5.3 Seabird Cumulative Effects

Section 3.5.4 describes other actions and trends affecting seabirds. North Pacific longline fisheries are likely the largest source of human-induced mortality, although the Hawaii pelagic longline fishery has implemented mitigation measures that have substantially reduced seabird incidental catch. Designation of the NWHI as a Marine National Monument may also mitigate human-induced mortality by protecting important habitat.

The proposed fishery would add incrementally to fishery-related seabird mortality. Estimates of this incremental increase are discussed above under direct and indirect impacts.

4.5.4 Summary of Seabird Impacts

Will Short-tailed Albatross Take Exceed the HMS FMP BO ITS?

The likelihood of a short-tailed albatross take would increase with the size of the fishery authorized. In comparison to the historical Hawaii and West Coast SSLL fisheries operating without seabird mitigation measures, the risk would be relatively reduced. Under Alternative 2, a fishery authorized at a smaller size than the proposed maximum of 20 vessels would have a small risk of taking a short-tailed albatross, less then what was evaluated in the HMS FMP BO (USFWS 2004). A 20-vessel fishery would approach the risk of a take as discussed in the BO. Under Alternatives 3 and 4, the risk could exceed that identified in the BO, increasing the likelihood that the ITS of one short-tailed albatross taken per year in all HMS FMP fisheries is exceeded. Sea turtle take caps and 100 percent observer coverage proposed under the action alternatives act as additional constraints on fishing effort and may reduce the likelihood of short-tailed albatross takes.

Will Black-footed and Laysan Albatross Captures Degrade the Status of the Species?

Although the alternatives as adopted by the Council do not specifically address seabird mitigation measures, for the purposes of this analysis it has been assumed that the regulatory requirements for seabird mitigation would be comparable to those applicable to the Hawaii pelagic longline fishery. Furthermore, the regulations pursuant to the HMS FMP include seabird mitigation measures that were not previously applicable to West Coast pelagic longline fisheries. Estimates of the number of black-footed and Laysan albatrosses that may be captured in the proposed fishery were discussed above. Additional captures are likely to be small, especially for a fishery of fewer than 20 vessels under Alternative 2. This level of mortality is not likely to have a substantial effect on these seabird populations. Of the two species there is greater concern for black-footed albatross both because the number of birds caught is likely to be higher and the status of the population. As noted in Section 3.5.2 the IUCN lists this species as "Endangered." The USFWS is also considering a petition to list this species under the ESA.

4.6 Socioeconomic Impacts (Fisheries, Communities)

4.6.1 Evaluation Criteria

The following evaluation criteria have been developed to asses socioeconomic impacts:

- Is the proposed fishery economically viable for individual participants?
- What are the personal income and employment impacts at the community level?

4.6.2 Direct and Indirect Impacts

4.6.2.1 *Estimating Economic Viability*

Stephen Stohs, economist at the NMFS SWFSC, modeled the potential economic viability of the proposed fishery under different sets of constraints (number of permits, fishing area, season start date, sea turtle take caps, and limited observer coverage) using the estimates of fishing effort described in Section 4.1 (2009, see Appendix B). The effort estimates described in Section 4.1 do not account for potential effects of limited availability of observer coverage or reaching a turtle cap before the season ends while Stohs' analysis explores their potential constraining effect on fishing effort in the proposed fishery. Economic viability is assessed based on estimates of accounting profit (variable profits minus fixed costs) and economic profit (accounting profit minus opportunity cost).[26] The results are shown in Table 4-16 for six scenarios. The first five scenarios assume observer coverage is constrained to 785 sets, reflecting a revised contractual arrangement which would allow for more observer coverage than what could be funded out of the current contract (Lyle Enriquez, NMFS SWR Observer Program, personal communication, 2009); the sixth scenario constrains observer availability to 300 sets, reflecting only the sea days of observer coverage which could be funded out of the current contract.[27] Figure 4-1 shows aggregate economic profit under the economic viability scenarios, which is simply the product of the number of vessels and the per-vessel economic profit.

[26] See Appendix B for definitions of these terms.

[27] The estimated numbers of sets are conservative from the standpoint that it is possible that more observer coverage could become available and optimistic in the sense that no allowance was built into the estimates for days spent transiting to the fishing grounds and back to port.

Table 4-16. Economic viability under different sets of constraints for different size fisheries (Source: Stohs 2009).

Number of Vessels

1. Base Case (All Areas, Leatherback Cap = 8, Loggerhead Cap = 9, Q1 Season Start)

	5	10	15	20	30
Total Expected Effort	142.8	78.5	52.3	39.2	26.2
Total Expected Revenues	$3,284,331	$3,610,377	$3,610,377	$3,610,377	$3,610,377
Per Vessel Accounting Profit	$283,361	$118,383	$51,286	$17,738	($15,810)
Per Vessel Economic Profit	$221,625	$79,988	$22,389	($6,410)	($35,209)

2. Area Restriction 1 (E of 150, Leatherback Cap = 8, Loggerhead Cap = 9, Q1 Season Start)

	5	10	15	20	30
Total Expected Effort	142.8	78.5	52.3	39.2	26.2
Total Expected Revenues	$3,058,546	$3,362,058	$3,362,058	$3,362,058	$3,362,058
Per Vessel Accounting Profit	$238,204	$93,551	$34,732	$5,322	($24,088)
Per Vessel Economic Profit	$176,468	$55,156	$5,835	($18,826)	($43,486)

3. Area Restriction 2 (E of 140, Leatherback Cap = 8, Loggerhead Cap = 9, Q1 Season Start)

	5	10	15	20	30
Total Expected Effort	142.8	78.5	52.3	39.2	26.2
Total Expected Revenues	$2,714,705	$2,983,315	$2,983,315	$2,983,315	$2,983,315
Per Vessel Accounting Profit	$169,436	$55,677	$9,482	($13,615)	($36,712)
Per Vessel Economic Profit	$107,700	$17,282	($19,415)	($37,763)	($56,111)

4. Lower Turtle Caps (All Areas, Leatherback Cap = 4, Loggerhead Cap = 5, Q1 Season Start)

	5	10	15	20	30
Total Expected Effort	142.8	78.5	52.3	39.2	26.2
Total Expected Revenues	$3,284,285	$3,610,298	$3,610,298	$3,610,298	$3,610,298
Per Vessel Accounting Profit	$283,357	$118,380	$51,284	$17,736	($15,811)
Per Vessel Economic Profit	$221,621	$79,985	$22,388	($6,411)	($35,210)

5. Fourth Quarter Start (All Areas, Leatherback Cap = 8, Loggerhead Cap = 9, Q4 Season Start)

	5	10	15	20	30
Total Expected Effort	142.8	78.5	52.3	39.2	26.2
Total Expected Revenues	$3,284,572	$3,610,618	$3,610,618	$3,610,618	$3,610,618
Per Vessel Accounting Profit	$283,409	$118,407	$51,303	$17,750	($15,802)
Per Vessel Economic Profit	$221,673	$80,012	$22,406	($6,398)	($35,201)

6. Limited Observer Coverage (All Areas, Leatherback Cap = 8, Loggerhead Cap = 9, Q1 Season Start)

	5	10	15	20	30
Total Expected Effort	60	30	20	15	10
Total Expected Revenues	$1,379,585	$1,379,585	$1,379,585	$1,379,585	$1,379,585
Per Vessel Accounting Profit	$70,910	($5,999)	($31,635)	($44,453)	($57,271)
Per Vessel Economic Profit	$39,230	($26,789)	($48,795)	($59,798)	($70,801)

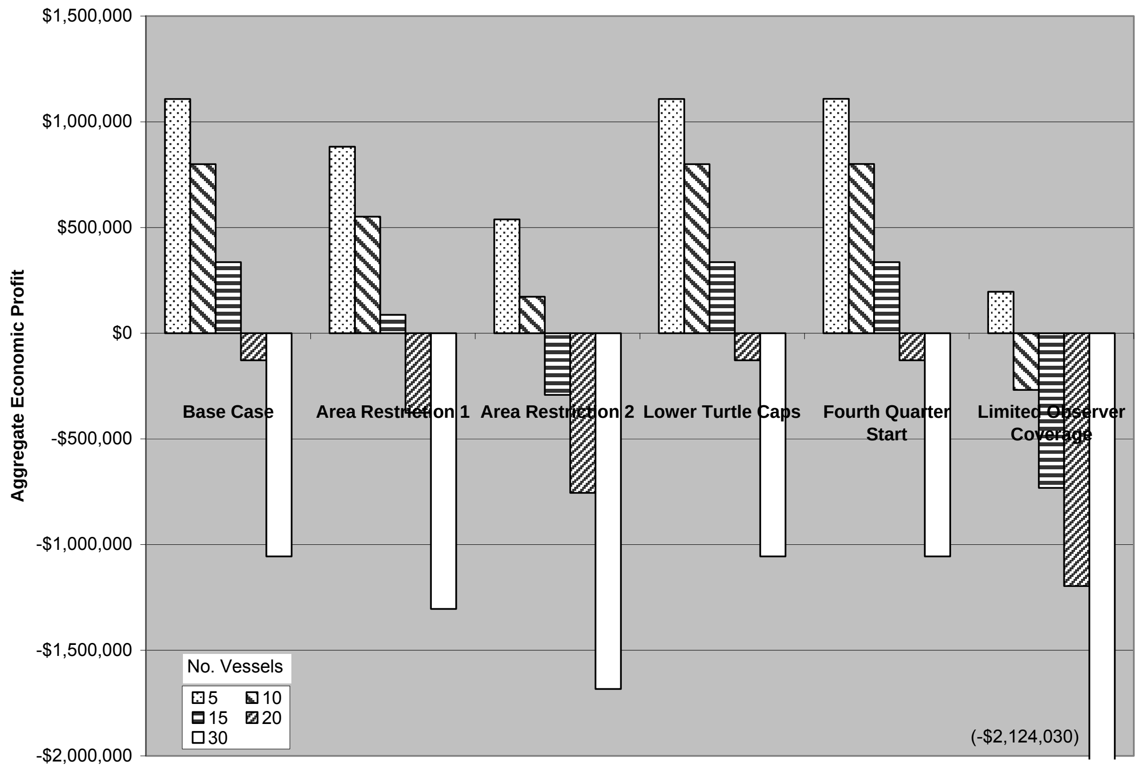

Figure 4-1. Aggregate economic profit under the economic viability scenarios.

4.6.2.2 *Alternative 1 (No Action)*

Under No Action the SSLL fishery would not be authorized. The socioeconomic impacts would be neutral since there would be no increase (or decrease) in income and employment over baseline trends.

4.6.2.3 *Alternative 2 (Limited Entry)*

Number of Permits

The results shown in Table 4-16 show the highest expected economic profit per vessel under each scenario occurs for the case with five vessels, with expected economic profit per vessel declining for each scenario as the number of vessels increases. This follows through to the calculation of aggregate economic profit shown in Figure 4-1. This is partly due to the assumption that effort per participant will be higher with fewer participants (the "highliner effect" discussed in Section 4.1). In addition, the effect of constraints (take caps, observer coverage) are spread over fewer vessels. All the scenarios, except for limited observer availability, show economic viability as measured by positive expected economic profit for up to 10 vessels, and negative economic profit under each scenario for a fishery with 30 vessels. Under the scenarios with a low observer coverage constraint (300 sets) and the one with fishing area restricted to east of 140° W. longitude, expected economic profit turns negative between 5 and 10 vessels.

Area Closure Options

The area closure options reduce economic profit in comparison to the base case scenario, due to limitations on participating fishers' choice of the most economically viable area to fish. Constraining the fishery east of 140° W. longitude would have a greater negative effect on economic viability than would constraining the fishery to east of 150° longitude.

Effects of Other Features of the Alternative

Imposition of sea turtle take caps is assumed for all the economic viability scenarios (since it is a feature of all the action alternatives) so a comparison to a fishery not constrained by take caps is unwarranted. However, the lower turtle take caps (Scenario 4, which assumes they would be set at five loggerheads and four leatherbacks) have no material effect on the estimate of economic viability in comparison to the base case. According to Stohs this is "due to the upper bound assumption of 785 available observer sets and the low probability a turtle cap would be reached by the time that many sets had occurred." Limiting available observer coverage to 300 sets (Scenario 6), which approximates current levels of observer availability, has a substantial effect on economic viability. As noted above, economic viability turns negative at between 10 and 15 vessels under this scenario. The risk of hitting a turtle cap at either of the cap levels used in the economic viability analysis would have a negligible effect on economic viability under either assumption about the availability of observer coverage.

Although not proposed under the action alternatives, Stohs evaluated the effect of a fourth quarter (October 1st) start date for opening the fishery. This would put the start of fishing at the time of year when CPUE (and thus revenue per unit of effort) is higher. This would have a small positive impact on economic viability. However, administrative and other logistical effects of having a fishery start date different from the start of the fishing year defined in the HMS FMP are unknown.

4.6.2.4 *Alternative 3 (Large Limited Entry Program) and Alternative 4 (Open Access)*

Since the number of vessels participating in the fishery is effectively unlimited under Alternatives 3 and 4 an estimate of 30 vessels has been used for evaluation purposes (see Section 4.1 for rationale). Under both of these alternatives the fishery would be constrained to east of 140° W. longitude. According to the economic viability scenario with this constraint economic profit would be negative, suggesting that these alternatives are not economically viable, due to the likelihood that on average, participants would not be able to earn enough revenues from catching and selling swordfish to cover their fixed and variable costs of fishing effort.

4.6.3 Cumulative Effects

Section 3.6.3 describes other actions and trends affecting demand and input costs. As noted, the current economic downturn is likely to affect demand for swordfish, at least over the short term. This could result in falling prices. Depending on the general macroeconomic climate, any such changes could be compensated by changes in input costs. Consumer perception that the proposed fishery has adverse environmental effects could have a marginal effect on demand. If consumers are able to discriminate between swordfish caught in this fishery in comparison to swordfish caught in other fisheries with higher adverse impacts (e.g., longline fisheries not using circle hooks and mackerel-type bait) it could have a positive effect on demand. However, the proposed fishery is small in comparison to total U.S. demand (13,226 mt in 2006, see Table 3-16 in NMFS and PFMC 2007). About three-quarters of U.S. demand comes from imports, which likely come from fisheries with greater environmental impacts. Thus, for high awareness consumers, swordfish from the proposed fishery could offer an acceptable alternative. On March 5, 2008, NMFS received a petition for Federal rulemaking pursuant to section 101(a)(2) of the MMPA, which requires a ban on importing fish "which have been caught with commercial fishing technology which results in the incidental kill or incidental serious injury of ocean mammals in excess of United States standards" (73 FR 75988). The petition focused on imports of swordfish from countries that have not satisfied the MMPA requirement. NMFS is currently considering the petition. If the Federal government were to impose a ban on some or all imports based on the merits of the petition, this could substantially increase demand from domestic fisheries found to be compliant with applicable law.

4.6.4 Summary of Socioeconomic Impacts

Is the Proposed Fishery Economically Viable for Individual Participants?

According to Stohs' analysis of economic viability, a fishery under Alternative 2 with up to 15 vessels would be economically viable, defined as having a positive expected economic profit, under most scenarios analyzed. The exceptions are the case with the fishing area restricted to east of 140° W. longitude and the case with observer coverage limited to 300 sets. Higher levels of viability (economic profit) are estimated for a fishery with fewer numbers of participants. Since the modeled limit on observer coverage (Scenario 6) has a substantial effect on economic profit, if this constraint were combined with an area closure the resulting fishery would only be expected to be viable with a small number of vessels. No alternative is expected to be economically viable with 10 or more participating vessels based on estimates of economic profit if only the current level of observer coverage is available.

What are the Personal Income and Employment Impacts at the Community Level?

Personal income impacts at the community level are a function of returns directly to fishery participants and the effect of their expenditures on the local economy. These impacts are sometimes modeled using regional econometric models; however, no such modeling has been done for this impact analysis. Instead, ex-vessel revenue (estimated as part of the economic viability model) is compared to ex-vessel revenue across all fisheries in Southern California counties (see Table 4-17). Based on information in the HMS FMP it is expected that landings would be made to ports in these counties. It is less likely, although possible, that landings would also occur in Central California ports. Total expected revenue values (Table 4-16) range from about $1.4 to $3.6 million, depending on the scenario. This is substantial compared to region-wide HMS ex-vessel revenue shown in Table 4-17 ($2.9 million). The high end of the range represents about 6 percent of ex-vessel revenues from all fisheries in the region.

It is important to note that any fishing effort in the proposed fishery that represents a shift from other fisheries, such as DGN, would have less impact on personal income than if the activity represented entirely new effort.

The proposed fishery would likely have a modest impact on employment, both because the proposed fishery would likely include a small number of vessels and some employment could represent a shift from other fisheries, depending on the degree to which use of this gear substitutes for other gear types used to target swordfish on the West Coast (particularly DGN).

Table 4-17. Ex-vessel revenue in selected California counties, 2008, by species group. (Source: PacFIN 1981-2008 W-O-C All Species by County data set.)

Species Group	Santa Barbara	Ventura	Los Angeles	Orange	San Diego	Regional Total
CPS	$3,914	$11,879,677	$16,990,508		$642	$28,874,741
Crab	$687,214	$327,030	$213,724	$21,764	$108,077	$1,357,809
Groundfish	$209,620	$293,563	$549,640	$330,775	$190,175	$1,573,773
HMS	$85,531	$120,787	$1,241,732	$80,315	$1,419,352	$2,947,717
Other	$5,292,022	$4,287,067	$3,329,914	$1,476,969	$3,919,515	$18,305,487
Salmon	$0	$0	$0	$0	$0	$0
Shrimp	$476,107	$1,396,571	$791,064	$316,931	$435,974	$3,416,647
Total	$6,754,408	$18,304,695	$23,116,582	$2,226,754	$6,073,735	$56,476,174

CHAPTER 5 CONSISTENCY WITH THE MSA NATIONAL STANDARDS

Completed after Council final action.

CHAPTER 6 OTHER APPLICABLE LAW

6.1 Other Federal Laws

6.1.1 Coastal Zone Management Act

Section 307(c)(1) of the Federal 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. The Council's preliminary 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 Washington, Oregon, and California. This determination will be submitted to the responsible state agencies for review under Section 307(c)(1) of the CZMA. The HMS FMP has been found to be consistent with the Washington, Oregon, and California coastal zone management programs (PFMC 2003, see Section 10.7). The recommended action is consistent and within the scope of the actions contemplated under the framework FMP.

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 endangrered or threatened marine species or adversely modify designated critical habitat. NMFS PRD will conduct a Section 7 consultation for these species based on the preferred alternative. For other ESA-listed species the USFWS is the lead agency. NMFS has informed the USFWS of the proposed action; USFWS will determine whether a formal Section 7 consultation is required.

6.1.3 Marine Mammal Protection Act

The MMPA of 1972 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 U.S. Fish and Wildlife Service is responsible for walrus, sea otters, and the West Indian manatee.

Sections 3.4 and 4.4 describe the marine mammals species that occur in the action area and those likely to be affected by the proposed action.

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 is a shared agreement between the United States, Canada, Japan, Mexico, and Russia to protect a common migratory bird resource. The MBTA prohibits the directed take of seabirds, but the incidental take of seabirds does occur. Impacts to seabirds are evaluated in Section 4.5.

6.1.5 Paperwork Reduction Act

The purposes of the Paperwork Reduction Act (PRA) are to minimize the burden of information collection by the Federal Government on the public; maximize the utility of any information thus collected; improve the quality of information used in Federal decision making, minimize the cost of collection, use, and dissemination of such information; and improve accountability. The PRA requires Federal agencies to obtain clearance from the Office of Management and Budget before collecting information. This clearance requirement is triggered if certain conditions are met. "Collection of information" is defined broadly. In summary it means obtaining information from third parties or the public by or for an agency through a standardized method imposed on 10 or more persons. Collection of information need not be mandatory to meet the trigger definition. Even information collected by a third party, if at the behest of a Federal agency, may trigger the clearance requirement. Within NMFS the Office of the Chief Information Officer is responsible for PRA compliance. Obtaining clearance can take up to 9 months and is one aspect of NMFS's review and approval of Council decisions.

The proposed action, as implemented by any of the alternatives considered in this EIS, may require collection-of-information subject to the Paperwork Reduction Act.

6.1.6 Regulatory Flexibility Act

The purpose of the RFA is to relieve small businesses, small organizations, and small governmental entities of burdensome regulations and record-keeping requirements. Major goals of the RFA are; (1) to increase agency awareness and understanding of the impact of their regulations on small business, (2) to require agencies communicate and explain their findings to the public, and (3) to encourage agencies to use flexibility and to provide regulatory relief to small entities. The RFA emphasizes predicting impacts on small entities as a group distinct from other entities and the consideration of alternatives that may minimize the impacts while still achieving the stated objective of the action. An IRFA is conducted unless it is determined that an action will not have a "significant economic impact on a substantial number of small entities." The RFA requires that an IRFA include elements that are similar to those required by EO 12866 and NEPA. Therefore, the IRFA has been combined with the RIR and both are substantially based on the analyses contained in this EIS document. Appendix X summarizes the analytical conclusions specific to the RFA and EO 12866.

6.2 Executive Orders

6.2.1 EO 12866 (Regulatory Impact Review)

EO 12866, Regulatory Planning and Review, was signed on September 30, 1993, and established guidelines for promulgating new regulations and reviewing existing regulations. The EO covers a variety of regulatory policy considerations and establishes procedural requirements for analysis of the benefits and costs of regulatory actions. Section 1 of the EO deals with the regulatory philosophy and principles that are to guide agency development of regulations. It stresses that in deciding whether and how to regulate, agencies should assess all of the costs and benefits across all regulatory alternatives. Based on this analysis, NMFS should choose those approaches that maximize net benefits to society, unless a statute requires another regulatory approach.

The RIR and IRFA determinations are part of the combined summary analysis in Appendix X of this document.

6.2.2 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.

In support of environmental analyses supporting Council groundfish actions, 2000 census data have been analyzed to identify coastal communities that may be considered low income and/or having a large minority population (PFMC 2004, Appendix A, Section 8.5) and "communities of concern" because their populations have a lower income or a higher proportion of minorities than comparable communities in their region. As discussed in that analysis (PFMC 2004, page 299) the demographic characteristics of ports in urbanized areas may not accurately reflect what groups will be affected by fishery actions. This is the case for many of the ports in the Southern California region that vessels in the proposed fishery would operate from. 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. Because of the limited scope of the proposed action it is unlikely to disproportionately affect low income or minority populations.

6.2.3 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.

6.2.4 EO 13175 (Consultation and Coordination with Indian Tribal Government)

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.

The Secretary recognizes the sovereign status and co-manager role of Indian tribes over shared Federal and tribal fishery resources. At Section 302(b)(5), the MSA 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 proposed action does not affect fish stocks or fisheries in which Tribes have a treaty right or substantial participation.

6.2.5 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 discusses impacts to seabirds.

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Appendix A: Analysis of Permit Qualification Options

Alternative 2 includes four different options for determining the pool of individuals that would potentially qualify for permits. To varying degrees the options evaluate landings from or participation in the west-coast-based SSLL and DGN swordfish fisheries. Data for this evaluation were derived from the Pacific Fisheries Information Network (PacFIN) and the California Department of Fish and Game (CDFG) records. It should be emphasized that as part of the program implementation, any data used to determine qualification for a limited entry permit will have to be verified; thus the evaluation provided here may not exactly match results after such verification (see Section 2.2.3.1). In total, there are 92 vessels with longline landings of swordfish from 1996-2007, but only 42 of these vessels meet the recent landings requirement. There are 174 DGN permit holders that made landings from 1996-2007, but only 83 meet the recent landings requirement.

Option 1 considers the sum of landings for each vessel participating in the West Coast SSLL and DGN fisheries. A total of 112 vessels potentially qualify under this option. Of these 112 vessels, 70 made only DGN landings, 13 made both DGN and SSLL landings, and 29 made only SSLL landings. Table A-6 shows the rank of potential qualifiers under Option 1. To address confidentiality requirements landings are reported as a percent of the median value. The first column shows which fishery the landings came from. It can be seen that this option generally favors those vessels that participated in both fisheries, since four out of the top five have landings from both, although the top-ranked vessel has only DGN landings. In the top 20, nine vessels participated only in the DGN fishery, seven have landings from both, and four have only SSLL landings.

A total of 68 DGN permit holders qualify under Option 2. This option is based on awarding points according to four criteria. All of the criteria include a requirement to own a DGN permit in 2007, yielding 68 potential qualifiers. As seen in Table A-7, the scoring system results in many ties. The tiebreaker rule under this option largely reduces this to a landings-based system. However, as seen in the Table A-7, the second criterion, having longline-caught swordfish landings in 2007, strongly influences the rankings.[28] There are only three permit holders that had longline swordfish landings, thus the additional point they are allotted for this (along with the fact that they meet the other criteria and are long-time participants in the DGN fishery) gives them an advantage. These top ranked qualifiers have DGN landings lower than those below them on the ranking; overall their DGN landings rank 6th, 18th, and 48th, respectively, while the individual ranked fourth has the highest landings amount. The individuals ranked 4th through 50th all tie at 14 points, so the tiebreaker rule using total amount of swordfish landings determine their rankings. The remaining 18 permit holders at the bottom of the list have scores of 13 (6 permit holders), 12 (4 permit holders), 11 (1 permit holder), 10 (1 permit holder), 7 (2 permit holders), 6 (1 permit holder), 5 (2 permit holders), and 4 (1 permit holder). Thus, the scoring system more strongly influences rankings at the bottom of the list, but this would not affect who would receive one of the 20 permits.

Note that under Option 2, it is proposed that a weighting factor could be applied to criterion 4, the number of years owning a permit. However, since all of the top-ranked permit holders have the same value for this criterion applying a weight would not alter the results.

Option 3 only considers SSLL landings. Rather than being based on the amount of landings, this option favors overall activity in the fishery by counting the number of landings and the number of years in

[28] As discussed previously, SSLL swordfish landings could only be made with a Hawaii permit in 2007. Those vessels showing landings could have been Hawaii-permitted vessels or vessels targeting tuna with longline gear, which are allowed to retain up to 10 incidentally-caught swordfish per trip.

which landings were made. As noted above, 42 SSLL vessels potentially qualify when the recent landings requirement is considered. The results are shown in Table A-8. As shown in the table, the value for number of landings has been scaled so that those values fall within the range of values for years with landings (i.e., 1-9). This was done by simply multiplying the actual number of landings by 0.45455, which is 9 divided by 198, the value of the highest number of landings.

Comparing Options 1 and 3 with Option 2 is somewhat difficult because Options 1 and 3 are based on landings attributed to vessels, while Option 2 attributes landings to permits. Some DGN permit holders operate different vessels, so a permit may be associated with the landings from several different vessels, and by the same token the landings for a given vessel (used in Option 1) can be attributed to different permit holders (used for the tiebreaker in Option 2). The 68 DGN permit holders included under Option 2 are associated with 76 vessels, of which 17 vessels are associated with two or more permits. Of the 68 permits, 21 have fished on more than one vessel.

This difference between the options also makes it difficult to evaluate the combined scoring system proposed under Option 4. There are two reasons for this. First, Options 1 and 3 are based on vessels, while Option 2 is based on permits. The approach taken was to match vessels owner names in Option 1 to permit names in Option 2 (only longline vessels are included in Option 3 and all these vessels are also included in Option 1, so they can be matched directly to the vessels in Option 1). Vessel owner information was obtained from the U.S. Coast Guard vessel documentation database.[29] However, there are several situations that make it difficult to ensure all matches can be made: 1) the vessel does not have a U.S. Coast Guard documentation number (just a State of California vessel identification number); 2) ownership information for a vessel is missing from the database; 3) the registered owner of a vessel is a corporation or other business entity that does not match a permit holder name; and 4) the vessel owner is a spouse or someone else with a different first name. For the purposes of this analysis, in cases where first names differed but the addresses matched, it was assumed that the permit holder and vessel owner were the same. Also there were a few cases where landings under Option 2 were only associated with a single vessel, which was also a vessel under Option 1; in these cases it was also assumed that the vessel owner and permit holder were the same. The vessel documentation database contains vessel ownership information for vessels with current issuance and expiration dates on their Certificate of Documentation, or which have not exceeded their expiration date by more than 180 days. The evaluation assumes these are the current owners and therefore attributes landings to the current vessel owner, not the owner at the time the landings were made.

The second issue was how to calculate the score for Option 4 since each of the options uses a different scoring system. Option 2 is especially problematic since it combines both a point score and the landings-based tiebreaker. The approach taken was simply to scale the rankings in each option (descending order rank divided by the highest rank value) and take the sum. Since there are different numbers of qualifiers under each of the options (112, 68, and 42) this approach will give somewhat greater weight to scores from the options with smaller qualification pools since the incremental value for a given rank is greater. (i.e., Option 3 gets more weight than Options 2 and 1, Option 2 gets more weight than Option 1). The results of this scoring approach are shown in Table A-9.

Table A-1 compares those vessels ranked in the top 20 under Option 1 that are associated with permits ranked in the top 20 under Option 2. It can be seen that there are nine top-20 ranked vessels associated with 11 unique top-20 ranked permits. Four vessels are associated with more than one permit and the 16th ranked permit fished on four different vessels.

[29] http://www.st.nmfs.noaa.gov/st1/CoastGuard/VesselByName.html

Table A-1. Comparison of vessels ranked in the top 20 under Options 1 and 2.

Option 1 Vessel Rank	Option 2 Permit Rank
1	4, 16
6	6
8	8, 16
9	12, 16
10	14
12	5
16	1, 7, 16
17	11
19	9

Comparing Option 1 with Option 3 in a similar fashion yields the results shown in Table A-2 below. There are 10 vessels that fall in the top 20 under both Option 1 and Option 3. Note that Option 3 only considers SSLL landings, so all the vessels with only DGN landings under Option 1 would not qualify under Option 3 (i.e., those ranked 1, 6, 8, 10, etc.). Furthermore, the vessel ranked 19th under Option 1 ranks 42nd under Option 3 and is not shown in the table.

Table A-2. Comparison of vessels ranked in the top 20 under Options 1 and 3.

Option1 Rank	Option3 Rank
2	3
3	16
4	2
5	8
7	19
9	1
11	20
13	13
14	6
15	9

Since Option 3 includes only vessels that fished in the SSLL fishery there are relatively few commonalities with Option 2 permit holders. Table A-3 below shows those DGN permit holders by rank (in the top 20 under Option 2) associated with vessels in the top 20 under Option 3. Five DGN permit holders under Option 2 are associated with four vessels under Option 3. The top ranked DGN permit holder is associated with two vessels while two vessels are associated with more than one DGN permit holder.

Table A-3. Comparison of drift gillnet permit holders in the top 20 under Options 2 and 3.

Option 2 Permit Rank	Option 3 Vessel Rank
1	7, 15
2	4
12	1
16	1
17	4

The evaluation of Option 4 offers another way of looking at the overlap in individuals between the first three options. As noted above, there are several caveats that may mean that not all permit holders have been matched to a vessel they own. With this in mind, Figure A-1 is a Venn diagram indicating the number of qualifying permits/vessels that overlap among each of the first three options. Adding together the numbers contained in one circle will give the total number in the qualification pool for that option (e.g., for Option 1, 31 + 39 + 6 + 36 = 112). It can be seen that no individual only qualifies under Option 3 (they all also qualify under Option 1 or all three options). Likewise, there is no overlap between Options 2 and 3. Comparing this with Table A-9, it can be seen that the six individuals who are in all three qualification pools also are all in the top 20 under the scoring system used for Option 4.

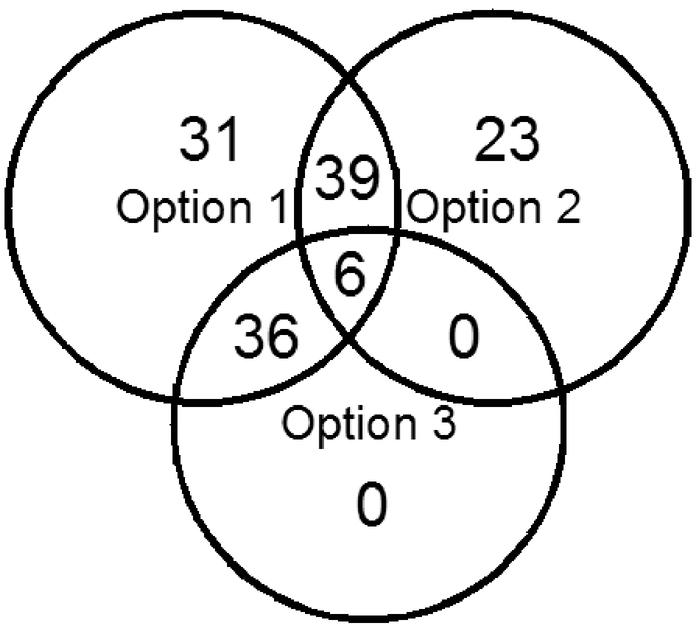

Figure A-1. Overlap between options based on Option 4 evaluation.

Table A-4 evaluates where vessel/permit owners rank under Option 4 in comparison to where they rank under the other options. Reading across, the first row shows how many individuals rank in the top 5 under Option 4, and also rank in the top 5, 6-10, etc. for each of the other three options. For example, three individuals rank in the top 5 under Option 4 and also rank in the top 5 under Option 1; in addition, all of the individuals ranked in the top 5 under Option 1 rank in the top 20 under Option 4.

Table A-4. Comparison of ranks of vessel/permit owners under all Option 4 and all other options.

	Option 1						Option 2						Option 3					
Option 4	1-5	6-10	11-15	16-20	>20	Total	1-5	6-10	11-15	16-20	>20	Total	1-5	6-10	11-15	16-20	>20	Total
1-5	3	1			1	5	2		1			3	3	1				4
6-10	1	1	1	1	1	5	1	2				3		2			1	3
11-15		1		3	1	5		1	2		1	4		1	1		1	3
16-20	1		1		3	5	1	1	1			3			1	1	1	3
Total	5	3	2	4	6	20	4	4	4	0	1	13	3	4	2	1	3	13

Under Alternative 3, the open access fishery, any individual who made at least one swordfish landing from 2005 to 2007 would qualify for a limited entry permit. According to CDFG records, 98 individuals would qualify. Table A-5 shows the types of gear used to make these landings and the number of individuals who used each gear type. Because an individual may have used more than one gear type, the total is greater than 98.

Table A-5. Number of individuals and gear types used to make swordfish landings, 2005-2007.

Gear Type	Number
Hook and line	3
Vertical hook and line	1
Longline, set	5
Troll, albacore	1
Harpoon/spear	45
Diving	1
Gillnet, drift	55
Gillnet, set	4
TOTAL	114

Table A-6. Landings under Option 1.

Fishery	Rank	Total landings as % of median	Fishery	Rank	Total landings as % of median
DGN	1	2255.5%	DGN	44	288.9%
Both	2	1508.4%	DGN	45	243.4%
Both	3	1433.5%	DGN	46	211.3%
Both	4	1380.7%	DGN	47	207.5%
Both	5	1261.0%	DGN	48	201.8%
DGN	6	1218.5%	DGN	49	198.6%
LL	7	1168.6%	DGN	50	191.8%
DGN	8	1012.3%	DGN	51	188.0%
Both	9	998.7%	LL	52	182.7%
DGN	10	951.3%	DGN	53	128.4%
Both	11	950.7%	DGN	54	109.4%
DGN	12	917.6%	DGN	55	106.8%
LL	13	888.4%	DGN	56	100.7%
LL	14	838.9%	DGN	57	99.3%
LL	15	818.0%	DGN	58	61.0%
DGN	16	807.1%	DGN	59	48.7%
DGN	17	781.3%	DGN	60	48.5%
DGN	18	755.6%	DGN	61	41.2%
Both	19	751.9%	DGN	62	39.9%
DGN	20	718.5%	Both	63	35.6%
LL	21	702.8%	DGN	64	29.9%
Both	22	696.9%	DGN	65	27.0%
DGN	23	686.2%	DGN	66	22.2%
Both	24	662.1%	DGN	67	21.7%
LL	25	659.6%	DGN	68	19.8%
DGN	26	622.5%	DGN	69	19.7%
DGN	27	587.4%	DGN	70	19.6%
DGN	28	564.1%	DGN	71	17.7%
DGN	29	562.5%	DGN	72	14.5%
DGN	30	530.3%	DGN	73	11.7%
DGN	31	475.8%	DGN	74	11.2%
LL	32	445.9%	DGN	75	10.7%
LL	33	380.0%	DGN	76	10.7%
DGN	34	378.0%	Both	77	10.0%
LL	35	362.6%	DGN	78	8.8%
Both	36	351.3%	DGN	79	8.7%
DGN	37	341.6%	DGN	80	8.3%
DGN	38	331.9%	Both	81	8.3%
LL	39	310.7%	DGN	82	4.7%
DGN	40	308.2%	DGN	83	4.5%
DGN	41	303.8%	DGN	84	4.4%
DGN	42	302.6%	DGN	85	4.4%
DGN	43	296.5%	DGN	86	3.8%

Table A–6 (cont.)

Fishery	Rank	Total landings as % of median
DGN	87	3.4%
LL	88	3.3%
DGN	89	3.1%
DGN	90	2.5%
DGN	91	2.4%
LL	92	2.3%
DGN	93	2.2%
LL	94	1.4%
DGN	95	1.2%
DGN	96	1.1%
LL	97	1.0%
LL	98	0.9%
LL	99	0.8%
LL	100	0.7%
DGN	101	0.7%
LL	102	0.7%
LL	103	0.7%
LL	104	0.6%
LL	105	0.6%
LL	106	0.6%
LL	107	0.5%
LL	108	0.4%
LL	109	0.4%
LL	110	0.4%
LL	111	0.3%
LL	112	0.2%

Table A-7. Qualifiers under Option 2.

Rank	Q1	Q2	Q3	Q4	Score	Tiebreaker as % of median	Tiebreaker Rank
1	1	1	1	12	15	539%	6
2	1	1	1	12	15	286%	18
3	1	1	1	12	15	49%	48
4	1	0	1	12	14	1124%	1
5	1	0	1	12	14	849%	2
6	1	0	1	12	14	645%	3
7	1	0	1	12	14	581%	4
8	1	0	1	12	14	577%	5
9	1	0	1	12	14	499%	7
10	1	0	1	12	14	402%	9
11	1	0	1	12	14	400%	10
12	1	0	1	12	14	367%	12
13	1	0	1	12	14	347%	13
14	1	0	1	12	14	330%	14
15	1	0	1	12	14	307%	15
16	1	0	1	12	14	296%	16
17	1	0	1	12	14	269%	19
18	1	0	1	12	14	262%	20
19	1	0	1	12	14	259%	21
20	1	0	1	12	14	243%	22
21	1	0	1	12	14	231%	23
22	1	0	1	12	14	223%	24
23	1	0	1	12	14	204%	25
24	1	0	1	12	14	181%	26
25	1	0	1	12	14	168%	27
26	1	0	1	12	14	160%	28
27	1	0	1	12	14	120%	32
28	1	0	1	12	14	105%	34
29	1	0	1	12	14	95%	35
30	1	0	1	12	14	93%	37
31	1	0	1	12	14	89%	38
32	1	0	1	12	14	83%	39
33	1	0	1	12	14	82%	40
34	1	0	1	12	14	76%	41
35	1	0	1	12	14	73%	42
36	1	0	1	12	14	67%	43
37	1	0	1	12	14	59%	45
38	1	0	1	12	14	52%	47
39	1	0	1	12	14	43%	50
40	1	0	1	12	14	42%	51
41	1	0	1	12	14	31%	52
42	1	0	1	12	14	30%	54
43	1	0	1	12	14	25%	56

Table A–7 Cont.

Rank	Q1	Q2	Q3	Q4	Score	Tiebreaker as % of median	Tiebreaker Rank
44	1	0	1	12	14	24%	57
45	1	0	1	12	14	16%	61
46	1	0	1	12	14	11%	62
47	1	0	1	12	14	8%	64
48	1	0	1	12	14	6%	66
49	1	0	1	12	14	2%	67
50	1	0	1	12	14	2%	68
51	1	0	1	11	13	469%	8
52	1	0	1	11	13	379%	11
53	1	0	1	11	13	293%	17
54	1	0	1	11	13	157%	29
55	1	0	1	11	13	139%	31
56	1	0	1	11	13	66%	44
57	1	0	1	10	12	113%	33
58	1	0	1	10	12	27%	55
59	1	0	1	10	12	24%	58
60	1	0	1	10	12	17%	60
61	1	0	1	9	11	11%	63
62	1	0	1	8	10	140%	30
63	1	0	1	5	7	55%	46
64	1	0	1	5	7	31%	53
65	1	0	1	4	6	94%	36
66	1	0	1	3	5	47%	49
67	1	0	1	3	5	22%	59
68	1	0	1	2	4	7%	65

Table A-8. Qualifiers under Option 3.

Rank	Number of landings, 1996-2007	Years 96-07 with landings	Scaled landings value	Total	Rank	Number of landings, 1996-2007	Years 96-07 with landings	Scaled landings value	Total
1	198	9	9.00	18.00	22	23	6	1.05	7.05
2	129	9	5.86	14.86	23	65	4	2.95	6.95
3	98	8	4.45	12.45	24	36	5	1.64	6.64
4	49	10	2.23	12.23	24	36	5	1.64	6.64
5	81	8	3.68	11.68	26	35	5	1.59	6.59
6	67	8	3.05	11.05	27	29	4	1.32	5.32
7	88	7	4.00	11.00	28	11	4	0.50	4.50
8	62	8	2.82	10.82	29	10	4	0.45	4.45
9	58	8	2.64	10.64	30	9	4	0.41	4.41
10	68	7	3.09	10.09	31	8	4	0.36	4.36
11	59	7	2.68	9.68	32	26	3	1.18	4.18
12	36	8	1.64	9.64	33	22	3	1.00	4.00
13	52	7	2.36	9.36	34	14	3	0.64	3.64
14	73	6	3.32	9.32	35	13	3	0.59	3.59
15	86	5	3.91	8.91	36	12	3	0.55	3.55
16	64	6	2.91	8.91	37	8	3	0.36	3.36
17	53	6	2.41	8.41	38	10	2	0.45	2.45
18	65	5	2.95	7.95	39	8	2	0.36	2.36
19	58	5	2.64	7.64	40	4	2	0.18	2.18
20	56	5	2.55	7.55	41	2	1	0.09	1.09
21	28	6	1.27	7.27	42	1	1	0.05	1.05

Table A-9. Summary of scoring under Option 4, ranked according to Option 4 score (right-hand column).

Fishery	Option 1 Rank	Option 2 Rank	Option 3 Rank	Option 4 Score
Both	9	12	1	2.766807
Both	77	1	7	2.178571
DGN	1	4		1.955882
Both	4		2	1.949405
Both	2		3	1.943452
Both	22	2	41	1.845413
DGN	8	8		1.834559
Both	5		8	1.797619
DGN	16	7		1.777836
LL	14		6	1.764881
Both	19	9	42	1.745448
DGN	10	14		1.728466
DGN	17	11		1.710084
LL	15		9	1.684524
DGN	36	55	11	1.655287
Both	81	3	27	1.637255
DGN	27	10		1.635504
Both	3		16	1.625
LL	13		13	1.607143
DGN	23	15		1.597689
DGN	30	13		1.564601
LL	7		19	1.517857
LL	32		10	1.508929
DGN	28	19		1.494223
Both	24		14	1.485119
LL	52		4	1.473214
Both	11		20	1.458333
LL	21		17	1.440476
DGN	31	22		1.423319
LL	39		12	1.39881
DGN	6	40		1.381828
DGN	44	20		1.33666
LL	25		21	1.309524
DGN	34	30		1.278887
DGN	41	26		1.27521
DGN	47	24		1.25105
DGN	55	21		1.223739
LL	33		22	1.214286
LL	88		5	1.127976
LL	35		24	1.125
DGN	59	27		1.09979
DGN	51	32		1.097689

Table A–9. Cont.

Fishery	Option 1 Rank	Option 2 Rank	Option 3 Rank	Option 4 Score
DGN	20	51		1.095063
DGN	54	31		1.085609
DGN	50	34		1.077206
DGN	53	33		1.065126
DGN	61	29		1.052521
Both	63		18	1.041667
DGN		5		0.941176
DGN		6		0.926471
DGN	12			0.901786
DGN	62	41		0.867122
DGN	42	54		0.854517
DGN	18			0.848214
DGN	46	56		0.789391
DGN	78	37		0.783088
DGN		16		0.779412
DGN	26			0.776786
DGN		17		0.764706
DGN		18		0.75
DGN	29			0.75
DGN	67	46		0.74895
DGN	43	62		0.727941
DGN	74	45		0.701155
DGN	38	67		0.699055
LL	110		15	0.693452
DGN	37			0.678571
DGN		23		0.676471
DGN	49	63		0.659664
DGN	40			0.651786
DGN		25		0.647059
DGN	48	66		0.624475
LL	92		24	0.616071
DGN	45			0.607143
DGN		28		0.602941
LL	100		23	0.592262
DGN	64	59		0.584559
LL	94		26	0.574405
DGN	57	64		0.573529
DGN	84	49		0.553046
DGN	56			0.508929
DGN		35		0.5
LL	97		28	0.5
DGN	58			0.491071

Table A–9. Cont.

Fishery	Option 1 Rank	Option 2 Rank	Option 3 Rank	Option 4 Score
DGN		36		0.485294
DGN	60			0.473214
DGN	96	48		0.460609
LL	99		29	0.458333
DGN		38		0.455882
DGN		39		0.441176
DGN	79	60		0.435924
DGN	65			0.428571
DGN	72	65		0.424895
DGN	66			0.419643
DGN	68			0.401786
LL	103		30	0.39881
DGN		42		0.397059
DGN	69			0.392857
DGN	70			0.383929
DGN		43		0.382353
DGN	71			0.375
DGN		44		0.367647
DGN	73			0.357143
LL	104		32	0.342262
DGN	75			0.339286
LL	107		31	0.339286
DGN	76			0.330357
LL	98		35	0.324405
DGN		47		0.323529
DGN	80			0.294643
DGN		50		0.279412
DGN	82			0.276786
DGN	83			0.267857
LL	108		34	0.258929
LL	111		33	0.255952
DGN		52		0.25
DGN	85			0.25
DGN	86			0.241071
LL	102		37	0.241071
DGN		53		0.235294
DGN	87			0.232143
LL	106		36	0.229167
DGN	89			0.214286
DGN	90			0.205357
DGN	91			0.196429
LL	105		38	0.190476

Table A–9. Cont.

Fishery	Option 1 Rank	Option 2 Rank	Option 3 Rank	Option 4 Score
DGN	93			0.178571
DGN		57		0.176471
DGN		58		0.161765
DGN	95			0.160714
LL	109		39	0.130952
DGN		61		0.117647
DGN	101			0.107143
LL	112		40	0.080357
DGN		68		0.014706

Appendix B: Economic Viability Analysis for SSLL Amendment 2 EIS

March 18, 2009

Stephen M. Stohs

Executive Summary

Economic viability of a shallow set longline (SSLL) limited entry permit system established under Amendment 2 to the HMS fishery management plan (FMP) would critically depend on the relationship between the number of permits issued, swordfish, other marketable species and protected turtle species catch rates, swordfish and other marketable species prices, costs of fishing and potential effort constraints due to regulatory requirements for sea turtle take caps and 100 percent observer coverage. This analysis measures the economic viability of alternative policy configurations. Economic viability is assessed based on estimates of accounting profit (variable profits minus fixed costs) and economic profit (accounting profit minus opportunity cost) for a representative participant in the SSLL fishery.

The steps in the method are outlined below:

1. Effort estimates for different numbers of permits developed by Kit Dahl are used to estimate the potential level of effort which could occur for each number of permits.

2. An estimate of the number of sets which could be covered by observers is applied as an upper limit on potential effort.

3. The historical distribution of fishing effort over quarters for the area which would be fished is used to allocate potential effort over quarters.

4. A probability model which reflects the risk of hitting a turtle cap is used to estimate the chance that effort will survive to any given number of sets up to the maximum potential level of effort.

5. Estimates of expected profit per set (adjusted for changes in swordfish CPUE and swordfish prices by quarter) are used in conjunction with expected effort in each quarter to estimate variable profits for the entire fleet. This quantity is divided by the number of participants to estimate variable accounting profits for a representative fisherman.

6. An estimate of the fixed cost of participation is subtracted from variable profits to estimate accounting profits for a representative participant.

7. An estimate of the opportunity cost of participation (based on what a fisherman could earn in alternative occupation) is subtracted from accounting profits to estimate economic profits.

The estimates derived in 6. and 7. can be used as indicators of economic viability. The potential to earn positive accounting profits would be a bare minimum requirement for economic viability, and positive economic profits would indicate the prospect of participating in an Amendment 2 fishery would compare favorably to alternative opportunities. The methodology is used to gauge the potential effects on the economic viability of the fishery of (i) the number of permits, (ii) the areas open to fishing, (iii) the quarter in which the season starts, (iv) the levels of turtle caps and (v) the availability of observers to cover trips.

Results of the economic viability analysis are shown in tables provided in Section IV of this report for six different scenarios under consideration. A qualitative summary of these results is provided below:

- Economic viability is generally highest for scenarios which assume the issuance of either five or ten limited entry permits, with expected accounting profits and economic profits decreasing under each scenario as the number of permits is increased.

- The most important parameter affecting economic viability for the scenarios presented in this report was the level of observer coverage, under the assumption that 100% observer coverage would be included as a regulatory requirement under FMP Amendment 2, with observer coverage availability constraining effort for all scenarios with ten or more participating vessels. As the number of permits increases, the potential level of (observed) effort per participant decreases, reducing the ability of a participant to cover the fixed costs of participation out of his variable profits.

- For the assumed levels of observer coverage, the risk of effort ending the season prematurely due to reaching a turtle cap (assuming cap levels of 8 leatherbacks and 9 loggerheads) is negligible. A large increase in the number of sets which could be observed could potentially increase the probability of hitting a turtle cap to a level where the risk of reaching it would be significant.

- Limiting the area where fishing effort is allowed to occur could potentially have a material negative impact on economic viability.

- Changing the season start date to the fourth quarter is expected to have little effect on economic viability, given the other assumptions used for this analysis.

- For scenarios with limited observer coverage availability (300 sets) or with area restrictions, viability drops off to low or negative levels as the number of permits increases to the high end of the range, suggesting that adequate observer coverage and the broadest possible area open to fishing would help to ensure an economically viable fishery.

I. Unconstrained Effort

Effort estimates developed by Kit Dahl were used to relate the average annual number of trips depending on the number of permits, and to derive the following estimates of proportional relationships between hooks, sets and trips:

Av. Hooks/set	748.75
Av. Sets/trip	20.39
Hooks/trip	15,267.92

This approach produced following overall annual effort estimates:

Vessels	Trips/vessel	Effort (hooks)
5	7	534,377
10	6	916,075
15	5	1,145,094
20	4	1,221,434
30	4	1,832,151

The California observer data was further used to stratify the resulting fleet effort by area and season, resulting in estimates of the percentage of effort that would occur in each quarter depending on whether the fishery occurred (1) without area restrictions; (2) east of 150 degrees west longitude; (3) east of 140 degrees west longitude. The resulting effort estimates are described at length in the SEIS. For purposes of estimating economic viability, they were used to develop estimates of the maximum effort which would occur in each quarter in a fishery with no other limits on effort besides potential area restrictions. The assumptions underlying the unconstrained effort estimates and the distribution of effort are further described in Appendix 1.

II. The Effect of Effort Constraints

Assuming turtle caps and 100 percent observer coverage would be used to limit incidental takes of loggerhead and leatherback turtles, effort in the SSLL fishery would potentially be constrained by the number of available observers and by the possibility a turtle cap would be reached before the end of the season.

Effort could also be limited by factors related to economic and environmental factors (including time) which bear on the decisions and ability to prosecute SSLL effort. The effort estimates developed in the previous section implicitly take into consideration season length and economic and environmental factors as they historically affected the fishery. They also reflect the estimated effect of the number of permits on effort, recognizing that fewer permits are likely to result in relatively more effort per participant, since fishers with high historical landings are likely to be given a higher formula ranking in determining qualification for a limited entry permit.

This section considers the additional effects of observer availability and turtle caps on limiting effort which could occur. We make the simplifying assumption that expected effort will occur at the levels and distribution over area and seasons which would occur under the effort model without constraints unless a turtle cap or limit in available observer coverage limits effort.

The Effect of Observer Availability on Allowable Effort

The effect of observer availability can be modeled by simply considering the available number of observers and making assumptions about a constant number of trips per observer and a constant number of sets per trip. For example, if there were ten observers available and each observer covered five trips, with fifteen sets per trip, the implied effort constraint would be 10 × 5 × 15 = 750 sets. With ten permits in the fishery, this number of observers would imply a limit of five trips and 75 sets per vessel.

Turtle Caps and Expected Effort

Historical evidence suggests that while sea turtle takes occur at random points with respect to fishing effort, the randomness can be reasonably characterized using a probability model which considers each hook fished in a set of longline fishing effort as having a small independent chance of catching either a leatherback or a loggerhead turtle, akin to tossing an unfairly weighted coin with a small chance of landing tails (take) and a very large chance of landing heads (no take) on a given toss. This insight coupled with the large number of hooks fished on a single set of longline fishing suggests modeling the probability distributions of leatherback and loggerhead turtle bycatch using a Poisson distribution, assuming a rate parameter

$$\mu_{jq} = \text{(number of hooks)} \times \text{(turtle species } j \text{ bycatch per hook in quarter } q\text{)},$$

where $j=1$ for leatherbacks and $j=2$ for loggerheads and $q = 1, 2, 3, 4$ denotes the quarter when fishing occurs. The rate parameter can be reasonably approximated by historic levels of bycatch per unit of effort.

The properties of the Poisson model may be used in conjunction with assumptions about the leatherback and loggerhead take cap levels to estimate the probability that effort will survive to a given number of sets without hitting a cap. Assuming all effort faces the same turtle take risk, the probability that effort survives to set z without hitting turtle cap j is given by the Poisson probability that the number of turtle takes of type j has not reached the cap as of the end of set
$z-1$:

$$S_j(z) = F_j(c_j - 1 | z-1).$$

$S_j(z)$ denotes the probability that allowable effort survives to set z, assuming that fishing effort has not ended for other reasons such as a lack of observer availability, the end of the season or a decision by fishers to stop fishing due to economic or environmental factors. The simple model described above becomes more complicated if turtle take rates differ by season and area where fishing occurs; details of this approach are described in a technical appendix.

Assuming independence in take probabilities for the two turtle types, the probability effort survives through set z_i without hitting either cap is given by $S_\tau(z_i) = S_1(z_i) \cdot S_2(z_i)$,
that is, the product of the probabilities of effort surviving the risk of hitting each cap. This probability can be used in conjunction with other relevant assumptions to develop estimates of expected effort and expected revenue under alternative policy scenarios.

Expected Effort, Catch, and Revenues

Expected effort can be computed using the survival probability estimated above in conjunction with information about other potential limits on effort based on observer availability, number of active permits and historical effort in the fishery. Let z_{max} denote the potential level of effort based on historic experience in the West Coast shallow set longline fishery, adjusted if necessary to reflect a limit on available observer coverage. Expected effort for the season, adjusted for the risk of early termination due to hitting a turtle cap, is estimated by

$$EZ = \sum_{i=1}^{z_{\max}} S_{\tau}(i)\,.$$

Expected catch is calculated using the formula

$$EY_{swd} = \sum_{i=1}^{z_{\max}} CPUE(q_i)S_{\tau}(i),$$

where $CPUE(q_i)$ is estimated swordfish catch per unit of effort during the quarter q_i when set i is fished[30]. Similarly, expected incidental takes for sea turtle species $j = 1, 2,$ where *1* denotes leatherback turtles and *2* denotes loggerhead turtles, is given by

$$EYj = \sum_{i=1}^{z_{\max}} BPUE_j(q_i)S_{\tau}(i),$$

where $BPUE_j(q_i)$ denotes the bycatch per set of sea turtle species j in quarter q_i.

Finally, if P_{swd} denotes the price of swordfish, w is a conversion factor reflecting the assumed swordfish weight and discard rate which converts from expected number of fish caught to expected retained weight and f is a markup factor to reflect additional revenues from selling other marketable catch besides swordfish, then total expected gross revenues for the fleet are given by

$$ETR = w(1+f)P_{swd}EY_{swd}\,.$$

Fixed Costs and Variable Costs

Fixed costs (such as vessel purchase and maintenance, permit fees, capital expenditures and the opportunity cost of alternative employment to fishing) are those costs which participants in the fishery incur regardless of the level of fishing effort.

Fixed costs and variable cost per set are estimated based on historical experience in the Hawaii SSLL fishery (Pooley and O'Malley). Swordfish prices catch rates and prices by quarter were based on estimates in the HI SSLL Amendment 18 EIS (WPFMC). A markup value for other marketable catch besides swordfish is estimated using shallow-set longline fishing data from PacFIN.

The fixed cost estimate is developed starting with the average annual fixed pecuniary costs for the Hawaii swordfish vessels, which was $66,008 in the year 2000. This is inflated to a current cost estimate using the change in the GDP deflator[31] between the third quarter of 1999 (98.022) to the third quarter of 2008 (123.117), yielding an estimated fixed pecuniary cost of $82,907 in 2009 dollars, assuming inflation continues at its recent trend rate.

[30] The expected catch in set i equals the expected catch if set i is fished, $BPUE_j(q_i)$, times the probability that effort survives through set i, $S_{\tau}(i)$.

[31] Gross National Product: Chain-type Price Index (GNPCTPI), U.S. Department of Commerce: Bureau of Economic Analysis

The variable cost per set was developed by dividing the average annual variable cost estimate of $242,933 for the Hawaii shallow set longline fishery by the average 150 sets per swordfish fishermen to obtain estimated variable costs of $1620 per set for the year 2000. This was also inflated by the GDP deflator to obtain a current cost estimate of $2035 per set in 2009 dollars.

III. Economic Viability

The likely effects of the number of permits, available observers and turtle caps on economic viability is addressed by adopting assumptions about fixed cost and variable revenue per set of SSLL fishing, then using these with expected fishing effort, swordfish catch, swordfish price and other marketable species catch to develop an estimate of aggregate profit for the fishery. Aggregate profit may be divided by the assumed number of participants to estimate profit per permit. A positive profit (or profit per permit) is a favorable indicator of economic viability, while negative profit calls economic viability into question.

Generally speaking, if fixed costs per vessel are approximately constant and effort per vessel decreases as more permits are issued, economic viability will tend to decrease with more permits. In particular, if a sufficient amount of effort occurs so that a turtle cap is hit or observer availability constrains effort, then any additional permits would have the effect of adding new fixed costs of fishing, while spreading available profits over a larger number of vessels. With a sufficiently large number of permits, added fixed costs coupled with declining variable profit per permit is expected to result in a negative average profit per participating vessel.

Expected Profit and Economic Viability

Economic viability of a limited entry permit system would depend critically on the ability of participants in the fishery to engage in enough effort to generate profits in excess of their fixed costs. In order to consider the potential effects of the number of permits, turtle caps, area restrictions and other possible limits on fishing effort on economic viability, profit per permit is estimated under the simplifying assumption that available effort would be evenly distributed across participants.

Expected accounting profits are the excess of the expected *ex vessel* revenues from catching and selling fish, less fixed costs and variable costs of fishing effort. Expected accounting profits for a representative participant is estimated by

$$EAP = (ETR - VC*EZ)/n - FC,$$

where EAP denotes expected accounting profits, ETR is expected revenue for the entire fleet, EZ is expected fleet effort in number of sets, VC is variable cost per set, n is the number of (active) limited entry permits and FC is the fixed cost of participation. The parenthesized expression on the right hand side represents expected variable profit for the entire fleet, and dividing this by the number of permits produces an estimate of expected variable profit per permit.

Expected economic profits are obtained by subtracting the opportunity cost of participation from expected accounting profits. The opportunity cost of participation includes the return on the participant's entrepreneurial skills if he pursued other occupation during the time it takes to participate in the shallow set longline fishery and return on vessel and other physical fishing capital which could be earned if the physical capital were rented out or used to pursue other fishing opportunities. The opportunity cost is developed as an ongoing estimate (not reflecting any one-time costs of entering the fishery) by assuming it is proportional to expected time requirements (in days) of participating.

The opportunity cost of participation is estimated using an approach designed to reflect that fewer days of fishing effort entail a lower opportunity cost. Given that at least some participants may divide their time between participation in a limited entry shallow set longline fishery and the drift gillnet fishery for swordfish and thresher shark, an estimate of the daily variable profits from drift gillnet fishing *(DGN)* was used to gauge the opportunity cost of limited entry shallow set longline participation.

The time requirements are estimated as a fixed number of days per season spent preparing for shallow set longline fishing *(STC)* plus an estimate of the variable number of days due to fishing effort. Variable days are estimated as expected effort in sets (*EZ)* times a variable time cost load factor *(VTC)* to reflect additional variable time costs of effort (for instance, days spent steaming to the fishing grounds or landing the catch):

$$TRP = STC + VTC \times EZ$$

The estimated time requirement for participation is multiplied by an estimate of the financial opportunity cost per set of fishing to estimate the opportunity cost of participation:

$$OCP = DGN \times TRP.$$

With the estimated opportunity cost of participation available, the expected economic profits *(EEP)* are calculated using

$$EEP = EAP - OCP,$$

where *EEP* denotes expected economic profits for a representative participant and *OCP* denotes the opportunity cost of participation,

At a minimum, economic viability requires expected accounting profits to be greater than zero; otherwise participation would be a money-losing proposition. Further, unless expected economic profits are greater than zero, participation would be expected to provide participants with less income relative to alternative employment, at least in expectation. For the fishery to provide fishers with an income level sufficient to make participation attractive relative to alternative income generating activities, both accounting profits and economic profits should be greater than zero.

Qualitative Effect of Alternative Policy Scenarios on Economic Viability

The likely qualitative effects of variations in policy parameters on economic viability are discussed below.

1) Area restrictions

Area restrictions could potentially impact economic viability through their effect on expected revenues per set and on sea turtle interaction risk. Generally speaking, keeping an area with relatively high swordfish *CPUE* open would tend to increase revenues, and hence economic viability, while keeping an area open which had relatively higher sea turtle interaction risk could reduce economic viability, by decreasing the expected effort that would be allowed before a turtle cap was reached. The effect of keeping open an area with both higher swordfish *CPUE* and higher sea turtle interaction risk would be ambiguous, but could be quantified using the methodology presented here.

2) Turtle cap levels

Generally speaking, more restrictive (lower) turtle caps result in less expected effort before a cap is reached. Conversely, less restrictive (higher) turtle caps increase the probability that effort will not be constrained by reaching a turtle cap before the end of the season. Because expected revenues are positively correlated with expected effort, less restrictive turtle caps imply an increase in economic viability.

3) Alternative season start dates

The season start date could impact economic viability of the fishery. For instance, if the season started at a quarter when expected revenues per set of fishing effort were relatively high compared to sea turtle interaction risk (e.g. due to high swordfish *CPUE* coupled with relatively low sea turtle *CPUE*), economic viability might prove higher than if fishing started during a quarter when expected revenues per set were relatively low compared to sea turtle interaction risk. Unfortunately, the available evidence suggests that swordfish *CPUE* and sea turtle *BPUE* are positively correlated, suggesting limited potential gains to this strategy.

4) Sharing of observer costs between industry and government

There is a potential that economic viability could be increased through sharing of observer costs between industry and government. Suppose G is the government expenditure for funding k observer trips, and let $m \geq 0$ be the number of additional observer trips funded through cost sharing, at additional expenditure of $H = m \times G/k$. Let Δ denotes th increase due to the increase in a variable as a result of adding m additional observed trips. Assuming the same number of participants as before[32], so long as the resulting increase in variable profits

$$\Delta(ETR - VC*EZ) = (\Delta ETR - VC*\Delta EZ)$$

exceeded the additional observer coverage expenditure H, adding observers with costs shared over the participants has the effect of increasing economic viability.

[32] The situation would be more complicated if additional observers were added to fund an increase in number of participants, as the increase to observer costs would be shared by more participants, but fixed costs for the fleet would also increase.

IV. Alternative Policy Scenarios for Estimating Economic Viability

Quantitative economic viability assessments were conducted under policy scenarios chosen to be representative of the range of alternatives under consideration. For each of the policy scenarios presented below, estimates of expected effort (in number of sets), accounting profits and economic profits per participant are provided for a range of possible numbers of permits. Expected revenues are provided as an aggregate measure for all participating vessels.

Base Case (All Areas, Leatherback Cap = 8, Loggerhead Cap = 9, Q1 Season Start)					
	5	10	15	20	30
Expected Effort	142.8	78.5	52.3	39.2	26.2
Expected Total Revenues	$3,284,331	$3,610,377	$3,610,377	$3,610,377	$3,610,377
Accounting Profit per Participant	$283,361	$118,383	$51,286	$17,738	-$15,810
Economic Profit per Participant	$221,625	$79,988	$22,389	-$6,410	-$35,209

Area Restriction 1 (E of 150, Leatherback Cap = 8, Loggerhead Cap = 9, Q1 Season Start)					
	5	10	15	20	30
Expected Effort	142.8	78.5	52.3	39.2	26.2
Expected Total Revenues	$3,058,546	$3,362,058	$3,362,058	$3,362,058	$3,362,058
Accounting Profit per Participant	$238,204	$93,551	$34,732	$5,322	-$24,088
Economic Profit per Participant	$176,468	$55,156	$5,835	-$18,826	-$43,486

Area Restriction 2 (E of 140, Leatherback Cap = 8, Loggerhead Cap = 9, Q1 Season Start)					
	5	10	15	20	30
Expected Effort	142.8	78.5	52.3	39.2	26.2
Expected Total Revenues	$2,714,705	$2,983,315	$2,983,315	$2,983,315	$2,983,315
Accounting Profit per Participant	$169,436	$55,677	$9,482	-$13,615	-$36,712
Economic Profit per Participant	$107,700	$17,282	-$19,415	-$37,763	-$56,111

Lower Turtle Caps (All Areas, Leatherback Cap = 4, Loggerhead Cap = 5, Q1 Season Start)					
	5	10	15	20	30
Expected Effort	142.8	78.5	52.3	39.2	26.2
Expected Total Revenues	$3,284,285	$3,610,298	$3,610,298	$3,610,298	$3,610,298
Accounting Profit per Participant	$283,357	$118,380	$51,284	$17,736	-$15,811
Economic Profit per Participant	$221,621	$79,985	$22,388	-$6,411	-$35,210

Fourth Quarter Start (All Areas, Leatherback Cap = 8, Loggerhead Cap = 9, Q4 Season Start)					
	5	10	15	20	30
Expected Effort	142.8	78.5	52.3	39.2	26.2
Expected Total Revenues	$3,284,572	$3,610,618	$3,610,618	$3,610,618	$3,610,618
Accounting Profit per Participant	$283,409	$118,407	$51,303	$17,750	-$15,802
Economic Profit per Participant	$221,673	$80,012	$22,406	-$6,398	-$35,201

Limited Observer Coverage (All Areas, Leatherback Cap = 8, Loggerhead Cap = 9, Q1 Season Start)					
	5	10	15	20	30
Expected Effort	60.0	30.0	20.0	15.0	10.0
Expected Total Revenues	$1,379,585	$1,379,585	$1,379,585	$1,379,585	$1,379,585
Accounting Profit per Participant	$70,910	-$5,999	-$31,635	-$44,453	-$57,271
Economic Profit per Participant	$39,230	-$26,789	-$48,795	-$59,798	-$70,801

The base case scenario is chosen to represent a case where turtle caps and observer availability are both set to levels reflecting currently available information about likely levels of turtle caps and observer coverage.

Due to the assumption of 785 (or 300) available observer sets and the low probability a turtle cap would be reached by the time that many sets had occurred, the turtle caps have no measurable impact on allowable effort or economic viability under the scenarios considered here. Even for the scenario where turtle caps are reduced considerably below the base case, the probability a cap is reached is negligible. This situation could change if more sets of effort were allowed or turtle take rates proved considerably higher than those assumed for this analysis.

Accounting and economic profits per participant are expected to be highest under each scenario for the case with the smallest number of permits, due to the assumptions that effort per participant will decline with an increasing number of active permits and that participants would need to cover a fixed cost of participation before realizing any profit. It is noteworthy that in all cases under consideration except for the base case with five vessels, adding participants has no effect on the overall expected level of effort. This indicates that for the cases analyzed here, the observer constraint is expected to limit effort even if more than five permits are issued. The decline in expected profits over scenarios with more than five vessels fishing is solely due to spreading allowable effort over more fishers as the number of permits is increased. Generally speaking, economic viability looks quite healthy for scenarios with low numbers of participants, and it declines on a per-participant basis for scenarios with higher numbers of participants.

For scenarios with limited observer coverage availability (300 sets) or with area restrictions, viability drops off to low or negative levels as the number of permits increases to the high end of the range, suggesting that adequate observer coverage and the broadest possible area open to fishing would help ensure an economically viable fishery.

V. Conclusions and Further Considerations

This report presents a methodology for estimating the economic viability of alternative policy configurations for a shallow set longline fishery with limited entry, taking into consideration potential constraints on effort due to take caps on leatherback and loggerhead turtles and observer coverage requirements. If turtle caps or observer availability creates a binding constraint on overall fleet effort, then economic viability of the fishery will decrease with an increase in the number of permits, as allowable effort (and potential revenue) would be divided over a larger number of participants, while fixed costs per vessel would not.

If fixed costs of fishing represent a significant capital investment while overall fleet effort is limited by turtle caps and observer availability, there is a possibility that fishers will not be able on average to achieve sufficient levels of effort to generate profits in excess of their fixed costs. In this case, participation would not, on average, be economically viable, as fixed costs in excess of variable profits indicate that a fisher would lose money from participating in the shallow set longline fishery rather than pursuing other employment.

A number of assumptions made for this viability estimate may not bear out in practice. Since the fishery in question is not currently in operation, estimates of expected effort, catch rates, costs and prices were developed using historic data for the west coast and Hawaii based shallow set longline fisheries as proxies for what might actually occur when the fishery begins operation. Actual experience could differ substantially from what is assumed for developing these estimates, implying the economic viability analysis presented here might not be relevant in actual practice. The estimates presented here should be viewed as providing an indication of the effects of different regulatory configurations on likely economic viability, rather than a forecast of what would occur in actual practice.

As the approach relies on obtaining estimates of expected profit per vessel, variance in individual vessel costs and revenues were not explicitly addressed. In actual practice, some fishers are likely to earn positive profits after fixed costs, while others may be less successful and earn negative profits; however, the number of fishers who can cover their costs out of catch revenues is expected to increase with higher expected profit per vessel.

The methodology presented here focuses on the narrow question of the short run viability of a shallow set longline limited entry permit system under alternative policy scenarios, assuming recent conditions in the area where fishing would occur are reasonably representative of the conditions which the new fishery would experience. Given that the likely level of catch would represent a small fraction of overall catch for the swordfish stock and other stocks in question, no consideration is given to bioeconomic feedback between increased shallow set longline catch under this fishery and future stock levels.

Future requirements for economic viability could change due to evolving environmental conditions, including relevant economic factors and the stock levels of marketable species and protected species. Thus it is desirable to consider designing and implementing an adaptive management policy which periodically evaluates the operation of the fishery as new information becomes available, with provisions for adjusting regulatory parameters in light of emerging data.

Appendix I: Assumptions Underlying Viability Estimates

The following assumptions underlie the estimates presented in this report.

Level of Unconstrained Fishing Effort

Assumptions about the numbers of hooks which would be fished for each number of active vessels in the fishery were translated into numbers of sets using the proportional relationship between hooks and sets estimated by Kit Dahl. This resulted in the following estimates of (expected) unconstrained effort for all participants, in number of sets:

Vessels	Effort (hooks)	Effort (sets)
5	534,377	713.7
10	916,075	1,223.4
15	1,145,094	1,529.4
20	1,221,434	1,631.3
30	1,832,151	2,447.0

Availability of Observer Coverage

Based on personal communication with Lyle Enrique, a base case assumption of 785 sets of available observer coverage was used as a constraint on allowable fishing effort. This assumption was employed for all scenarios included in this report except for the "Limited Observer Coverage" case, which assumed only 300 sets of observer coverage would be available. For each possible number of participating vessels in the scenarios considered here, a maximum effort level in sets was computed as the lesser of the unconstrained effort estimate from the table above and the assumed number of available observer sets. This available observer coverage constraint was binding for all cases under consideration except for the 5 permit case with 785 available observer sets.

Distribution of Fishing Effort

Kit Dahl used observer records to develop the following distribution of fishing effort, depending upon where fishing effort might be allowed to occur under an Amendment 2 SSLL fishery:

Quarter	First	Second	Third	Fourth
All Areas	31.4%	15.4%	13.6%	39.5%
East of 150	20.1%	8.0%	18.7%	53.2%
East of 140	0.5%	2.4%	35.9%	61.2%

The analysis conducted for this report made the assumption that planned effort would distribute across quarters and areas open to fishing in the same proportions observed to occur historically, and would continue until either a limit on available coverage or a turtle cap was reached. This assumption may prove unrealistic for various reasons, including the temporal pattern of observer availability, decisions of participants about when to fish, and the spatial-temporal pattern of swordfish migration across times and areas open to fishing. Further, the historical pattern of effort across quarters and areas reflects a period when all areas were open to fishing; it is unpredictable how effort would redistribute across areas and time periods if the fishery were reopened subject to area restrictions. Another question is whether participants would actually be willing and able to fish all allowable sets.

Seasonal Distribution of Catch Rates and Swordfish Prices

The following table displays the assumed swordfish, loggerhead and leatherback catch rates used in the analysis. Swordfish prices catch rates and prices by quarter were based on estimates in the HI SSLL Amendment 18 EIS (WPFMC). Leatherback and loggerhead catch rates were developed using observer data from the historic west coast based SSLL fishery.

Quarter	First	Second	Third	Fourth
Swordfish CPUE (catch count / set)	15.15	12.22	8.89	9.78
Leatherback CPUE (takes / 1000 sets)	0.0000	0.0941	0.0000	0.2923
Loggerhead CPUE (takes / 1000 sets)	1.0185	0.4392	0.4258	0.2339
Swordfish Price	$2.38	$2.11	$2.59	$2.21

Weight and Discard Rate of Caught Swordfish

The average dressed weight of a caught swordfish was estimated at 166 pounds and the discard rate of caught fish was assumed to be 10.8 percent, matching the estimates used for the HI SSLL Amendment 18 EIS analysis (WPFMC). These assumptions were used to develop a conversion factor to estimate weight sold per fish caught:

w = (100% - 10.8%) * 166 = 148.072 lbs of swordfish sold per each swordfish caught.

This conversion factor was applied to the expected catch count under each scenario to compute the expected weight (in lbs) of swordfish sold.

Economic Assumptions

Economic assumptions were adopted to enable estimation of the revenues and costs of different levels of fishing effort which might occur, and to further estimate the opportunity cost of participation. Assumed prices at which participants would be able to sell their catch are displayed in the table shown above. A markup factor of 1.15 was developed based on the ratio of all ex vessel revenues to swordfish ex vessel revenues as shown in the 2007 HMS SAFE report (PFMC); this factor was applied to the estimated swordfish ex vessel revenue to account for revenue due to other marketable catch besides swordfish.

Assumptions about the fixed and variable financial costs of participation were developed from an analysis of the HI SSLL fishery's costs as presented in Pooley and O'Malley. Their estimates were adjusted to current dollar levels for inflation during the period since they conducted their survey.

The value of a day of drift gillnet fishing was used as a proxy for the financial opportunity cost of participation in the Amendment 2 SSLL fishery. The estimated variable financial profit for a day of drift gillnet fishing developed for the DGN EFP EA was updated for inflation to obtain a current estimate of $330 per day. To develop the estimated opportunity cost of a given number of sets of SSLL fishing, thirty days of startup time were assumed to be necessary for participation in shallow set longline fishing. In addition, a ten percent load factor was applied to sets of shallow set longline fishing to estimate time unavailable for other economic activities. The total estimated days required for shallow set longline participation were multiplied by the estimated daily profit from drift gillnet fishing to estimate the financial opportunity cost of shallow set longline participation.

Appendix II: Estimating Take Risk to Reflect Area and Quarter when Effort Occurs

Area variation in leatherback and loggerhead turtle takes may be estimated for any particular area configuration by using historic observations which are representative of what might occur in a reopened shallow set longline fishery to estimate take rates for each area-season combination, then computing a weighted average of these rates based on expected effort in each area. Historic take rates should either be based on observations representative of the gear requirements under Amendment 2 (e.g., circle hook and mackerel bait), or else should be adjusted to reflect expected changes in take rates due to regulatory requirements.

Suppose the average take rate of turtle type *j* per set is estimated for fishing in open area[33] *i* during quarter *q* as $\mu_{jiq,}$ and the number of sets fished through the set before the next one to be fished (set number z_i) in area-season combination *it* is z_{iq} for $q = 1, 2, 3, 4$. Under the assumption that turtle take risk is independent across sets once the effects of time and season are considered, the probability effort reaches level $z_i = z_{i1} + z_{i2} + z_{i3} + z_{i4} + 1$ without reaching the cap is given by the Poisson cumulative probability function as

$$S_j(z_i) = \sum_{i=0}^{c_i - 1} \exp[-\mu_j(z_i)]\mu_j(z_i)^i / i!,$$

where $\mu_j(z_i) = z_{i1*}\,\mu_{ji1} + z_{i2*}\,\mu_{ji2} + z_{i3*}\,\mu_{ji3} + z_{i4*}\,\mu_{ji4}$ is the pooled *CPUE* for takes of turtle type *j* through $z_i - 1$ units of effort, considering seasonal variation in the take rate. We take
$S_j(1) \equiv 1$ to reflect that no turtle cap could be reached before the first set is fished.

[33] The analysis conducted for this report uses turtle catch rates stratified by quarter and turtle species (leatherback or loggerhead) but not by area. The description presented here allows for generalizing the methodology to the case where catch rates are further stratified by the area where fishing occurs. Whether it is better to stratify catch rate estimates by area is an unresolved empirical question.

References

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catch histories. This date was announced at the Council's January 2009 meeting, and was chosen because it coincides with the end of the immediately preceding fishing year in which landings would be documented. Publication of the control date in the **Federal Register** informs participants of the Council's considerations, and gives notice to anyone entering the fishery after the control date they would not be assured of future access should a management regime be implemented using the control date as a means to restrict participation. Implementation of any such program would require preparation of an amendment to the FMP and subsequent rulemaking with appropriate public comment periods.

Consideration of a control date does not commit the Council or NMFS to any particular management regime or criteria for eligibility in the commercial sector of the Gulf reef fish fishery. The Council may or may not make use of this control date as part of the qualifying criteria for participation in that sector of the fishery. Fishermen are not guaranteed future participation in a fishery regardless of their entry date or intensity of participation in the fishery before or after the control date under consideration. The Council subsequently may choose a different control date or a management regime that does not make use of a control date. The Council also may choose to take no further action to control entry or access to the fishery, in which case the control date may be rescinded.

Authority: 16 U.S.C. 1801 *et seq.*

Dated: March 12, 2009.

James W. Balsiger,

Acting Assistant Administrator for Fisheries, National Marine Fisheries Service.

[FR Doc. E9–5864 Filed 3–17–09; 8:45 am]

BILLING CODE 3510–22–S

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 665

RIN 0648–AW49

Fisheries in the Western Pacific; Pelagic Fisheries; Hawaii-based Shallow-set Longline Fishery

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice of availability of fishery management plan amendment; request for comments.

SUMMARY: NMFS announces that the Western Pacific Fishery Management Council (Council) proposes to amend the Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region (FMP). If approved by the Secretary of Commerce (Secretary), Amendment 18 would remove the annual limit on the number of fishing gear deployments (sets) for the Hawaii-based pelagic longline fishery. The amendment would also revise the current maximum limit on the number of physical interactions that occur annually between loggerhead sea turtles and vessels registered for use under Hawaii longline limited access permits while shallow-setting. Other measures currently applicable to the fishery would remain unchanged. Amendment 18 is intended to increase opportunities for the shallow-set fishery to sustainably harvest swordfish and other fish species, without jeopardizing the continued existence of sea turtles and other protected resources.

DATES: Comments on Amendment 18 must be received by May 18, 2009.

ADDRESSES: You may send comments on Amendment 18, identified by 0648–AW49, to either of the following addresses:

- Electronic Submission: Submit all electronic public comments via the Federal e-Rulemaking Portal www.regulations.gov; or
- Mail: Mail written comments to William L. Robinson, Regional Administrator, NMFS, Pacific Islands Region (PIR), 1601 Kapiolani Blvd., Suite 1110, Honolulu, HI 96814–4700.

Instructions: All comments received are a part of the public record and will generally be posted to *www.regulations.gov* without change. All personal identifying information (e.g., name, address, etc.) submitted voluntarily by the commenter may be publicly accessible. Do not submit confidential business information, or otherwise sensitive or protected information. NMFS will accept anonymous comments (enter ''N/A'' in the required fields, if you wish to remain anonymous). Attachments to electronic comments will be accepted in Microsoft Word or Excel, WordPerfect, or Adobe PDF file formats only.

Copies of Amendment 18 (which includes a final supplemental environmental impact statement) are available from *www.regulations.gov*, and the Council, 1164 Bishop St., Suite 1400, Honolulu, HI 96813, tel 808–522–8220, fax 808–522–8226, *www.wpcouncil.org*.

FOR FURTHER INFORMATION CONTACT: Adam Bailey, Sustainable Fisheries Division, NMFS PIR, 808–944–2248.

SUPPLEMENTARY INFORMATION:

Electronic Access

This proposed rule is also accessible at *www.gpoaccess.gov/fr*.

Background

The Hawaii-based shallow-set pelagic longline fishery primarily targets swordfish in the western Pacific north of the Hawaiian Archipelago. The fishery is carefully regulated through a management program intended, among other goals, to reduce the number and severity of unintended bycatch interactions, particularly between longline fishing gear and sea turtles. Management measures include the mandatory use of large (18/0) offset circle hooks and mackerel-type bait, and 100 percent observer coverage. The required use of circle hooks and mackerel-type bait has reduced the sea turtle interaction rate by approximately 90 percent for loggerheads, and 83 percent for leatherbacks, compared to the period 1994–2002 when the fishery was operating without such requirements.

Because the use of circle hooks and mackerel-type bait have proven effective in reducing sea turtle interaction rates, the Council has recommended in Amendment 18 changes to the management program that would enable the shallow-set fishery to increase and sustainably harvest swordfish and other fish, without jeopardizing the continued existence and recovery of threatened and endangered sea turtles and other protected resources.

Amendment 18 would remove the annual limit on the number of longline shallow sets. The shallow-set certificate program, which is used to monitor and control the number of sets, with the elimination of set limits. Amendment 18 would also increase the number of allowable incidental interactions between longline fishing gear to 46 for loggerhead sea turtles (from the current limit of 17). The allowable interaction limit for leatherback sea turtles would remain unchanged at 16.

All other measures currently applicable to the fishery would remain unchanged, including, but not limited to, limited access permits, vessel and gear marking requirements, vessel length restrictions, Federal catch and effort logbooks, 100 percent observer coverage, large longline restricted areas around the Hawaiian Archipelago, vessel monitoring system (VMS), annual protected species workshops, and the use of sea turtle, seabird, and marine mammal handling and mitigation gear and techniques.

The proposed management changes are intended to further the intent of the Magnuson-Stevens Fishery Conservation and Management Act by fostering optimum yield from the shallow-set longline fishery, while minimizing bycatch and associated bycatch mortality.

Public comments on proposed Amendment 18 must be received by May 18, 2009 to be considered by NMFS in the decision to approve, partially approve, or disapprove the amendment. A proposed rule to implement the measures recommended in Amendment 18 has been prepared for Secretarial review and approval, and NMFS expects to publish and request public comment on the proposed rule in the near future.

Authority: 16 U.S.C. 1801 *et seq.*

Dated: March 13, 2009.

Emily H. Menashes,

Acting Director, Office of Sustainable Fisheries, National Marine Fisheries Service.

[FR Doc. E9–5888 Filed 3–17–09; 8:45 am]

BILLING CODE 3510–22–S

Decision Summary for HMS FMP Amendment 2, SSLL Fishery

Alternative 1: No Action

Alternative 2: Limited Entry

Area Closure	1. 150° W. 2. 140° W. 3. None
Gear Requirements	Part of the alternative; no Council decision required
Sea Turtle Take Caps	Council Recommendation or ITS?
Number of LE Permits	1-20
Limit on LE Permit Transfer	1 or 2 years 0-5 landings during time period
LE Permit Qualification Option	Option 1: DGN and SSLL landing amount Option 2: DGN point system Option 3: SSLL landings, number and duration
Prohibition on Simultaneous use of Hawaii LE Permit	Part of the alternative; no Council decision required (except to exclude)
LE Permit Application and Issuance	Not currently addressed
Seabird Mitigation Measures	Apply measures equivalent to Hawaii regulations (60 CFR 665.35)?

Alternative 3: Limited Entry with no Permit Cap

- Fishery closed west of 140° W.
- Sea turtle mitigation measures same as Alternative 2.
- Estimated that up to 98 people could qualify.

Alternative 4: Open Access

- Fishery closed west of 140° W.
- Sea turtle mitigation measures same as Alternative 2.
- Hawaii longline limited access permit owners “would not qualify”: Implementation issues because this is an open access fishery. Interpreted as could not simultaneously possess a general west coast HMS permit.

Agenda Item D.2.a
Supplemental PowerPoint Presentation (Dahl)
April 2009

HMS FMP Amendment 2

To Authorize a Shallow-set Longline Fishery Outside the West Coast EEZ

Alternatives (Overview)

- All action alternatives include gear requirements, incidental take limits ("turtle caps") and 100% observer coverage
- Alternative 1: No Action
- Alternative 2: Limited Entry
- Alternative 3: Large Limited Entry Program
- Alternative 4: Open Access

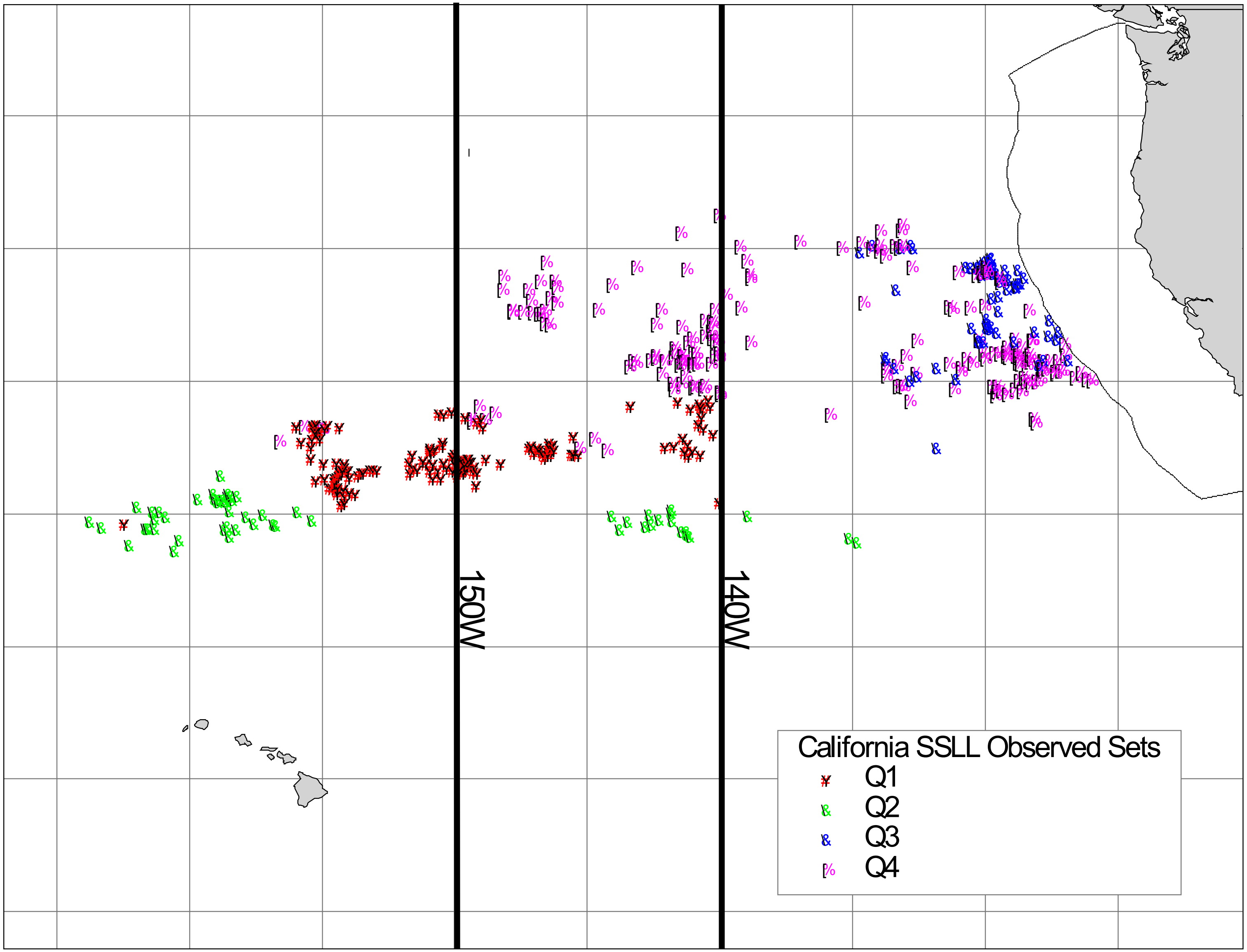
Alternative 2: LE Program, ≤20 Permits

- A maximum of 20 permits could be issued; analyzed for 5, 10, 15, & 20 permits
- Closed area options (no closure, E. of 150 W, E. of 140 W)
- Permit transfer restriction (1 or 2 years); minimum number of landings (0-5)
- Permit qualification (options 1-4)

Alternatives 3 & 4

- Alternative 3: Permits limited to those making at least one west coast swordfish landing, 2005-2007
- Alternative 4: Open Access
- Under both options fishery closed west of 140° W. longitude

Distribution of Observed West Coast Sets, 2001-2004



Sea Turtle Impacts

Impact evaluation compares estimated sea turtle mortality under the alternatives to 2004 NMFS guidance: low levels of sea turtle mortality approximating no jeopardy levels in DGN fishery

Sea Turtle Mortality Estimates

	5 vessels	10 vessels	15 vessels	20 vessels
E of 140	1 loggerhead 1 leatherback	2 loggerhead 1 leatherback	2 loggerhead 2 leatherback	2 loggerhead 2 leatherback
E of 150	2 loggerhead 1 leatherback	3 loggerhead 2 leatherback	3 loggerhead 2 leatherback	4 loggerhead 2 leatherback
No closure	2 loggerhead 1 leatherback	3 loggerhead 1 leatherback	4 loggerhead 2 leatherback	4 loggerhead 2 leatherback

Other Impacts

- Finfish
- Marine Mammals
- Seabirds
- Economic viability

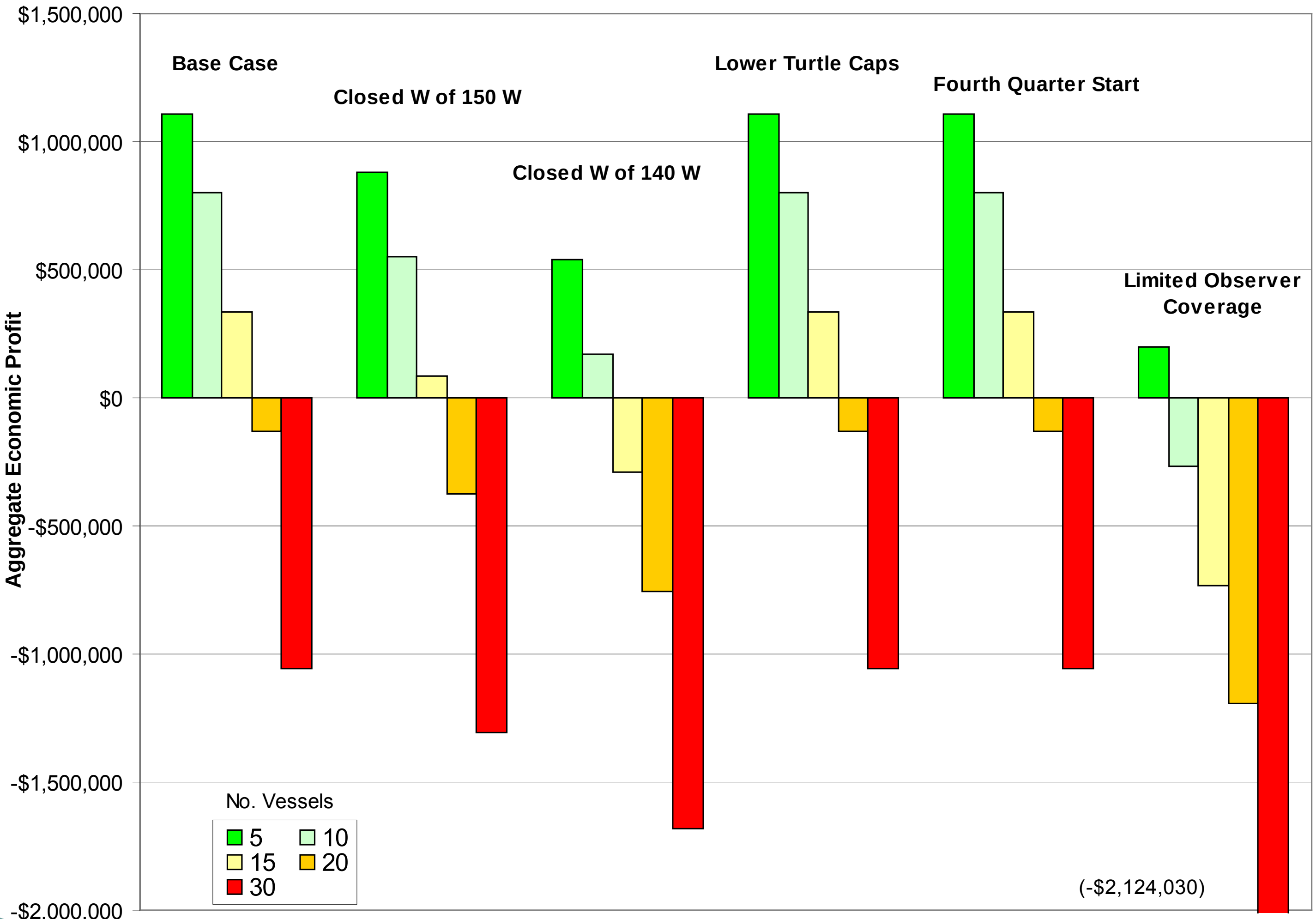
Economic Viability Analysis

- Characterize economic viability as expected profits to a SSLL participant
- Gauge effect of different factors on viability
  - turtle caps (leatherback/loggerhead = 8/9, 4/5)
  - observer coverage (785 sets, 300 sets)
  - areas open to fishing (no limit, E. of 150, E. of 140)
  - number of permits issued (5, 10, 15, 20, 30)

Scenario Summary Table Example

Area Restriction 2 (E of 140, Leatherback Cap = 8, Loggerhead Cap = 9, Q1 Season Start)					
No. of Vessels	**5**	**10**	**15**	**20**	**30**
Expected Effort	**142.8**	**78.5**	**52.3**	**39.2**	**26.2**
Expected Total Revenues	**$2,714,705**	**$2,983,315**	**$2,983,315**	**$2,983,315**	**$2,983,315**
Accounting Profit per Participant	**$169,436**	**$55,677**	**$9,482**	**-$13,615**	**-$36,712**
Economic Profit per Participant	**$107,700**	**$17,282**	**-$19,415**	**-$37,763**	**-$56,111**

Estimated Aggregate Economic Profit



Key Economic Conclusions

- Turtle caps did not significantly limit effort.
- Key potential limiting factors on economic viability are (1) area limits; (2) observer availability; (3) number of permits.
- Given constrained fleet effort, average profit per participant declines as the number of vessels increases.
- For a number of scenarios, the fishery might not be economically viable.

Decisions to be Made

- Choice of Alternative
- Number of permits/vessels
- Area closure
- Permit transfer limit / minimum landings
- LE qualification option
- LE Permit Application and Issuance
- Gear measures equivalent to Hawaii

HIGHLY MIGRATORY SPECIES ADVISORY SUBPANEL REPORT ON FISHERY MANAGEMENT PLAN AMENDMENT 2 – HIGH SEAS SHALLOW-SET LONGLINE

The primary intent of the Magnuson-Stevens Act is to promote the sustainability of fishery resources in the U.S. and contribute to the national food supply. The supply of swordfish is shifting from our domestic producers, and less regulated foreign fleets are likely taking more turtles per unit of effort. In order to encourage a more holistic management approach, the U.S. must have active fisheries. Having an active, well managed and regulated U.S. fishery also provides leverage to promote Pacific-wide sea turtle conservation. Such a fishery also provides an incentive to develop bycatch-reducing gear and methods that could be exported to other countries' fleets that interact with sea turtles.

The Highly Migratory Species Advisory Subpanel (HMSAS) would like to recommend Alternative 2 (limited entry) for the shallow-set longline (SSLL) fishery as the most conservative action alternative listed in the Preliminary Draft Supplemental Environmental Impact Statement (DSEIS) (Attachment 1). Under Alternative 2 the HMSAS recommends the following provisions:

- Area closure: Adopt the fishery closure west of 140° W. longitude (Option 2). The HMSAS recognizes the benefit of minimal take of sea turtles resulting from this closure along with lower fuel cost and better quality of seafood by fishing in the area closer to the west coast.

- Gear requirements: Adopt the same gear requirements as under the Hawaii Pelagics Fishery Management Plan (FMP), i.e., circle hooks, mackerel-type bait, etc. The HMSAS recognizes the 89 percent reduction of turtle take with this gear type compared to J-hooks and squid bait previously used in the Hawaii (and west coast) SSLL fishery.

- Sea turtle take caps: To be determined by NMFS Protected Resources Division through the ESA section 7 consultation process.

- Number of limited entry permits: Initially issue 10 permits with the ultimate objective of issuing a maximum of 20 permits based on a review of the economic viability and environmental impacts of the fishery at the end of second year after implementation. This is a conservative approach and depends on the economic and environmental impact of the fishery.

- Limited entry permit transfer: No permit transfer (i.e., sale) in the first two years and a minimum of two landings during the two-year time period.

- Limited entry permit qualification option: The HMSAS suggests Option 2 – drift gillnet (DGN) point system. The HMSAS does not want to increase additional fishing effort; under this option the HMSAS would like to see the transfer of fishing from one gear type to the other. To encourage this transfer between gear types the HMSAS recommends that the DGN permit be tied to the new SSLL limited entry permit so that the two permits could not be fished at the same time.

- Additional concerns: The HMSAS recommends establishment of a permit review board to review permit qualifications, permit transfers, and any other challenges confronting the management of the fishery. The HMSAS also recommends that a permit application process, as discussed in section 2.2.3.1 in the Preliminary DSEIS (Attachment 1), be part of the Council's recommendation. This provision would be similar to what was established under the Groundfish FMP limited entry program.

A minority of the HMSAS (Meghan Jeans, Ocean Conservancy) believe that the Council should select the status quo alternative as its final preferred alternative for Amendment 2 to the HMS FMP and discontinue the development of a management framework for a high seas shallow set longline fishery off the west coast of the United States. Rather than seeking to allow a high seas longline fishery, the Council and NMFS should maintain the current prohibition on shallow-set longlining east of 150°W longitude and strengthen this measure by prohibiting Hawaii longline permit holders from fishing in this area and landing their catch on the west coast. Development of a west coast-based shallow set longline fishery is premature and is not based on a comprehensive evaluation of potential impacts or consideration of a reasonable range of alternatives. NMFS must better define the purpose and need for its proposal to allow the fishery and consider a broader range of alternatives to achieve the goal of providing more sustainable fishing opportunities while promoting the recovery of endangered and threatened sea turtles, vulnerable marine mammal, seabird, and fish populations. We also encourage NMFS to prioritize the development of a coordinated management strategy for pelagic fisheries between the Pacific Fishery Management Council ("PFMC") and the Western Pacific Regional Fishery Management Council ("WPRFMC").

PFMC
04/04/09

HIGHLY MIGRATORY SPECIES MANAGEMENT TEAM REPORT ON FISHERY MANAGEMENT PLAN AMENDMENT 2-HIGH SEAS SHALLOW-SET LONGLINE

The Highly Migratory Species Management Team (HMSMT) discussed the alternatives under Highly Migratory Species (HMS) Fishery Management Plan (FMP) Amendment 2. If the Council chooses to recommend the fishery, the HMSMT recommends Alternative 2 with 10 or fewer permits and Area Closure Option 1 (east of 150 degrees W longitude) or 2 (east of 140 degrees W longitude) for the following reasons.

Observer data from the Hawaii and historic California SSLL fisheries shown in Table 4-11 of the preliminary draft Supplemental Environmental Impact Statement (SEIS) suggests there is a higher risk of loggerhead interactions to the west of 140° W than to the east of 140° W longitude. A lower level of effort resulting from a smaller fishery would help to minimize bycatch of nontarget and protected species of concern. Fishing in the area east of 140° W is also likely to reduce the chance of interactions with marine mammal stocks of concern. Conversely, allowing a fishery out to 150° W may increase economic viability by leaving more area open to fishing effort.

The HMSMT notes that under Alternative 2, take caps for allowable leatherback and loggerhead interactions would be set at levels consistent with the incidental take statement.

The economic viability analysis in Appendix B of the SEIS suggests that a fishery with up to 10 permits would be economically viable, while economic viability becomes less certain for fisheries with over 10 permits. The results showing that a fishery larger than 10 permits might not be economically viable are largely driven by the assumption that effort would be constrained by observer availability.

If the Council recommends the fishery, the HMSMT notes that under the action alternatives gear restrictions consistent with those currently applicable to the Hawaii limited access fishery permit holders fishing with SSLL gear would be required in the proposed fishery. These include the requirement to use large 18/0 circle hooks with up to a 10° offset and mackerel-type bait. Although not explicitly described under action alternatives, the HMSMT suggests that seabird mitigation measures comparable to Hawaii's be included and that skippers be required to attend workshops presented by NMFS Protected Resources Division.

The HMSMT recommends the Council consider the use of a limited entry permit application and issuance process. Given the Council's previous experience with limited entry in the groundfish management plan, the HMSMT recommends the Council considers the use of an initial application window for those who might qualify for a permit, followed by a length of time during which applicants could be ranked (see discussion in section 2.2.3.1 of the SEIS).

PFMC
4/4/09

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON FISHERY MANAGEMENT PLAN AMENDMENT 2 - HIGH SEAS SHALLOW-SET LONGLINE

The Scientific and Statistical Committee (SSC) reviewed a preliminary draft Supplemental Environmental Impact Statement (SEIS) for a proposed high seas shallow-set longline fishery. Dr. Kit Dahl and Dr. Steve Stohs of the Highly Migratory Species Management Team and Ms. Elizabeth Petras of National Marine Fisheries Service Southwest Regional Office were available to answer questions.

With regard to sea turtle protective measures, all of the action alternatives include 100 percent observer coverage and hard bycatch caps, which will ensure that take will not exceed that allowed by subsequent Endangered Species Act consultation. A lack of available data weakens the analysis of SEIS alternatives. Full evaluation of these alternatives requires information on spatial and temporal distribution of the target and bycatch species and response of the fishery to area restrictions. However, this proposal is for a fishery in an area that has not been fished in recent years, using significantly modified gear. The language and conclusions of the SEIS need to explicitly acknowledge uncertainty and simplifying assumptions to avoid giving a false sense of precision in the evaluation of alternatives. Nonetheless, the current document is sufficient for Council decision-making, with the caveat that catch rates and take estimates are imprecise and quantitative estimates of fishery profitability are not reliable at this time.

The SSC noted some shortcomings of the economic analysis that could be addressed but probably would not alter the general evaluation of the proposed alternatives. Evaluation of fishery impacts and profits for the alternative westward boundary designations should use available spatial information on swordfish catch per unit of effort (CPUE) as well as interactions with protected species. The current analysis holds swordfish CPUE spatially constant and oversimplifies redistribution of fishing effort. Likewise, most of the economic evaluation relies on cost estimates from the Hawaii-based fishery. Predictable differences between this fishery and the west coast-based fishery, such as distance travelled to the fishing grounds, should be documented in the analysis.

The evaluation of impacts and economic benefits of alternative fleet size limits is also quite uncertain. The opportunity costs associated with the required observer coverage should be explicitly evaluated, including identification of which fisheries might lose coverage if observers must be diverted to meet the 100 percent coverage required by this fishery. Uncertainty in the magnitude of fishery interactions with protected species and resulting take estimates should also be explicitly acknowledged.

In development of future Environmental Impact Statements, the SSC encourages further discussion about the ecosystem effects of different fisheries and gear types. The Highly Migratory Species Fishery Management Plan should approach the issue of bycatch and ecosystem effects comprehensively.

PFMC
04/04/09

Conserving Ocean Fish and Their Environment
Since 1973

Agenda Item D.2.a

March 30, 2009

Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, OR 97220-1384

RE: Amendment 2 to the West Coast HMS FMP: Authorize a Shallow-Set Longline Fishery Seaward of the EEZ

Dear Council Members,

The National Coalition for Marine Conservation (NCMC), founded in 1973 by conservation-minded fishermen, opposes authorizing a west coast-based high seas longline fishery in the eastern Pacific on the grounds that pelagic longlining carries too high a price tag in terms of its well-documented environmental costs, as well as its proven high management costs because of the significant time and resources required to monitor and manage such an indiscriminate method of fishing.

We share the environmental community's concern about the impact of a high seas longline fishery on endangered loggerhead and leatherback sea turtles. We are also concerned, however, about the potential longline bycatch of non-target fish. By the Council's own estimation, although the target species is North Pacific swordfish, at least 28 non-target species are likely to be caught as bycatch in a longline fishery. Among these species are a number for which Amendment 2 identifies "conservation concerns": bigeye tuna ("overfishing occurring and stock overfished"), yellowfin tuna ("overfishing may be occurring"), striped marlin ("stock size low compared to historic levels...stock is depleted") and albacore tuna ("current fishing effort high...overfishing could occur"). In addition, major non-target species include shortfin mako sharks, which are listed as "Near Threatened" by the IUCN, and Pacific bluefin tuna, for which the Western & Central Pacific Fisheries Commission (WCPFC) is considering measures to prevent an increase in fishing effort.

4 Royal Street, S.E. • Leesburg, VA 20175 • (703) 777-0037 • fax (703) 777-1107
www.savethefish.org

The proposal to open the high seas beyond the United States EEZ to a west coast-based longline fishery is predicated on implementation of new fishing methods – the use of circle hooks and mackerel-type bait, as now used in the Hawaii-based longline fishery - aimed at reducing the take of endangered sea turtles, as required by the Endangered Species Act. But as Amendment 2 points out, "(n)o controlled experiments have been conducted in the Hawaii fishery to determine if the use of circle hooks and mackerel bait results in different CPUEs (catch rates) for finfish in comparison to J-hooks and squid bait."

Under the Council's proposal to authorize a high seas longline fishery, turtle takes will continue, albeit with measures to close the fishery when an as-yet-undefined cap is reached, while the catch of non-target finfish, many of them fully- or over-exploited, will increase significantly.

Turtle Takes Treated as a "Quota"

The likelihood of continued mortality of endangered loggerhead and leatherback sea turtles in a longline fishery which could add effort from 20 or more vessels (Alternatives 2-4) is, in our opinion, reason enough to continue the prohibition on longlining (Alternative 1; No Action). Turtle take caps (allowable takes) associated with the various alternatives are not delineated in the Amendment, but instead would be evaluated subsequent to approval of the fishery and established subject to a new Biological Opinion performed by the National Marine Fisheries Service. This approach suggests the Council and the Agency are treating turtle takes as an allowable catch, with a quota, rather than as an outcome to be avoided.

We are concerned that federal fishery managers are working backward from their *a priori* determination to establish a fishery and later determine how to accommodate it under the ESA. We say this because the substantial Hawaii longline fishery was permitted to resume in the North Pacific without coordination between the Western Pacific and Pacific Councils in developing their respective plans and thus without accounting for the potential additional impact of a west coast-based fishery on the high seas. Nor does this proposal account for the possibility of re-opening the west coast EEZ to longlining, which the Council is also proposing under a separate action (an EFP to test the viability of a swordfish longline fishery within 200 miles of the coastline). This *ad hoc* "allocation" of turtle takes to accumulating longline effort undermines the intent of the ESA along with the public's confidence in the process.

An Unmanageable Longline Fishery Will Contribute to Overfishing

The Council's consideration of the impact of the high seas longline fishery on finfish is equally problematic. While acknowledging an increase in mortality on a number of species that are already subject to overfishing, in an overfished condition, or whose status is unknown, Amendment 2 dismisses these "conservation concerns" by arguing that a) the expected increase in U.S. catch is a small portion of the total catch from the stock in question, and b) it is the responsibility of international agencies, such as the Inter-American Tropical Tuna Commission (IATTC) and WCPFC, to set limits on these highly migratory species, not the U.S.

Amendment 2 affirms that a high seas longline fishery will increase mortality of North Pacific albacore, bigeye tuna, striped marlin, bluefin tuna, yellowfin tuna and shortfin mako shark. Projections of the actual increase in catch of these species are highly uncertain, given that they are bycatch species taken incidentally and that the controls on the fishery contained in Amendment 2 are not designed to affect the catch of non-target fish. The history of managing longline fisheries, however, is one of indiscriminate and substantial bycatch of a long list of pelagic fish. Among those species of concern identified in the plan, and their conservation status as cited in the document (pp. 43-46), are:

- **Albabore**: "...fishing mortality (for albacore) is higher relative to most commonly used reference points, leading to a concern that overfishing could occur. Both the IATTC and WCPFC have passed resolutions calling on nations not to increase fishing effort on this stock." (
- **Bigeye Tuna** – "NMFS declared the stock subject to overfishing in 2004...(The Council's) strategy principally relies on making recommendations, through the U.S. delegations to the IATTC and WCPFC, on measures that would end overfishing...the IATTC has so far been unable to adopt such conservation and management measures."
- **Striped Marlin** – "...the stock is depleted. In 2007 and 2008 the ISC plenary recommended that 'the fishing mortality rate of striped marlin should be reduced from the current level...the fishing mortality rate should not be increased."
- **Shortfin Mako Shark** – "The IUCN lists this species as "Near Threatened."
- **Bluefin Tuna** – "Fishing mortality likely exceeds the rate predicted to produce maximum yield per recruit (ISC 2008). In 2008 the WCPFC considered a conservation and management measure calling on nations to not increase fishing effort on this stock but did not adopt it."
- **Yellowfin Tuna** – "Based in part on previous stock assessment results from the IATTC, NMFS declared that overfishing is occurring on this stock. In accordance with the MSA, in March 2007 the Council provided recommendations to NMFS and Congress on measures to end overfishing on this stock. Such measures would have to be implemented through the IATTC. To date the IATTC has been unsuccessful in adopting conservation measures to end overfishing on this stock."

These facts – clear concerns about the status of the species, the need for conservation measures, and the inability in most cases of international bodies to adopt them - make the Council's indifferent attitude troubling, to say the least, and presents an approach to conserving shared, highly migratory species that inevitably resigns these resources to mutually assured destruction.

First of all, to say that the expected increase in U.S. catch of any one species is a small part of the total catch is irrelevant for species that are overfished or for which overfishing is occurring. An increase in catch will increase overfishing. Secondly, to declare that the U.S. strategy for ending overfishing is to seek international measures through the IATTC and WCPFC, but that in the absence of such catch restrictions the U.S. will unilaterally increase its catch, is irresponsible. What it boils down to is this: because the U.S. alone cannot prevent overfishing, it is okay for us to take action that not only contributes to it, but actually promotes it.

Just as conserving a highly migratory species is a shared responsibility, overfishing is a cumulative effect. If a species is overfished or near that condition, as are a number of those species that will be taken in a high seas longline fishery, every nation fishing that stock has the responsibility not to increase fishing mortality at least until international measures are in place that would specifically permit it. If all nations fishing these stocks take the attitude reflected in Amendment 2 – that is, unilaterally increase fishing pressure while awaiting multi-lateral action - overall fishing mortality will substantially increase and international conservation of highly migratory species in the Pacific will be too little, too late.

Make no mistake. The day will come when the U.S. and other fishing nations are asked to limit their catch of a range of Pacific HMS, because overfishing is likely to continue on these species for the foreseeable future. When that day comes, you will find, as others have before you, that implementing conservation measures on non-target species in a longline fishery is costly, time-consuming and, ultimately, next to impossible. The Council will be confronted with controlling the bycatch, not just counting it. The only measure that has worked for a wide range of species has been area closures - taking the gear out of the water where and when it is doing the most damage. But you've already done that. You made the right decision the first time.

Thank you for considering our views.

Sincerely,

Ken Hinman

Ken Hinman
President

March 30, 2009

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

RE: D.2. Fishery Management Plan Amendment 2 – High Seas Shallow-Set Longline Fishery

Dear Mr. Hansen and Council members:

These comments are submitted on behalf of the Center for Biological Diversity, Defenders of Wildlife, the Monterey Bay Aquarium, Ocean Conservancy, Oceana, Turtle Island Restoration Network and our combined 1.5 million members nationwide regarding the National Marine Fisheries Service (NMFS) proposal to develop a high seas shallow-set (pelagic) longline fishery off the West Coast of the United States. As the Pacific Fishery Management Council moves forward to adopt a final preferred alternative from the Preliminary Draft Supplemental Environmental Impact Statement (SEIS), it should adopt Alternative 1, "No Action" as the preferred alternative. Creation of a high seas longline fishery is inappropriate given its potential adverse ecological consequences and the numerous legal, policy, and scientific concerns it raises. The Council should maintain the current prohibition on shallow-set longline gear east of 150°W longitude and to further strengthen this measure by prohibiting Hawaii longline permit holders from fishing in this area and landing their catch on the West Coast.

We submitted detailed comments describing our concerns to the National Marine Fisheries Service during scoping for the High Seas Shallow-Set Longline SEIS and those are incorporated here by reference.[1]

[1] Ocean Conservancy, Center for Biological Diversity, Defenders of Wildlife, Turtle Island Restoration Network, Oceana, Monterey Bay Aquarium. Letter to M. Helvey (NMFS). September 2, 2008. 18 p. RIN 0648-X167

The establishment of a high seas shallow-set longline fishery threatens numerous species.

A. Increased longline pressure threatens endangered sea turtle populations.

Sea turtles throughout the Pacific are hovering on the brink of extinction due in large part to incidental mortality associated with fishing operations. Pacific leatherbacks are classified as "endangered" throughout their range under the Endangered Species Act (ESA) and "critically endangered" by the World Conservation Union (IUCN). Numbering over 100,000 nesting females as recently as the 1980s, the species is in rapid decline with a current estimate of only 2,000-5000 nesting females.[2] In 2000, an article published in the scientific journal *Nature* predicted extinction of leatherbacks in the Pacific within decades.[3] The primary cause of the leatherback decline, and the greatest threat to its continued existence, is entanglement and drowning in longline fishing gear.[4]

According to the latest surveys, there are fewer nesting loggerheads in the Pacific than nesting leatherbacks. The two major loggerhead populations in the Pacific are found in Japan and Australia, with less than 1,000 and 300 turtles, respectively, nesting annually. The IUCN's Red List of Threatened Species identifies loggerheads as "endangered" while the ESA classifies loggerheads as "threatened" throughout their range. North Pacific loggerheads have declined by upwards of 80% in recent decades, and are likely approaching the perilous state of the Pacific leatherback. On July 12, 2007, the Center for Biological Diversity and Turtle Island Restoration Network petitioned NMFS to change the status of North Pacific loggerheads from threatened to endangered. NMFS determined that the status change may be warranted, 72 Fed. Reg. 64585 (Nov. 16, 2007), and the agency is now past its legal deadline to issue a final decision regarding the North Pacific loggerhead's status.

Scientists have concluded that the "critical issue for an individual turtle is the likelihood of capture across an ocean region, not capture by a particular nation. With multiple fleets deployed the cumulative effects of pelagic longlines across fleets in large ocean regions must be taken into account."[5] We have repeatedly called for a comprehensive evaluation of the impacts of all U.S. longlining in the Pacific on imperiled sea turtle populations, yet that essential step still has not occurred. The need for this evaluation is reinforced by the fact that, at the same time NMFS is considering developing a West Coast-based high seas longline fishery, the agency is also reviewing a proposal by the Western Pacific Fishery Management Council to remove effort limits and raise loggerhead sea turtle take caps in the Hawaii-based pelagic longline fishery[6] and is considering an Experimental Fishing Permit (EFP) for pelagic longline gear inside the West Coast Exclusive Economic Zone (EEZ).

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[2] Lewison, R. *et al*., (2004) Quantifying the effects of fisheries on threatened species: the impact of pelagic longlines on loggerhead and leatherback sea turtles, *Ecology Letters* 7:221.
[3] Spotila et al. (2000), Pacific leatherback turtles face extinction, *Nature* 405:529-530.
[4] *Id.*
[5] Crowder, L. B and R.I. Lewison. Putting Longline Bycatch of Sea Turtles into Perspective. Conservation Biology 2007, Volume 21, No.1, p. 81.
[6] 74 Fed.Reg. 11518 (March 18, 2009).

Amendment 2 to the Highly Migratory Species Fishery Management Plan would further increase impacts to the same threatened and endangered loggerhead and leatherback sea turtle populations taken in the Hawaii-based fishery and by the proposed longline EFP. The proposed high seas pelagic longline fishery would take 3 - 9 leatherbacks and 4 - 27 loggerheads, depending on the number of permits issued.[7] The executive summary of the Preliminary Draft SEIS notes that options under Alternative 2 that would issue up to 20 permits risk "substantial detrimental population level impacts for loggerhead and leatherback sea turtles."[8]

B. The proposed high seas longline fishery would cause harm to marine mammal and seabird populations.

Many species of protected marine mammals and seabirds occur in the area NMFS now proposes to open to shallow-set longline fishing. These species are known to become entangled, seriously injured or killed by pelagic longline gear. The Preliminary Draft SEIS identifies many marine mammals that may be taken and killed if this fishery is authorized including bottlenose dolphins, Bryde's whales, short-beaked common dolphins, false killer whales, endangered humpback whales, short-finned pilot whales and Risso's dolphins.[9] In addition, west of 150^{o}W longitude shallow-set longline fisheries have also taken sperm whales, spinner dolphins and striped dolphins.[10] The Preliminary Draft SEIS identifies black-footed albatross and Laysan albatross as two species of seabirds likely to be affected and the analysis finds that the action alternatives all increase the risk of taking endangered short-tailed albatross.[11] The IUCN has listed black-footed albatross as endangered and the U.S. Fish and Wildlife Service is currently considering a petition to list this seabird as endangered under the ESA. Allowing further take of these marine mammals and seabird species is neither scientifically supportable nor legally defensible.

C. Increased longline fishing effort and capacity threatens vulnerable fish populations and will increase bycatch.

In addition to potential negative interactions between shallow-set longline gear and endangered sea turtle populations, we are concerned about the impact of increased fishing effort and capacity on non-target fish species. While the proposed high seas shallow-set longline fishery specifies swordfish as the target catch, other more vulnerable highly migratory species may be targeted or caught incidentally. The Preliminary Draft SEIS estimates that all action alternatives will increase the bycatch of non-target fish including thousands of sharks, tunas and billfish.[12] Characterized by their slow growth, late maturity and low fecundity, shark species are particularly vulnerable to the impacts of longline fisheries.

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[7] HMS FMP Amendment 2 Preliminary Draft SEIS, 107-109.
[8] *Id*, at v.
[9] *Id*, at 113-114.
[10] *Id*, at 63.
[11] *Id*, at 117-120.
[12] *Id*, 99.

The Preliminary Draft SEIS for the high seas longline fishery acknowledges that thousands of tuna are likely to be caught incidentally during shallow-set longline activities.[13] Of greatest concern is the potential impact to yellowfin, bigeye and albacore tuna species. Both the Inter-American Tropical Tuna Commission (IATTC) and U.S. stock assessment scientists have identified eastern Pacific bigeye and yellowfin tuna populations as subject to overfishing.[14] In 2006, the IATTC adopted a resolution which declared that "bigeye stocks are below the level that would produce the average maximum sustainable yield (AMSY)" and directed member nations to implement a seasonal closure for commercial purse seine and longline vessels targeting bigeye (and yellowfin) tuna.[15] The 2006 resolution has since expired and though bigeye and yellowfin are still experiencing overfishing, IATTC member nations have failed multiple times to reach an agreement on management measures.

The IATTC and the Western and Central Pacific Fisheries Commission (WCPFC) also adopted resolutions in 2005 identifying North Pacific albacore populations as experiencing overfishing and requiring member nations to cap fishing effort at current levels.[16] The first Stock Assessment and Fishery Evaluation (SAFE) Report for the U.S. West Coast HMS FMP echoed this conclusion and warned that "[t]he current fishing mortality rate is high…and may be cause for concern regarding the current stock status of North Pacific albacore."[17] Likewise, the most recent 2007 SAFE report referenced the ISC recommendation that all nations practice precautionary-based fishing "[c]onsidering the high fishing mortality rates, and the fact that total catch has been in decline since 2002…"[18] The U.S. has yet to characterize fishing effort, let alone take affirmative action to cap effort at current levels. As such, a proposal to establish a high seas longline fishery off the West Coast and increase domestic albacore catch by 20-77 mt/year contravenes international resolutions to cap fishing effort on North Pacific albacore.[19]

By violating its obligations under international agreements, the U.S. and its vessels are at risk of being classified as engaged in illegal, unreported or unregulated (IUU) fishing. As Dr. Rebecca Lent, Director of the Office of International Affairs for NMFS, testified at a hearing before the House Committee on Natural Resources, "[m]ost RFMOs have adopted procedures to identify and list vessels that have engaged in IUU fishing in areas and for stocks under their jurisdiction. The procedures require parties to the RFMO to apply a range of sanctions to listed vessels. Sanctions range from restricting access to port services to outright denial of port entry."[20] Should the U.S. and/or its vessels be identified as engaged in IUU fishing, U.S. fishermen may be subject to a range of sanctions. Moreover, other lawful and more sustainable fisheries, such as the West Coast pole and troll fishery for albacore, may be unfairly disadvantaged by whatever restrictions or sanctions are levied by RFMO member states.

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[13] *Id.*
[14] 2007 HMS Stock Assessment and Fishery Evaluation Report, Table 5-2, p. 122.
[15] Resolution C-06-02, IATTC, June 2006
[16] PROP IATTC-73-C1, June 2005
[17] 2005 HMS Stock Assessment and Fishery Evaluation Report, Section 5.3.1, page 106.
[18] 2007 HMS Stock Assessment and Fishery Evaluation Report, Section 5.3.1.1, p. 117-118.
[19] HMS FMP Amendment 2 DSEIS, March 2009, Table 4-9, p.99.
[20] Testimony of Dr. Rebecca Lent, NMFS, NOAA regarding "H.R. 1080, Illegal, Unreported, and Unregulated Fishing Enforcement Act of 2009" before the Committee on Natural Resources, Subcomittee on Insular Affairs, Oceans and Wildlife, United States House of Representatives, March 19, 2009.

In light of the vulnerable status of these tuna populations, expanding capacity, increasing fishing effort and establishing a high seas shallow-set longline fishery off the U.S. West Coast is not consistent with international resolutions, domestic regulations, the best available science or the principles of precautionary management.

Expanding shallow-set longlining in the Pacific would be inconsistent with key environmental laws.

The potential biological impacts of establishing a new high seas shallow-set longline fishery are so severe that the fishery would likely violate numerous federal laws, including the Endangered Species Act, Marine Mammal Protection Act, and Migratory Bird Treaty Act. Each of these violations is outlined in our September 2, 2008 letter to NMFS, which is incorporated here by reference.[21] In addition, authorizing a new fishery would increase bycatch of sea turtles, marine mammals, seabirds, sharks, tunas and other fishes and could, therefore, violate the Magnuson-Stevens Act requirement to minimize and avoid bycatch. Given the significant legal deficiencies with the proposed Alternatives 2, 3 and 4, Alternative 1, "No Action" remains the only viable alternative at this time.

NMFS should adopt import restrictions and demand-side strategies to reduce reliance on imported swordfish.

Proponents of the high seas longline proposal also claim that a West Coast-based fishery is warranted and necessary to meet the domestic demand for swordfish and reduce our reliance on imported swordfish from countries that may have weaker standards for sustainability and conservation. While the impact of U.S. swordfish imports is a legitimate concern, the implied assumption is that demand is static and therefore we must increase supply in order to meet demand. Previous efforts to inform and educate consumers about the ecological impacts of fishery operations have influenced demand and paved the way for more effective management strategies.

The U.S. has the authority and the legal responsibility to monitor and control imports from countries whose vessels are fishing in a manner that undermines the conservation of protected species. The recent reauthorization of the Magnuson-Stevens Act (MSA) clarified the intent of Congress to reduce IUU fishing in order to raise the bar for sustainability. Specifically, the Act requires that NMFS identify fishing vessels engaged in "fishing activities or practices…that result in bycatch of protected living marine resources..."[22] Moreover, the MSA specifically endorses the use of market-related measures such as import prohibitions and landing restrictions to combat IUU fishing.[23] Likewise, under the Marine Mammal Protection Act (MMPA), the U.S. can restrict imports of swordfish from countries that do not meet strong conservation standards to minimize the impact of fisheries on marine mammals. Though still pending, the

[21] Ocean Conservancy, Center for Biological Diversity, Defenders of Wildlife, Turtle Island Restoration Network, Oceana, Monterey Bay Aquarium. Letter to M. Helvey (NMFS). September 2, 2008. 18 p. RIN 0648-X167
[22] 16 USC 1826d et seq., Section 610(a)(1)(A)
[23] 16 USC 1826d et seq., Section 608(2)

Center for Biological Diversity and Turtle Island Restoration Network submitted a petition in 2008 to ban imports of swordfish from countries failing to submit proof of the effects of fishing technology on marine mammals pursuant to Section 101 of the MMPA. If NMFS is sincerely concerned about the impacts that foreign fleets are having on protected resources, limiting or restricting the import of swordfish caught in an unsustainable manner would be a powerful tool.

Conclusion

It would be irresponsible to re-establish a high seas longline fishery that we know risks killing threatened and endangered sea turtles, marine mammals, and seabirds and will increase the bycatch of non-target fish. The best available science indicates that Pacific leatherbacks, loggerheads, and other species simply cannot sustain another pelagic longline fishery. The United States has the responsibility and authority to take additional actions to protect endangered sea turtle populations such as identifying IUU fishing and restricting imports. A high seas longline fishery off the U.S West Coast is not justified at this time and, the Council should select Alternative 1, the "No Action" Alternative. However should the Amendment 2 process move forward, we recommend that an additional action alternative be included for analysis that would, in addition to maintaining the current closure, close the loophole whereby Hawaii-based fishermen with a pelagics permit are authorized to fish east of 150^{0} West longitude and land their catch on the West Coast.

Sincerely,

Meghan Jeans
Pacific Fish Conservation Manager
Ocean Conservancy

Jim Curland
Marine Program Associate
Defenders of Wildlife

Andrea A. Treece
Senior Attorney, Oceans Program
Center for Biological Diversity

Aimee David
Ocean Conservation Policy Manager
Center for the Future of the Oceans
Monterey Bay Aquarium

Ben Enticknap
Pacific Project Manager
Oceana

Michael Milne
Leatherback Campaign Coordinator
Turtle Island Restoration Network

Attachments:

1. Representative Farr, Representative Woolsey, et al. (21 members of the United States Congress). Letter to Dr. J.W. Balsiger. Dec 9, 2008.
2. California Assembly Joint Resolution No. 62. West Coast Sea Turtle Protection. May 21, 2008.

Congress of the United States
Washington, DC 20515

December 9, 2008

James W. Balsiger, PhD.,
Acting Assistant Administrator
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
1315 East West Highway, SSMC3
Silver Spring, MD 20910

Dear Dr. Balsiger:

As members of Congress who are deeply invested in the long-term sustainability of California's ocean health, we are writing to express our strong concerns about proposals to establish commercial longline fisheries for swordfish off the California Coast.

We have become aware that the National Marine Fisheries Service (NMFS) and its regional advisory body, the Pacific Fisheries Management Council (PFMC) are moving forward with plans to create two pelagic swordfish longline fisheries off the California coastline: an "exempted fishing permit" (EFP) for a swordfish fishery within California's Exclusive Economic Zone (EEZ) and a commercial swordfish fishery on the high seas off the US West Coast. California is a coastal state committed to the protection of its ocean resources, fisheries, and marine wildlife. The proposed longline fisheries threaten the health of California's ocean resources and marine wildlife.

As you know, the State of California has never permitted commercial pelagic longline swordfish fishing within its EEZ. California's state representatives continue to oppose the development of swordfish longline fisheries, recently passing the bi-partisan Assembly Joint Resolution 62. Yet, despite opposition from the California State Legislature, California state agencies such as the California Department of Fish and Game and the California Coastal Commission, and overwhelming opposition from the public, scientific, recreational fishing, and environmental community, the Pacific Fisheries Management Council and National Marine Fisheries Service continue to move forward with plans to rollback these important conservation measures prohibiting swordfish longlining.

Pelagic longline fishing is an indiscriminate fishing method, which can have devastating effects on marine wildlife. Observer data shows that pelagic swordfish longline fishing can yield by-catch rates of up to 40-60% by weight. Commercial longline fishing is a significant contributor to the rapid decline of the leatherback and loggerhead sea turtle populations in the Pacific. Many species found along California's coast—including endangered and protected whales, dolphins, sea lions, sea birds, sea turtles, sharks, and commercially valuable fish stocks— are also vulnerable to the impacts of pelagic longline fisheries.

We are particularly concerned by these proposals because they pose a serious risk to two endangered sea turtle species, the Pacific leatherback and the loggerhead, whose populations are already suffering from the impacts of fishing pressure elsewhere in their range. Recent scientific research and satellite tracking studies confirm that the waters off the California coast are a critical foraging area for the critically endangered Pacific leatherback sea turtle and an important migratory route for the threatened Pacific loggerhead sea turtle. Additional fishing pressure in this area would likely result in high rates of by-catch, injury, and death of these imperiled turtles.

Currently, two pending Endangered Species Act petitions will help ensure that fishery managers, scientists, and the public have the best available scientific information and that critical habitat, if appropriate, is designated for these species. The ESA requires that NMFS give the highest priority to the protection of threatened and endangered species. Moving forward with expanding pelagic longlining effort in the face of evidence that it will harm already declining sea turtle populations and key habitat flies in the face of NMFS's most vital responsibilities.

Sound science – not short-term economic gain – should drive fisheries management on the West coast. The health and sustainability of California's coastal economy depends on a diverse, abundant and resilient marine environment.

As such, we urge the National Marine Fisheries Service to withdraw support for the swordfish longline EFP and discontinue development of the proposed High Seas longline fishery. It is critical that NMFS honor existing fishing prohibitions and conservation measures to avoid jeopardizing threatened and endangered sea turtles and compromising the health and integrity of the diverse ocean environment that distinguishes and sustains California.

Thank you for your attention to this important matter. We look forward to your decision.

Sincerely,

Sam Farr
Member of Congress

Lynn Woolsey
Member of Congress

Cc: Rod McInnis, Regional Administrator, Southwest Region National Marine Fisheries Service

Lois Capps	Anna G. Eshoo
Diane E. Watson	Grace F. Napolitano
[illegible]	Michael [illegible]
Susan Davis	Mike Thompson
[illegible]	Linda T. Sánchez
Bob Filner	George Miller
Henry A. Waxman	Barbara Lee

Zoe Lofgren

Pete Stark

Doris O. Matsui

Loretta Sanchez

Maxine Waters

Assembly Joint Resolution No. 62

Introduced by Assembly Member Leno
(Coauthors: Assembly Members Berg, Evans, Hancock, Jones, and Nava)
(Coauthor: Senator Wiggins)

May 21, 2008

Assembly Joint Resolution No. 62—Relative to West Coast sea turtle protection.

legislative counsel's digest

AJR 62, as introduced, Leno. West Coast sea turtle protection.
This measure would request the National Marine Fisheries Service to delay consideration of, or deny, the swordfish longline exempted fishing permit for a specified period of time. The measure would request the National Marine Fisheries Service to defer consideration of efforts to introduce shallow-set longline fishing off the California coast for that specified period of time.
Fiscal committee: no.

WHEREAS, California is a coastal state that is dedicated to protection of our ocean resources, fisheries, and marine wildlife; and

WHEREAS, Sea turtles, fish, and marine mammals are a central component of California's natural heritage and marine biodiversity; and

WHEREAS, According to the National Marine Fisheries, the waters off the central California coast are a critical foraging area for Pacific leatherback sea turtles; and

WHEREAS, According to the National Marine Fisheries Service, the waters off the California coast are a significant migratory corridor and foraging area for North Pacific loggerhead sea turtles; and

WHEREAS, Scientists have determined that the populations of Pacific leatherback and North Pacific loggerhead sea turtles have declined by approximately 95 percent and 80 percent to 86 percent, respectively, in the last 25 years; and

WHEREAS, Scientists predict that the death of more than 1 percent of the adult female Pacific leatherback sea turtle population each year could lead to the extinction of the species, making the catch of small numbers of Pacific leatherback sea turtles a serious threat to their future survival; and

WHEREAS, Scientists estimate that the Pacific leatherback sea turtle could become extinct within 10 to 30 years if existing by-catch rates are not reduced; and

WHEREAS, Scientists predict that current population trends indicate a high probability that North Pacific loggerhead sea turtles will be effectively extinct within approximately 50 years; and

WHEREAS, Injury and mortality from interactions with longline fishing gear is a direct contributor to the rapid decline, and potential extinction, of Pacific leatherback and North Pacific loggerhead sea turtles; and

WHEREAS, Data collected from fishing vessels have revealed that shallow-set longlines are targeting swordfish snare turtles at a rate 10 times greater than deep-set longlines; and

WHEREAS, The National Marine Fisheries Service is considering approval of an exempted fishing permit (EFP) to authorize shallow-set longlining to target swordfish within the Exclusive Economic Zone (EEZ) of the California coast where the State of California has prohibited this activity since 1977; and

WHEREAS, The proposed EFP would allow longline fishing inside the Pacific leatherback sea turtle conservation area, an area that has been seasonally closed to fishing to protect Pacific leatherback sea turtles; and

WHEREAS, In 1992, the Department of Fish and Game banned all pelagic longline fishing in the Exclusive Economic Zone off the California coast; and

WHEREAS, The California Coastal Commission completed a consistency certification of a similar exempted fishing permit in 2007 and unanimously voted to deny certification; and

WHEREAS, The National Marine Fisheries Service is also considering authorizing the placement of a shallow-set longline fishery to target swordfish on the high seas (High Seas Swordfish Fishery) off the West Coast of the United States in an area known to be used by Pacific leatherback and North Pacific loggerhead sea turtles; and

WHEREAS, Longlining for swordfish has been prohibited on the high seas off the West Coast of the United States since 2004 when the federal government determined that by-catch of North Pacific loggerheads by the High Seas Swordfish Fishery would violate the federal Endangered Species Act's jeopardy prohibition; and

WHEREAS, A high seas swordfish fishery off the West Coast of the United States will also result in the intentional and incidental capture of Yellowfin, Bigeye, and Albacore tuna, which populations are already considered overfished or are experiencing overfishing by the Inter-American Tropical Tuna Commission (IATTC) or US Stock Assessments or both; and

WHEREAS, On December 27, 2007, the National Marine Fisheries Service accepted a petition to analyze whether California's waters should be designated as a critical habitat area for the endangered Pacific leatherback turtle; and

WHEREAS, On November 16, 2007, the federal government announced it was considering a petition to list the North Pacific loggerhead sea turtles found off the West Coast of the United States as endangered under the federal Endangered Species Act; and

WHEREAS, The federal Endangered Species Act requires the National Marine Fisheries Service to give highest priority to the protection of threatened and endangered species; now, therefore, be it

Resolved by the Assembly and the Senate of the State of California, jointly, That the Legislature of the State of California acknowledges the severe decline of Pacific leatherbacks and North Pacific loggerhead sea turtle populations and supports efforts to recover and preserve these populations; and be it further

Resolved, That the Legislature of the State of California requests the National Marine Fisheries Service to delay consideration of, or deny, the swordfish longline exempted fishing permit in the West Coast Exclusive Economic Zone, until Pacific leatherback sea turtle critical habitat is established, the federal status of the North Pacific loggerhead sea turtle is clarified, and critical habitat is designated for the North Pacific loggerhead sea turtle should it be uplisted to "endangered"; and be it further

Resolved, That the Legislature of the State of California requests that the National Marine Fisheries Service defer consideration of any efforts to introduce shallow-set longline fishing off the California coast, both inside and outside the EEZ, until Pacific leatherback sea turtle critical habitat is established, the federal status of the North Pacific loggerhead sea turtle is clarified, and critical habitat is designated for the North Pacific loggerhead sea turtle, if it is designated as "endangered"; and be it further

Resolved, That the Chief Clerk of the Assembly transmit copies of this resolution to the President and Vice President of the United States, to the Speaker of the House of Representatives, and to each Senator and Representative from California in the Congress of the United States.

O

Agenda Item D.2.c
Supplemental Public Comment 2
(Oceana PowerPoint)
April 2009

High Seas Longline Fishery

Leatherback sea turtle

Bigeye and yellowfin tuna

Bottlenose Dolphin

Blue Shark

Ben Enticknap, April 4, 2009. PFMC, D-2.

OCEANA | Protecting the World's Oceans

Expanding longline fisheries in the Pacific would be inconsistent with key environmental laws

- Endangered Species Act
- Migratory Bird Treaty Act
- Marine Mammal Protection Act
- Magnuson-Stevens Fishery Conservation and Management Act

"We conclude that leatherbacks are on the verge of extinction in the Pacific."

- Spotilla, J.R., et al. 2000. Pacific Leatherbacks Face Extinction. Nature.

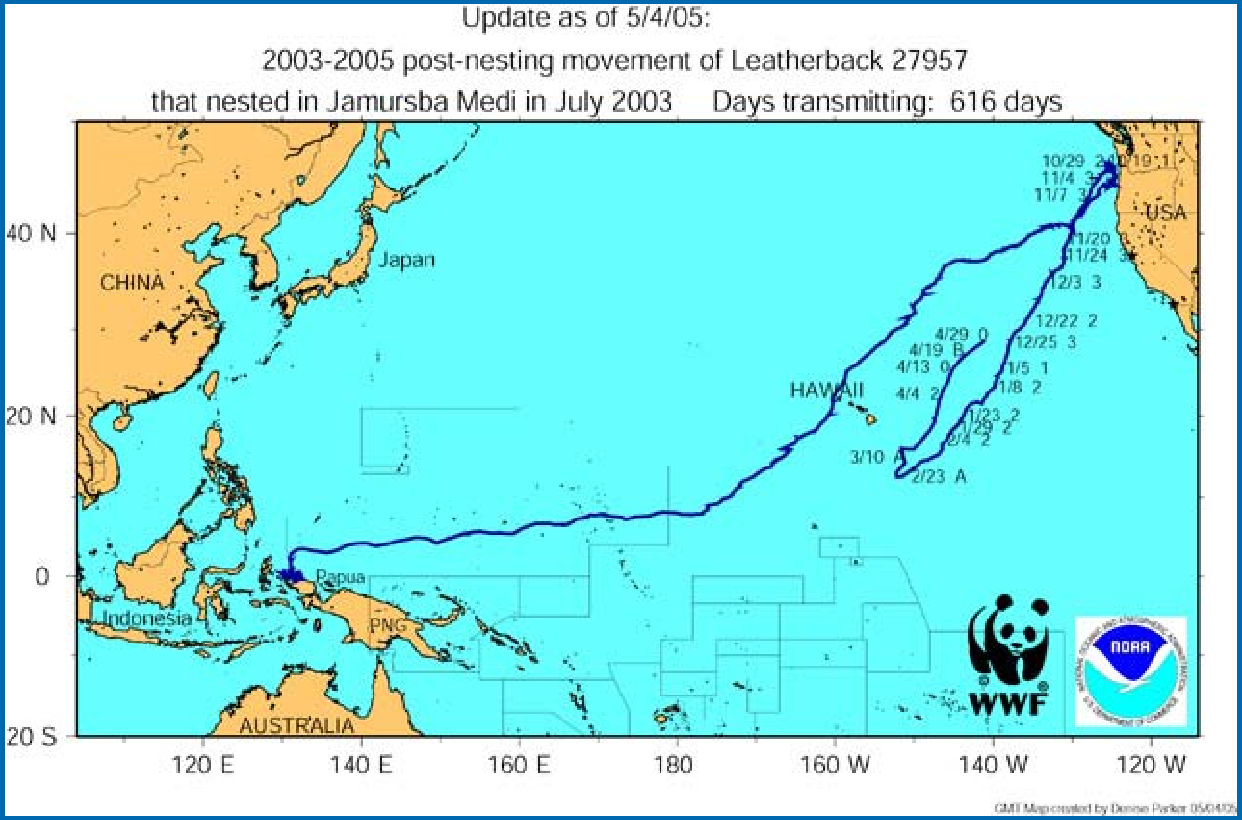
Leatherback in Monterey Bay, California. Photo: J. Sorensen

3 - 9

Estimated number of leatherback takes in proposed high seas longline fishery per year. DEIS at 107.

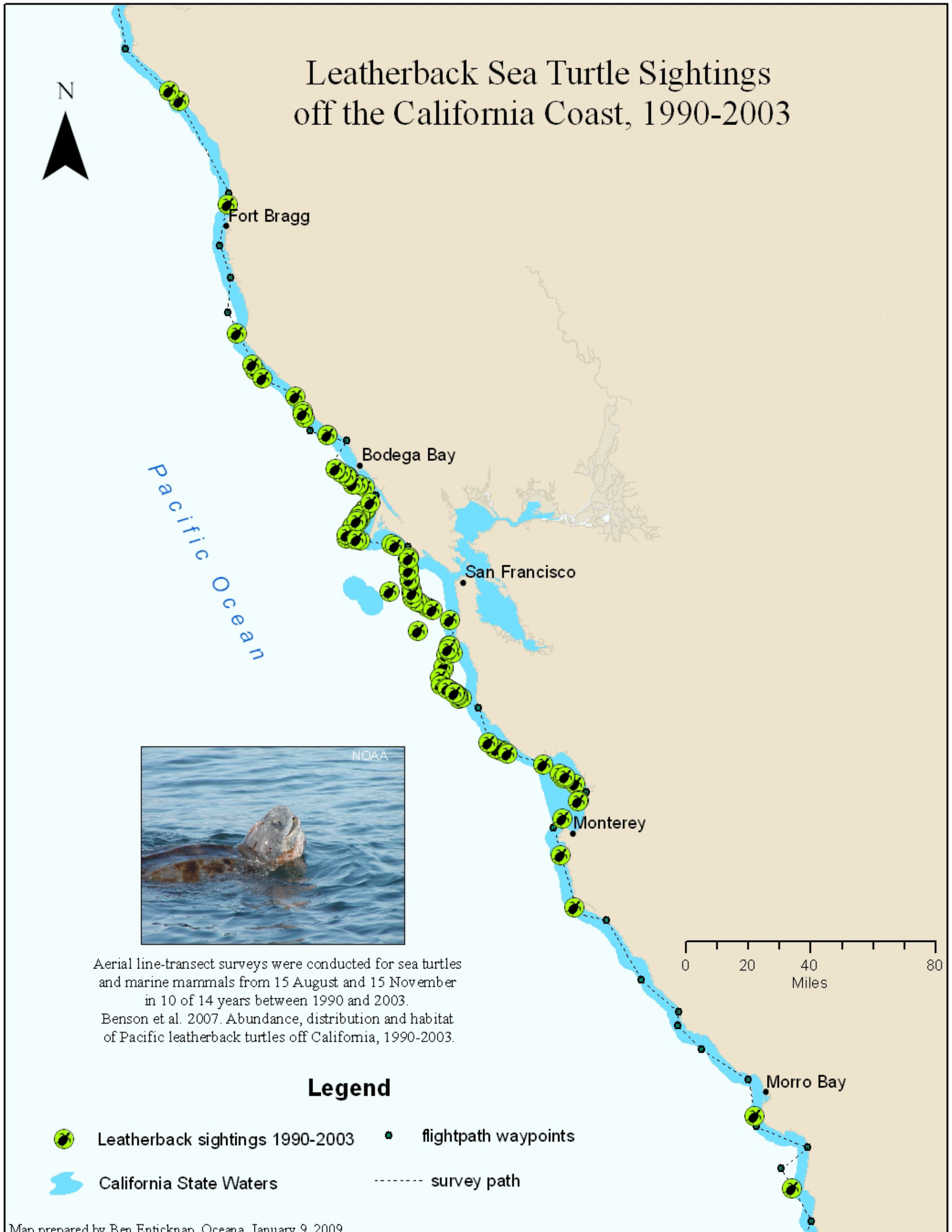
Mortality: 1 – 3

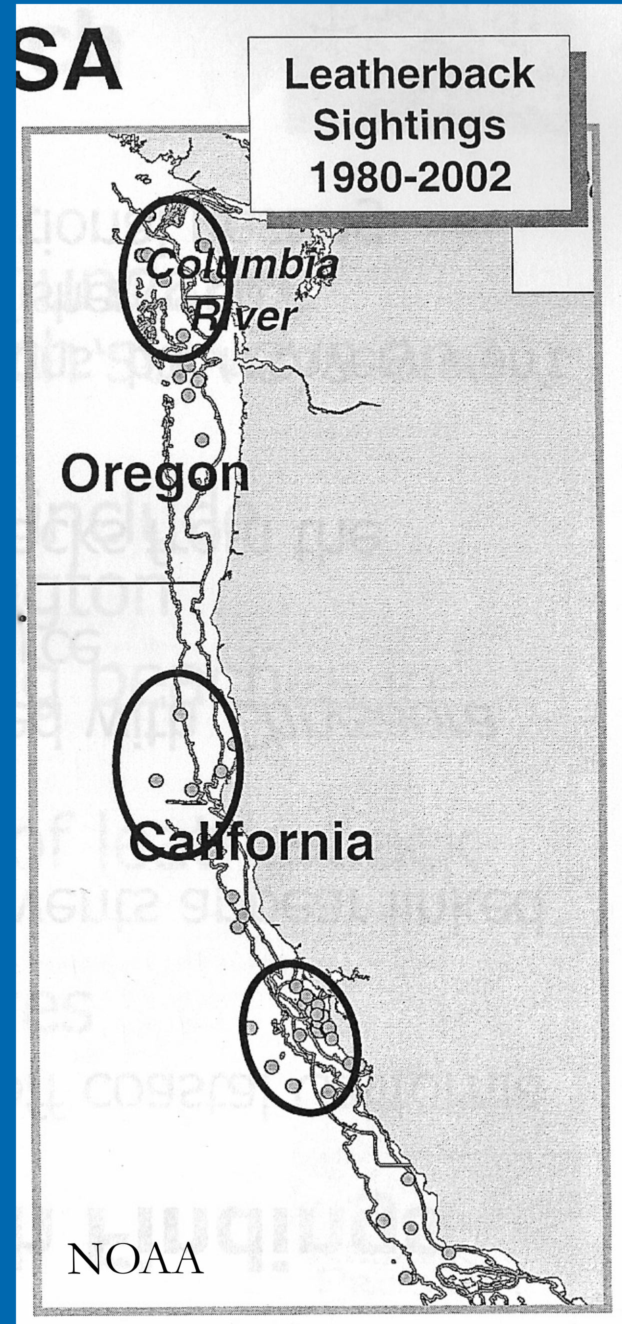
Trans-Pacific Leatherback Sea Turtle Migrations



"The track between New Guinea and shelf waters off Oregon, USA may represent the longest known migration between breeding and foraging areas of any marine vertebrate."

Scott Benson et al. 2007.


Leatherback Sea Turtle Sightings
off the California Coast, 1990-2003
N
Fort Bragg
Bodega Bay
Pacific Ocean
San Francisco
Monterey
Morro Bay
0 20 40 80
Miles
NOAA
Aerial line-transect surveys were conducted for sea turtles and marine mammals from 15 August and 15 November in 10 of 14 years between 1990 and 2003.
Benson et al. 2007. Abundance, distribution and habitat of Pacific leatherback turtles off California, 1990-2003.
Legend
Leatherback sightings 1990-2003
flightpath waypoints
California State Waters
survey path
Map prepared by Ben Enticknap, Oceana. January 9, 2009

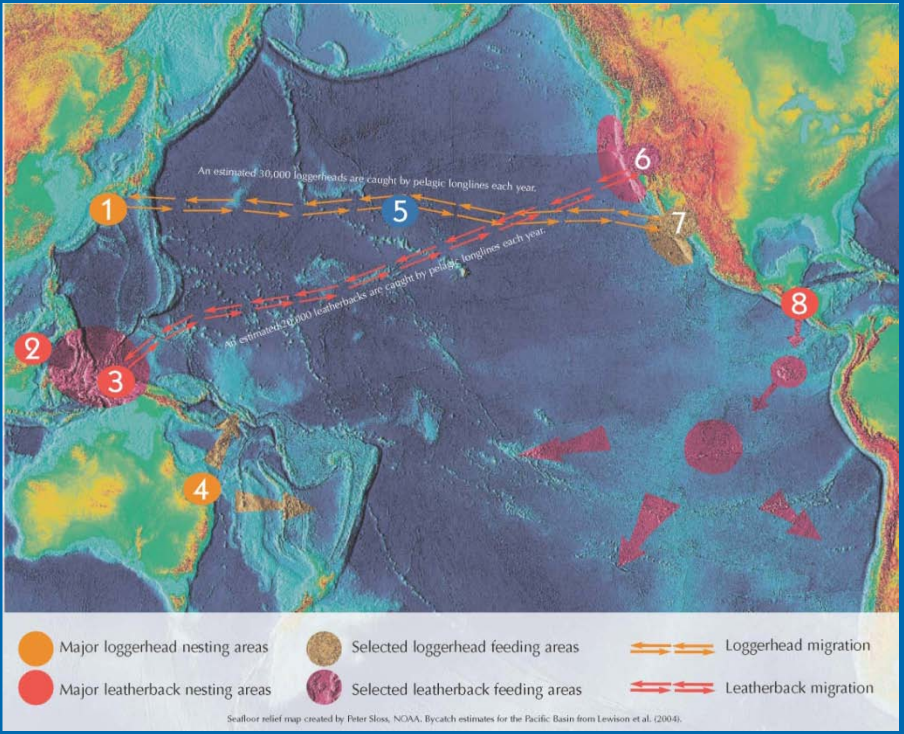

SA
Leatherback
Sightings
1980-2002
Columbia
River
Oregon
California
NOAA

Petition to Designate Critical Habitat

A critical foraging area for one of the largest remaining Pacific nesting populations

ESA-listed Loggerhead Sea Turtles

Loggerhead Sea Turtle, Oceana



4 – 27

Estimated Number of Loggerhead Takes in proposed fishery, DEIS at 107

17 – loggerhead cap in Hawaii SSLL fishery

46 – new proposed cap

Marine Mammals


Bottlenose Dolphin

5 – 10 marine mammals per year under Alternative 2.

"The species most likely to be taken are Risso's dolphins and bottelnose dolphins" DEIS at V


Humpback whale

Bottlenose dolphin, Bryde's whale, California sea lion, common dolphin, false killer whale, humpback whale, short-finned pilot whale, pygmy sperm whale, Risso's dolphin and striped dolphins have been observed taken in Hawaii and West Coast SSLL fisheries. DSEIS at 72

Increasing Bycatch of Fish

Blue Shark

5,900 – 30,900

sharks per year (blue, mako, oceanic whitetip and other sharks), DSEIS at 99


Bigeye and yellowfin tuna

1,600 – 5,500

tuna per year (bigeye, albacore, yellowfin, skipjack and others), DSEIS at 99

+ hundreds of Striped Marlin, Blue Marlin and others each year.

Alternative 1 - "No action"

Given the total cost and risk to threatened and endangered sea turtles, marine mammals, seabirds and the expected bycatch of thousands of sharks, tuna, billfish and others, we urge the Council to adopt Alternative 1 as its preferred alternative.

FMP AMENDMENTS TO IMPLEMENT ANNUAL CATCH LIMIT (ACL) REQUIREMENTS

The Magnuson-Steven Fishery Conservation and Management Reauthorization Act of 2006 (MSRA) established several new fishery management provisions pertaining to National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) which states, "Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry." On January 16, 2009, the National Marine Fisheries Service (NMFS) published a final rule in the Federal Register to implement the new MSRA requirements and revise the guidelines for National Standard 1. Agenda Item D3.a, Attachment 1 is the final rule package. Attachment 2 is a NMFS presentation summarizing its contents. (The attachments reproduce the March 2009 Agenda Items C.3.a Attachment 1 and Attachment 2, included with the analogous agenda topic for the Coastal Pelagic Species FMP.)

The revised National Standard 1 guidelines introduce new fishery management concepts including overfishing levels (OFLs), acceptable biological catch (ABC), annual catch limits (ACLs), annual catch targets (ACTs), and accountability measures (AMs) that are designed to better account for scientific and management uncertainty and to prevent and end overfishing. The final rule describes the relationship of these new management tools to existing fishery management concepts such as ABC and optimum yield (OY). The MSRA set implementation deadlines of 2011 for most species and by 2010 for those species designated as overfished. This new framework would need to be integrated into the existing framework in the Highly Migratory Species Fishery Management Plan (HMS FMP) by amendment. Attachment 3 is a summary of the management framework excerpted from the 2008 HMS Stock Assessment and Fishery Evaluation (SAFE) and associated tables summarizing current stock status information.

As part of initial scoping the Council should determine which HMS management unit species are subject to the ACL/AM requirements.

§660.310(g)(2)(ii) (see page 3210 in Attachment 1) describes an exception to addressing ACL and AM requirements for "stocks or stock complexes subject to management under an international agreement." The rule does not provide more specific guidance on what constitutes "subject to management." There are 13 management unit species (MUS) identified in the HMS FMP: 5 tuna species, 5 shark species, 2 billfish species, and dorado (*Coryphaena hippurus*). Attachment 4 excerpts the list of MUS from HMS FMP Chapter 3. Regional fishery management organizations have adopted conservation measures related to tunas and sharks. The relevant conventions may also reference those stocks subject to management in their founding agreement. For example, Article 2 of the Western and Central Pacific Fisheries Commission (WCPFC) Convention states "The objective of this Convention is to ensure, through effective management, the long-term conservation and sustainable use of highly migratory fish stocks in the western and central Pacific Ocean." The Convention further defines HMS as those species listed in Annex I to the United Nations Convention on the Law of the Sea. If the Annex I list (see Attachment 4) is used as the basis for determining applicability of the international exception, then all HMS FMP MUS would be exempted. However, this exception does not apply to other requirements, such as establishing the OFL and ABC.

The HMS FMP also includes a long list of species "included in the FMP for monitoring purposes" (see Attachment 4). Since they are listed separately from the MUS they may not be subject to ACL/AM requirements. The final rule includes the category of ecosystem component species. As part of initial scoping the Council may wish to discuss the status of the monitored species and whether they meet the criteria for ecosystem component species (see §660.310(d)(5), page 3205 in Attachment 1).

Once a list of species for which the requirements would be applicable is determined, then a preliminary list of required changes to the HMS FMP may be developed by comparing the current contents of the HMS FMP to the requirements enumerated in the final rule (see §660.310(c), page 3204 in Attachment 1). The Council also may wish to review the tentatively proposed schedule for meeting ACL/AM requirements for the HMS FMP (see Attachment 5).

Council guidance will provide the basis for any additional analysis and recommendations to be made by the HMSMT and HMSAS, which would be brought forward for Council action at a future meeting.

Council Task:

Conduct initial scoping on revisions to the HMS FMP to address revised National Standard 1 Guidelines and schedule for completing the action.

Reference Materials:

1. Agenda Item D.3.a, Attachment 1: Final Rule, Amendments to National Standard 1 Guidelines.
2. Agenda Item D.3.a, Attachment 2: Revisions to the National Standard 1 Guidelines; Guidance on Annual Catch Limits and Other Requirements; NMFS Presentation.
3. Agenda Item D.3.a, Attachment 3: Excerpt from 2008 HMS SAFE.
4. Agenda Item D.3.a, Attachment 4: HMS MUS, Monitored Species, and UNCLOS Annex I Species.
5. Agenda Item D.3.a, Attachment 5: Draft Schedule for Council Action on HMS FMP ACL Amendment.

Agenda Order:

a. Agenda Item Overview — Kit Dahl
b. Reports and Comments of Management Entities and Advisory Bodies
c. Public Comment
d. **Council Action:** Scope and Plan FMP Amendments to Implement ACL Requirements

PFMC
03/19/09

Agenda Item D.3.a
Attachment 1
April 2009

Federal Register

Friday,
January 16, 2009

Part III

Department of Commerce

National Oceanic and Atmospheric Administration

50 CFR Part 600

Magnuson-Stevens Act Provisions; Annual Catch Limits; National Standard Guidelines; Final Rule

§600.310 National Standard 1 – Optimum Yield

Table of Contents for the Codified Text
in the Jan. 16, 2009, FR Notice of the Final NS1 Guideline Revisions

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 600

[Docket No. 070717348–81398–03]

RIN 0648–AV60

Magnuson-Stevens Act Provisions; Annual Catch Limits; National Standard Guidelines

AGENCY: National Marine Fisheries Service (NMFS); National Oceanic and Atmospheric Administration (NOAA); Commerce.

ACTION: Final rule.

SUMMARY: This final action amends the guidelines for National Standard 1 (NS1) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA). This action is necessary to provide guidance on how to comply with new annual catch limit (ACL) and accountability measure (AM) requirements for ending overfishing of fisheries managed by Federal fishery management plans (FMPs). It also clarifies the relationship between ACLs, acceptable biological catch (ABC), maximum sustainable yield (MSY), optimum yield (OY), and other applicable reference points. This action is necessary to facilitate compliance with requirements of the Magnuson-Stevens Act to end and prevent overfishing, rebuild overfished stocks and achieve OY.

DATES: Effective February 17, 2009.

ADDRESSES: Copies of the Regulatory Impact Review (RIR)/Regulatory Flexibility Act Analysis (RFAA) can be obtained from Mark R. Millikin, National Marine Fisheries Service, 1315-East-West Highway, Room 13357, Silver Spring, Maryland 20910. The RIR/RFAA document is also available via the internet at *http://www.nmfs.noaa.gov/msa2007/catchlimits.htm*. Public comments that were received can be viewed at the Federal e-Rulemaking portal: *http://www.regulations.gov.*

FOR FURTHER INFORMATION CONTACT: Mark R. Millikin by phone at 301–713–2341, by FAX at 301–713–1193, or by *e-mail: Mark.Millikin@noaa.gov.*

SUPPLEMENTARY INFORMATION:

Table of Contents

I. Overview of Revisions to the NS1 Guidelines

The MSA serves as the chief authority for fisheries management in the U.S. Exclusive Economic Zone (EEZ). The Act provides for ten national standards (NS) for fishery conservation and management, and requires that the Secretary establish advisory guidelines based on the NS to assist in the development of fishery management plans. Guidelines for the NS are codified in subpart D of 50 CFR part 600. NS1 requires that conservation and management measures ''shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.''

The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (MSRA) amended the MSA to include new requirements for annual catch limits (ACLs) and accountability measures (AMs) and other provisions regarding preventing and ending overfishing and rebuilding fisheries. To incorporate these new requirements into current NS1 guidance, NMFS initiated a revision of the NS1 guidelines in 50 CFR 600.310. NMFS published a notice of intent (NOI) to prepare an environmental impact statement (EIS) and commenced a scoping period for this action on February 14, 2007 (72 FR 7016), and proposed NS1 guidelines revisions on June 9, 2008 (73 FR 32526). Further background is provided in the above-referenced **Federal Register** documents and is not repeated here. The proposed guidelines provided a description of the reasons that overfishing is still occurring and the categories of reasons for overfishing likely to be addressed by new MSA requirements combined with the NS1 guidelines. The September 30, 2008 NMFS Quarterly Report on the Status of U.S. Fisheries indicates that 41 stocks managed under Federal FMPs are undergoing overfishing.

NMFS solicited public comment on the proposed NS1 guidelines revisions through September 22, 2008, and during that time, held three public meetings, on July 10, 2008 (Silver Spring, Maryland), July 14, 2008 (Tampa, Florida), and July 24, 2008 (Seattle, Washington), and made presentations on the proposed revisions to each of the eight Regional Fishery Management Councils (Councils). NMFS received over 158,000 comments on all aspects of the proposed NS1 guidelines revisions. Many of the comment letters were form letters or variations on a form letter. In general, the environmental community supported the provisions in the proposed action but commented that they needed to be strengthened in the final action. Alternatively, comments from the fishing industry and some of the Councils said the proposed revisions were confusing, too proscriptive or strict, and lacked sufficient flexibility.

II. Major Components of the Proposed Action

Some of the major items covered in the proposed NS1 guidelines were: (1) A description of the relationship between MSY, OY, overfishing limits (OFL), ABC, ACLs, and annual catch targets (ACT); (2) guidance on how to combine the use of ACLs and AMs for a stock to prevent overfishing when possible, and adjust ACLs and AMs, if an ACL is exceeded; (3) statutory exceptions to requirements for ACLs and AMs and flexibility in application of NS1 guidelines; (4) ''stocks in the fishery'' and ''ecosystem component species'' classifications; (5) replacement of MSY control rules with ABC control rules and replacement of OY control rules with ACT control rules; (6) new requirements for scientific and statistical committees (SSC); (7) explanation of the timeline to prepare new rebuilding plans; (8) revised guidance on how to establish rebuilding time targets; (9) advice on action to take at the end of a rebuilding period if a stock is not yet rebuilt; and (10) exceptions to the requirements to prevent overfishing.

III. Major Changes Made in the Final Action

The main substantive change in the final action pertains to ACTs. NMFS proposed ACT as a required reference point that needed to be included in FMPs. The final action retains the concept of an ACT and an ACT control rule, but does not require them to be included in FMPs. After taking public comment into consideration, NMFS has decided that ACTs are better addressed as AMs. The final guidelines provide that: ''For fisheries without inseason management control to prevent the ACL from being exceeded, AMs should utilize ACTs that are set below ACLs so that catches do not exceed the ACL.''

In response to public comment, this final action also clarifies text on ecosystem component species, OFL, OY specification, ABC control rule and specification, SSC recommendations, the setting of ACLs, sector-ACLs, and AMs, and makes minor clarifications to other text. Apart from these clarifications, the final action retains the same approaches described in the proposed guidelines with regard to: (1) Guidance on how to combine the use of ACLs and AMs for a stock to prevent overfishing when possible, and adjust ACLs and AMs, if an ACL is exceeded; (2) statutory exceptions to requirements for ACLs and AMs and flexibility in application of NS1 guidelines; (3) ''stocks in the fishery'' and ''ecosystem component species'' classifications; (4) new requirements for SSCs; (5) the timeline to prepare new rebuilding plans; (6) rebuilding time targets; (7) advice on action to take at the end of a rebuilding period if a stock is not yet rebuilt; and (8) exceptions to the requirements to prevent overfishing. Further explanation of why changes were or were not made is provided in the ''Response to Comments'' section below. Detail on changes made in the codified text is provided in the ''Changes from Proposed Action'' section.

IV. Overview of the Major Aspects of the Final Action

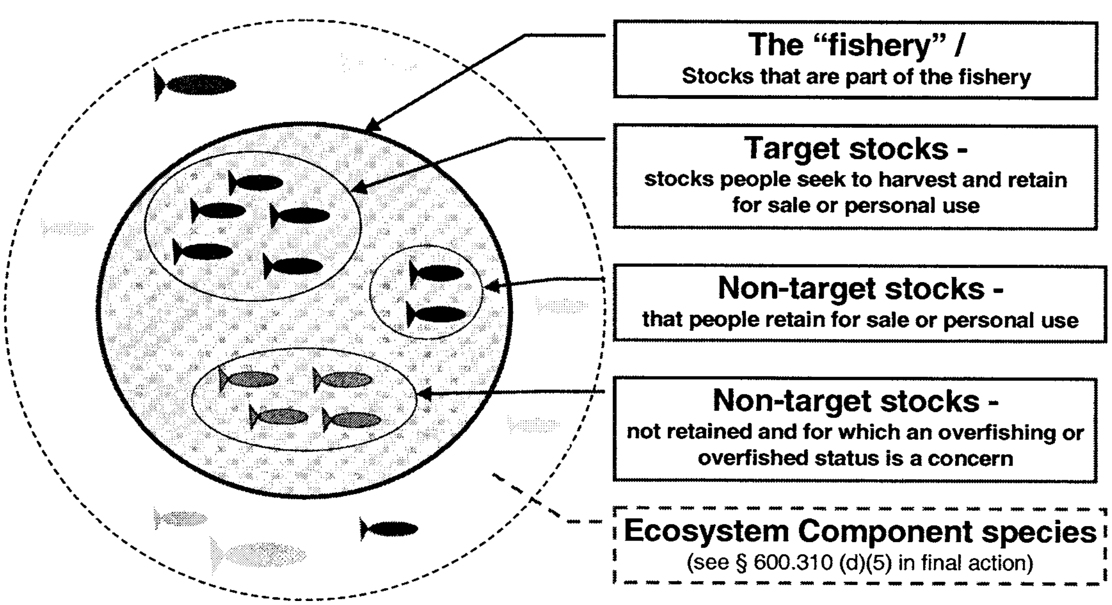
A. Stocks in the Fishery and Ecosystem Component Species

The proposed NS1 guidelines included suggested classifications of ''stocks in the fishery'' and ''ecosystem component (EC) species.'' *See* Figure 1 for diagram of classifications. Public comments reflected confusion about this proposal, so NMFS has clarified its general intent with regard to these classifications. More detailed responses to comments on this issue are provided later in this document.

The classifications in the NS1 guidelines are intended to reflect how FMPs have described ''fisheries,'' and to provide a helpful framework for thinking about how FMPs have incorporated and may continue to incorporate ecosystem considerations. To that end, the proposed NS1 guidelines attempted to describe the fact that FMPs typically include certain target species, and sometimes certain non-target species, that the Councils and/or the Secretary believed required conservation and management. In some FMPs, Councils have taken a broader approach and included hundreds of species, many of which may or may not require conservation and management but could be relevant in trying to further ecosystem management in the fishery.

NMFS wants to encourage ecosystem approaches to management, thus it proposed the EC species as a possible classification a Council or the Secretary could—but is not required to—consider. The final NS1 guidelines do not require a Council or the Secretary to include all target and non-target species as ''stocks in the fishery,'' do not mandate use of the EC species category, and do not require inclusion of particular species in an FMP. The decision of whether conservation and management is needed for a fishery and how that fishery should be defined remains within the authority and discretion of the relevant Council or the Secretary, as appropriate. NMFS presumes that stocks or stock complexes currently listed in an FMP are ''stocks in the fishery,'' unless the FMP is amended to explicitly indicate that the EC species category is being used. ''Stocks in the fishery'' need status determination criteria, other reference points, ACL mechanisms and AMs; EC species would not need them. NMFS recognizes the confusion caused by wording in the proposed action and has revised the final action to be more clear on these points.

Figure 1. General Framework for "Stocks in the Fishery" versus "Ecosystem Component Species." This figure describes the kind of stocks or stock complexes that might fall into the two classifications, but should not be viewed as requiring FMPs to include specific stocks or stock complexes in either category.

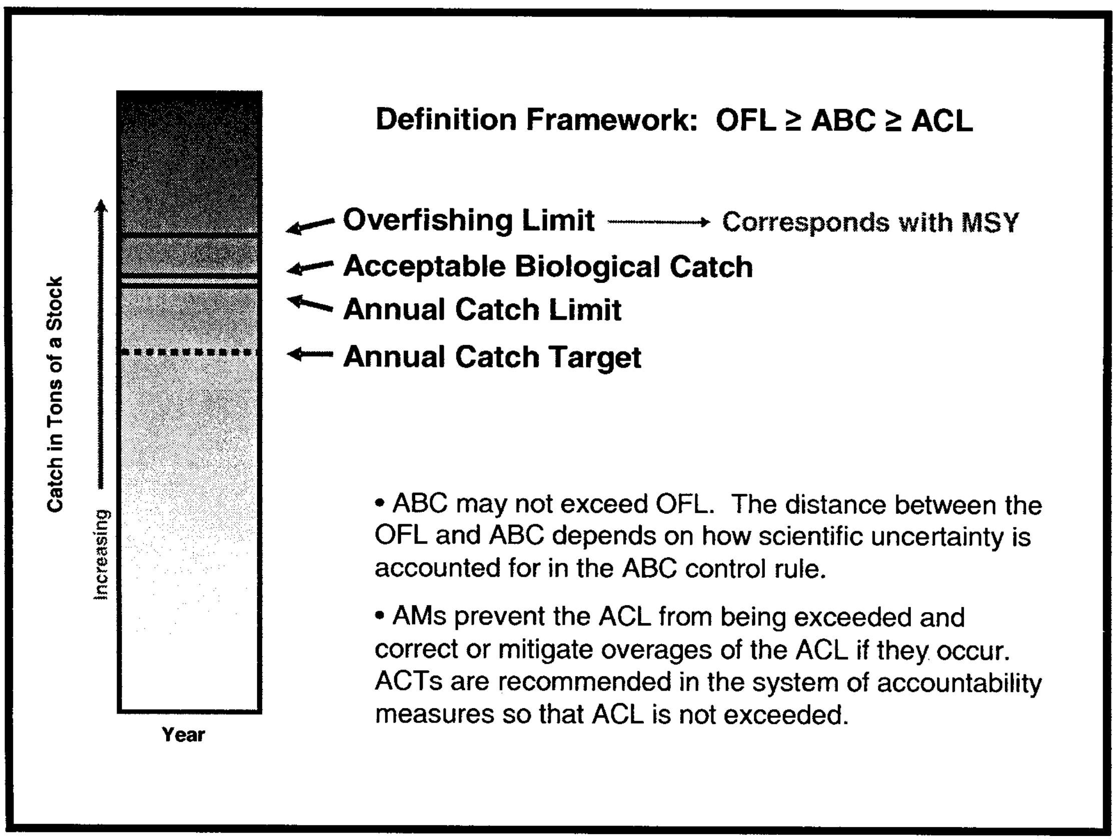


B. Definition Framework for OFL, ABC, and ACL

The MSRA does not define ACLs, AMs, and ABC, so NMFS proposed definitions for these terms in the proposed action. NMFS also proposed definitions for the terms OFL and ACT because it felt that they would be useful tools in helping ensure that ACLs are not exceeded and overfishing does not occur. The proposed NS1 guidelines described the relationship between the terms as: OFL ≥ ABC ≥ ACL ≥ ACT. In response to public comment, the final action revises the definition framework as: OFL ≥ ABC ≥ ACL. As described above, NMFS has retained ACT and the ACT control rule in the NS1 guidelines, but believes that they are more appropriate as AMs. NMFS believes ACTs could prove useful as management tools in fisheries with poor management control over catch (i.e., that frequently exceed catch targets).

NMFS received many comments on the definition framework, and some commenters stated that it should be revised as: OFL > ABC > ACL. Having considered public comment and reconsidered this issue, NMFS has decided to keep the framework as: OFL ≥ ABC ≥ ACL. However, NMFS believes there are few fisheries where setting OFL, ABC, and ACL all equal to each other would be appropriate. While the final action allows ABC to equal OFL, NMFS expects that in most cases ABC will be reduced from OFL to reduce the probability that overfishing might occur in a year. NMFS has added a provision to the final NS1 guidelines stating that, if a Council recommends an ACL which equals ABC, and the ABC is equal to OFL, the Secretary may presume that the proposal would not prevent overfishing, in the absence of sufficient analysis and justification for the approach. See figure 2 for an illustration of the relationship between OFL, ABC, ACL and ACT. Further detail on the definition framework and associated issues is provided in the ''Response to Comments'' section below.

Figure 2: Relationship between OFL, ABC, ACL and ACT



C. Accountability Measures (AMs)

Another major aspect of the revised NS1 guidelines is the inclusion of guidance on AMs. AMs are management controls to prevent ACLs, including sector-ACLs, from being exceeded, and to correct or mitigate overages of the ACL if they occur. NMFS has identified two categories of AMs, inseason AMs and AMs for when the ACL is exceeded. As described above, ACTs are recommended in the system of AMs so that ACLs are not exceeded. As a performance standard, if catch exceeds the ACL for a given stock or stock complex more than once in the last four years, the system of ACLs and AMs should be re-evaluated, and modified if necessary, to improve its performance and effectiveness.

D. SSC Recommendations and Process

Section 302(h)(6) of the MSA provides that each Council is required to ''develop annual catch limits for each of its managed fisheries that may not exceed the fishing level recommendations of its scientific and statistical committee or the peer review process established under subsection (g).'' MSA did not define ''fishing level recommendations,'' but in section 302(g)(1)(B), stated that an SSC shall provide ''recommendations for acceptable biological catch, preventing overfishing, maximum sustainable yield, and achieving rebuilding targets,'' and other scientific advice.

NMFS received a variety of public comments regarding interpretation of ''fishing level recommendations.'' Some commenters felt that the SSC's ''fishing level recommendations'' that should constrain ACLs is the overfishing limit (OFL); other commenters stated that ''fishing level recommendations'' should be equated with MSY. NMFS does not believe that MSA requires ''fishing level recommendations'' to be equated to the OFL or MSY. As described above, the MSA specifies a number of things that SSCs recommend to their Councils. Of all of these things, ABC is the most directly relevant to ACL, as both ABC and ACL are levels of annual catch.

The preamble to the proposed NS1 guidelines recommended that the Councils could establish a process in their Statement of Organization, Practices and Procedures (SOPPs) for: establishing an ABC control rule, applying the ABC control rule (i.e., calculating the ABC), and reviewing the resulting ABC. NMFS believes that this may have caused confusion and that some commenters misunderstood the intent of this recommendation. NMFS received comment regarding inclusion of the ABC control rule in the SOPPs, and wants to clarify that the actual ABC control rule should be described in the FMP. NMFS believes it is important to understand how the Councils, SSC, and optional peer review process work together to implement the provisions of the MSA and therefore recommends that the description of the roles and responsibilities of the Council, SSC, and optional peer review process be included in the SOPPs, FMP, or some other public document. The SSC recommends the ABC to the Council whether or not a peer review process is utilized.

E. Management Uncertainty and Scientific Uncertainty

A major aspect of the revised NS1 guidelines is the concept of incorporating management and scientific uncertainty in using ACLs and AMs. Management uncertainty occurs because of the lack of sufficient information about catch (*e.g.*, late reporting, underreporting and misreporting of landings or bycatch). Recreational fisheries generally have late reporting because of the method of surveying catches and the lack of an ability for managers to interview only marine recreational anglers. NMFS is addressing management uncertainty in the recreational fishery by implementing a national registry of recreational fishers in the Exclusive Economic Zone (EEZ) (see proposed rule published in the **Federal Register** (73 FR 33381, June 12, 2008)) and a Marine Recreational Implementation Program that will, in part, revise the sampling design of NMFS's marine recreational survey for fishing activity.

Management uncertainty also exists because of the lack of management precision in many fisheries due to lack of inseason fisheries landings data, lack of inseason closure authority, or the lack of sufficient inseason management in some FMPs when inseason fisheries data are available. The final NS1 guidelines revisions provide that FMPs should contain inseason closure authority that gives NMFS the ability to close fisheries if it determines, based on data that it deems sufficiently reliable, that an ACL has been exceeded or is projected to be reached, and that closure of a fishery is necessary to prevent overfishing. NMFS believes that such closure authority will enhance efforts to prevent overfishing. Councils can derive some idea of their overall extent of management uncertainty by comparing past actual catches to target catches to evaluate the magnitude and frequency of differences between actual catch and target catch, and how often actual catch exceeded the overfishing limit for a stock.

Scientific uncertainty includes uncertainty around the estimate of a stock's biomass and its maximum fishing mortality threshold (MFMT); therefore, any estimate of OFL has uncertainty. Stock assessment models have various sources of scientific uncertainty associated with them and many assessments have shown a repeating pattern that the previous assessment overestimated near-future biomass, and underestimated near-future fishing mortality rates (i.e., called retrospective patterns).

V. Response to Comments

NMFS received many comments about the proposed definition framework (OFL ≥ ABC ≥ ACL ≥ ACT), especially regarding the ACT and ACT control rule. Some commenters suggested that the ACT and ACT control rule should not be required, while others supported their use. NMFS also received comments expressing: That the proposed terminology should not be required; OFL should always be greater than ABC; and concern that too many factors (i.e., management and scientific uncertainty, and ACT) will reduce future target catches unnecessarily. Some commenters felt additional emphasis should be placed on T_{min} in the rebuilding provisions. Councils, for the most part, are very concerned about the challenge of implementing ACLs and AMs by 2010, and 2011, as required. Some commenters felt the international fisheries exception to ACLs is too broad. Several commenters stated that an EIS should have been or should be prepared and two commenters stated an Initial Regulatory Flexibility Analysis under the Regulatory Flexibility Act should be prepared. NMFS also received many comments regarding the mixed-stock exception.

NMFS received many comments expressing support for the proposed revisions to the Magnuson-Stevens Act National Standard 1 guidelines. Comments included: This good faith effort to implement Congress' intent will work to end overfishing and protect the marine ecosystem; these guidelines reduce the risk of overfishing and will work to rebuild depleted stocks through the use of science based annual catch limits, accountability measures, 'buffers' for scientific and management uncertainty, and protections for weak fish stocks; and this solid framework will ensure not only healthy stocks but healthy fisheries.

Comment 1: Several comments were received regarding NMFS's decision to not prepare an environmental impact statement or environmental assessment for this action. Some supported the decision, while others opposed it and believed that a categorical exclusion under the National Environmental Policy Act (NEPA) is not appropriate.

Response: NMFS believes a categorical exclusion is appropriate for this action. Under §§ 5.05 and 6.03c.3(i) of NOAA's Administrative Order (NAO) 216–6, the following types of actions may be categorically excluded from the requirement to prepare an EA or EIS: ''* * * policy directives, regulations and guidelines of an administrative, financial, legal, technical or procedural nature, or the environmental effects of which are too broad, speculative or conjectural to lend themselves to meaningful analysis and will be subject later to the NEPA process, either collectively or case-by-case. * * *''

In this instance, a Categorical Exclusion is appropriate for this action, because NMFS cannot meaningfully analyze potential environmental, economic, and social impacts at this stage. This action revises NS1 guidelines, which are advisory only; MSA provides that NS guidelines ''shall not have the force and effect of law.'' MSA section 301(b). *See Tutein* v. *Daley*, 43 F. Supp.2d 113, 121–122 (D. Mass. 1999) (reaffirming that the guidelines are only advisory and holding that the national standards are not subject to judicial review under the

MSA). The NS1 guidelines are intended to provide broad guidance on how to comply with new statutory requirements. While the guidelines explain in detail how different concepts, such as ACL, ABC, MSY, and OY, should be addressed, the guidelines do not mandate specific management measures for any fishery. It is not clear what Councils will or will not do in response to the NS1 guidelines. Thus, it is not possible to predict any concrete impacts on the human environment without the necessary intervening actions of the Councils, e.g., consideration of best available scientific information and development of specific conservation and management measures that may be needed based on that information. Any analysis of potential impacts would be speculative at best.

None of the exceptions for Categorical Exclusions provided by § 5.05c of NAO 216–6 apply. While there is controversy concerning the NS1 guidelines revisions, the controversy is primarily related to different views on how new MSA requirements should be interpreted, rather than potential environmental consequences. The NS1 guidelines would not, in themselves, have uncertain environmental impacts, unique or unknown risks, or cumulatively significant or adverse effects upon endangered or threatened species or their habitats. Moreover, this action would not establish a precedent or decision in principle about future proposals. As noted above, the guidelines provide broad guidance on how to address statutory requirements but do not mandate specific management actions.

Comment 2: One commenter criticized NMFS' approach as placing unnecessary burden on the Councils to conduct the NEPA analysis.

Response: No change was made. One of the Councils' roles is to develop conservation and management measures that are necessary and appropriate for management of fisheries under their authority. NMFS believes that Councils should continue to have the discretion to determine what measures may be needed in each fishery and what alternatives should be considered and analyzed as part of the fishery management planning process. Councils routinely incorporate NEPA into this process, and the actions to implement ACLs in specific fisheries must address the NEPA requirements, regardless of the level of analysis conducted for the guidelines. Therefore, having reviewed the issue again, NMFS continues to find that a categorical exclusion is appropriate for this action.

Comment 3: Two commenters stated that NMFS should have prepared an initial regulatory flexibility analysis under the RFA for this action. They said it was not appropriate to certify under the RFA because in their opinion, this action will have significant economic impacts on a substantial number of small entities.

Response: No change was made. The final NS1 guidelines will not have significant economic impacts on a substantial number of small entities. The guidelines are advisory only; they provide general guidance on how to address new overfishing, rebuilding, and related requirements under the MSA. Pursuant to MSA section 301(b), the guidelines do not have the force and effect of law. When the Councils/Secretary apply the guidelines to individual fisheries and implement ACL and AM mechanisms, they will develop specific measures in their FMPs and be able to analyze how the new measures compare with the status quo (e.g., annual measures before the MSRA was signed into law and the NS1 guidelines were revised) with respect to economic impacts on small entities. At this point, any analysis of impacts on small entities across the range of diverse, Federally-managed fisheries would be highly conjectural. Therefore, a certification is appropriate.

Comment 4: Several comments were received that the guidelines are too complex and they contain guidance for things, such as the ACT that are not required by the MSA. They suggested removing these provisions from the guidance, or only providing guidance for terms specifically mentioned in the statute.

Response: NMFS agrees that the guidelines can appear complex. However, the purpose of the guidelines is not simply to regurgitate statutory provisions, rather it is to provide guidance on how to meet the requirements of the statute. As discussed in other comments and responses, MSRA includes new, undefined terms (ABC and ACL), while retaining other long-standing provisions, such as the national standards. In considering how to understand new provisions in light of existing ones, NMFS considered different ways to interpret language in the MSA, practical challenges in fisheries management including scientific and management uncertainty, the fact that there are differences in how fisheries operate, and public comment on proposed approaches in the NS1 guidelines. MSA does not preclude NMFS from including additional terminology or explanations in the NS1 guidelines, as needed, in order to facilitate understanding and effective implementation of MSA mandates. In the case of NS1, conservation and management measures must prevent overfishing while achieving, on a continuing basis, the optimum yield. This is inherently challenging because preventing overfishing requires that harvest of fish be limited, while achieving OY requires that harvest of fish occur. In developing the guidelines, NMFS identified the reasons that overfishing was still occurring in about 20 percent of U.S. Fisheries, and wrote the guidelines to address the primary causes. These include:

(1) Setting OY too close to MSY,

(2) Failure to consider all sources of fishing mortality,

(3) Failure to adequately consider both uncertainty in the reference points provided by stock assessments (scientific uncertainty) and uncertainty in management control of the actual catch (management uncertainty),

(4) Failure to utilize best available information from the fishery for inseason management, and

(5) Failure to identify and correct management problems quickly.

NMFS believes that the guidelines address these causes and appropriately provide practical guidance on how to address them, while providing sufficient flexibility to acknowledge the differences in fisheries. NMFS believes that Congress intended that the ACLs be effective in ending and preventing overfishing. Simply amending the FMPs to include ACL provisions is not enough—the actual performance of the fishery is what ultimately matters. NMFS believes that all of the provisions in the guidelines are essential to achieving that goal, and that if the guidelines are followed, most of the problems that have led to continued overfishing will be addressed. NMFS has made changes in the final action to clarify the guidelines and simplify the provisions therein, to the extent possible. One specific change is that the final guidelines do not require that ACT always be established. Instead, NMFS describes how catch targets, such as ACT, would be used in a system of AMs in order to meet the requirements of NS1 to prevent overfishing and achieve OY. More details on these revisions are covered in responses pertaining to comments 8, 32, 44, 45, and 48.

Comment 5: Several commenters stated that Councils' workloads and the delay of final NS1 guidelines will result in some Councils having great difficulty or not being able to develop ACLs and AMs for overfishing stocks by 2010, and all other stocks by 2011.

Response: The requirements in MSA related to 2010 and 2011 are statutory; therefore ACLs and AMs need to be in place for those fishing years such that overfishing does not occur. NMFS understands that initial ACL measures for some fisheries have been developed before the NS1 guidelines were finalized in order to meet the statutory deadline, and thus may not be fully consistent with the guidelines. ACL mechanisms developed before the final guidelines should be reviewed and eventually revised consistent with the guidelines.

Comment 6: Several commenters stated that certain existing FMPs and processes are already in compliance with the ACL and AM provisions of the MSA and consistent with the proposed guidelines. One commenter stated that NMFS should bear the burden of determining whether current processes are inconsistent with the MSA, and indicate what action Councils should take. Another commenter stated that Congress intended Total Allowable Catch (TAC), which is already used in some fisheries, to be considered to be an ACL. NMFS also received comments stating that certain terms have had longstanding use under FMPs, and changing the terminology could cause too much confusion.

Response: NMFS believes that some existing FMPs may be found to need little or no modification in order to be found to be consistent with the MSA and NS1 guidelines. In general, these are fisheries where catch limits are established and the fishery is managed so that the limits are not exceeded, and where overfishing is not occurring. NMFS agrees that, in some fisheries, the TAC system currently used may meet the requirements of an ACL. However, there are a wide variety of fisheries that use the term TAC, and while some treat it as a true limit, others treat it simply as a target value on which to base management measures. Therefore, NMFS does not agree that the use of a TAC necessarily means the fishery will comply with the ACL and AM provisions of the MSA. NMFS will have to review specific FMPs or FMP amendments. In addition, upon request of a Council, NMFS can provide input regarding any changes to current processes that might be needed for consistency with the MSA and guidance in the NS1 guidelines.

Regarding the comment about terminology, the preamble to the proposed action provided that Councils could opt to retain existing terminology and explain in a proposed rule how the terminology and approaches to the FMPs are consistent with those set forth in the NS1 guidelines. NMFS has given this issue further consideration and believes that a proposed rule would not be necessary or appropriate. Instead, a Council could explain in a **Federal Register** notice why its terminology and approaches are consistent with the NS1 guidelines.

Comment 7: Some commenters thought that before requiring implementation of a new management system, it should first be demonstrated that the current management system is not effective at preventing overfishing or rebuilding stocks that are overfished, and that a new management system would be more effective. Changing a management system that is effective and responsive would not be productive.

Response: While NMFS understands that current conservation and management measures prevent overfishing in some fisheries, the MSA requires a mechanism for specifying ACLs and AMs in all fisheries, including those that are not currently subject to overfishing, unless an exception applies. There is no exception to the requirement for ACLs and AMs for fisheries where other, non-ACL management measures are preventing overfishing. NMFS is required by the MSRA to implement the new provisions in all FMPs, unless an exception applies, even on those whose current management is preventing overfishing. NMFS believes the guidance provides the tools for Councils to implement ACLs in these fisheries that will continue to prevent overfishing without disrupting successful management approaches. The guidelines provide flexibility to deviate from the specific framework described in the guidelines, if a different approach will meet the statutory requirements and is more appropriate for a specific fishery (*see* § 600.310(h)(3) of the final action).

Comment 8: Some commenters supported the use of ACT to address management uncertainty in the fishery. Others did not support ACTs, and commented that ACTs are not required under the MSA and that inclusion of ACTs in the guidelines creates confusion and complexity. One commenter stated that the proposed guidelines were ''out of line'' with NMFS's mandate and authority provided under the MSA because the guidelines for ACTs and associated control rules completely undermine the clear directive Congress provides in National Standard 1 to achieve optimum yield on an ongoing basis.

Response: The proposed guidelines stressed the importance of addressing scientific and management uncertainty in establishing ACL and AM mechanisms. Scientific uncertainty was addressed in the ABC control rule, and management uncertainty was addressed in the ACT control rule. Use of catch targets associated with catch limits is a well-recognized principle of fishery management. The current NS1 guidelines call for establishment of limits, and targets set sufficiently below the limits so that the limits are not exceeded. The revised guidelines are based on this same principle, but, to incorporate the statutory requirements for ABC and ACLs, are more explicit than the current guidelines. While MSA does not refer to the term ACT, inclusion of the term in the NS1 guidelines is consistent with the Act. The NS1 guidelines are supposed to provide advice on how to address MSA requirements, including how to understand terminology in the Act and how to apply that terminology given the practical realities of fisheries management. In developing the proposed guidelines, NMFS considered a system that used ABC as the limit that should not be exceeded, and that required that ACL be set below the ABC to account for management uncertainty. This had the advantage of minimizing the number of terms, but would result in the ACL having been a target catch level. NMFS decided, that since Congress called for annual catch limits to be set, that the ACL should be considered a true limit—a level not to be exceeded. ACT was the term adopted for the corresponding target value which the fishery is managed toward so that the ACL is not exceeded.

Taking public comment into consideration, NMFS has decided to retain ACTs and ACT control rules in the final guidelines, but believes they are better addressed as AMs for a fishery. One purpose of the AMs is to prevent the ACL from being exceeded. Setting an ACT with consideration of management uncertainty is one way to achieve this, but may not be needed in all cases. In fisheries where monitoring of catch is good and in-season management measures are effective, managers may be able to prevent ACLs from being exceeded through direct monitoring and regulation of the fishery. Therefore, the final guidelines make ACTs optional, but, to prevent ACLs from being exceeded, Councils must adequately address the management uncertainty in their fisheries using the full range of AMs.

NMFS disagrees that ACTs undermine NS1. NS1 requires that conservation and management measures prevent overfishing while achieving, on a continuing basis, the OY. The MSA describes that OY is based on MSY, as reduced based on consideration of several factors. In some cases, the amount of reduction may be zero, but in no case may the OY exceed MSY. Therefore, if OY is set close to MSY, the conservation and management measures in the fishery must have very good control of the amount of catch in order to achieve the OY without overfishing.

The amount of fishing mortality that results in overfishing is dictated by the biology of the stock and its environment, and establishes a limit that constrains fisheries management. However, the specification of OY and the conservation and management measures for the fishery are both set by fishery managers. To achieve the dual requirements of NS1, Councils must specify an OY and establish conservation and management measures for the fishery that can achieve the OY without overfishing. The closer that OY is set to MSY, the greater degree of control over harvest is necessary in order to meet both objectives. The choice of conservation and management measures for a fishery incorporates social and economic considerations. For example, a Council may prefer to use effort controls instead of hard quotas to have a year-round fishery without a ''race for fish,'' and to provide higher average prices for the fishermen. However, compared to hard quotas, management with effort controls gives more uncertainty in the actual amount of fish that will be caught. Because of this increased uncertainty, the OY needs to be reduced from MSY so that overfishing does not occur. Thus the social and economic considerations of the choice of management measures should be considered in setting the OY.

In cases where the conservation and management measures for a fishery are not capable of achieving OY without overfishing occurring, overfishing must be ended even if it means the OY is not achieved in the short-term. Overfishing a stock in the short term to achieve OY jeopardizes the capacity of the stock to produce OY in the long term, and thus cannot be sustained. Preventing overfishing in a fishery on an annual basis is important to ensure that a fishery can continue to achieve OY on a continuing basis. The specification of OY and the associated conservation and management measures need to be improved so that OY can be achieved without overfishing occurring. In a fishery where the NS1 objectives are fully met, the OY specification will adequately account for the management uncertainty in the associated conservation and management measures. Overfishing will not occur, and the OY will be achieved.

Comment 9: Commenters stated that the designation of the Virgin Islands Coral Reef Monument was not being taken into account in the Caribbean Council's FMPs.

Response: NMFS does not believe any revision of the NS1 guidelines is necessary in response to this comment but will forward the comment to the Council for its consideration.

Comment 10: NMFS received comments in support of the flexibility given to councils to manage stocks for which ACLs are not a good fit, such as management of Endangered Species Act listed species, stocks with unusual life history characteristics, and aquaculture operations. Commenters noted that Pacific salmon should be treated with flexibility under the NS1 guidelines, because they are managed to annual escapement levels that are functionally equivalent to ACLs, and there are accountability, review, and oversight measures in the fishery.

Response: NMFS agrees that flexibility is needed for certain management situations, and clarifies that § 600.310(h)(3) provides for flexibility in application of the NS1 guidelines but is not an exception from requirements of MSA section 303(a)(15) or other sections.

Comment 11: Congress did not mandate that all fisheries be managed by hard quotas, and so NMFS should include guidance for the continuation of successful, non-quota management systems, such as that used to successfully manage the Atlantic sea scallop fishery.

Response: NMFS agrees that the conservation and management measures for a fishery are not required to be ''hard quotas.'' However, NMFS believes that the ACL was intended by Congress to be a limit on annual catch. Therefore, conservation and management measures must be implemented so that the ACL is not exceeded, and that accountability measures must apply whenever the ACL is exceeded. Congress did not exempt any fisheries from the ACL requirement on the basis that current management was successful. If the current conservation and management measures are effective in controlling harvest of sea scallops such that the ACL is not regularly exceeded, the ACL would have little effect on the fishery. If the current management measures are not effective in keeping catch from exceeding the ACL, then consistent with the ACL requirement in the MSA, additional management action should be taken to prevent overfishing.

Comment 12: The summary list of items to be included in FMPs should be ''as appropriate'' (see § 600.310(c) of the final action).

Response: No change was made. NMFS believes that if any item does not apply to a particular fishery, the Council can explain why it is not included, but believes that ''as appropriate'' would create further confusion as there is no clear definition of what appropriate means in this context.

Comment 13: The list of items to include in FMPs related to NS1 is extremely long, and it is unclear whether each item on the list needs to be addressed for all stocks that are ''in the fishery,'' which is a very broad term. Including the extra information is unlikely to materially improve management.

Response: As a default, all the stocks or stock complexes in an FMP are considered ''in the fishery'' (see § 600.310(d)(1)), unless they are reclassified as ecosystem component stocks through an FMP amendment process. Further explanation of these classifications is provided below in other comments and responses. The benefit of including this list of items is to provide transparency in how the NS1 guidelines are being met. In addition, Councils should already have some of the items in their FMPs (ex: MSY, status determination criteria (SDC), and OY). The other items are new requirements of the MSA or a logical extension of the MSA.

Comment 14: NMFS received several comments both supporting and opposing the proposed ''stocks in a fishery'' and ''ecosystem component species'' (EC) classifications of stocks in a FMP. Comments included: EC species are not provided under the MSA and should not be required in FMPs; EC species classification is needed but may lead to duplication in different FMPs; support for the distinction between ''stocks in a fishery'' and EC species; and clarify how data collection only species should be classified.

Response: NMFS provided language for classifying stocks in a FMP into two categories: (1) ''Stocks in the fishery'' and (2) ''ecosystem component species.'' MSA requires that Councils develop ACLs for each of their managed fisheries (see MSA sections 302(h)(6) and 303(a)(15)), but Councils have had, and continue to have, considerable discretion in defining the ''fishery'' under their FMPs. As a result, some FMPs include one or a few stocks (*e.g.* , Bluefish FMP, Dolphin-Wahoo FMP) that have been traditionally managed for OY, whereas others have begun including hundreds of species (e.g., Coral Reef Ecosystem of the Western Pacific Region FMP) in an effort to incorporate ecosystem approaches to management.

While EC species are not explicitly provided in the MSA, in the MSRA, Congress acknowledged that certain Councils have made significant progress in integrating ecosystem considerations, and also included new provisions to support such efforts (*e.g.*, MSA section 303(b)(12)). As noted in the preamble of this action, NMFS wants to continue to encourage Councils to incorporate ecosystem considerations, and having classifications for ''stocks in the fishery'' versus ''ecosystem component species'' could be helpful in this regard. Thus, the final guidelines do not require Councils or the Secretary to change which species are or are not included in FMPs, nor do the guidelines require FMPs to incorporate the EC species classification. NMFS has revised the final guidelines to state explicitly that Councils or the Secretary may—but are not required to—use an EC species classification.

In developing the text regarding EC species and ''stocks in the fishery,'' NMFS examined what existing FMPs are already doing and utilized that in its description of these classifications. For example, based on existing FMPs, the guidelines envision that species included for data collection and other monitoring purposes could be considered EC species (assuming they meet the criteria described in § 600.310(d)(5)(i)). However, such species could also be ''stocks in the fishery,'' as described under the NS3 guidelines (§ 600.320(d)(2)). NMFS recognizes the desire for greater specificity regarding exactly which species could or could not be considered EC species, but does not believe that further detail in the guidelines could clarify things definitively. Determining whether the EC category is appropriate requires a specific look at stocks or stock complexes in light of the general EC species description provided in the NS1 guidelines as well as the broader mandates and requirements of the MSA. If Councils decide that they want to explore potential use of the EC species classification, NMFS will work closely with them to consider whether such a classification is appropriate.

Comment 15: NMFS received several comments regarding the level of interaction that would be appropriate for the EC classification. Comments included: *de minimis* levels of catch should be defined to clarify the difference between ''stocks in a fishery'' and EC species; all stocks that interact with a fishery should be included as ''stocks in a fishery''; requiring non-target stocks to be considered part of the fishery as written supersedes NS9; guidelines should clarify that EC species do not have significant interaction with the fishery; and, bycatch species should not be included as ''stocks in a fishery.''

Response: NMFS is revising the final guidelines to clarify preliminary factors to be taken into account when considering a species for possible classification as an EC species. Such factors include that the species should: (1) Be a non-target species or non-target stock; (2) not be determined to be subject to overfishing, approaching overfished, or overfished; (3) not likely to become subject to overfishing or overfished, according to the best available information, in the absence of conservation and management measures; and (4) not generally retained for sale or personal use. Factors (2) and (3) are more relevant to species that are currently listed in FMPs and that have specified SDCs. With regard to factor (4), the final guidelines add new language in § 600.310(d)(5)(i)(D)—''not generally retained for sale or personal use''—in lieu of ''*de minimis* levels of catch'' and clarify that occasional retention of a species would not, in itself, preclude consideration of a species in the EC classification. The NS1 guidelines provide general factors to be considered, as well as some examples of possible reasons for using the EC category. However, the decision of whether to use an EC classification requires consideration of the specific fishery and a determination that the EC classification will be consistent with conservation and management requirements of the MSA.

Under the MSA, a Council prepares and submits FMPs for each fishery under its authority that requires conservation and management, and there is considerable latitude in the definition of the fishery under different FMPs. The definition of ''fishery'' is broad, and could include one or more stocks of fish treated as a unit for different purposes, as well as fishing for such stock (see MSA section 3(13)(B)). While some comments encouraged inclusion of all species that might interact with a fishery, all bycatch species, or all species for which there may be ''fishing'' as defined in MSA section 3(13)(B), NMFS does not believe that MSA mandates such a result. MSA does not compel FMPs to include particular stocks or stock complexes, but authorizes the Councils or the Secretary to make the determination of what the conservation and management needs are and how best to address them. Taking the broader approaches noted above would interfere with this discretion and also could result in overlapping or duplicative conservation and management regimes in multiple FMPs under different Council jurisdictions. As National Standard 6 requires that conservation and management measures, where practicable, minimize costs and avoid unnecessary duplication, NMFS believes that Councils should retain the discretion to determine which fisheries require specific conservation and management measures. With regard to bycatch, regardless of whether a species is identified as part of a fishery or not, National Standard 9 requires that FMPs, to the extent practicable, minimize bycatch and to the extent it cannot be avoided minimize bycatch mortality. Additional protections are afforded to some species under the Endangered Species Act, regardless of whether they are listed as stocks in a fishery. Further, as a scientific matter, NMFS disagrees that every bycatch species would require conservation and management measures to protect the species from becoming overfished, because some bycatch species exhibit high productivity levels (*e.g.*, mature early) and low susceptibilities to fishery (*e.g.*, rarely captured) that preclude them from being biologically harmed or depleted by particular fisheries.

Comment 16: NMFS received several comments requesting that the guidelines include a description of vulnerability and how it should be determined, since it is referenced throughout the guidelines.

Response: NMFS agrees, and has added § 600.310(d)(10) to the final action, to define vulnerability. In general, to determine the vulnerability of a species/stock becoming overfished, NMFS suggests using quantitative estimates of biomass and fishing rates where possible; however, when data are lacking, qualitative estimates can be used. NMFS is currently developing a qualitative methodology for evaluating the productivity and susceptibility of a stock to determine its vulnerability to the fishery, and anticipates the methodology to be finalized by February 2009. The methodology is based on the productivity-susceptibility analysis (PSA) developed by Stobutzki *et al.* (2001), which was suggested by many commenters. Stocks that have low susceptibilities (*e.g.*, rarely interact with the fishery, no indirect impacts to habitat, etc.) and high productivities (*e.g.*, mature at an early age, highly fecund, etc.) are considered to have a low vulnerability of becoming overfished, while stocks that have low productivities and high susceptibilities to the fishery are considered highly vulnerable to becoming overfished.

Comment 17: Some commenters noted that the EC classification could be used to avoid reference point specification.

Response: NMFS believes that the guidelines provide mechanisms to address this issue. As a default, NMFS presumes that all stocks or stock complexes that Councils or the Secretary decided to include in FMPs are ''stocks in the fishery'' that need ACL mechanisms and AMs and biological reference points. Whether it would be appropriate to include species in the EC category would require consideration of whether such action was consistent with the NS1 guidelines as well as the MSA as a whole. If a Council or the Secretary wishes to add or reclassify stocks, a FMP amendment would be required, which documents rationale for the decision. However, the guidelines have been modified to note that EC species should be monitored to the extent that any new pertinent scientific information becomes available (*e.g.*, catch trends, vulnerability, etc.) to determine if the stock should be reclassified.

Comment 18: With regard to ecological, economic, and social (EES) factors related to OY, some commenters requested more specific guidance in incorporating the factors, and others commented that accounting for the factors is too time consuming. Other commenters expressed support for the reference to forage fish species and suggested including text on maximum economic yield and fish health.

Response: The NS1 guidelines generally describe OY as the long-term average amount of desired yield from a stock, stock complex, or fishery. OY is prescribed on the basis of MSY as reduced by EES factors (MSA section 3(33)). The NS1 guidelines set forth examples of different considerations for each factor, and NMFS believes the examples provide sufficient guidance on EES factors. NMFS has not made substantive changes from the proposed action, but has clarified that FMPs must address each factor but not necessarily each example.

Comment 19: NMFS received several comments in support of using stock complexes as a management tool in data poor situations and other comments that expressed concern about the use of stock complexes and indicator species. Comments included: stock complexes should only be used when sufficient data are lacking to generate species-specific SDCs and related reference points; there is little ecological basis for using indicator species to set ACLs for stock complexes (see Shertzer and Williams (2008)) as stocks within a stock complex exhibit different susceptibilities to the fishery; if used, stock complexes should be managed using the weakest or most vulnerable stock within the complex as a precautionary approach to management; it would be helpful to have examples of how a data poor stock could be periodically examined to determine if the stock is overfished or subject to overfishing.

Response: NMFS agrees that where possible Councils should generate stock-specific SDCs and related reference points for stocks in fishery; however, there are other circumstances in which stock complex management could be used. NMFS notes in § 600.310(d)(8) of the final action that stocks may be grouped into complexes for various reasons, including: where stocks in a multispecies fishery cannot be targeted independent of one another and MSY can not be defined on a stock-by-stock basis (see § 600.310(e)(1)(iii) of the final action); where there is insufficient data to measure their status relative to SDC; or when it is not feasible for fishermen to distinguish individual stocks among their catch.

NMFS believes that the guidelines sufficiently addressed the issue that stock complexes should be managed using the most vulnerable stock within the complex. In § 600.310(d)(9) of the final action the guidelines note that ''if the stocks within a stock complex have a wide range of vulnerability, they should be reorganized into different stock complexes that have similar vulnerabilities; otherwise the indicator stock should be chosen to represent the more vulnerable stocks within the complex. In instances where an indicator stock is less vulnerable than other members of the complex, management measures need to be more conservative so that the more vulnerable members of the complex are not at risk from the fishery.'' Additionally, these guidelines address the concerns of Shertzer and Williams (2008), by recommending that both productivity and susceptibility of the stock (*i.e.*, vulnerability to the fishery) is considered when creating or re-organizing stock complexes.

Lastly, NMFS agrees and has modified the phrase in § 600.310(d)(9) of the proposed action ''Although the indicator stock(s) are used to evaluate the status of the complex, individual stocks within complexes should be examined periodically using available quantitative or qualitative information to evaluate whether a stock has become overfished or may be subject to overfishing'' to provide examples of quantitative or qualitative analysis.

Comment 20: NMFS received comments regarding the process for specifying the ACL for either a stock complex or for a single indicator species. The commenters were concerned that the proper data will not be utilized to determine whether the ACL should be set for the stock complex or for single indicator species. They feel that the use of single indicator species would not represent the stock's abundance, especially in the St. Thomas/St. John and St. Croix fisheries.

Response: NMFS understands the concern, but does not believe the guidelines need to be revised. NMFS will refer this comment to the Council.

Comment 21: NMFS received comments stating that the final action should clarify how SDCs and ACLs should be applied to stocks that are targeted in one fishery and bycatch in another, as well as circumstances where the stock is targeted by two or more FMPs that are managed by different regional councils.

Response: NMFS believes that the guidelines sufficiently addressed this issue in § 600.310(d)(7) of the final action, which notes ''* * * Councils should choose which FMP will be the primary FMP in which management objectives, SDC, the stock's overall ACL and other reference points for the stock are established.'' NMFS believes that the Councils should continue to have the discretion to make such determinations. NMFS, however, suggests that the primary FMP should usually be the FMP under which the stock is targeted. In instances where the stock is targeted in two or more FMPs (*e.g.*, managed by two or more Councils), Councils should work together to determine which FMP is the primary.

Comment 22: Several commenters requested further clarification on how prohibited species should be classified under the proposed classification scheme (see § 600.310(d)) because they felt it was unclear whether a species for which directed catch and retention is prohibited would be classified as ''in the fishery'' or as an ''ecosystem component''.

Response: NMFS believes that the information in § 600.310(d) provides a sufficient framework in which decisions can be made about how to classify a prohibited species under an FMP. Prohibition on directed catch and/or retention can be applied to either a stock that is ''in the fishery'' or an ''ecosystem component'' species. Managers should consider the classification scheme outlined in § 600.310(d) of the final action as well as MSA conservation and management requirements generally. If a stock contains one of the ''in the fishery'' characteristics, then it belongs ''in the fishery'', regardless of the management tools that will be applied to it (*e.g.*, prohibition, bag limits, quotas, seasons, etc.). Also, if the intent is to prohibit directed fishing and retention throughout the exclusive economic zone (EEZ) for which a Council has jurisdiction, then the stock would, most likely, be identified in an FMP as ''in the fishery'' rather than as an ecosystem component of one particular FMP.

Comment 23: Several commenters asked at what level an ACL would be specified for a species for which directed catch and retention is prohibited. Setting the ACL at zero would not be logical because if even one was caught incidentally then AMs would be triggered. Setting it higher would also not be logical because the point is to ensure little to no catch of the stock.

Response: Prohibiting retention is a management measure to constrain the catch to a minimal amount. If listed as a stock in the fishery, the reference points for the species, such as OFL and ABC, should be set based on the MSY for the stock, or, if ESA listed, would be set according to the associated ESA consultation's incidental take statement, regardless of the management approach used. The ACL may not exceed the ABC, but should be set at a level so that the mortality resulting from catch and discard is less than the ACL.

Comment 24: NMFS received a comment stating that the specification of MSY must incorporate risk, be based on gear selectivity and support a healthy, functioning ecosystem. The commenter supported revisions to § 600.310(e)(1) of the proposed action but suggested that it should be strengthened to address ecosystem principles. The commenter cited NOAA Tech Memo NMFS–F/SPO–40 in contending that the concept of MSY contains inherent risks that must be addressed in establishing reference points. Other commenters stated that: Councils establish management measures with high probabilities of success (*e.g.*, 80 percent); ''fishery technological characteristics'' should be re-evaluated every two years; and MSY values normally equate to fishing down a population to forty percent of historic abundance and this may not be consistent with ecosystem based management.

Response: NMFS agrees that ecological conditions and ecosystem factors should be taken into account when specifying MSY and has added additional language to § 600.310(e)(1)(iv) of the final action to highlight this point. Such factors might include establishing a higher target level of biomass than normally associated with the specific stock's B_{msy}. In addition, ecological conditions not directly accounted for in the specification of MSY can be among the ecological factors considered when setting OY below MSY. Regarding the comment about establishing management measures with a high probability of success, this is addressed in comment #63. NMFS does not believe that the NS1 guidelines need to be revised to require that fishery technological characteristics be evaluated every 2 years; such characteristics would be routinely updated with each stock assessment. The MSA bases management of fishery resources on MSY, but provides that OY can be reduced from MSY for ecological factors. NMFS believes the guidelines are consistent with the MSA and allow Councils to implement ecosystem approaches to management.

Comment 25: Several comments requested the guidelines state that specification of reference points should not be required for a stock ''in the fishery'' if its directed catch and retention is prohibited because managers applied the prohibition in an effort to prevent overfishing.

Response: Prohibition of retention does not necessarily mean that overfishing is prevented. Even though the species cannot be retained, the level of fishing mortality may still result in overfishing. Many stocks for which prohibitions are currently in place are considered data-poor. NMFS acknowledges that specifying reference points and AMs will be a challenge for such stocks, but reiterates the requirement to establish ACLs and AMs for all managed fisheries, unless they fall under the two statutory exceptions (see § 600.310(h)(2) of the final action), and also the need to take into consideration best scientific information available per National Standard 2.

Comment 26: NMFS received comments voicing a concern about the NMFS process of determining the overfishing status of a fishery, because fishery management measures have been implemented to end overfishing, but stocks are still listed as subject to overfishing and require ACLs by 2010. The commenters felt that several species under the Caribbean Fishery Management Council's protection should currently be removed from the overfished species list.

Response: NMFS agrees that this is an important issue. Due to the process inherent in determining the status of a stock there is inevitably a lag time between implementation of management measures and a new assessment of the stock's status under those measures. NMFS is required by the MSA to establish new requirements to end and prevent overfishing through the use of ACLs and AMs. The fisheries subject to overfishing, including several in the Caribbean, are required to have ACLs by 2010, and all other fisheries must have ACLs by 2011. The Council's Comprehensive Amendment that implemented the Sustainable Fisheries Act in 2006 included measures designed to end overfishing. Although these measures may have ameliorated fishing pressure for some fishery resources in the U.S. Virgin Islands, the Council will need to evaluate the existing fishery management measures to determine whether they are sufficient to meet the new statutory requirements for ACLs and AMs.

Comment 27: Several commenters stated that NMFS should not include the OFL as the basis for overfishing SDC. Specific comments included: (1) The MSA does not define or require OFL, so NMFS should not use it in the guidelines; (2) catch-based SDC are inconsistent with the Magnuson-Stevens Act intent and SDC should only be based on the fishing mortality rate as it relates to a stock or stock complex's capacity to achieve MSY on a continual basis; (3) the Magnuson-Stevens Act does not require use of the long term average OFL as MSY; (4) NMFS increases the risk of overfishing when theoretical catch estimates or a constant fishing mortality rate (F) are used to manage a fishery especially when a retrospective pattern exists in a stock or stock complex.

Response: The term, OFL, is not defined in the MSA. However, OFL is directly based on requirements of the MSA, including the concept of MSY, and the requirement to prevent overfishing. NMFS does not believe that lack of a definition in the MSA precludes definition and use of OFL in order to meet the objectives of the MSA. The MSA defines overfishing as a rate or level of fishing mortality that jeopardizes the capacity of the stock to produce MSY. This mortality rate is defined by NMFS as the MFMT. The OFL for a year is calculated from the MFMT and the best estimate of biomass for a stock in that year, and thus is simply the MFMT converted into an amount of fish. The OFL is an annual level of catch that corresponds directly to the MFMT, and is the best estimate of the catch level above which overfishing is occurring. OFL is in terms of catch, and thus is in the same units as ABC and ACL. NMFS believes, therefore, that comparing catch to OFL is a valid basis for determining if overfishing has occurred that year. The relationship of MSY to OFL is that MSY is the maximum yield that the stock can provide, in the long term, while OFL is an annual estimate of the amount of catch above which overfishing is occurring. The annual OFL varies above and below the MSY level depending on fluctuations in stock size. Since both MSY and OFL are related to the highest fishing mortality rate that will not result in overfishing, it is expected that the long-term average of OFLs would equate to MSY, provided that the stock abundance is high enough to support MSY.

The NS1 guidelines give the Councils flexibility to determine if overfishing occurs by using either MFMT (F > MFMT) or actual annual catch (catch > OFL) as the criteria for overfishing determinations. There are advantages and disadvantages of using either measure. The advantages of using OFL as a SDC are that catch can be easily understood by constituents, a determination can be made as soon as catch totals are available, and there is no retrospective problem with setting the SDC itself. Use of OFL might not be appropriate for stocks with highly variable recruitment that can not be predicted and therefore incorporated into the forecast of stock condition on which OFL is based. The advantage of using MFMT to determine if overfishing is occurring is because F is based on a stock assessment analyzing the past performance of the fishery. This means that the MFMT method is less sensitive than the OFL method to recent fluctuations in recruitment. However, F cannot not be calculated until an assessment has been updated, which may lag the fishery by several years. Therefore, a status determination based on MFMT could be less current than a determination based on OFL and catch, and reflects past, rather than current, fishery performance. Also, if there is a retrospective pattern in the assessment, then the hindsight estimate of F for a particular year used for the SDC will be different than the forecast estimate of stock condition used when setting target catch levels and management measures for that same year. The choice of SDC for a stock should consider things like the frequency of stock assessments, the ability to forecast future stock size, and any known retrospective patterns in the assessment. If the SDC are appropriately chosen, NMFS does not believe that one method necessarily presents more risk that overfishing will occur.

Comment 28: NMFS received one comment which proposed that instead of being required to choose between OFL or MFMT as the SDC, that Councils should have the flexibility to use both. The comment implied that this would allow Councils to use MFMT as the SDC in years in which there is an assessment and OFL in years in which there is not an assessment.

Response: The NS1 guidelines require documentation for the rationale a Council uses to select the SDC within the FMP including defining overfishing status in terms of the MFMT (*i.e.*, fishing mortality rate) or OFL (*i.e.*, annual total catch) in such a way that overfishing can be monitored and determined on an annual basis. A Council could develop SDC based on both criteria, if sufficient rationale is provided.

Comment 29: NMFS received two comments in opposition to the ''overfished'' definition used by NMFS in the proposed rule. They point out that the current overfished definition could include stocks that are ''depleted'' due to changing environmental conditions not caused by fishing pressure. They propose that NMFS should revise the definition of ''overfished'' and create a ''depleted'' category for stocks that have declined below the minimum stock size threshold (MSST) due to changing environmental conditions.

Response: The overfished definition used by NMFS is consistent with the MSA. NMFS acknowledges that factors other than fishing mortality can reduce stock size below the MSST but NMFS believes the definition of overfished should not be altered. For stocks in a FMP, the MSA requires the Councils to rebuild the stock to a level consistent with producing the MSY regardless of the contributing factors. In most cases, the variation in relative contribution of environmental and fishing factors from year to year in reducing stock abundance is not known. When specifying SDC the Council is required to provide an analysis of how the SDC were chosen and how they relate to the reproductive potential of the stock. Specifically, the MSST should be expressed in terms of reproductive potential or spawning biomass. Furthermore, the stock assessment process can adjust the B_{msy} estimates and associated SDC due to environmental and ecological factors or changes in the estimates of reproductive potential, size/age at maturity, or other biological parameters.

Comment 30: Several comments suggested that NMFS should strike § 600.310(e)(2)(iii)(B) from the proposed action as it contradicts § 600.310(e)(2)(iii)(A) and could increase fishing pressure on a depleted stock by attributing low stock abundance to environmental conditions. Commenters criticized the requirement at § 600.310(e)(2)(iii)(B) that Councils ''must'' take action to modify SDC, and stated that there is little scientific evidence to show linkages between stock size and environmental conditions (citing to Restrepo *et al.* 1998 and NMFS. 2000. Endangered Species Act—Section 7 Consultation Biological Opinion and Incidental Take Statement). Commenters asserted that there is no statutory basis for this provision in the MSA and the legal standard for the word ''affect'' is vague and inadequate for ending overfishing. The comments stated that, in a time of anthropogenic climate change, stock dynamics are likely to change and by establishing this provision in the final action NMFS will undermine the statute's mandate to end overfishing. Commenters asserted that fisheries managers have and will respecify SDC to justify circumventing rebuilding targets, and the final guidelines should establish a high burden of proof to modify SDC due to changing environmental conditions or ''regime change'' (citing Fritz & Hinckley 2005).

Response: Section 600.310(e)(2)(iii) of this final action is essentially the same as text at § 600.310(d)(4) in the current NS1 guidelines, except for clarifications noted below. There is no change in the usage of ''must'' between the current guidance and this final NS1 guidance at § 600.310(e)(2)(iii). NMFS believes that the requirement of NS2, that conservation and management measures be based on the best available science, applies to the establishment of SDC. Therefore, in cases where changing environmental conditions alter the long-term reproductive potential of a stock, the SDC must be modified. As stocks and stock complexes are routinely assessed, long-term trends are updated with current environmental, ecological, and biological data to estimate SDCs. NMFS allows for flexibility in these provisions to account for variability in both environmental changes and variation in a stock's biological reaction to the environment.

The guidelines include language requiring a high standard for changing SDC that is consistent with NMFS Technical Guidance (Restrepo *et al.* 1998). NMFS outlines the relationship of SDC to environmental change in both the short and long-term in

§ 600.310(e)(2)(iii) of the final action. Total mortality of fish stocks includes many factors other than fishing mortality. Short-term environmental changes may alter the size of a stock or complex, for instance, by episodic recruitment failures, but these events are not likely to change the reproductive biology or reproductive potential of the stock over the long-term. In this case the Council should not change the SDC. Other environmental changes, such as some changes in ocean conditions, can alter both a stock's short-term size, and alter long-term reproductive biology. In such instances the Councils are required to respecify the SDC based on the best available science and document how the changes in the SDC relate to reproductive potential. In all cases, fishing mortality must be controlled so that overfishing does not occur. NMFS notes that, depending on the impact of the environmental change on the stock, failure to respecify SDC could result in overfishing, or could result in failure to achieve OY. In both cases, the fishery would not meet the requirements of NS1.

One change from § 600.310(d)(4) of the current NS1 guidelines occurs in § 600.310(e)(2)(iii)(A) of this final action. NMFS clarified that SDC ''should not'' rather than ''need not'' be changed if the long-term reproductive potential of a stock has not been affected by a changing environment. NMFS feels that this is consistent with setting a high standard for changing the SDC due to environmental changes. In addition, this action changes the phrase ''long-term productive capacity'' from the current NS1 guidance to ''long-term reproductive potential.'' NMFS believes the latter phrase is clearer and more accurately reflects the language in MSA section 303(a)(10).

Any changes to SDC are subject to Secretarial approval (§ 600.310(e)(2)(iv) of the final action), and the NS1 guidelines set a high standard for respecification of SDC due to environmental change. The Council must utilize the best available science, provide adequate rationale, and provide a basis for measuring the status of the stock against these criteria, and the SDC must be consistent with § 600.310(e)(2)(iii) of the final action. If manmade environmental changes are partially responsible for the overfished condition, the Council should recommend restoration of habitat and ameliorative programs in addition to curtailing fishing mortality.

Comment 31: NMFS received several comments that state that by requiring reference points to be point estimates NMFS is not acknowledging the uncertainty inherent in fishery management science. The comments expressed that the best way to incorporate uncertainty was to express SDCs as ranges and not point estimates.

Response: NMFS believes that uncertainty in SDC, OFL, and other fishing level quantities is best dealt with by fully analyzing the probability that overfishing will occur and that the stock might decline into an overfished condition, but we recognize that such a full analysis is not possible in many data-limited situations. When using a probability based approach, the distribution of probabilities includes a point estimate and it extends along a range. A probability based approach is already used in many rebuilding plans, for example, what fishing level will provide at least a 70% chance that the stock will be rebuilt in 10 years. NMFS scientists are working on a technical document that will describe some of the currently available methods to do such calculations, as well as some proxy approaches that could be used in situations where available data and methods do not allow calculation of the probability distributions.

Comment 32: NMFS received a number of comments regarding the proposed description of the relationship between ACT and OY—that achieving the ACT on an annual basis would, over time, equate to the OY. Comments requested more clarification, or did not agree with the described ACT–OY relationship.

Response: NMFS has revised the final action to remove the requirement that ACT be established, and instead discussed how targets, including ACT, function within the system of AMs to prevent the ACL from being exceeded. NMFS has also removed the discussion about the relationship of ACT to OY, based on the comments received. The full range of conservation and management measures for a fishery, which include the ACL and AM provisions, are required to achieve the OY for the fishery on a continuing basis. NMFS interprets the phrase ''achieving, on a continuing basis, the optimum yield for each fishery'' to mean producing from each stock or stock complex or fishery a long-term series of catches such that the average catch is equal to OY, overfishing is prevented, the long-term average biomass is near or above B_{msy}, and overfished stocks and stock complexes are rebuilt consistent with timing and other requirements of section 304(e)(4) of the MSA and § 600.310(j) of the final NS1 guidelines. NMFS notes that for fisheries where stock abundance is below the level that can produce the OY without the fishing mortality rate exceeding the MFMT, the annual yield will be less than the long-term OY level. In the case of an overfished fishery, ''optimum'' with respect to yield from a fishery means providing for rebuilding to a level consistent with producing the MSY in such fishery. When stock abundance is above $B_{msy,}$ a constant fishing mortality control rule may allow the annual catch to exceed the long-term average OY without overfishing occurring, but frequent stock assessments need to be conducted to update the level of stock abundance.

Comment 33: One commenter stated that ''OY equates with the acceptable biological catch (''ABC''), which in turn is the level at which ACL should be set.'' Another commenter stated that, in specifying ACLs, a Council should not exceed MSY, because MSY—as opposed to ABC—is the ''fishing level recommendation'' that should not be exceeded per MSA 302(h)(6).

Response: MSA includes the terms ''fishing level recommendations,'' ''acceptable biological catch,'' and ''annual catch limits'' but does not define them. As such, NMFS has considered how to interpret these provisions in light of the statutory text and taking into consideration public comment during scoping and in response to the proposed NS1 guidelines. NMFS believes that ABC refers to a level of ''catch'' that is ''acceptable'' given the ''biological'' characteristics of the stock or stock complex. As such, OY does not equate with ABC. The specification of OY is required to consider a variety of factors, including social and economic factors, and the protection of marine ecosystems, which are not part of the ABC concept. The Councils determine the ACL, which may not exceed the fishing level recommendations of its science advisors. Of the several required SSC recommendations (MSA 302(g)(1)(B)), the ABC is most directly applicable as the constraint on the Council's ACL. Although MSY and ABC are both derived from a control rule, the ABC is the appropriate constraint on ACL because it is the annualized result of applying that control rule (thus is responsive to current stock abundance) whereas the MSY is the expected long-term average from a control rule. The Council should generally set the ACL lower than the ABC to take into account other factors related to preventing overfishing or achieving OY, or it may set the ACL equal to the ABC and take these additional factors into account when setting an ACT below the ACL.

Comment 34: Several commenters stated that NMFS's definition framework for ACLs contains buffers that are not required by the Magnuson-Stevens Act and reduce or prevent the likelihood that OY can be achieved for a stock (Reducing a stock's OFL for scientific and management uncertainty, and OY factors results in too many reductions and makes it too difficult to achieve OY).

Response: NMFS believes that fisheries managers cannot consistently meet the requirements of the MSA to prevent overfishing and achieve, on a continuing basis, OY unless they address scientific and management uncertainty. The reductions in fishing levels that may be necessary in order to prevent overfishing should be only the amount necessary to achieve the results mandated by the MSA. Properly applied, the system described in the guidelines does not result in ''too many deductions,'' but rather, sets forth an approach that will prevent overfishing, achieve on a continuing basis OY, and incorporate sufficient flexibility so that the guidelines can be applied in different fisheries.

Comment 35: Several commenters suggested that NMFS clarify language to ensure that all aspects of fishing mortality (e.g., dead discards and post-release mortality) are accounted for in the estimates of ABC or when setting the ACL, and that all catch is counted against OY. NMFS also received comments that accounting for bycatch mortality in data poor situations should not be required.

Response: NMFS agrees that all sources of fishing mortality, including dead discards and post-release mortality from recreational fisheries must be accounted for, but believes that language in § 600.310(e)(3)(v)(C), (f)(2)(i) and (f)(3)(i) in both the proposed and final action sufficiently explains that catch includes fish that are retained for any purposes, mortality of fish that have been discarded, allocations for scientific research, and mortality from any other fishing activity. NMFS, however, disagrees that, when bycatch data is lacking, managers could ignore this known source of fishing mortality. Ignoring a known source of fishing mortality because data are lacking leads to underestimating catch. Unless this is factored in—for instance, as increased uncertainty leading to more conservative ABC and appropriate AMs (including ACT control rules)—overfishing could occur. NMFS's National Bycatch Report (due to be published in late 2008 or early 2009) provides comprehensive estimates of bycatch of fish, marine mammals, and non-marine mammal protected resources in major U.S. commercial fisheries. For instances where the National Bycatch Report does not provide bycatch data, NMFS suggests developing proxies based on National Bycatch Report bycatch ratios in similar fisheries until better data are available. For more information on the National Bycatch Report, *see http://www.st.nmfs.noaa.gov/st4/nop/Outreach/NBR_Factsheet_Final.pdf.* However, the decision about the best methodology for estimating bycatch should be made by the Council in consultation with its SSC, considering the best available scientific information.

Comment 36: One commenter requested clearer guidance for the specification of ABC and ultimately an ACL in cases where scientific uncertainty ''overwhelms'' the SSC's ability to make a valid ABC recommendation.

Response: The NS1 Guidelines recognize that precise quantitative assessments are not available for all stocks and some stocks do not have sufficient data for any assessment beyond an accounting of historical catch. It remains important to prevent overfishing in these situations, even though the exact level of catch that causes overfishing is not known. The overall guidance is that when stocks have limited information about their potential yield, harvest rates need to be moderated until such information can be obtained. Possible approaches include setting the ABC as 75% of recent average catch; see NMFS' Technical Guidance in Restrepo *et al.* (1998). NMFS is currently working on a report on control rules that will provide additional examples of possible approaches for data-limited situations as well as approaches that can use a better set of information.

Comment 37: ABC and ACT control rules should be revised to require consideration of life history characteristics (e.g., productivity, geographic range, habitat preferences, etc.) of a stock when setting control rules or catch limits.

Response: NMFS agrees that the productivity of stock, as well as the stocks susceptibility to the fishery should be considered when developing the ABC control rule. NMFS refers to these factors together as the vulnerability of stock, which is defined in § 600.310(d)(10) of the final action. The ABC control rule (see § 600.310(f)(4) of the final action) is based on scientific knowledge about the stock, which includes a stock's vulnerability to the fishery.

Regarding the ACT control rule, the final guidelines do not require that ACTs always be established, but provide that ACTs may be used as part of a system of AMs. When used, ACT control rules address management uncertainty, which is not related to the productivity of the stock. As noted in § 600.310(g)(3) of the final action, however, a Council could choose a higher performance standard (e.g., a stock's catch should not exceed its ACL more often than once every five or six years) for a stock that is particularly vulnerable to the effects of overfishing. In considering the performance standard, a Council should consider if the vulnerability of the stock has been accounted for in the ABC control rule, so as not to double count this type of uncertainty and provide unduly cautious management advice.

Comment 38: NMFS received comments requesting that text in § 600.310(f) of the proposed action be modified to clarify that ABC may not equal or exceed OFL; Councils are required to establish ABC control rules; the ABC and ACT control rules must stipulate the stock level at which fishing will be prohibited; and ACL cannot equal or exceed the ABC.

Response: NMFS does not agree that the guidelines should prohibit ABC from being equal to OFL, or ACL from being equal to ABC. NMFS has added text to the guidelines (§ 600.310(f)(3) and (f)(4)) to clarify that it believes that ABC should be reduced from OFL in most cases, and that if a Council recommends an ACL which equals ABC, and the ABC is equal to OFL, the Secretary may presume that the proposal would not prevent overfishing, in the absence of sufficient analysis and justification for the approach. NMFS agrees that an ABC control rule is required. NMFS does not agree, however, that the ABC and ACT control rules must stipulate the level at which fishing is prohibited. Here it is important to distinguish between setting an annual level of catch equal to zero because the stock biomass is low, from prohibiting landings for the remainder of a fishing year because the ACL has already been achieved. For the first type of prohibition, an ABC control rule could stipulate the level at which fishing is prohibited due to low stock biomass, but such a low level of biomass is likely to be below the MSST which will invoke development of a rebuilding plan with associated modification of the ABC control rule for the duration of the plan. NMFS, however, disagrees that the ACT control rule should have a similar stipulation as the primary function of this control rule is to account for management uncertainty and to serve as the target for inseason management actions.

Comment 39: NMFS received several comments that spatial-temporal management of ACLs should be employed as an integral part of effective catch-limit management. The commenters noted that apportioning ACLs by seasons and areas could reduce bycatch, protect sensitive habitats, reduce competition among fishery sectors, avoid localized and serial depletions of stocks, and ensure geographic and seasonal availability of prey to key predators.

Response: NMFS acknowleges that spatial and temporal considerations of fishery removals from a stock can be important. Many fisheries currently incorporate spatial and temporal considerations. However, in the context of NS1, these considerations would be relevant only if the overfishing definition or the OY definition for a stock included spatial or temporal divisions of the stock structure. NMFS believes the guidelines give Councils flexibility to consider spatial and temporal issues in establishing ACLs for a stock, and does not agree that the NS1 guidelines need to specifically address this issue. Apportioning ACLs by seasons and areas could be considered as Councils develop conservation and management measures for a fishery to meet the full range of MSA requirements, including the NS for basing conservation and management measures upon the best scientific information available (NS2); taking into account the importance of fishery resources to fishing communities to provide sustained participation and minimize adverse economic impacts (NS8); minimizing bycatch (NS9); and allocating fishing privileges among various U.S. fishermen that are fair and equitable, reasonably calculated, and carried out in such a manner that no particular entity acquires an excessive share of the catch (NS4).

Comment 40: NMFS received several comments about the role of the SSC in specifying ABC. Several commenters stated that the final ABC recommendation should be provided by the SSC (i.e., final peer review process), rather than an additional peer review process. Some commenters expressed concern that both the SSC and peer review process would recommend an ABC, leaving the Council to use the lower of the two recommended ABC values. One comment stated that the SSC should have the discretion to recommend an ABC that is different from the result of the control rule calculation in cases where there was substantial uncertainty or concern relating to the control rule calculated ABC.

Response: NMFS agrees that the SSC should provide the final ABC recommendation to their Council. In the preamble of the proposed NS1 revisions, NMFS acknowledged that the statutory language could be subject to different interpretations (*see* p. 32532 of 73 FR 32526; June 9, 2008). MSA refers to not exceeding fishing level recommendations of ''scientific and statistical committee or peer review process'' in one place and SSC recommendations for ABC and MSY in another place. Compare MSA sections 302(h)(6) and 302(g)(1)(B). Section 302(g)(1)(E) of the MSA provides that the Secretary and a Council may, but are not required to, establish a peer review process. NMFS feels that the Council should not receive ABC recommendations from two different sources (SSC and peer review). In order to avoid confusion, and in consideration of the increased role of SSCs in the MSA, NMFS believes that the SSC should provide the ABC recommendation and Councils should establish a clear process for receiving the ABC recommendation (as described in § 600.310(f)(3) of this action). The advance notice of proposed rulemaking (ANPR) (73 FR 54132; September 18, 2008) for potential revision of the National Standard 2 Guidelines includes consideration of the relationship between SSCs and peer review processes. NMFS believes the roles of the peer review process and the SSC complement each other. For example, a peer review process may conduct an extensive technical review of the details of each stock assessment. The SSC can then use the assessment document and its peer review, consider unresolved uncertainties, seek consistency with assessment decisions made for other stocks in the region, and arrive at an ABC recommendation. In addition, NMFS agrees that SSCs could provide an ABC recommendation that differed from the result of the ABC control rule calculation based on the full range of scientific information available to the SSC. The SSC would have explain why the recommendation differed from the calculated value. NMFS has added clarifying language into § 600.310(f)(3) of this action.

Comment 41: NMFS received a variety of comments on the role of the SSC and suggestions that the SSC role should be clarified. Comments included: There should be a mandatory peer review of significant SSC recommendations; the SSC should be directed to draw information and recommendations from the broadest possible range of scientific opinion; the SSC recommendation should include a discussion of alternative recommendations that were considered and alternative methodologies that were explored; what is the role of the SSC in providing recommendations for achieving rebuilding targets?; what is the SSC's role in providing ''reports on stock status and health, bycatch, habitat status, social and economic impacts of management measures and sustainability of fishing practices''?; the rule should clarify that the SSC is not charged with actually collecting the data and writing reports; the guidelines should specify the appropriate qualifications and membership of the SSCs and peer review process; the guidelines should specify the relative roles of the SSCs, peer review process, and Councils in establishing ACLs; the guidelines should specify the relative roles of NMFS, the Councils, the SSCs and the peer review process in selecting and evaluating AMs; NMFS should establish formal criteria for SSC membership, including formal training and/or experience in fisheries and/or ecological science or economics; NMFS should create oversight mechanisms and responsibility within NMFS to ensure that members are both qualified and acting in the public interest rather than representing stakeholders; NMFS should provide adequate training programs so that new members are well-prepared to meet these challenges; and NMFS should provide a mechanism for SSC members to identify and challenge political interventions, including potentially the development of a new scientific appeal function, staffed by a board of objective, external expert scientists.

Response: In developing the NS1 guidelines, NMFS focused on the SSC recommendation of the ABC as it is an important reference point for the Councils to use when developing ACLs. NMFS feels that the NS1 guidelines as proposed are clear in that the SSC provides the ABC recommendation and the Councils establish the ACLs. Both the ABC control rules and the ACT control rules could be developed with input from the SSC, Council, and peer review process as appropriate. NMFS believes that the NS1 guidelines adequately address the requirements for SSC recommendations that pertain to NS1. NMFS believes that other specific roles of the SSC would be more appropriately addressed in the National Standard 2 (NS2) guidelines.

Comment 42: Some commenters supported the proposed guidelines regarding the SSC, its relation to the Council, and provision of science advice such as ABC, but requested that the guidelines further emphasize that managers follow the advice of their scientific advisors in all cases when setting catch limits. Other commenters opposed the provisions and stated that accounting for scientific uncertainty is a matter of policy, not science and therefore should be delegated to the Council. Instead, the commenters proposed that the SSC should be recommending the OFL and that the Council may not set an ACL in excess of the OFL as determined by the SSC.

Response: NMFS believes that determining the level of scientific uncertainty is not a matter of policy and is a technical matter best determined by stock assessment scientists as reviewed by peer review processes and SSCs. Determining the acceptable level of risk of overfishing that results from scientific uncertainty is the policy issue. The SSC must recommend an ABC to the Council after the Council advises the SSC what would be the acceptable probability that a catch equal to the ABC would result in overfishing. This risk policy is part of the required ABC control rule. The Council should use the advice of its science advisors in developing this control rule and should articulate the control rule in the FMP. In providing guidance on establishing a control rule for the ABC, NMFS recognizes that all estimates of the OFL are uncertain, and that in order to prevent overfishing with more than a 50 percent probability of success, the ABC must be reduced from the OFL. The guidance is clear that the control rule policy on the degree of reduction appropriate for a particular stock is established by the Council. To the extent that it results in the ABC being reduced from the OFL, the SSC is carrying out the policy established by the Council. NMFS disagrees that the SSC should recommend OFL and not ABC. The MSA specifies a number of things that make up the recommendations that SSCs provide to their Council including recommendations for ABC, preventing overfishing, MSY, achieving rebuilding targets, reports on stock status and health, bycatch, habitat status, social and economic impacts of management measures, and sustainability of fishing practices. Of these, the ABC is directly relevant as the fishing level recommendation that constrains the ACL.

Comment 43: One comment expressed that Councils must be allowed to specify information needed in the SAFE report.

Response: NMFS agrees. NMFS has removed the following sentence from § 600.310(b)(2)(v)(B) of the final action: ''The SSC may specify the type of information that should be included in the Stock Assessment and Fishery Evaluation (SAFE) report (see § 600.315).''

The contents of the SAFE report fall under the purview of the National Standard 2 (NS2) guidelines. NMFS is currently considering revising the NS2 guidelines, including modification of the language describing the content and purpose of SAFE reports. NMFS recently published an advance notice of proposed rulemaking (73 FR 54132; September 18, 2008) to revise the NS2 guidelines and encourages the public to provide comment.

Comment 44: One commenter believed the ACT should be a suggested component of a fishery management plan rather than a mandated component of an FMP. Although the ACT may clearly distinguish management uncertainty from other sources of uncertainty, adding a target does not fundamentally improve the process. It is more important to correctly adjust the ACL based on actual performance data than to create a separate target or ACT control rule based on theory to account solely for management uncertainty.

Response: The final guidelines do not require that ACTs always be established, but provide that ACTs may be used as part of a system of AMs. NMFS disagrees that a target does not fundamentally improve the process. ACL is to be treated as a limit—an amount of catch that the fishery should not exceed. The purpose of utilizing an ACT is so that, given uncertainty in the amount of catch that will result from the conservation and management measures in the fishery, the ACL will not be exceeded. Whether or not an ACT is explicitly specified, the AMs must address the management uncertainty in the fishery in order to avoid exceeding the ACL. ACLs are subject to modification by AMs.

Comment 45: One comment stated that the purpose of an ACT is to address ''management uncertainty'' which seems to be a very abstract and unquantifiable concept that the Councils are likely to struggle with.

Response: NMFS disagrees that management uncertainty is an abstract concept. It relates to the difference between the actual catch and the amount of catch that was expected to result from the management measures applied to a fishery. It can be caused by untimely catch data that usually prevents inseason management measures from being effective. Management uncertainty also results from underreporting, late reporting and misreporting and inaccurate assumptions about discard mortality of a stock in commercial and recreational fisheries. One way to estimate management uncertainty is to examine a set of annual actual catches compared to target catches or catch quotas for a stock. If all or most of the catches fall closely around their target catches and don't exceed the OFL then management uncertainty is low; if actual catches often or usually result in overfishing then the management uncertainty is high and should be accounted for when establishing the AMs for a fishery, which may include setting an ACT.

Comment 46: NMFS received several comments regarding scientific and management uncertainty. In general these comments included: Clarify the meaning of scientific uncertainty; clarify that some types of uncertainty may not be considered in the ABC control rule process; increase research efforts in order to deal with scientific uncertainty; provide flexibility in the guidelines regarding how the Councils deal with uncertainty; and recognize that recreational fisheries are unduly impacted by the guidelines due to delayed monitoring of catch.

Response: Scientific uncertainty occurs in estimates of OFL because of uncertainty in calculations of MFMT, projected biomass amounts, and estimates in F (i.e., confidence intervals around those parameter estimates). In addition, retrospective patterns in estimates of future stock biomass and F (i.e., biomass may be overestimated and F underestimated on a regular basis) occur in some stock assessments and should be accounted for in determining ABC. NMFS revised the guidelines to make clear that all sources of scientific uncertainty—not just uncertainty in the level of the OFL—must be considered in establishing the ABC, and that SSCs may incorporate consideration of uncertainty beyond that specifically accounted for in the ABC control rule, when making their ABC recommendation. Management uncertainty should be considered primarily in establishing the ACL and AMs, which could include ACTs, rather than in specification of the ABC.

Comment 47: The definition of ABC in § 600.310(f)(2)(ii) of the proposed rule provides that ABC is a level of catch ''that accounts for scientific uncertainty in the estimate of OFL'' and is specified based on the ABC control rule. Scientific uncertainty is not and should not be limited to the estimate of OFL. That restriction would make it more difficult to implement other appropriate methods for incorporating scientific uncertainty in other quantities such as distribution of long term yield.

Response: NMFS agrees. NMFS has revised §§ 600.310(f)(2)(ii), (f)(2)(iii), and (f)(4) of the action to state that ABC accounts for scientific uncertainty in the estimate of OFL and other scientific uncertainty.

Comment 48: Several commenters stated that buffers, or margins of safety, need to be required between the overfishing level and annual catch limits to account for uncertainty, and that the final action should require the use of such buffers to achieve a high probability that overfishing does not occur. NMFS received comments suggesting that buffers between limit and target fishing levels reduce the chance that overfishing will occur and should be recognized as an accountability measure. Other commenters thought that the provision for setting ACT less than ACL meant that a Council has no discretion but to establish buffers. They said that while buffers may be appropriate in certain circumstances, they may also prevent achievement of OY in some circumstances.

Response: As noted elsewhere, NMFS has revised the final guidelines: they do not require that ACTs always be established, but provide that ACTs may be used as part of a system of AMs. The guidelines are intended only to provide Councils with direction on how the requirements of NS1 can be met, incorporating the requirement for ACLs and AMs such that overfishing does not occur. To prevent overfishing, Councils must address scientific and management uncertainty in establishing ABC, ACLs, and AMs. In most cases, some reduction in the target catch below the limit will result. NMFS does not believe that requiring buffers is appropriate, as there may be circumstances where that is not necessary to prevent overfishing. However, the guidelines require that AMs in a fishery be adequate to prevent ACLs from being exceeded, and that additional AMs are invoked if ACL is exceeded.

Comment 49: Some commenters stated that Councils needed flexibility to effectively tailor fishery management plans to the unique conditions of their fisheries, and that Councils should also have flexibility in how to account for scientific and management uncertainty.

Response: NMFS agrees that Councils should have flexibility, so long as they meet the requirements of the statute. ACLs to prevent overfishing are required, and management and scientific uncertainty must be considered and addressed in the management system in order to achieve that objective. NMFS also believes that Councils should be as transparent and explicit as possible in how uncertainty is determined and addressed, and believes the guidelines provide a good framework to meet these objectives.

Comment 50: One commenter supported NMFS' attention to scientific and management uncertainty, but thought that the better approach to deal with uncertainty is to reduce uncertainty. They stated that to accomplish this objective NMFS must increase its support for agency scientific research specific to stock assessments and ecosystem science.

Response: NMFS agrees. However, the processes proposed in the guidelines will address the current levels of uncertainty and accommodate reduced uncertainty in the future, as improvements in data are made.

Comment 51: Some commenters said that implementing ACLs would lead to economic disruption, particularly in the recreational fishing sector, because of a large degree of management uncertainty. One commenter cited difficulties in obtaining timely and accurate data, particularly for recreational fisheries, and asked if recreational allocations would have to be reduced due to delays in obtaining recreational harvest estimates.

Response: Preventing overfishing is a requirement of the MSA. The ACL mechanisms and AMs for a fishery must be adequate to meet that requirement, and in some cases, reductions in catch levels and economic benefits from a fishery may result. The specific impacts of implementing ACLs in a fishery will be analyzed when the ACLs are established in an FMP.

Comment 52: One commenter stated that the guidelines would require reducing catches well below existing OY levels, and that many species are known to be fished at low levels which are highly unlikely to lead to overfishing. They stated that this is inconsistent with responsible marine management and seems unlikely to represent the intent of Congress.

Response: Nothing in the guidelines would require a reduction in fishing if, in fact, the stocks are fished at low levels which are highly unlikely to lead to overfishing, and this conclusion is supported by science.

Comment 53: One commenter asked if OY could be specified for a fishery or a complex, or if the guidelines would require specification of OY for each species or complex.

Response: The guidelines provide that OY can be specified at the stock, stock complex or fishery level.

Comment 54: NMFS received several comments both supporting and opposing the use of inseason AMs (§ 600.310(g) of the proposed action). The commenters that supported the use of inseason AMs typically suggested that the Councils and NMFS improve their capability to use inseason AMs and/or that NMFS must make inseason closure authority a required element of FMPs. Opponents of inseason AMs commented that it is more reasonable to implement AMs after reviewing annual fishery performance data; there is no requirement in the law to impose inseason measures; inseason closures without individual transferable quotas will generate derby fisheries; and the requirement to use inseason AMs whenever possible would be difficult where monitoring data is not available.

Response: MSA provides for ACLs to be limits on annual catch, thus it is fully appropriate and consistent with the Act that available data be utilized to prevent ACLs from being exceeded. Conservation and management measures for a fishery should be designed so that ACLs are not routinely exceeded. Therefore, FMPs should contain inseason closure authority giving NMFS the ability to close fisheries if it determines, based on data that it deems sufficiently reliable, that an ACL has been exceeded or is projected to be reached, and that closure of the fishery is necessary to prevent overfishing. NMFS believes that the alternative result, which is that data are available inseason that show an ACL is being exceeded, but no management action is taken to prevent overfishing, would not meet the intent of the MSA. The MSA requires ACLs in all fisheries. It does not provide an exemption based on a concern about derby fishing. NMFS has modified the language in § 600.310(g)(2) of this action to indicate that ''For fisheries without inseason management control to prevent the ACL from being exceeded, AMs should utilize ACTs that are set below ACLs so that catches do not exceed the ACL.''

Comment 55: NMFS received some comments that generally expressed that AMs will be difficult to implement and that the provisions need to be clarified. Comments included: if an ACL is exceeded, a review by the Council must occur before implementation of the AMs; the Council must examine the ''problem'' that caused the overage—which means nothing will happen quickly; and it is not clear what ''biological consequences'' means in § 600.310(g)(3) of the proposed action.

Response: As proposed, AMs are management measures designed to prevent an ACL from being exceeded, as well as measures to address an overage of an ACL if it does occur. NMFS recommends that, whenever possible, Councils implement AMs that allow inseason monitoring and adjustment of the fishery. The AMs should consider the amount of time required for a Council to conduct analyses and develop new measures. In general, AMs need to be pre-planned so they can be effective/available in the subsequent year, otherwise, there could be considerable delay from the time that an overage occurs to the time when measures are developed to address the overage. Not all overages may warrant the same management response. Consider hypothetically the example of a fishery for which a 3 fish bag limit with 16 inch minimum size is expected to achieve the target catch level without exceeding the ACL. For such a fishery, the Council might implement AMs such that, if the catch was under the ACL or exceeded it by less than 5 percent, the same bag and size limits would apply the following year. If the ACL was exceeded by 5–25 percent, the bag limit the following year would be reduced to 2 fish, and if the ACL was exceeded by more than 25 percent the bag limit would be reduced to 1 fish. The AMs could also address a situation where catch was below the target level, indicating that the initial measures might be too strict. The objective is to have pre-planned management responses to ACL overages that will be implemented in the next season, so that flawed management measures do not result in continuing overages for years while Councils consider management changes. An FMP must contain AMs (see § 600.310(c)(5) of the final action). However, NMFS believes that the FMP could contain more general framework measures and that specific measures, such as those described hypothetically above, could be implemented through harvest specifications or another rulemaking process.

By ''biological consequences,'' NMFS means the impact on the stock's status, such as its ability to produce MSY or achieve rebuilding goals. For example, if information was available to indicate that, because of stronger than expected recruitment, a stock was above its B_{msy} level and continued to grow, even though the ACL was exceeded for the year, that could indicate that the overage did not have any adverse biological consequences that needed to be addressed through the AM. On the other hand, if the ACL for a long lived stock with low reproductive potential was exceeded by 100 percent, AMs should be responsive to the likelihood that some long-term harm to the stock may have been caused by the overage.

Comment 56: One commenter expressed concern about the term ''re-evaluated'' in §§ 600.310(g)(3) and (g)(4) in the proposed action. They stated that this could imply that Councils simply have to increase ACLs when they have ACL exceedances, and suggested that, if catch exceeds ACL more than once in last four years, there should be automatic buffer increases in setting ACL below OFL to decrease likelihood of exceeding ACL.

Response: If the performance standard is not met, the Councils must re-evaluate the system of ACLs and AMs, and modify it if necessary so that the performance standard is met. Since the ACL cannot exceed the ABC recommended by the SSC, NMFS does not believe that the scenario described by the commenter would arise. NMFS also does not believe that the guidelines should recommend automatic buffer increases in this case. The specific factors that caused the performance standard to not be met need to be analyzed and addressed. NMFS also notes that, in addition to this re-evaluation of the system of ACLs and AMs, AMs themselves are supposed to prevent and address ACL overages.

Comment 57: Several comments were received related to accountability measures for when catch exceeds the ACL. Some comments supported the concept that a full payback of ACL overages should be required for all stocks. Comments included: Overage deductions should be normal business for rebuilding and healthy stocks alike; NMFS should require all overages to be accounted for in full for all managed fisheries no later than when the ACL for the following fishing year is determined; and overage deductions must be viewed as an independent requirement from actions geared to preventing overages from occurring in the future, such as modifications of management measures or changes to the full system of ACLs, ACTs, and AMs.

Response: MSRA is silent with regard to mandatory payback of ACL overages. However, in developing the ACL provisions in the MSRA, it appears that Congress considered mandatory paybacks and did not include that requirement in the MSRA. NMFS believes that paybacks may be an appropriate AM in some fisheries, but that they should not be mandated, but rather considered on a case by case basis for stocks and stock complexes that are not in a rebuilding plan.

Comment 58: Several comments opposed the concept of an overage adjustment when catch exceeds the ACL for stocks that are in rebuilding plans (§ 600.310(g)(3) of the proposed action). Comments included: The MSA does not require this, this provision was removed from the drafts of the MSRA, and a full ''payback'' the following year may be unnecessary. Other comments supported the concept but wanted to strengthen § 600.310(g)(3) of the guidelines to remove text that stated: ''unless the best scientific information available shows that a reduced overage adjustment, or no adjustment, is needed to mitigate the effects of the overages.''

Response: NMFS believes that more stringent requirements for AMs are necessary for stocks in rebuilding plans. MSA 304(e)(3) provides that, for overfished stocks, an FMP, FMP amendment, or proposed regulations are needed to end overfishing immediately in the fishery and rebuild overfished stocks. There are a number of examples where failure to constrain catch to planned levels early in a rebuilding plan has led to failure to rebuild and the imposition of severe catch restrictions in later years in order to attempt to meet the required rebuilding timeframe. Thus, for rebuilding stocks, NMFS believes that an AM which reduces a subsequent year's ACL by the amount of any overage is appropriate, and will help prevent stocks failing to rebuild due to annual rebuilding targets being exceeded. NMFS does provide that if there is an analysis to show that all or part of the deduction is not necessary in order to keep the stock on its rebuilding trajectory, the full overage payback is not necessary. For example, an updated stock assessment might show that the stock size has increased faster than expected, in spite of the overage, and that a deduction from the subsequent ACL was not needed. For most rebuilding stocks, assessments cannot be updated annually, and in the absence of such analytical information, NMFS believes that the guideline provision is necessary to achieve rebuilding goals for overfished stocks.

Comment 59: Some commenters expressed support for the AMs as proposed and agreed that AMs should prevent catch from exceeding the ACL and address overages if they should occur. Other commenters suggested that AMs should be tied to overfishing or that AMs should be triggered when catch exceeds the ABC (as opposed to the ACL). Some commenters expressed that the MSA does not require the application of AMs if the ACL is exceeded.

Response: In developing the guidelines, NMFS considered using OFL or ABC as a point at which mandatory AMs should be triggered. However, NMFS believes that Congress intended the ACL to be a limit, and as such, it should not be exceeded. In addition, ''measures to ensure accountability'' are required in association with the ACL in MSA section 303(a)(15). Therefore, it is most appropriate to apply AMs if the ACL is exceeded. In addition, the purpose of ACLs is to prevent overfishing, and AMs triggered at the ACL level should be designed so that the ABC and OFL are not exceeded.

Comment 60: Several comments were received regarding the proposed performance standards. The performance standard that NMFS proposed in the proposed action stated that: ''If catch exceeds the ACL more than once in the last four years, the system of ACLs, ACTs and AMs should be re-evaluated to improve its performance and effectiveness.'' In cases where AMs are based on multi-year average data, the proposed performance standard stated: ''If average catch exceeds the average ACL more than once in the last four years, then the ACL, ACT and AM system should be re-evaluated.'' The commenters that supported the proposed performance standard suggested that it would allow the Council more flexibility in the management of their fisheries with ACLs. Commenters that disliked the proposed performance standard suggested that the Councils should have more flexibility in determining the performance standards, expressed concerns that the performance standard may not be precautionary enough, or expressed that it was arbitrary.

Response: NMFS believes it is important to establish a performance standard to establish accountability for how well the ACL mechanisms and AMs are working that is consistent across all Councils and fisheries. NMFS believes that ACLs are designed to prevent overfishing and that it is important to prevent catches from exceeding ACLs. NMFS also believes that, given scientific and management uncertainty, it is possible that catch will occasionally exceed ACL for a given stock or stock complex. However, it would be unacceptable to allow catch to continually exceed ACL. Therefore, NMFS proposed the performance standard to allow for some flexibility in the management system but also prevent overfishing. It should not limit a Council from establishing stronger performance measures, or from reevaluating their management measures more often. Notwithstanding the performance standard, if, at any time, a Council determines that the conservation and management measures for a fishery are not achieving OY while preventing overfishing, it should revise the measures as appropriate.

Comment 61: Several comments were received that suggested that fishery managers should or be required to re-evaluate the system of ACLs, ACT and AMs every time catch exceeds ACL. In addition, some expressed that NMFS should make clear that the ''reevaluation'' called for in the proposed action does not authorize simply raising ACLs or other numeric fishing restrictions in order to avoid the inconvenient fact that they have been exceeded.

Response: NMFS does not agree that a re-evaluation of the entire system of ACLs and AMs should be required every time an ACL is exceeded. If catch exceeds ACL in any one year, or if the average catch exceeds the average ACL, then AMs will be implemented and they should correct the operational issues that caused the overage, as well as any biological consequences resulting from the overage. Councils should be allowed the opportunity to see if their AMs work to prevent future overages of the ACL.

Comment 62: NMFS received comments that requested clarification or changes to the proposed performance standard. For example, one commenter suggested that NMFS should require a higher performance standard for vulnerable stocks. Two commenters expressed that the performance standard should apply at the stock or stock complex level as opposed to the fishery or FMP level. Another commenter questioned if the performance standard was if catch exceeds the ACL more than once in the last four years or if average catch exceeds the average ACL more than once in the last four years. NMFS also received some comments about the phrase ''to improve its performance and effectiveness'' in paragraph § 600.310(g)(3) of the proposed action. Those comments included: The phrase does not make sense in this context, because simply re-evaluating a system cannot improve its performance or effectiveness (only changing a system can do so); and use of this phrase in § 600.310(g)(3) is inconsistent with a similar sentence in paragraph § 600.310(g)(4) of the proposed action, where the same requirement is expressed, but this phrase does not appear.

Response: NMFS stated in the preamble of the proposed guidelines that a Council could choose a higher performance standard for a stock that is particularly vulnerable to the effects of overfishing. While NMFS agrees that a higher performance standard could be used for a stock or stock complex that is particularly vulnerable, NMFS believes the discretion to use a higher performance standard should be left to the Council. To reiterate this point, NMFS is adding additional language in § 600.310(g)(3) of the final action. NMFS intended that the performance standards would apply at the stock or stock complex level and is adding additional clarifying language in the regulatory text. The National Standard 1 guidelines as proposed offered two performance standards, one applies when annual catch is compared to the ACL for a given stock or stock complex, as described in paragraph § 600.310(g)(3) of this action, the other performance standard applies in instances when the multi-year average catch is compared to the average ACL, as described in § 600.310(g)(4) of this action. NMFS intended that in both scenarios, if the catch exceeds the ACL more than once in the last four years, or if the average catch exceeds the average ACL more than once in the last four years, then the system of ACLs and AMs should be re-evaluated and modified if necessary to improve its performance and effectiveness. NMFS has modified language to § 600.310(g)(3) and (4) of this action to clarify this issue.

Comment 63: NMFS received several suggestions to require a specific and high probability of success in either preventing overfishing, preventing catch from exceeding the ACL, or achieving the ACT. Comments included: The rule should make clear that management measures must have a high probability of success in achieving the OY or ACT; we recommend a probability of at least eighty percent of achieving the OY or ACT; NMFS should establish a performance standard that defines low risk, as well as an acceptable probability of successfully managing catch levels of 90 percent; National Standard guidelines should explicitly define the maximum acceptable risk of overfishing. One commenter cited to several court cases (NRDC v. Daley, Fishermen's Dock Coop., and Coastal Conservation Ass'n) and stated that the ACT control rule should be revised to state that the risk of exceeding the ACL due to management uncertainty is no greater than 25 percent.

Response: Considering and making appropriate allowances for uncertainty in science and management is emphasized in the NS1 guidelines. NMFS believes that, if this is done, ACLs will not often be exceeded, and when they are, the overages will typically be small and will not jeopardize the status of the stock. Fisheries where ACLs are exceeded regularly or by large amounts should be quickly modified to improve the measures.

During the initial scoping period, NMFS received many comments on the topic of setting a specific probability of success; some commenters expressed that a 50 percent probability of success is all that is legally required, while other commenters expressed that the probability of success should be higher (e.g. 75 or 100 percent). When developing the definition framework of OFL, ABC, ACL, and ACT, NMFS considered including specific probabilities of success regarding preventing overfishing or preventing catch from exceeding ACL. NMFS did not specify a particular probability in the NS1 guidelines, for a number of reasons. NMFS did not believe it had a basis for picking a specific probability number that would be appropriate for all stocks and stock complexes in a fishery. Councils should analyze a range of alternatives for the probability that ACL will not be exceeded or that overfishing will not occur. NMFS recognizes that fisheries are different and that the biological, social and economic impacts of managing at a specific probability will differ depending on the characteristics of the fishery. NMFS also recognizes that it is not possible to calculate a probability of success in many fisheries, due to data limitations.

NMFS does not believe that MSA and relevant case law require use of specific probabilities. However, a 50 percent probability of success is a lower bound, and NMFS believes it should not simply be used as a default value. Therefore, in § 600.310(f)(4) of the final action, NMFS states that the determination of ABC should be based, when possible, on the probability that catch equal to the stock's ABC would result in overfishing, and that this probability cannot exceed 50 percent and should be a lower value.

To determine if the system of ACLs was working adequately, NMFS decided to establish a performance standard in terms of the frequency that ACLs were exceeded. The comparison of catch to an ACL is a simpler task than calculating a probability of success, and can be applied to all fisheries, albeit some fisheries have more timely catch data than others. This does not preclude the Councils from using the probability based approach to setting limits and targets in their fisheries if they are able to do so.

Comment 64: Several comments were received urging NMFS to either require or encourage the use of sector ACLs and AMs and hold each sector accountable. Comments expressed that to provide the right incentives for conservation, catch reductions and increases must be tied to compliance and performance in adhering to ACLs. One commenter stated that MSA 303(a)(14) compels distinct ACLs and AMs for each sector due in part to the variation in management uncertainty among sectors. Sector management should be required in FMPs to ensure equitable treatment for all stakeholder groups including harvest restrictions and benefits to each sector.

Response: Separate ACLs and AMs for different fishery sectors may be appropriate in many situations, but the Councils should have the flexibility to determine this for each fishery. The decision to use sectors should be at the discretion of each Council. NMFS agrees that, if Councils decide to use sectors, each sector should be held accountable if catches for a sector exceed sector-ACLs. In addition, the NS1 guidelines provide that the ACL/AM system must protect the stock or stock complex as a whole. NMFS does not believe that MSA necessarily compels use of sector ACLs and AMs, thus the final action does not require their use. However, in developing any FMP or FMP amendment, it is important to ensure consistency with MSA 303(a)(14), NS 4, and other MSA provisions. Section 303(a)(14) pertains to allocation of harvest restrictions or recovery benefits fairly and equitably among commercial, recreational, and charter fishing sectors. NS 4, in part, pertains to fair and equitable allocations.

Comment 65: Some commenters expressed that managing recreational fisheries with ACLs and AMs will be difficult as they typically lack timely data. Comments included: The initiative to set ACLs and AMs for any fishery that has a recreational component cannot be done and any attempt will be arbitrary at best; in-season management is impractical in most recreational fisheries; current data collection programs used to evaluate recreational fishing activity do not offer a level of confidence to fisheries managers or fishermen to implement ACL in the recreational sector; and NMFS should improve recreational data collection to a level where inseason management is possible.

Response: NMFS acknowledges that recreational fisheries often do not have timely catch data and that is why NMFS suggested the multi-year averaging provision for AMs. NMFS and the Council still need to meet the mandate of the MSA and have ACLs for all fisheries. NMFS is developing a new data collection program for recreational fisheries to improve the data needed to implement the new provisions of the MSA.

Comment 66: Some commenters suggested that for recreational fisheries, catch limits should be expressed in terms of fishing mortality rates or in terms of numbers of fish instead of pounds of fish.

Response: NMFS intends that ACLs be expressed in terms of weight or numbers of fish. In fact, the definition of ''catch'' in the proposed guidelines indicates that catch is measured in weight or numbers of fish. NMFS disagrees that ACL can be expressed in terms of fishing mortality rates. While conservation and management measures for a fishery can be designed to achieve a target fishing mortality rate, the fishing mortality rates that are achieved can only be estimated by performing a stock assessment. Stock assessments usually lag the fishery by a year or more, and are not suitable as the basis for ACL accountability measures.

Comment 67: One commenter suggested that when recreational fisheries account for a significant portion of the catch, the buffers should be correspondingly larger to account for the management uncertainty.

Response: NMFS believes that management uncertainty should be addressed in all fisheries. Accountability measures may include an ACT set below the ACL based on the degree of uncertainty that the conservation and management measures will achieve the ACL. This applies to all fisheries, commercial or recreational.

Comment 68: NMFS received a few comments expressing that Councils should have flexibility when specifying AMs.

Response: NMFS agrees and believes that the guidelines provide this flexibility.

Comment 69: AMs should be approved by the Secretary of Commerce, should be subject to regular scientific review, and should provide opportunities for public comment; performance must be measurable and AMs must be modified if not working; AMs should be reviewed annually as part of the catch specification process.

Response: AMs will be implemented through public processes used for amending FMPs and implementing regulations. There is no need for additional guidance in the NS1 guidelines.

Comment 70: NMFS received comments that support the use of AMs based on comparisons of average catch to average ACL, if there is insufficient data to compare catch to ACL, either inseason or on an annual basis. In recreational fisheries, the use of a three-year rolling average ACL would moderate wild swings in ACLs due to variable fishing conditions and participation from year to year. Flexibility, such as the use of a multi-year average for the recreational sector, is needed due to limitations in the data collection. However, some commenters expressed concerns about using the multi-year averaging approach and stated that it should be used rarely. In order to use such an approach, Councils should provide clear and compelling reasons in their FMPs as to why the use of multi-year average data are necessary and a plan for moving the fishery to AMs based on annual data. The guidelines should make it clear that AMs will be triggered annually in cases where the average catch exceeds the average ACL. NMFS should engage its quantitative experts in an investigation of the performance of using multi-year averages for managing highly variable fisheries with poor inseason data. Until such results are available, NMFS should use annual statistics for management of all fisheries, including those involving highly variable stocks or catch limits.

Response: Use of AMs based on comparison of average catch to average ACL is only appropriate in a limited number of fisheries, such as fisheries that have high variability in the estimate of total annual catch or highly fluctuating annual catches and no effective way to monitor and control catches inseason. NMFS intends that a comparison of the moving average catch to the average ACL would be conducted annually and that AMs would be implemented if average catch exceeds the average ACL. If the average catch exceeds the average ACL more than once in the last four years, then the system of ACLs and AMs should be re-evaluated and modified if necessary to improve its performance and effectiveness. NMFS agrees that the Council should analyze and explain why they are basing AMs on multi-year averaged data. NMFS has added clarifying language to § 600.310(g)(4) of the final action to make these points clear. Future improvements in data and management approaches should also be pursued so that true annual accountability for catch can be achieved. In addition, NMFS believes that AMs such as the use of ACT may be appropriate in fisheries that use the multi-year averaging approach.

Comment 71: Several comments were received regarding ACLs and AMs for fisheries that occur partly in state waters. Some comments stated that accountability measures for State-Federal fisheries could use further elaboration and should specifically address fisheries where management had been delegated to the state. Some commenters supported separate ACLs and AMs for Federal and state portions of the fishery, while others wanted combined overall ACLs and AMs. Some comments disagreed that closure of Federal waters while fishing continues in non-Federal waters is a preferred option, and that efforts should be made to undertake cooperative management that allows coordinated responses.

Response: When stocks are co-managed by Federal, state, tribal, and/or territorial fishery managers, the goal should be to develop collaborative conservation and management strategies to prevent overfishing of shared stocks and ensure their sustainability. NMFS encourages collaboration with state managers to develop ACLs and AMs that prevent overfishing of the stock as a whole. As FMPs currently consider whether overfishing is occurring for a stock or stock complex overall, NMFS thinks it is appropriate to specify an overall ACL for the stock or stock complex. This ACL could be subdivided into state and Federal ACLs, similar to the approach used for sector-ACLs. However, NMFS recognizes that Federal management authority is limited to that portion of the fishery under Federal jurisdiction and therefore the NS1 guidelines only require AMs for the Federal fishery. The AMs could include closing the EEZ when the Federal portion of the ACL is reached, closing the EEZ when the overall stock or stock complex's ACL is reached, or other measures. NMFS recognizes the problem that may occur when Federal fisheries are closed but fishing continues in state waters. NMFS will continue to work with states to ensure consistency and effectiveness of management measures. If Councils delegate management under an FMP to the states, the FMPs still need to meet the requirements of the MSA, including establishment of ACLs and AMs.

Comment 72: One commenter asked, in the case where ACLs are exceeded because of the regulatory failures of one state, if other states in the Council's or the Atlantic States Marine Fisheries Commission's (ASMFC) area of jurisdiction be affected through mandatory AMs. Barring state-by-state allocations for all species (as with summer flounder), the proposed regulations could punish commercial fishermen and anglers in all states in a region.

Response: The guidelines acknowledge that NMFS and the Councils cannot mandate AMs on state fisheries. However, NMFS encourages collaboration between state and Federal managers to develop ACLs and AMs to prevent overfishing for the stock as a whole. In cases where there is collaboration, accountability measures for the fishery should be designed to address this issue. Specific AMs that may be needed would have to be evaluated and addressed on a case-by-case basis.

Comment 73: NMFS received a question regarding the meaning of the phrase ''large majority'' in § 600.310(g)(5) of the proposed action. NMFS had stated that: ''For stocks or stock complexes that have a large majority of harvest in state or territorial waters, AMs should be developed for the portion of the fishery under Federal authority and could include closing the EEZ when the Federal portion of the ACL is reached, or the overall stock's ACL is reached, or other measures.'' The commenter stated that the meaning of the term ''large majority'' and its importance is not clear and should therefore be eliminated.

Response: NMFS agrees that ACL and AMs need to be established for all stocks and stock complexes in Federal fisheries regardless of the whether a large majority of harvest occurs in state waters. NMFS agrees the amount, *i.e.*, ''large majority,'' is not pertinent to this provision. Therefore, § 600.310(f)(5)(iii) and (g)(5) have been revised in the final action.

Comment 74: NMFS received several comments noting that NMFS should require or recommend the use of limited access privilege programs (LAPPs) or catch shares by Councils in the final rule. Many commenters referenced an article on catch shares (Costello *et al.* 2008).

Response: The article cited above and other articles note the potential benefits of LAPPs. NMFS supports use of LAPPs, and believes they can be a beneficial approach to use in implementing effective ACLs. However, while ACLs are required in all fisheries, under the MSRA, LAPPs are optional and at the discretion of each Council. NMFS does not have authority to require Councils to use LAPPs, but is currently developing guidelines on LAPPs that will be published for public comment in the future.

Comment 75: One comment requested that NMFS expand the concept of accountability measures to include effective catch monitoring, data collection and analysis, and enforcement. The commenter suggested that for accountability measures that are not LAPPs, managers should demonstrate how the measures will ensure compliance with the ACLs as well as improve data and enforcement, reduce bycatch, promote safety, and minimize adverse economic impacts at least as well as LAPPs.

Response: NMFS agrees that catch monitoring, data collection and analysis, and enforcement are all important to consider in developing

AMs for a fishery and believes the guidelines are adequate. Under § 600.310(i) of the final action, FMPs, or associated documents such as SAFE reports, must describe data collection methods. In addition, § 600.310(g)(2) of the final action, states that whenever possible, inseason AMs should include inseason monitoring and management measures to prevent catch from exceeding ACLs. NMFS believes the guidelines are clear that catch monitoring data is very important to consider when Councils establish their AMs. Councils are already directed to: minimize adverse economic impacts under National Standard 8; minimize bycatch and bycatch mortality under National Standard 9; and promote safety of human life at sea under National Standard 10. *See* MSA 301(a)(8), (9), and (10) (setting forth specific requirements of the national standards).

Comment 76: NMFS received comments expressing concern about establishing ACL and AM mechanisms in FMPs. One commenter expressed concern that if ACL and AM mechanisms were located in the FMP, it would require a multi-year process to change any measure. They instead suggested that Councils should have the ability to framework the mechanisms and establish an annual or multi-year process for making adjustments. Another commenter suggested that Councils should be required to modify their SOPPs to incorporate a mechanism for specifying ACLs and reviewing AMs annually through regular catch specification procedures. NMFS received another comment that disagreed with the idea that the Council's SOPPs are the proper place to describe the process for establishing ABC Control Rules, including the role of SouthEast Data Assessment and Review (SEDAR) and the SSC. This commenter recommended instead that ABC Control Rules be included in Fishery Management Plans and have the ability to refine management through framework actions.

Response: The FMP needs to contain the ACL mechanisms and AMs, as they are part of the conservation and management measures for the fishery. The ACL mechanisms and AMs can contain framework provisions and utilize specification processes as appropriate. NMFS does not agree that the ACL and AM mechanisms should be established in the SOPPs. Also, NMFS never intended that ABC control rules would be described in the SOPPs and agrees that the ABC control rules should be described in the Fishery Management Plans. However, it is important to understand how the Councils, SSC, and peer review process work together to implement the provisions of the MSA, and that can be explained in the SOPPs, FMP, or some other document.

Comment 77: NMFS received several comments supporting the exception to the ACL rule for stocks with a life cycle of approximately one year. Commenters asked for a list of species which fit the exception, specific guidance on how to set ACLs for these stocks if they become overfished, and expansion of the exception to species with a two year life cycle.

Response: Due to their unique life history, the process for setting ACLs does not fit well for stocks which have a life cycle of approximately one year. The exception for species with an annual life cycle allows flexibility for Councils to use other management measures for these stocks which are more appropriate for the unique life history for each stock and the specifics of the fishery which captures them. NMFS believes that the final guidance should not include a list of stocks which meets these criteria; this is a decision that is best made by the regional Councils. Even though ACLs are not required for these stocks, Councils are still required to estimate other biological reference points such as SDC, MSY, OY, ABC and an ABC control rule. However, the MSA limits the exception and clearly states that if overfishing is occurring on the stock, the exception can not be used, therefore ACLs would be required. MSA only provided for a 1-year life cycle exception, thus NMFS cannot expand the exception to two years. Section (h)(3) of the final action acknowledges that there may be circumstances when flexibility is needed in applying the NS1 guidelines. Whether such flexibility is appropriate for certain two year life cycle species would have to be considered on a case-by-case basis.

Comment 78: NMFS received many comments expressing different interpretations of the MSA's ACL international exception. Some commented that the exception only pertains to the 2010/2011 timing requirement. If fisheries under international agreements were intended to be exempt from ACLs, Congress could have drafted the exception to say that ACLs ''shall not apply'' to such fisheries, similar to language used in the one-year life cycle exception. Several comments stated that by requiring ACLs for U.S. fishermen, the U.S. would be in a better bargaining position in international fora by taking the ''higher ground.'' Others agreed with the exception as set forth in the proposed guidelines but requested clarification. For example, one comment was that the exception should be expanded to cover the US/Canada Resource Sharing Understanding and other arrangements that may not be formal international agreements. Other suggestions included clarifying that the exception applied where a regional fishery management organization had approved a stock assessment, where there were conservation and management measures under an international agreement, or where there were annual catch limits established under international agreement consistent with MSA overfishing and rebuilding requirements.

Response: The ACL international exception is set forth in an uncodified note to MSA section 303. MSRA, Public Law 109–479 section 104(b)(1). The text is vague, and NMFS has spent considerable time looking at different possible interpretations of this text in light of the plain language of the text, public comments, and other relevant MSA provisions. NMFS agrees that one possible interpretation, in light of the text of the one-year life cycle exception (MSRA section 104(b)(2)), is that stocks under international management are only exempt from timing requirements. However, Congress added significant new requirements under the MSRA regarding international fisheries, thus NMFS has tried to interpret the exception in light of these other statutory provisions.

In many fisheries, the U.S. unilaterally cannot end overfishing or rebuild stocks or make any measurable progress towards those goals, even if it were to stop all U.S. harvest. Thus, it has signed onto various treaties and negotiates binding, international conservation and management measures at regional fishery management organizations (RFMOs) to try to facilitate international efforts to end overfishing and rebuild overfished stocks. MSRA acknowledged the challenges facing the United States in international fisheries by, among other things, including a new ''International Overfishing'' section (MSA section 304(i)) that refers domestic regulations to address ''relative impact'' of U.S. vessels; changes to highly migratory species provisions (MSA section 102(b)–(c)); and amendments to the High Seas Driftnet Fishing Moratorium Protection Act, 16 U.S.C. 1826h–1826k, to encourage strengthening of RFMOs and establish a process for identification and certification of nations whose vessels engage in illegal, unreported or unregulated (IUU) fishing and bycatch of protected living marine resources.

While NMFS actively communicates and promotes MSA requirements regarding ending overfishing and rebuilding overfished stocks at the international level (*see*, *e.g.*, MSA section 102(c)), it is unlikely that RFMOs will adopt ACL/AM mechanisms as such mechanisms are understood and required in the context of U.S. domestic fisheries. Given the practical problem of ensuring the U.S. could negotiate such mechanisms, and Congress' clear recognition of U.S. fishing impact versus international fishing effort, NMFS believes that a reasonable interpretation of the exception is that it should apply to the ACL requirement, not just the effective date. If ACLs were required, a likely outcome is that U.S. fishermen may be subject to more restrictive measures than their foreign counterparts, *e.g.*, each country may be assigned a catch quota but the U.S. portion may be subject to further restriction below the assigned amount. Further, requiring ACLs may raise potential conflicts with implementing legislation for some of the international fishery agreements.

NMFS believes that the intent of MSRA is to not unfairly penalize U.S. fishermen for overfishing which is occurring predominantly at the international level. In many cases, applying ACL requirements to U.S. fishermen on just the U.S. portion of the catch or quota, while other nations fished without such additional measures, would not lead to ending overfishing and could disadvantage U.S. fishermen. The guidance given for the international exception allows the Councils to continue managing the U.S. portion of stocks under international agreements, while the U.S. delegation works with RFMOs to end overfishing through international cooperation. The guidelines do not preclude Councils or NMFS from applying ACLs or other catch limits to stocks under international agreements, if such action was deemed to be appropriate and consistent with MSA and other statutory mandates.

NMFS considered different suggestions on how the exception might be clarified, *e.g.*, exception would only apply where there is an approved stock assessment, conservation and management measures, annual catch limits consistent with MSA overfishing and rebuilding requirements, etc. Regardless of how the exception could be revised, establishing ACL mechanisms and AMs on just the U.S. portion of the fishery is unlikely to have any impact on ending overfishing and rebuilding. For these reasons, and taking into consideration possible statutory interpretations and public comment, NMFS has decided not to revise the international exception.

With regard to whether an arrangement or understanding is an ''international agreement,'' it will be important to consider the facts and see if the arrangement or understanding qualifies as an ''international agreement'' as understood under MSA section 3(24) (defining ''international fishery agreement'') and as generally understood in international negotiation. The Case-Zablocki Act, 1 U.S.C. 112b, and its implementing regulations provide helpful guidance on interpreting the term ''international agreement.''

Comment 79: With regard to fisheries data (§ 600.310(i) of NS1 guidelines), comments included: data collection guidelines are burdensome, clarification is needed on how the Councils would implement the data collection requirements, and that data collection performance standards and real-time accounting are needed.

Response: NMFS believes that § 600.310(i) of the final action provides sufficient guidance to the Councils in developing and updating their FMPs, or associated public documents such as SAFE reports, to address data needed to meet the new requirements of the MSRA. There is a close relationship between the data available for fishery management and the types of conservation and management measures that can be employed. Also, for effective prevention of overfishing, it is essential that all sources of fishing mortality be accounted for. NMFS believes that detailing the sources of data for the fishery and how they are used to account for all sources of fishing mortality in the annual catch limit system will be beneficial. NMFS revised the final guidelines to clarify that a SAFE report, or other public document adopted by a Council, can be used to document the required fishery data elements.

Comment 80: NMFS received several comments requesting that better data be used when creating conservation and management measures.

Response: NMFS agrees that improvements in fishery data can lead to more effective conservation and management measures, including ACLs. NMFS is aware of the various gaps in data collection and analysis for FMPs in U.S. fisheries, and has ongoing and future plans to improve the data needed to implement the new provisions of the MSRA. NMFS programs and initiatives that will help produce better quality data include the: Marine Recreational Information Program (MRIP), National Permits System, and Fisheries Information and National Saltwater Angler Registry.

Comment 81: Some comments recognized the ongoing programs to improve data, but were concerned that the time that it would take to implement and fold these new data into the management process could cause overly restrictive measures when implementing ACLs on fisheries that are data poor (*e.g.* recreational fisheries).

Response: ACLs must be implemented using the best data and information available. Future improvements in data will allow corresponding improvements in conservation and management measures. This is an incremental process. NMFS believes that Councils must implement the best ACLs possible with the existing data, but should also look for opportunities to improve the data and the ACL measures in the future. It is important that the ACL measures prevent overfishing without being overly restrictive. In data poor situations, it is important to monitor key indicators, and have accountability measures that quickly adjust the fishery in response to changes in those indicators.

Comment 82: Some commenters noted they want more transparency in the data being used to manage fisheries.

Response: NMFS believes the NS1 guidelines provide sufficient guidance to the Councils in developing and updating their FMPs, or associated public documents such as SAFE reports, to address data needed to meet the new requirements of the MSRA. NMFS agrees that transparency in the Council process and NMFS decision process in regard to data and data analysis is critical to the public and user groups understanding of how fisheries are managed. NMFS is aware of this issue and will continue to seek improvements in such processes.

Comment 83: NMFS received several comments about the timing associated with submitting a rebuilding plan. Commenters asked for clarification on when the clock started for the implementation of the plan, stated that Councils should have two years to submit the plan to the Secretary, and suggested that a 6-month review/implementation period be used instead of a 9-month period. Commenters noted that MSA provides for specific time periods for Secretarial review.

Response: Ending overfishing and rebuilding overfished stocks is an important goal of the MSA and the performance of NMFS is measured by its ability to reach this goal. Currently, the Council has 12 months to submit an FMP, FMP amendment, or proposed regulations to the Secretary, but there is no time requirement for implementation of such actions. MSA section 304(e)(3), which is effective July 12, 2009, requires that a Council prepare and implement an FMP, FMP amendment, or proposed regulations within 2 years of the Secretary notifying the council that the stock is overfished or approaching a condition of being overfished. The guidelines provide that such actions should be submitted to the Secretary within 15 months so NMFS has 9 months to review and implement the plan and regulations. NMFS recognizes that there are timing requirements for Secretarial review of FMPs and regulations (MSA section 304(a),(b)). The 15-month period was not intended to expand the time for Secretarial review, but rather, to address the new requirement that actions be implemented within two years. NMFS believes the timing set forth in the guidelines is appropriate as a general rule: it would continue to allow for 60 days for public comment on an FMP, 30 days for Secretarial review, and 6 months for NMFS to implement the rebuilding plan. However, in specific cases NMFS and a Council may agree on a schedule that gives the Council more time, if the overall objective can still be met.

Comment 84: NMFS received many comments in support of the language regarding ending overfishing immediately. One comment, however, stated that intent of the MSA is to end all overfishing, not just chronic overfishing, as described in the preamble.

Response: NMFS agrees that the intent of the MSA is to end overfishing, and in the context of a rebuilding plan, overfishing must be ended immediately. However, as long as fishing is occurring, there always is a chance that overfishing may occur given scientific and management uncertainty. The guidelines explain how to incorporate scientific and management uncertainty so that fishing may continue but with an appropriately low likelihood of overfishing. The term ''chronic overfishing'' is used to mean that annual fishing mortality rates exceed the MFMT on a consistent basis over a period of years. The MSA definition of overfishing is ''* * * a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis.'' NMFS believes that the best way to ensure that overfishing does not occur is to keep annual fishing mortality rates below the MFMT. However, exceeding the MFMT occasionally does not necessarily jeopardize the capacity of a fishery to produce the MSY on a continuing basis. The more frequently MFMT is exceeded, the more likely it becomes that the capacity of a fishery to produce the MSY on a continuing basis is jeopardized. Thus, NMFS believes that ACLs and AMs should be designed to prevent overfishing on an annual basis, but that conservation and management measures need not be so conservative as to prevent any possibility that the fishing mortality rate exceeds the MFMT in every year.

Comment 85: NMFS received several comments regarding what happens when a rebuilding plan reaches T_{max} but the stock is not fully rebuilt. Commenters supported the approach in the proposed action that provided that the rebuilding F should be reduced to no more than 75 percent of MFMT until the stock or stock complex is rebuilt. One commenter suggested clarifying the final guidelines text to provide: ''If the stock or stock complex has not rebuilt by T_{max}, then the fishing mortality rate should be maintained at $F_{rebuild}$ or 75% of the MFMT, whichever is less.'' Other commenters stated that 75 percent MFMT is not precautionary enough and that 50 percent MFMT (or less) should be used.

Response: This new language in the guidelines fills a gap in the current guidelines which did not prescribe how to proceed when a stock had reached T_{max} but had not been fully rebuilt. NMFS believes that requiring that F does not exceed $F_{rebuild}$ or 75 percent MFMT, whichever is lower, is an appropriate limit, but Councils should consider a lower mortality rate to meet the requirement to rebuild stocks in as short a time as possible, pursuant to the provisions in MSA section 304(e)(4)(a)(i). NMFS agrees that the suggested edit would clarify the provision, and has revised the guidelines.

Comment 86: NMFS received many comments on the relationship between T_{min}, T_{target} and T_{max}. Some comments supported the proposed guidelines and others stated that the guidelines should be modified. Comments included: T_{min} is inconsistent with MSA's requirement to take into account needs of fishing communities and should include those needs when evaluating whether rebuilding can occur in 10 years or less; management measures should be designed to achieve rebuilding by the T_{target} with at least a 50% probability of success and achieve T_{max} with a 90% probability of success; as in the 2005 proposed NS1 guidelines revisions, T_{max} should be calculated as T_{min} plus one mean generation time for purposes of determining whether rebuilding can occur in 10 years or less; per *NRDC* v. *NMFS,* 421 F.3d 872 (9th Cir. 2005), T_{target} should be as close to T_{min} as possible without causing a short-term disaster; rebuilding timeframes should only be extended above T_{min} where ''unusually severe impacts on fishing communities can be demonstrated, and where biological and ecological implications are minimal;'' rebuilding times for stock complexes must not be used to delay recovery of complex member species; and the ''generation time'' calculation for T_{max} should refer to generation time of the current population.

Response: In developing the guidance for rebuilding plans, NMFS developed guidelines for Councils which, if followed, are strong enough to rebuild overfished stocks, yet flexible enough to work for a diverse range of fisheries. The timeline for a rebuilding plan is based on three time points, T_{min}, T_{target} and T_{max}. T_{min} is the amount of time, in the absence of any fishing mortality, for the stock to have a 50% probability of reaching the rebuilding goal, B_{msy}. T_{min} is the basis for determining the rebuilding period, consistent with section 304(e)(4)(A)(ii) of the MSA which requires that rebuilding periods not exceed 10 years, except in cases where the biology of the stock of fish, other environmental conditions, or management measures under an international agreement in which the United States participates dictate otherwise. T_{min} provides a biologically determined lower limit to T_{target}. Needs of fishing communities are not part of the criteria for determining whether a rebuilding period can or cannot exceed 10 years, but are an important factor in establishing T_{target}.

Just as T_{min} is a helpful reference point of the absolute shortest time to rebuild, T_{max} provides a reference point of the absolute longest rebuilding period that could be consistent with the MSA. T_{max} is clearly described in the guidelines as either 10 years, if T_{min} is 10 years or less, or T_{min} plus one generation time for the stock if T_{min} is greater than 10 years. NMFS agrees that this calculation can cause a discontinuity problem when calculating T_{max}, and proposed revisions to the NS1 guidelines in 2005 that would have addressed the issue by basing T_{max} on T_{min} + one generation time in all cases, which would have removed the requirement that T_{max} is 10 years in all cases where T_{min} was less than 10 years. NMFS did not finalize those revisions, but proposed the same changes to the MSA in the Administration's proposed MSA reauthorization bill. However, when MSRA was passed, Congress did not accept the Administration's proposal and chose to keep the existing provision. NMFS has, therefore, not revised this aspect of the NS1 guidelines.

The generation time is defined in the guidelines as ''the average length of time between when an individual is born and the birth of its offspring.'' Typically this is calculated as the mean age of the spawners in the absence of fishing mortality (per Restrepo *et al.,* 1998), but the exact method is not specified in the guidance.

T_{max} is a limit which should be avoided. When developing a rebuilding plan, it is good practice for Councils to calculate the probability of the potential management alternatives to achieve rebuilding by T_{max}, in order to inform their decision.

T_{target} is bounded by T_{min} and T_{max} and is supposed to be established based on the factors specified in MSA section 304(e)(4). Section 600.310(j)(3) of the final action reiterates the statutory criteria on specifying rebuilding periods that are ''as short as possible,'' taking into account specified factors. Management measures put in place by the rebuilding plan should be expected (at least 50% probability) to achieve rebuilding by T_{target}. NMFS does not believe these sections should be revised to focus on ''short-term disasters'' or ''unusually severe'' community impacts, as the MSA provides for several factors to be considered. NMFS believes the final guidelines provide sufficient general guidance on the MSA requirements, but acknowledges that there is case law in different jurisdictions (such as NRDC v. NMFS), that fishery managers should consider in addition to the general guidance.

Comment 87: A commenter stated that § 600.310(j)(3)(i)(E) of the proposed action should be revised to state that ''as short as possible'' is a mandate, not just a priority.

Response: NMFS deleted the ''priority'' text in § 600.310 (j)(3)(i)(E) of the final action. That text is unnecessary given that § 600.310 (j)(3)(i) of the guidelines explains ''as short as possible'' and other rebuilding time period requirements from MSA section 304(e)(4).

Comment 88: Commenters raised several questions about the relationship of NS1 and National Standard 8 (NS 8), including whether NS 1 ''trumps'' NS 8 and whether the ACL guidance provides sufficient flexibility to address NS 8 considerations.

Response: NS 1 states: ''Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.'' MSA section 301(a)(1). NS 8 states: ''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 by utilizing economic and social data that meet the requirements of paragraph (2) [*i.e.*, National Standard 2] , in order to (A) provide for sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.'' MSA section 301(a)(8) (*emphasis added*).

The objectives in NS8 for sustained participation of fishing communities and minimization of adverse economic impacts do not provide a basis for continuing overfishing or failing to rebuild stocks. The text of NS8 explicitly provides that conservation and management measures must prevent overfishing and rebuild overfished stocks. MSA does provide, however, for flexibility in the specific conservation and management measures used to achieve its conservation goals, and NMFS took this into consideration in developing the revised NS1 guidelines.

Comment 89: NMFS received many comments regarding § 600.310(m) of the proposed action, a provision commonly called the ''mixed stock exception.'' One comment supported the revision as proposed. Some commenters noted that the provision is very important in managing specific mixed stock fisheries, and that changes in the proposed guidelines would make it impossible to use. Specific concern was noted about text that stated that the ''resulting rate of fishing mortality will not cause any stock or stock complex to fall below its MSST more than 50 percent of the time in the long term.'' In addition, commenters stated that the proposed revisions do not allow for social and economic aspects to be taken in to account adequately and would negatively impact several fisheries and fishing communities. Many others commented that the provision should be removed entirely, because it is contrary to the intent of the MSA. The MSA, as amended by the MSRA, requires preventing and ending overfishing, and a mixed stock exception would allow for chronic overfishing on vulnerable fish stocks within a complex.

Response: MSRA amended overfishing and rebuilding provisions of the MSA, reflecting the priority to be given to the Act's conservation goals. NMFS believes that the final NS1 guidelines provide helpful guidance on the new statutory requirements and will strengthen efforts to prevent overfishing from occurring in fisheries. Preventing overfishing and achieving, on a continuing basis, the OY is particularly challenging in mixed stock fisheries. To address this issue, the proposed action retained a mixed stock exception. NMFS recognizes the concerns raised about how the exception will impact efforts to prevent and end overfishing, and thus, revised the current NS1 guidelines text in light of new MSRA provisions.

The current mixed stock exception allows overfishing to occur on stocks within a complex so long as they do not become listed under the Endangered Species Act (ESA). As explained in the proposed guidelines, NMFS believes that ESA listing is an inappropriate threshold, and that stocks should be managed so they retain their potential to achieve MSY. The revised guidelines propose a higher threshold, limiting F to a level that will not lead to the stock becoming overfished in the long term. In addition, if any stock, including those under the mixed stock exception, were to drop below its MSST, it would be subject to the rebuilding requirements of the MSA, which require that overfishing be ended immediately and that the stock be rebuilt to B_{msy} (see § 600.310(j)(2)(ii)(B) of the final action). The exception, as revised, addresses concerns regarding social, economic, and community impacts as it could allow for continued harvest of certain stocks within a mixed stock fishery.

Having considered public comments on the proposed guidelines, NMFS has decided to retain the mixed stock exception as proposed in the guidance. While NMFS has chosen in the NS1 guidelines to emphasize the importance of stock-level analyses, MSA refers to preventing overfishing in a fishery and provides for flexibility in terms of the specific mechanisms and measures used to achieve this goal. The mixed stock exception provides Councils with needed flexibility for managing fisheries, while ensuring that all stocks in the fishery continue to be subject to strong conservation and management. However, NMFS believes that the mixed stock exception should be applied with a great deal of caution, taking into consideration new MSRA requirements and NS1 guidance regarding stock complexes and indicator species. NMFS also believes that Councils should work to improve selectivity of fishing gear and practices in their mixed-stock fisheries so that the need to apply the mixed stock exception is reduced in the future.

VI. Changes From Proposed Action

Annual catch target (ACT) is described as a management option, rather than a required reference point in paragraphs (f)(1), (f)(2)(v), (f)(6), (f)(6)(i), and (g)(2) in the final action.

The following sentence was deleted from paragraph (b)(2)(v)(B): ''The SSC may specify the type of information that should be included in the Stock Assessment and Fishery Evaluation (SAFE) report (*see* § 600.315).'' Paragraph (b)(2)(v)(C) was revised to make some clarifying edits regarding the SSC and peer review process. The following sentence was included in (b)(2)(v)(D): ''The SSC recommendation that is the most relevant to ACLs is ABC, as both ACL and ABC are levels of annual catch.''

Paragraph (c)(5) is removed because ''ACT control rule'' is no longer a required part of the definition framework. Paragraph (c)(6) in the proposed action is re-designated as paragraph (c)(5) in the final action. Paragraph (c)(7) in the proposed action is re-designated as paragraph (c)(6) in the final action.

Paragraph (d)(1) was revised to clarify that Councils may, but are not required to, use the ''ecosystem component'' species classification. Paragraphs (d)(2) through (d)(7) were revised to better clarify the classification system for stocks in an FMP. Paragraph (d)(9) is revised to emphasize that indicator stocks are stocks with SDC that can be used to help manage more poorly known stocks that are in a stock complex. Paragraph (d)(10) has been added to describe in general how to evaluate ''vulnerability'' of a stock.

Paragraph (e)(1)(iv) was revised to clarify that ecological conditions should be taken into account when specifying MSY. The following sentence was added to paragraph (e)(2)(i)(C): ''The MFMT or reasonable proxy may be expressed either as a single number (a fishing mortality rate or F value), or as a function of spawning biomass or other measure of reproductive potential.'' The following sentence was added to paragraph (e)(2)(i)(D): ''The OFL is an estimate of the catch level above which overfishing is occurring.'' The following sentence was deleted from (e)(2)(ii)(A)(*1*): ''The MFMT must not exceed F_{msy}.'' Paragraph (e)(3)(iv) was revised to improve clarity. The following sentence was deleted from (e)(3)(v)(A): ''As a long-term average, OY cannot exceed MSY.''

Paragraph (f)(1) was revised to give examples of scientific and management uncertainty. Paragraphs (f)(2)(ii) and (iii) were revised to clarify that scientific uncertainty in the OFL and any other scientific uncertainty should be accounted for when specifying ABC and the ABC control rule. Paragraph (f)(3) was revised to improve clarity; to acknowledge that the SSC may recommend an ABC that differs from the result of the ABC control rule calculation; and to state that while the ABC is allowed to equal OFL, NMFS expects that in most cases ABC will be reduced from OFL to reduce the probability that overfishing might occur in a year. Paragraph (f)(4) on the ABC control rule was revised to include the following sentences: ''The determination of ABC should be based, when possible, on the probability that an actual catch equal to the stock's ABC would result in overfishing. This probability that overfishing will occur cannot exceed 50 percent and should be a lower value. The ABC control rule should consider reducing fishing mortality as stock size declines and may establish a stock abundance level below which fishing would not be allowed.'' Paragraph (f)(5)(i) was revised to include the following sentences: ''ACLs in coordination with AMs must prevent overfishing (see MSA section 303(a)(15)). If a Council recommends an ACL which equals ABC, and the ABC is equal to OFL, the Secretary may presume that the proposal would not prevent overfishing, in the absence of sufficient analysis and justification for the approach.'' Also, paragraph (f)(5)(i) was revised to clarify that ''a multiyear plan must provide that, if an ACL is exceeded for a year, then AMs are triggered for the next year consistent with paragraph (g)(3) of this section.'' Paragraph (f)(5)(ii) now clarifies that ''if the management measures for different sectors differ in degree of management uncertainty, then sector-ACLs may be necessary so appropriate AMs can be developed for each sector.'' Paragraphs (f)(5)(iii) and (g)(5) were revised to remove the phrase ''large majority'' from both provisions. The description of the relationship between OFL to MSY and ACT to OY was removed from paragraph (f)(7) and is replaced with the following sentence: ''A Council may choose to use a single control rule that combines both scientific and management uncertainty and supports the ABC recommendation and establishment of ACL and if used ACT.''

Paragraph (g)(2) on inseason AMs was revised to include the following sentences: ''FMPs should contain inseason closure authority giving NMFS the ability to close fisheries if it determines, based on data that it deems sufficiently reliable, that an ACL has been exceeded or is projected to be reached, and that closure of the fishery is necessary to prevent overfishing. For fisheries without inseason management control to prevent the ACL from being exceeded, AMs should utilize ACTs that are set below ACLs so that catches do not exceed the ACL.'' Paragraph (g)(3) was revised to improve clarity and to include the following sentence: ''A Council could choose a higher performance standard (e.g., a stock's catch should not exceed its ACL more often than once every five or six years) for a stock that is particularly vulnerable to the effects of overfishing, if the vulnerability of the stock has not already been accounted for in the ABC control rule.'' Paragraph (g)(4) on AMs based on multi-year average data was revised to clarify: That Councils should explain why basing AMs on a multi-year period is appropriate; that AMs should be implemented if the average catch exceeds the average ACL; the performance standard; and that Councils can use a stepped approach when initially implementing AMs based on multi-year average data.

Paragraph (h) was revised to include the sentence: ''These mechanisms should describe the annual or multiyear process by which specific ACLs, AMs, and other reference points such as OFL, and ABC will be established.'' Paragraph (h)(1)(v) was removed because the requirement to describe fisheries data is covered under paragraph (i). Paragraph (i) is revised to clarify that Councils must describe ''in their FMPs, or associated public documents such as SAFE reports as appropriate,'' general data collection methods.

Paragraph (j)(2)(ii)(C) was removed and paragraph (j)(2)(ii)(B) was revised to include information about stocks or stock complexes that are approaching an overfished condition. Paragraph (j)(3)(i)(E) was revised to remove the ''priority'' text. That text is unnecessary given that section (j)(3)(i) explains ''as short as possible'' and other rebuilding time period requirements from MSA section 304(e)(4). Paragraph (j)(3)(ii) was revised to clarify that ''if the stock or stock complex has not rebuilt by T_{max}, then the fishing mortality rate should be maintained at $F_{rebuild}$ or 75 percent of the MFMT, whichever is less.''

Introductory language (General) has been added to paragraph (l) to clarify the relationship of other national standards to National Standard 1. Also, paragraph (l)(4) has been revised to ensure that the description about the relationship between National Standard 8 with National Standard 1 reflects more accurately, section 301(a)(8) of the Magnuson-Stevens Act.

The words ''should'' or ''recommended'' in the proposed rule are changed to ''must'' or ''are required'' or ''need to'' in this action's codified text if NMFS interprets the guidance to refer to ''requirements of the Magnuson-Stevens Act'' and ''the logical extension thereof'' (see section 600.305(c) of the MSA). In the following, items in paragraphs of § 600.310 are followed by an applicable MSA section that contains pertinent requirements:

Paragraph (b)(3) is revised to state that Councils ''must take an approach that considers uncertainty in scientific information and management control of the fishery'' because it needs to meet requirements in MSA section 303(a)(15).

Paragraph (c) is revised to state ''* * * Councils must include in their FMPs * * *'' because it needs to meet various requirements in MSA section 303(a).

Paragraph (c) is revised to state ''Councils must also describe fisheries data * * *'' because it needs to meet requirements of various portions of MSA sections 303(a) and 303(a)(15).

Paragraph (c) is revised to state ''* * * Councils must evaluate and describe the following items in their FMPs * * *'' because it needs to meet requirements of various portions of MSA sections 303(a) and 303(a)(15).

Paragraph (e)(1) is revised to state that ''Each FMP must include an estimate of MSY * * *'' because it needs to meet requirements of MSA section 303(a)(3).

Paragraph (e)(2)(ii) is revised to state that a Council ''must provide an analysis of how the SDC were chosen * * *'' because it needs to meet requirements of MSA section 303(a)(10).

Paragraph (e)(2)(ii)(A) is revised to state ''each FMP must describe which of the following two methods * * *'' because it needs to meet requirements of MSA section 303(a)(10).

Paragraph (e)(2)(ii)(B) is revised to state ''the MSST or reasonable proxy must be expressed in terms of spawning biomass * * *'' because it needs to meet requirements of MSA section 303(a)(10).

Paragraph (f)(4) is revised to state each Council ''must establish an ABC control rule * * *'' because it needs to meet requirements of MSA sections 303(a)(15) and 302(g)(1)(B).

Paragraph (f)(4) is revised to state ''The ABC control rule must articulate how ABC will be set compared to the OFL * * *'' because it needs to meet requirements of MSA sections 303(a)(15) and 301(a)(2).

Paragraph (f)(5)(i) is revised to state ''A multiyear plan must include a mechanism for specifying ACLs for each year * * *'' because it needs to meet requirements of MSA section 303(a)(15).

Paragraph (f)(5)(i) is also revised to state ''A multiyear plan must provide that, if an ACL is exceeded * * *'' because it needs to meet requirements of MSA section 303(a)(15).

Paragraph (f)(6)(i) is revised to state ''Such analyses must be based on best available scientific * * *'' because it needs to meet requirements of MSA section 301(a)(2).

Paragraph (g)(3) is revised to state a Council ''must determine as soon as possible after the fishing year if an ACL is exceeded * * *'' because it needs to meet requirements of MSA sections 303(a)(15), 301(a)(1) and 301(a)(2).

Paragraph (h) is revised to state FMPs or FMP amendments ''must establish ACL mechanisms and AMs * * *'' because it needs to meet requirements of MSA section 303(a)(15).

Paragraph (h)(3) is revised to state ''Councils must document their rationale for any alternative approaches * * *'' because it needs to meet requirements of MSA section 303(a)(15).

Paragraph (j)(2) is revised to state ''FMPs or FMP amendments must establish ACL and AM mechanisms in 2010 * * *'' because it needs to meet requirements of MSA section 303(a)(15).

Paragraph (j)(2)(i)(A) is revised to state that '' * * * ACLs and AMs themselves must be specified * * *'' because it needs to meet requirements of MSA section 303(a)(15).

Paragraph (k) is revised to state that ''The Secretary, in cooperation with the Secretary of State, must immediately take appropriate action at the international level * * *'' because it needs to meet requirements of MSA section 304(i)—INTERNATIONAL OVERFISHING.

Paragraph (k)(3) is revised to state that ''Information used to determine relative impact must be based upon the best available scientific * * *'' because it needs to meet requirements of MSA section 301(a)(2).

Paragraph (l)(2) is revised to state that ''Also scientific assessments must be based on the best information * * *'' because it needs to meet requirements of MSA section 301(a)(2).

VII. References Cited

A complete list of all the references cited in this final action is available online at: *http://www.nmfs.noaa.gov/msa2007/catchlimits.htm* or upon request from Mark Millikin [*see* **FOR FURTHER INFORMATION CONTACT**].

VIII. Classification

Pursuant to the Magnuson-Stevens Act, the NMFS Assistant Administrator has determined that these final NS1 guidelines are consistent with the Magnuson-Stevens Act, and other applicable law.

The final NS1 guidelines have been determined to be significant for purposes of Executive Order 12866. NOAA prepared a regulatory impact review of this rulemaking, which is available at: *http://www.nmfs.noaa.gov/msa2007/catchlimits.htm.* This analysis discusses various policy options that NOAA considered in preparation of the proposed action, given NOAA's interpretation of the statutory terms in the MSRA, such as the appropriate meaning of the word ''limit'' in ''Annual Catch Limit,'' and NOAA's belief that it has become necessary for Councils to consider separately the uncertainties in fishery management and the scientific uncertainties in stock evaluation in order to effectively set fishery management policies and ensure fulfillment of the goals to end overfishing and rebuild overfished stocks.

The Chief Counsel for Regulation of the Department of Commerce certified to the Chief Counsel for Advocacy of the Small Business Administration during the proposed rule stage that these revisions to the NS1 guidelines, if adopted, would not have any significant economic impact on a substantial number of small entities. The factual basis for the certification was published in the proposed action and is not repeated here. Two commenters stated that an initial regulatory flexibility analysis should be prepared, and NMFS has responded to those comments in the ''Response to Comments.'' After considering the comments, NMFS has determined that a certification is still appropriate for this action. Therefore, a regulatory flexibility analysis is not required for this action and none was prepared.

List of Subjects in 50 CFR Part 600

Fisheries, Fishing, Reporting and recordkeeping requirements.

Dated: January 9, 2009.

James W. Balsiger,

Acting Assistant Administrator, for Fisheries, National Marine Fisheries Service.

PART 600—MAGNUSON-STEVENS ACT PROVISIONS

■ 1. The authority citation for part 600 continues to read as follows:

Authority: 16 U.S.C. 1801 *et seq.*

■ 2. Section 600.310 is revised to read as follows:

§ 600.310 National Standard 1—Optimum Yield.

(a) *Standard 1.* Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield (OY) from each fishery for the U.S. fishing industry.

(b) *General.* (1) The guidelines set forth in this section describe fishery management approaches to meet the objectives of National Standard 1 (NS1), and include guidance on:

(i) Specifying maximum sustainable yield (MSY) and OY;

(ii) Specifying status determination criteria (SDC) so that overfishing and overfished determinations can be made for stocks and stock complexes that are part of a fishery;

(iii) Preventing overfishing and achieving OY, incorporation of scientific and management uncertainty in control rules, and adaptive management using annual catch limits (ACL) and measures to ensure accountability (AM); and

(iv) Rebuilding stocks and stock complexes.

(2) *Overview of Magnuson-Stevens Act concepts and provisions related to NS1*—(i) *MSY.* The Magnuson-Stevens Act establishes MSY as the basis for fishery management and requires that: The fishing mortality rate does not jeopardize the capacity of a stock or stock complex to produce MSY; the abundance of an overfished stock or stock complex be rebuilt to a level that is capable of producing MSY; and OY not exceed MSY.

(ii) *OY.* The determination of OY is a decisional mechanism for resolving the Magnuson-Stevens Act's conservation and management objectives, achieving a fishery management plan's (FMP) objectives, and balancing the various interests that comprise the greatest overall benefits to the Nation. OY is based on MSY as reduced under paragraphs (e)(3)(iii) and (iv) of this section. The most important limitation on the specification of OY is that the choice of OY and the conservation and management measures proposed to achieve it must prevent overfishing.

(iii) *ACLs and AMs.* Any FMP which is prepared by any Council shall establish a mechanism for specifying ACLs in the FMP (including a multiyear plan), implementing regulations, or annual specifications, at a level such that overfishing does not occur in the fishery, including measures to ensure accountability (Magnuson-Stevens Act section 303(a)(15)). Subject to certain exceptions and circumstances described in paragraph (h) of this section, this requirement takes effect in fishing year 2010, for fisheries determined subject to overfishing, and in fishing year 2011, for all other fisheries (Magnuson-Stevens Act section 303 note). ''Council'' includes the Regional Fishery Management Councils and the Secretary of Commerce, as appropriate (*see* § 600.305(c)(11)).

(iv) *Reference points.* SDC, MSY, acceptable biological catch (ABC), and ACL, which are described further in paragraphs (e) and (f) of this section, are collectively referred to as ''reference points.''

(v) *Scientific advice.* The Magnuson-Stevens Act has requirements regarding scientific and statistical committees (SSC) of the Regional Fishery Management Councils, including but not limited to, the following provisions:

(A) Each Regional Fishery Management Council shall establish an SSC as described in section 302(g)(1)(A) of the Magnuson-Stevens Act.

(B) Each SSC shall provide its Regional Fishery Management Council recommendations for ABC as well as other scientific advice, as described in Magnuson-Stevens Act section 302(g)(1)(B).

(C) The Secretary and each Regional Fishery Management Council may establish a peer review process for that Council for scientific information used to advise the Council about the conservation and management of a fishery (see Magnuson-Stevens Act section 302(g)(1)(E)). If a peer review process is established, it should investigate the technical merits of stock assessments and other scientific information used by the SSC or agency or international scientists, as appropriate. For Regional Fishery Management Councils, the peer review process is not a substitute for the SSC and should work in conjunction with the SSC. For the Secretary, which does not have an SSC, the peer review process should provide the scientific information necessary.

(D) Each Council shall develop ACLs for each of its managed fisheries that may not exceed the ''fishing level recommendations'' of its SSC or peer review process (Magnuson-Stevens Act section 302(h)(6)). The SSC recommendation that is the most relevant to ACLs is ABC, as both ACL and ABC are levels of annual catch.

(3) *Approach for setting limits and accountability measures, including targets, for consistency with NS1.* In general, when specifying limits and accountability measures intended to avoid overfishing and achieve sustainable fisheries, Councils must take an approach that considers uncertainty in scientific information and management control of the fishery. These guidelines describe how to address uncertainty such that there is a low risk that limits are exceeded as described in paragraphs (f)(4) and (f)(6) of this section.

(c) *Summary of items to include in FMPs related to NS1.* This section provides a summary of items that Councils must include in their FMPs and FMP amendments in order to address ACL, AM, and other aspects of the NS1 guidelines. As described in further detail in paragraph (d) of this section, Councils may review their FMPs to decide if all stocks are ''in the fishery'' or whether some fit the category of ''ecosystem component species.'' Councils must also describe fisheries data for the stocks, stock complexes, and ecosystem component species in their FMPs, or associated public documents such as Stock Assessment and Fishery Evaluation (SAFE) Reports. For all stocks and stock complexes that are ''in the fishery'' (see paragraph (d)(2) of this section), the Councils must evaluate and describe the following items in their FMPs and amend the FMPs, if necessary, to align their management objectives to end or prevent overfishing:

(1) MSY and SDC (see paragraphs (e)(1) and (2) of this section).

(2) OY at the stock, stock complex, or fishery level and provide the OY specification analysis (see paragraph (e)(3) of this section).

(3) ABC control rule (see paragraph (f)(4) of this section).

(4) Mechanisms for specifying ACLs and possible sector-specific ACLs in relationship to the ABC (see paragraphs (f)(5) and (h) of this section).

(5) AMs (see paragraphs (g) and (h)(1) of this section).

(6) Stocks and stock complexes that have statutory exceptions from ACLs (see paragraph (h)(2) of this section) or which fall under limited circumstances which require different approaches to meet the ACL requirements (see paragraph (h)(3) of this section).

(d) *Classifying stocks in an FMP*—(1) *Introduction.* Magnuson-Stevens Act section 303(a)(2) requires that an FMP contain, among other things, a description of the species of fish involved in the fishery. The relevant Council determines which specific target stocks and/or non-target stocks to include in a fishery. This section provides that a Council may, but is not required to, use an ''ecosystem component (EC)'' species classification. As a default, all stocks in an FMP are considered to be ''in the fishery,'' unless they are identified as EC species (see § 600.310(d)(5)) through an FMP amendment process.

(2) *Stocks in a fishery.* Stocks in a fishery may be grouped into stock complexes, as appropriate. Requirements for reference points and management measures for these stocks are described throughout these guidelines.

(3) ''Target stocks'' are stocks that fishers seek to catch for sale or personal use, including ''economic discards'' as defined under Magnuson-Stevens Act section 3(9).

(4) ''Non-target species'' and ''non-target stocks'' are fish caught incidentally during the pursuit of target stocks in a fishery, including ''regulatory discards'' as defined under Magnuson-Stevens Act section 3(38). They may or may not be retained for sale or personal use. Non-target species may be included in a fishery and, if so, they should be identified at the stock level. Some non-target species may be identified in an FMP as ecosystem component (EC) species or stocks.

(5) *Ecosystem component (EC) species.* (i) To be considered for possible classification as an EC species, the species should:

(A) Be a non-target species or non-target stock;

(B) Not be determined to be subject to overfishing, approaching overfished, or overfished;

(C) Not be likely to become subject to overfishing or overfished, according to the best available information, in the absence of conservation and management measures; and

(D) Not generally be retained for sale or personal use.

(ii) Occasional retention of the species would not, in and of itself, preclude consideration of the species under the EC classification. In addition to the general factors noted in paragraphs (d)(5)(i)(A)–(D) of this section, it is important to consider whether use of the EC species classification in a given instance is consistent with MSA conservation and management requirements.

(iii) EC species may be identified at the species or stock level, and may be grouped into complexes. EC species may, but are not required to, be included in an FMP or FMP amendment for any of the following reasons: For data collection purposes; for ecosystem considerations related to specification of OY for the associated fishery; as considerations in the development of conservation and management measures for the associated fishery; and/or to address other ecosystem issues. While EC species are not considered to be ''in the fishery,'' a Council should consider measures for the fishery to minimize bycatch and bycatch mortality of EC species consistent with National Standard 9, and to protect their associated role in the ecosystem. EC species do not require specification of reference points but should be monitored to the extent that any new pertinent scientific information becomes available (e.g., catch trends, vulnerability, etc.) to determine changes in their status or their vulnerability to the fishery. If necessary, they should be reclassified as ''in the fishery.''

(6) *Reclassification.* A Council should monitor the catch resulting from a fishery on a regular basis to determine if the stocks and species are appropriately classified in the FMP. If the criteria previously used to classify a stock or species is no longer valid, the Council should reclassify it through an FMP amendment, which documents rationale for the decision.

(7) *Stocks or species identified in more than one FMP.* If a stock is identified in more than one fishery, Councils should choose which FMP will be the primary FMP in which management objectives, SDC, the stock's overall ACL and other reference points for the stock are established. Conservation and management measures in other FMPs in which the stock is identified as part of a fishery should be consistent with the primary FMP's management objectives for the stock.

(8) *Stock complex.* ''Stock complex'' means a group of stocks that are sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that the impact of management actions on the stocks is similar. At the time a stock complex is established, the FMP should provide a full and explicit description of the proportional composition of each stock in the stock complex, to the extent possible. Stocks may be grouped into complexes for various reasons, including where stocks in a multispecies fishery cannot be targeted independent of one another and MSY can not be defined on a stock-by-stock basis (*see* paragraph (e)(1)(iii) of this section); where there is insufficient data to measure their status relative to SDC; or when it is not feasible for fishermen to distinguish individual stocks among their catch. The vulnerability of stocks to the fishery should be evaluated when determining if a particular stock complex should be established or reorganized, or if a particular stock should be included in a complex. Stock complexes may be comprised of: one or more indicator stocks, each of which has SDC and ACLs, and several other stocks; several stocks without an indicator stock, with SDC and an ACL for the complex as a whole; or one of more indicator stocks, each of which has SDC and management objectives, with an ACL for the complex as a whole (this situation might be applicable to some salmon species).

(9) *Indicator stocks.* An indicator stock is a stock with measurable SDC that can be used to help manage and evaluate more poorly known stocks that are in a stock complex. If an indicator stock is used to evaluate the status of a complex, it should be representative of the typical status of each stock within the complex, due to similarity in vulnerability. If the stocks within a stock complex have a wide range of vulnerability, they should be reorganized into different stock complexes that have similar vulnerabilities; otherwise the indicator stock should be chosen to represent the more vulnerable stocks within the complex. In instances where an indicator stock is less vulnerable than other members of the complex, management measures need to be more conservative so that the more vulnerable members of the complex are not at risk from the fishery. More than one indicator stock can be selected to provide more information about the status of the complex. When indicator stock(s) are used, periodic re-evaluation of available quantitative or qualitative information (e.g., catch trends, changes in vulnerability, fish health indices, etc.) is needed to determine whether a stock is subject to overfishing, or is approaching (or in) an overfished condition.

(10) *Vulnerability.* A stock's vulnerability is a combination of its productivity, which depends upon its life history characteristics, and its susceptibility to the fishery. Productivity refers to the capacity of the stock to produce MSY and to recover if the population is depleted, and susceptibility is the potential for the stock to be impacted by the fishery, which includes direct captures, as well as indirect impacts to the fishery (e.g., loss of habitat quality). Councils in consultation with their SSC, should analyze the vulnerability of stocks in stock complexes where possible.

(e) *Features of MSY, SDC, and OY.*—(1) *MSY.* Each FMP must include an estimate of MSY for the stocks and stock complexes in the fishery, as described in paragraph (d)(2) of this section).

(i) *Definitions.* (A) *MSY* is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological, environmental conditions and fishery technological characteristics (e.g., gear selectivity), and the distribution of catch among fleets.

(B) *MSY fishing mortality rate (F_{msy})* is the fishing mortality rate that, if applied over the long term, would result in MSY.

(C) *MSY stock size (B_{msy})* means the long-term average size of the stock or stock complex, measured in terms of spawning biomass or other appropriate measure of the stock's reproductive potential that would be achieved by fishing at F_{msy}.

(ii) *MSY for stocks.* MSY should be estimated for each stock based on the best scientific information available (see § 600.315).

(iii) *MSY for stock complexes.* MSY should be estimated on a stock-by-stock basis whenever possible. However, where MSY cannot be estimated for each stock in a stock complex, then MSY may be estimated for one or more indicator stocks for the complex or for the complex as a whole. When indicator stocks are used, the stock complex's MSY could be listed as ''unknown,'' while noting that the complex is managed on the basis of one or more indicator stocks that do have known stock-specific MSYs, or suitable proxies, as described in paragraph (e)(1)(iv) of this section. When indicator stocks are not used, MSY, or a suitable proxy, should be calculated for the stock complex as a whole.

(iv) *Specifying MSY.* Because MSY is a long-term average, it need not be estimated annually, but it must be based on the best scientific information available (*see* § 600.315), and should be re-estimated as required by changes in long-term environmental or ecological conditions, fishery technological characteristics, or new scientific information. When data are insufficient to estimate MSY directly, Councils should adopt other measures of reproductive potential, based on the best scientific information available, that can serve as reasonable proxies for MSY, F_{msy}, and B_{msy}, to the extent possible. The MSY for a stock is influenced by its interactions with other stocks in its ecosystem and these interactions may shift as multiple stocks in an ecosystem are fished. These ecological conditions should be taken into account, to the extent possible, when specifying MSY. Ecological conditions not directly accounted for in the specification of MSY can be among the ecological factors considered when setting OY below MSY. As MSY values are estimates or are based on proxies, they will have some level of uncertainty associated with them. The degree of uncertainty in the estimates should be identified, when possible, through the stock assessment process and peer review (*see* § 600.335), and should be taken into account when specifying the ABC Control rule. Where this uncertainty cannot be directly calculated, such as when proxies are used, then a proxy for the uncertainty itself should be established based on the best scientific information, including comparison to other stocks.

(2) *Status determination criteria*—(i) *Definitions.* (A) *Status determination criteria (SDC)* mean the quantifiable factors, MFMT, OFL, and MSST, or their proxies, that are used to determine if overfishing has occurred, or if the stock or stock complex is overfished. Magnuson-Stevens Act (section 3(34)) defines both ''overfishing'' and ''overfished'' to mean a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the MSY on a continuing basis. To avoid confusion, this section clarifies that ''overfished'' relates to biomass of a stock or stock complex, and ''overfishing'' pertains to a rate or level of removal of fish from a stock or stock complex.

(B) *Overfishing* (to overfish) occurs whenever a stock or stock complex is subjected to a level of fishing mortality or annual total catch that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis.

(C) *Maximum fishing mortality threshold (MFMT)* means the level of fishing mortality (F), on an annual basis, above which overfishing is occurring. The MFMT or reasonable proxy may be expressed either as a single number (a fishing mortality rate or F value), or as a function of spawning biomass or other measure of reproductive potential.

(D) *Overfishing limit (OFL)* means the annual amount of catch that corresponds to the estimate of MFMT applied to a stock or stock complex's abundance and is expressed in terms of numbers or weight of fish. The OFL is an estimate of the catch level above which overfishing is occurring.

(E) *Overfished.* A stock or stock complex is considered ''overfished'' when its biomass has declined below a level that jeopardizes the capacity of the stock or stock complex to produce MSY on a continuing basis.

(F) *Minimum stock size threshold (MSST)* means the level of biomass below which the stock or stock complex is considered to be overfished.

(G) *Approaching an overfished condition.* A stock or stock complex is approaching an overfished condition when it is projected that there is more than a 50 percent chance that the biomass of the stock or stock complex will decline below the MSST within two years.

(ii) *Specification of SDC and overfishing and overfished determinations.* SDC must be expressed in a way that enables the Council to monitor each stock or stock complex in the FMP, and determine annually, if possible, whether overfishing is occurring and whether the stock or stock complex is overfished. In specifying SDC, a Council must provide an analysis of how the SDC were chosen and how they relate to reproductive potential. Each FMP must specify, to the extent possible, objective and measurable SDC as follows (*see* paragraphs (e)(2)(ii)(A) and (B) of this section):

(A) *SDC to determine overfishing status.* Each FMP must describe which of the following two methods will be used for each stock or stock complex to determine an overfishing status.

(*1*) *Fishing mortality rate exceeds MFMT.* Exceeding the MFMT for a period of 1 year or more constitutes overfishing. The MFMT or reasonable proxy may be expressed either as a single number (a fishing mortality rate or F value), or as a function of spawning biomass or other measure of reproductive potential.

(*2*) *Catch exceeds the OFL.* Should the annual catch exceed the annual OFL for 1 year or more, the stock or stock complex is considered subject to overfishing.

(B) *SDC to determine overfished status.* The MSST or reasonable proxy must be expressed in terms of spawning biomass or other measure of reproductive potential. To the extent possible, the MSST should equal whichever of the following is greater: One-half the MSY stock size, or the minimum stock size at which rebuilding to the MSY level would be expected to occur within 10 years, if the stock or stock complex were exploited at the MFMT specified under paragraph (e)(2)(ii)(A)(*1*) of this section. Should the estimated size of the stock or stock complex in a given year fall below this threshold, the stock or stock complex is considered overfished.

(iii) *Relationship of SDC to environmental change.* Some short-term environmental changes can alter the size of a stock or stock complex without affecting its long-term reproductive potential. Long-term environmental changes affect both the short-term size of the stock or stock complex and the long-term reproductive potential of the stock or stock complex.

(A) If environmental changes cause a stock or stock complex to fall below its MSST without affecting its long-term reproductive potential, fishing mortality must be constrained sufficiently to allow rebuilding within an acceptable time frame (*also see* paragraph (j)(3)(ii) of this section). SDC should not be respecified.

(B) If environmental changes affect the long-term reproductive potential of the stock or stock complex, one or more components of the SDC must be respecified. Once SDC have been respecified, fishing mortality may or may not have to be reduced, depending on the status of the stock or stock complex with respect to the new criteria.

(C) If manmade environmental changes are partially responsible for a stock or stock complex being in an overfished condition, in addition to controlling fishing mortality, Councils should recommend restoration of habitat and other ameliorative programs, to the extent possible (see also the guidelines issued pursuant to section 305(b) of the Magnuson-Stevens Act for Council actions concerning essential fish habitat).

(iv) *Secretarial approval of SDC.* Secretarial approval or disapproval of proposed SDC will be based on consideration of whether the proposal:

(A) Has sufficient scientific merit;

(B) Contains the elements described in paragraph (e)(2)(ii) of this section;

(C) Provides a basis for objective measurement of the status of the stock or stock complex against the criteria; and

(D) is operationally feasible.

(3) *Optimum yield*—(i) *Definitions*—(A) *Optimum yield (OY).* Magnuson-Stevens Act section (3)(33) defines ''optimum,'' with respect to the yield from a fishery, as the amount of fish that will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities and taking into account the protection of marine ecosystems; that is prescribed on the basis of the MSY from the fishery, as reduced by any relevant economic, social, or ecological factor; and, in the case of an overfished fishery, that provides for rebuilding to a level consistent with producing the MSY in such fishery. OY may be established at the stock or stock complex level, or at the fishery level.

(B) In NS1, use of the phrase ''achieving, on a continuing basis, the optimum yield from each fishery'' means producing, from each stock, stock complex, or fishery: a long-term series of catches such that the average catch is equal to the OY, overfishing is prevented, the long term average biomass is near or above B_{msy}, and overfished stocks and stock complexes are rebuilt consistent with timing and other requirements of section 304(e)(4) of the Magnuson-Stevens Act and paragraph (j) of this section.

(ii) *General.* OY is a long-term average amount of desired yield from a stock, stock complex, or fishery. An FMP must contain conservation and management measures, including ACLs and AMs, to achieve OY on a continuing basis, and provisions for information collection that are designed to determine the degree to which OY is achieved. These measures should allow for practical and effective implementation and enforcement of the management regime. The Secretary has an obligation to implement and enforce the FMP. If management measures prove unenforceable—or too restrictive, or not rigorous enough to prevent overfishing while achieving OY—they should be modified; an alternative is to reexamine the adequacy of the OY specification. Exceeding OY does not necessarily constitute overfishing. However, even if no overfishing resulted from exceeding OY, continual harvest at a level above OY would violate NS1, because OY was not achieved on a continuing basis. An FMP must contain an assessment and specification of OY, including a summary of information utilized in making such specification, consistent with requirements of section 303(a)(3) of the Magnuson-Stevens Act. A Council must identify those economic, social, and ecological factors relevant to management of a particular stock, stock complex, or fishery, and then evaluate them to determine the OY. The choice of a particular OY must be carefully documented to show that the OY selected will produce the greatest benefit to the Nation and prevent overfishing.

(iii) *Determining the greatest benefit to the Nation.* In determining the greatest benefit to the Nation, the values that should be weighed and receive serious attention when considering the economic, social, or ecological factors used in reducing MSY to obtain OY are:

(A) The benefits of food production are derived from providing seafood to consumers; maintaining an economically viable fishery together with its attendant contributions to the national, regional, and local economies; and utilizing the capacity of the Nation's fishery resources to meet nutritional needs.

(B) The benefits of recreational opportunities reflect the quality of both the recreational fishing experience and non-consumptive fishery uses such as ecotourism, fish watching, and recreational diving. Benefits also include the contribution of recreational fishing to the national, regional, and local economies and food supplies.

(C) The benefits of protection afforded to marine ecosystems are those resulting from maintaining viable populations (including those of unexploited species), maintaining adequate forage for all components of the ecosystem, maintaining evolutionary and ecological processes (e.g., disturbance regimes, hydrological processes, nutrient cycles), maintaining the evolutionary potential of species and ecosystems, and accommodating human use.

(iv) *Factors to consider in OY specification.* Because fisheries have limited capacities, any attempt to maximize the measures of benefits described in paragraph (e)(3)(iii) of this section will inevitably encounter practical constraints. OY cannot exceed MSY in any circumstance, and must take into account the need to prevent overfishing and rebuild overfished stocks and stock complexes. OY is prescribed on the basis of MSY as reduced by social, economic, and ecological factors. To the extent possible, the relevant social, economic, and ecological factors used to establish OY for a stock, stock complex, or fishery should be quantified and reviewed in historical, short-term, and long-term contexts. Even where quantification of social, economic, and ecological factors is not possible, the FMP still must address them in its OY specification. The following is a non-exhaustive list of potential considerations for each factor. An FMP must address each factor but not necessarily each example.

(A) *Social factors.* Examples are enjoyment gained from recreational fishing, avoidance of gear conflicts and resulting disputes, preservation of a way of life for fishermen and their families, and dependence of local communities on a fishery (e.g., involvement in fisheries and ability to adapt to change). Consideration may be given to fishery-related indicators (e.g., number of fishery permits, number of commercial fishing vessels, number of party and charter trips, landings, ex-vessel revenues etc.) and non-fishery related indicators (e.g., unemployment rates, percent of population below the poverty level, population density, etc.). Other factors that may be considered include the effects that past harvest levels have had on fishing communities, the cultural place of subsistence fishing, obligations under Indian treaties, proportions of affected minority and low-income groups, and worldwide nutritional needs.

(B) *Economic factors.* Examples are prudent consideration of the risk of overharvesting when a stock's size or reproductive potential is uncertain (*see* § 600.335(c)(2)(i)), satisfaction of consumer and recreational needs, and encouragement of domestic and export markets for U.S. harvested fish. Other factors that may be considered include: The value of fisheries, the level of capitalization, the decrease in cost per unit of catch afforded by an increase in stock size, the attendant increase in catch per unit of effort, alternate employment opportunities, and economic contribution to fishing communities, coastal areas, affected states, and the nation.

(C) *Ecological factors.* Examples include impacts on ecosystem component species, forage fish stocks, other fisheries, predator-prey or competitive interactions, marine mammals, threatened or endangered species, and birds. Species interactions that have not been explicitly taken into account when calculating MSY should be considered as relevant factors for setting OY below MSY. In addition, consideration should be given to managing forage stocks for higher biomass than B_{msy} to enhance and protect the marine ecosystem. Also important are ecological or environmental conditions that stress marine organisms, such as natural and manmade changes in wetlands or nursery grounds, and effects of pollutants on habitat and stocks.

(v) *Specification of OY.* The specification of OY must be consistent with paragraphs (e)(3)(i)–(iv) of this section. If the estimates of MFMT and current biomass are known with a high level of certainty and management controls can accurately limit catch then OY could be set very close to MSY, assuming no other reductions are necessary for social, economic, or ecological factors. To the degree that such MSY estimates and management controls are lacking or unavailable, OY should be set farther from MSY. If management measures cannot adequately control fishing mortality so that the specified OY can be achieved without overfishing, the Council should reevaluate the management measures and specification of OY so that the dual requirements of NS1 (preventing overfishing while achieving, on a continuing basis, OY) are met.

(A) The amount of fish that constitutes the OY should be expressed in terms of numbers or weight of fish.

(B) Either a range or a single value may be specified for OY.

(C) All catch must be counted against OY, including that resulting from bycatch, scientific research, and all fishing activities.

(D) The OY specification should be translatable into an annual numerical estimate for the purposes of establishing any total allowable level of foreign fishing (TALFF) and analyzing impacts of the management regime.

(E) The determination of OY is based on MSY, directly or through proxy. However, even where sufficient scientific data as to the biological characteristics of the stock do not exist, or where the period of exploitation or investigation has not been long enough for adequate understanding of stock dynamics, or where frequent large-scale fluctuations in stock size diminish the meaningfulness of the MSY concept, OY must still be established based on the best scientific information available.

(F) An OY established at a fishery level may not exceed the sum of the MSY values for each of the stocks or stock complexes within the fishery.

(G) There should be a mechanism in the FMP for periodic reassessment of the OY specification, so that it is responsive to changing circumstances in the fishery.

(H) Part of the OY may be held as a reserve to allow for factors such as uncertainties in estimates of stock size and domestic annual harvest (DAH). If an OY reserve is established, an adequate mechanism should be included in the FMP to permit timely release of the reserve to domestic or foreign fishermen, if necessary.

(vi) *OY and foreign fishing.* Section 201(d) of the Magnuson-Stevens Act provides that fishing by foreign nations is limited to that portion of the OY that will not be harvested by vessels of the United States. The FMP must include an assessment to address the following, as required by section 303(a)(4) of the Magnuson-Stevens Act:

(A) *DAH.* Councils and/or the Secretary must consider the capacity of, and the extent to which, U.S. vessels will harvest the OY on an annual basis. Estimating the amount that U.S. fishing vessels will actually harvest is required to determine the surplus.

(B) *Domestic annual processing (DAP).* Each FMP must assess the capacity of U.S. processors. It must also assess the amount of DAP, which is the sum of two estimates: The estimated amount of U.S. harvest that domestic processors will process, which may be based on historical performance or on surveys of the expressed intention of manufacturers to process, supported by evidence of contracts, plant expansion, or other relevant information; and the estimated amount of fish that will be harvested by domestic vessels, but not processed (*e.g.*, marketed as fresh whole fish, used for private consumption, or used for bait).

(C) *Joint venture processing (JVP).* When DAH exceeds DAP, the surplus is available for JVP.

(f) *Acceptable biological catch, annual catch limits, and annual catch targets.* The following features (see paragraphs (f)(1) through (f)(5) of this section) of acceptable biological catch and annual catch limits apply to stocks and stock complexes in the fishery (see paragraph (d)(2) of this section).

(1) *Introduction.* A control rule is a policy for establishing a limit or target fishing level that is based on the best available scientific information and is established by fishery managers in consultation with fisheries scientists. Control rules should be designed so that management actions become more conservative as biomass estimates, or other proxies, for a stock or stock complex decline and as science and management uncertainty increases. Examples of scientific uncertainty include uncertainty in the estimates of MFMT and biomass. Management uncertainty may include late catch reporting, misreporting, and underreporting of catches and is affected by a fishery's ability to control actual catch. For example, a fishery that has inseason catch data available and inseason closure authority has better management control and precision than a fishery that does not have these features.

(2) *Definitions.* (i) *Catch* is the total quantity of fish, measured in weight or numbers of fish, taken in commercial, recreational, subsistence, tribal, and other fisheries. Catch includes fish that are retained for any purpose, as well as mortality of fish that are discarded.

(ii) *Acceptable biological catch (ABC)* is a level of a stock or stock complex's annual catch that accounts for the scientific uncertainty in the estimate of OFL and any other scientific uncertainty (see paragraph (f)(3) of this section), and should be specified based on the ABC control rule.

(iii) *ABC control rule* means a specified approach to setting the ABC for a stock or stock complex as a function of the scientific uncertainty in the estimate of OFL and any other scientific uncertainty (*see* paragraph (f)(4) of this section).

(iv) *Annual catch limit (ACL)* is the level of annual catch of a stock or stock complex that serves as the basis for invoking AMs. ACL cannot exceed the ABC, but may be divided into sector-ACLs (*see* paragraph (f)(5) of this section).

(v) *Annual catch target (ACT)* is an amount of annual catch of a stock or stock complex that is the management target of the fishery, and accounts for management uncertainty in controlling the actual catch at or below the ACL. ACTs are recommended in the system of accountability measures so that ACL is not exceeded.

(vi) *ACT control rule* means a specified approach to setting the ACT for a stock or stock complex such that the risk of exceeding the ACL due to management uncertainty is at an acceptably low level.

(3) *Specification of ABC.* ABC may not exceed OFL (see paragraph (e)(2)(i)(D) of this section). Councils should develop a process for receiving scientific information and advice used to establish ABC. This process should: Identify the body that will apply the ABC control rule (*i.e.* , calculates the ABC), and identify the review process that will evaluate the resulting ABC. The SSC must recommend the ABC to the Council. An SSC may recommend an ABC that differs from the result of the ABC control rule calculation, based on factors such as data uncertainty, recruitment variability, declining trends in population variables, and other factors, but must explain why. For Secretarial FMPs or FMP amendments, agency scientists or a peer review process would provide the scientific advice to establish ABC. For internationally-assessed stocks, an ABC as defined in these guidelines is not required if they meet the international exception (*see* paragraph (h)(2)(ii)). While the ABC is allowed to equal OFL, NMFS expects that in most cases ABC will be reduced from OFL to reduce the probability that overfishing might occur in a year. Also, *see* paragraph (f)(5) of this section for cases where a Council recommends that ACL is equal to ABC, and ABC is equal to OFL.

(i) *Expression of ABC.* ABC should be expressed in terms of catch, but may be expressed in terms of landings as long as estimates of bycatch and any other fishing mortality not accounted for in the landings are incorporated into the determination of ABC.

(ii) *ABC for overfished stocks.* For overfished stocks and stock complexes, a rebuilding ABC must be set to reflect the annual catch that is consistent with the schedule of fishing mortality rates in the rebuilding plan.

(4) *ABC control rule.* For stocks and stock complexes required to have an ABC, each Council must establish an ABC control rule based on scientific advice from its SSC. The determination of ABC should be based, when possible, on the probability that an actual catch equal to the stock's ABC would result in overfishing. This probability that overfishing will occur cannot exceed 50 percent and should be a lower value. The ABC control rule should consider reducing fishing mortality as stock size declines and may establish a stock abundance level below which fishing would not be allowed. The process of establishing an ABC control rule could also involve science advisors or the peer review process established under Magnuson-Stevens Act section 302(g)(1)(E). The ABC control rule must articulate how ABC will be set compared to the OFL based on the scientific knowledge about the stock or stock complex and the scientific uncertainty in the estimate of OFL and any other scientific uncertainty. The ABC control rule should consider uncertainty in factors such as stock assessment results, time lags in updating assessments, the degree of retrospective revision of assessment results, and projections. The control rule may be used in a tiered approach to address different levels of scientific uncertainty.

(5) *Setting the annual catch limit*—(i) *General.* ACL cannot exceed the ABC and may be set annually or on a multiyear plan basis. ACLs in coordination with AMs must prevent overfishing (see MSA section 303(a)(15)). If a Council recommends an ACL which equals ABC, and the ABC is equal to OFL, the Secretary may presume that the proposal would not prevent overfishing, in the absence of sufficient analysis and justification for the approach. A ''multiyear plan'' as referenced in section 303(a)(15) of the Magnuson-Stevens Act is a plan that establishes harvest specifications or harvest guidelines for each year of a time period greater than 1 year. A multiyear plan must include a mechanism for specifying ACLs for each year with appropriate AMs to prevent overfishing and maintain an appropriate rate of rebuilding if the stock or stock complex is in a rebuilding plan. A multiyear plan must provide that, if an ACL is exceeded for a year, then AMs are triggered for the next year consistent with paragraph (g)(3) of this section.

(ii) *Sector-ACLs.* A Council may, but is not required to, divide an ACL into sector-ACLs. ''Sector,'' for purposes of this section, means a distinct user group to which separate management strategies and separate catch quotas apply. Examples of sectors include the commercial sector, recreational sector, or various gear groups within a fishery. If the management measures for different sectors differ in the degree of management uncertainty, then sector ACLs may be necessary so that appropriate AMs can be developed for each sector. If a Council chooses to use sector ACLs, the sum of sector ACLs must not exceed the stock or stock complex level ACL. The system of ACLs and AMs designed must be effective in protecting the stock or stock complex as a whole. Even if sector-ACLs and AMs are established, additional AMs at the stock or stock complex level may be necessary.

(iii) *ACLs for State-Federal Fisheries.* For stocks or stock complexes that have harvest in state or territorial waters, FMPs and FMP amendments should include an ACL for the overall stock that may be further divided. For example, the overall ACL could be divided into a Federal-ACL and state-ACL. However, NMFS recognizes that Federal management is limited to the portion of the fishery under Federal authority (*see* paragraph (g)(5) of this section). When stocks are co-managed by Federal, state, tribal, and/or territorial fishery managers, the goal should be to develop collaborative conservation and management strategies, and scientific capacity to support such strategies (including AMs for state or territorial and Federal waters), to prevent overfishing of shared stocks and ensure their sustainability.

(6) *ACT control rule.* If ACT is specified as part of the AMs for a fishery, an ACT control rule is utilized for setting the ACT. The ACT control rule should clearly articulate how management uncertainty in the amount of catch in the fishery is accounted for in setting ACT. The objective for establishing the ACT and related AMs is that the ACL not be exceeded.

(i) *Determining management uncertainty.* Two sources of management uncertainty should be accounted for in establishing the AMs for a fishery, including the ACT control rule if utilized: Uncertainty in the ability of managers to constrain catch so the ACL is not exceeded, and uncertainty in quantifying the true catch amounts (*i.e.,* estimation errors). To determine the level of management uncertainty in controlling catch, analyses need to consider past management performance in the fishery and factors such as time lags in reported catch. Such analyses must be based on the best available scientific information from an SSC, agency scientists, or peer review process as appropriate.

(ii) *Establishing tiers and corresponding ACT control rules.* Tiers can be established based on levels of management uncertainty associated with the fishery, frequency and accuracy of catch monitoring data available, and risks of exceeding the limit. An ACT control rule could be established for each tier and have, as appropriate, different formulas and standards used to establish the ACT.

(7) A Council may choose to use a single control rule that combines both scientific and management uncertainty and supports the ABC recommendation and establishment of ACL and if used ACT.

(g) *Accountability measures.* The following features (see paragraphs (g)(1) through (5) of this section) of accountability measures apply to those stocks and stock complexes in the fishery.

(1) *Introduction.* AMs are management controls to prevent ACLs, including sector-ACLs, from being exceeded, and to correct or mitigate overages of the ACL if they occur. AMs should address and minimize both the frequency and magnitude of overages and correct the problems that caused the overage in as short a time as possible. NMFS identifies two categories of AMs, inseason AMs and AMs for when the ACL is exceeded.

(2) *Inseason AMs.* Whenever possible, FMPs should include inseason monitoring and management measures to prevent catch from exceeding ACLs. Inseason AMs could include, but are not limited to: ACT; closure of a fishery; closure of specific areas; changes in gear; changes in trip size or bag limits; reductions in effort; or other appropriate management controls for the fishery. If final data or data components of catch are delayed, Councils should make appropriate use of preliminary data, such as landed catch, in implementing inseason AMs. FMPs should contain inseason closure authority giving NMFS the ability to close fisheries if it determines, based on data that it deems sufficiently reliable, that an ACL has been exceeded or is projected to be reached, and that closure of the fishery is necessary to prevent overfishing. For fisheries without inseason management control to prevent the ACL from being exceeded, AMs should utilize ACTs that are set below ACLs so that catches do not exceed the ACL.

(3) *AMs for when the ACL is exceeded.* On an annual basis, the Council must determine as soon as possible after the fishing year if an ACL was exceeded. If an ACL was exceeded, AMs must be triggered and implemented as soon as possible to correct the operational issue that caused the ACL overage, as well as any biological consequences to the stock or stock complex resulting from the overage when it is known. These AMs could include, among other things, modifications of inseason AMs or overage adjustments. For stocks and stock complexes in rebuilding plans, the AMs should include overage adjustments that reduce the ACLs in the next fishing year by the full amount of the overages, unless the best scientific information available shows that a reduced overage adjustment, or no adjustment, is needed to mitigate the effects of the overages. If catch exceeds the ACL for a given stock or stock complex more than once in the last four years, the system of ACLs and AMs should be re-evaluated, and modified if necessary, to improve its performance and effectiveness. A Council could choose a higher performance standard (e.g., a stock's catch should not exceed its ACL more often than once every five or six years) for a stock that is particularly vulnerable to the effects of overfishing, if the vulnerability of the stock has not already been accounted for in the ABC control rule.

(4) *AMs based on multi-year average data.* Some fisheries have highly variable annual catches and lack reliable inseason or annual data on which to base AMs. If there are insufficient data upon which to compare catch to ACL, either inseason or on an annual basis, AMs could be based on comparisons of average catch to average ACL over a three-year moving average period or, if supported by analysis, some other appropriate multi-year period. Councils should explain why basing AMs on a multi-year period is appropriate. Evaluation of the moving average catch to the average ACL must be conducted annually and AMs should be implemented if the average catch exceeds the average ACL. As a performance standard, if the average catch exceeds the average ACL for a stock or stock complex more than once in the last four years, then the system of ACLs and AMs should be re-evaluated and modified if necessary to improve its performance and effectiveness. The initial ACL and management measures may incorporate information from previous years so that AMs based on average ACLs can be applied from the first year. Alternatively, a Council could use a stepped approach where in year-1, catch is compared to the ACL for year-1; in year-2 the average catch for the past 2 years is compared to the average ACL; then in year 3 and beyond, the most recent 3 years of catch are compared to the corresponding ACLs for those years.

(5) *AMs for State-Federal Fisheries.* For stocks or stock complexes that have harvest in state or territorial waters, FMPs and FMP amendments must, at a minimum, have AMs for the portion of the fishery under Federal authority. Such AMs could include closing the EEZ when the Federal portion of the ACL is reached, or the overall stock's ACL is reached, or other measures.

(h) *Establishing ACL mechanisms and AMs in FMPs.* FMPs or FMP amendments must establish ACL mechanisms and AMs for all stocks and stock complexes in the fishery, unless paragraph (h)(2) of this section is applicable. These mechanisms should describe the annual or multiyear process by which specific ACLs, AMs, and other reference points such as OFL, and ABC will be established. If a complex has multiple indicator stocks, each indicator stock must have its own ACL; an additional ACL for the stock complex as a whole is optional. In cases where fisheries (e.g., Pacific salmon) harvest multiple indicator stocks of a single species that cannot be distinguished at the time of capture, separate ACLs for the indicator stocks are not required and the ACL can be established for the complex as a whole.

(1) In establishing ACL mechanisms and AMs, FMPs should describe:

(i) Timeframes for setting ACLs (e.g., annually or multi-year periods);

(ii) Sector-ACLs, if any (including set-asides for research or bycatch);

(iii) AMs and how AMs are triggered and what sources of data will be used (e.g., inseason data, annual catch compared to the ACL, or multi-year averaging approach); and

(iv) Sector-AMs, if there are sector-ACLs.

(2) *Exceptions from ACL and AM requirements*—(i) *Life cycle.* Section 303(a)(15) of the Magnuson-Stevens Act ''shall not apply to a fishery for species that has a life cycle of approximately 1 year unless the Secretary has determined the fishery is subject to overfishing of that species'' (as described in Magnuson-Stevens Act section 303 note). This exception applies to a stock for which the average length of time it takes for an individual to produce a reproductively active offspring is approximately 1 year and that the individual has only one breeding season in its lifetime. While exempt from the ACL and AM requirements, FMPs or FMP amendments for these stocks must have SDC, MSY, OY, ABC, and an ABC control rule.

(ii) *International fishery agreements.* Section 303(a)(15) of the Magnuson-Stevens Act applies ''unless otherwise provided for under an international agreement in which the United States participates'' (Magnuson-Stevens Act section 303 note). This exception applies to stocks or stock complexes subject to management under an international agreement, which is defined as ''any bilateral or multilateral treaty, convention, or agreement which relates to fishing and to which the United States is a party'' (see Magnuson-Stevens Act section 3(24)). These stocks would still need to have SDC and MSY.

(3) *Flexibility in application of NS1 guidelines*. There are limited circumstances that may not fit the standard approaches to specification of reference points and management measures set forth in these guidelines. These include, among other things, conservation and management of Endangered Species Act listed species, harvests from aquaculture operations, and stocks with unusual life history characteristics (e.g., Pacific salmon, where the spawning potential for a stock is spread over a multi-year period). In these circumstances, Councils may propose alternative approaches for satisfying the NS1 requirements of the Magnuson-Stevens Act than those set forth in these guidelines. Councils must document their rationale for any alternative approaches for these limited circumstances in an FMP or FMP amendment, which will be reviewed for consistency with the Magnuson-Stevens Act.

(i) *Fisheries data*. In their FMPs, or associated public documents such as SAFE reports as appropriate, Councils must describe general data collection methods, as well as any specific data collection methods used for all stocks in the fishery, and EC species, including:

(1) Sources of fishing mortality (both landed and discarded), including commercial and recreational catch and bycatch in other fisheries;

(2) Description of the data collection and estimation methods used to quantify total catch mortality in each fishery, including information on the management tools used (i.e., logbooks, vessel monitoring systems, observer programs, landings reports, fish tickets, processor reports, dealer reports, recreational angler surveys, or other methods); the frequency with which data are collected and updated; and the scope of sampling coverage for each fishery; and

(3) Description of the methods used to compile catch data from various catch data collection methods and how those data are used to determine the relationship between total catch at a given point in time and the ACL for stocks and stock complexes that are part of a fishery.

(j) *Council actions to address overfishing and rebuilding for stocks and stock complexes in the fishery*—(1) *Notification*. The Secretary will immediately notify in writing a Regional Fishery Management Council whenever it is determined that:

(i) Overfishing is occurring;

(ii) A stock or stock complex is overfished;

(iii) A stock or stock complex is approaching an overfished condition; or

(iv) Existing remedial action taken for the purpose of ending previously identified overfishing or rebuilding a previously identified overfished stock or stock complex has not resulted in adequate progress.

(2) *Timing of actions*—(i) *If a stock or stock complex is undergoing overfishing*. FMPs or FMP amendments must establish ACL and AM mechanisms in 2010, for stocks and stock complexes determined to be subject to overfishing, and in 2011, for all other stocks and stock complexes (*see* paragraph (b)(2)(iii) of this section). To address practical implementation aspects of the FMP and FMP amendment process, paragraphs (j)(2)(i)(A) through (C) of this section clarifies the expected timing of actions.

(A) In addition to establishing ACL and AM mechanisms, the ACLs and AMs themselves must be specified in FMPs, FMP amendments, implementing regulations, or annual specifications beginning in 2010 or 2011, as appropriate.

(B) For stocks and stock complexes still determined to be subject to overfishing at the end of 2008, ACL and AM mechanisms and the ACLs and AMs themselves must be effective in fishing year 2010.

(C) For stocks and stock complexes determined to be subject to overfishing during 2009, ACL and AM mechanisms and ACLs and AMs themselves should be effective in fishing year 2010, if possible, or in fishing year 2011, at the latest.

(ii) *If a stock or stock complex is overfished or approaching an overfished condition*. (A) For notifications that a stock or stock complex is overfished or approaching an overfished condition made before July 12, 2009, a Council must prepare an FMP, FMP amendment, or proposed regulations within one year of notification. If the stock or stock complex is overfished, the purpose of the action is to specify a time period for ending overfishing and rebuilding the stock or stock complex that will be as short as possible as described under section 304(e)(4) of the Magnuson-Stevens Act. If the stock or stock complex is approaching an overfished condition, the purpose of the action is to prevent the biomass from declining below the MSST.

(B) For notifications that a stock or stock complex is overfished or approaching an overfished condition made after July 12, 2009, a Council must prepare and implement an FMP, FMP amendment, or proposed regulations within two years of notification, consistent with the requirements of section 304(e)(3) of the Magnuson-Stevens Act. Council actions should be submitted to NMFS within 15 months of notification to ensure sufficient time for the Secretary to implement the measures, if approved. If the stock or stock complex is overfished and overfishing is occurring, the rebuilding plan must end overfishing immediately and be consistent with ACL and AM requirements of the Magnuson-Stevens Act.

(3) *Overfished fishery*. (i) Where a stock or stock complex is overfished, a Council must specify a time period for rebuilding the stock or stock complex based on factors specified in Magnuson-Stevens Act section 304(e)(4). This target time for rebuilding (T_{target}) shall be as short as possible, taking into account: The status and biology of any overfished stock, the needs of fishing communities, recommendations by international organizations in which the U.S. participates, and interaction of the stock within the marine ecosystem. In addition, the time period shall not exceed 10 years, except where biology of the stock, other environmental conditions, or management measures under an international agreement to which the U.S. participates, dictate otherwise. SSCs (or agency scientists or peer review processes in the case of Secretarial actions) shall provide recommendations for achieving rebuilding targets (*see* Magnuson-Stevens Act section 302(g)(1)(B)). The above factors enter into the specification of T_{target} as follows:

(A) The ''minimum time for rebuilding a stock'' (T_{min}) means the amount of time the stock or stock complex is expected to take to rebuild to its MSY biomass level in the absence of any fishing mortality. In this context, the term ''expected'' means to have at least a 50 percent probability of attaining the B_{msy}.

(B) For scenarios under paragraph (j)(2)(ii)(A) of this section, the starting year for the T_{min} calculation is the first year that a rebuilding plan is implemented. For scenarios under paragraph (j)(2)(ii)(B) of this section, the starting year for the T_{min} calculation is 2 years after notification that a stock or stock complex is overfished or the first year that a rebuilding plan is implemented, whichever is sooner.

(C) If T_{min} for the stock or stock complex is 10 years or less, then the maximum time allowable for rebuilding (T_{max}) that stock to its B_{msy} is 10 years.

(D) If T_{min} for the stock or stock complex exceeds 10 years, then the maximum time allowable for rebuilding a stock or stock complex to its B_{msy} is T_{min} plus the length of time associated with one generation time for that stock or stock complex. ''Generation time'' is the average length of time between when an individual is born and the birth of its offspring.

(E) T_{target} shall not exceed T_{max}, and should be calculated based on the factors described in this paragraph (j)(3).

(ii) If a stock or stock complex reached the end of its rebuilding plan period and has not yet been determined to be rebuilt, then the rebuilding F should not be increased until the stock or stock complex has been demonstrated to be rebuilt. If the rebuilding plan was based on a T_{target} that was less than T_{max}, and the stock or stock complex is not rebuilt by T_{target}, rebuilding measures should be revised, if necessary, such that the stock or stock complex will be rebuilt by T_{max}. If the stock or stock complex has not rebuilt by T_{max}, then the fishing mortality rate should be maintained at $F_{rebuild}$ or 75 percent of the MFMT, whichever is less.

(iii) Council action addressing an overfished fishery must allocate both overfishing restrictions and recovery benefits fairly and equitably among sectors of the fishery.

(iv) For fisheries managed under an international agreement, Council action addressing an overfished fishery must reflect traditional participation in the fishery, relative to other nations, by fishermen of the United States.

(4) *Emergency actions and interim measures.* The Secretary, on his/her own initiative or in response to a Council request, may implement interim measures to reduce overfishing or promulgate regulations to address an emergency (Magnuson-Stevens Act section 304(e)(6) or 305(c)). In considering a Council request for action, the Secretary would consider, among other things, the need for and urgency of the action and public interest considerations, such as benefits to the stock or stock complex and impacts on participants in the fishery.

(i) These measures may remain in effect for not more than 180 days, but may be extended for an additional 186 days if the public has had an opportunity to comment on the measures and, in the case of Council-recommended measures, the Council is actively preparing an FMP, FMP amendment, or proposed regulations to address the emergency or overfishing on a permanent basis.

(ii) Often, these measures need to be implemented without prior notice and an opportunity for public comment, as it would be impracticable to provide for such processes given the need to act quickly and also contrary to the public interest to delay action. However, emergency regulations and interim measures that do not qualify for waivers or exceptions under the Administrative Procedure Act would need to follow proposed notice and comment rulemaking procedures.

(k) *International overfishing.* If the Secretary determines that a fishery is overfished or approaching a condition of being overfished due to excessive international fishing pressure, and for which there are no management measures (or no effective measures) to end overfishing under an international agreement to which the United States is a party, then the Secretary and/or the appropriate Council shall take certain actions as provided under Magnuson-Stevens Act section 304(i). The Secretary, in cooperation with the Secretary of State, must immediately take appropriate action at the international level to end the overfishing. In addition, within one year after the determination, the Secretary and/or appropriate Council shall:

(1) Develop recommendations for domestic regulations to address the relative impact of the U.S. fishing vessels on the stock. Council recommendations should be submitted to the Secretary.

(2) Develop and submit recommendations to the Secretary of State, and to the Congress, for international actions that will end overfishing in the fishery and rebuild the affected stocks, taking into account the relative impact of vessels of other nations and vessels of the United States on the relevant stock. Councils should, in consultation with the Secretary, develop recommendations that take into consideration relevant provisions of the Magnuson-Stevens Act and NS1 guidelines, including section 304(e) of the Magnuson-Stevens Act and paragraph (j)(3)(iv) of this section, and other applicable laws. For highly migratory species in the Pacific, recommendations from the Western Pacific, North Pacific, or Pacific Councils must be developed and submitted consistent with Magnuson-Stevens Reauthorization Act section 503(f), as appropriate.

(3) *Considerations for assessing ''relative impact.''* ''Relative impact'' under paragraphs (k)(1) and (2) of this section may include consideration of factors that include, but are not limited to: Domestic and international management measures already in place, management history of a given nation, estimates of a nation's landings or catch (including bycatch) in a given fishery, and estimates of a nation's mortality contributions in a given fishery. Information used to determine relative impact must be based upon the best available scientific information.

(l) *Relationship of National Standard 1 to other national standards—General.* National Standards 2 through 10 provide further requirements for conservation and management measures in FMPs, but do not alter the requirement of NS1 to prevent overfishing and rebuild overfished stocks.

(1) *National Standard 2 (see § 600.315).* Management measures and reference points to implement NS1 must be based on the best scientific information available. When data are insufficient to estimate reference points directly, Councils should develop reasonable proxies to the extent possible (*also see* paragraph (e)(1)(iv) of this section). In cases where scientific data are severely limited, effort should also be directed to identifying and gathering the needed data. SSCs should advise their Councils regarding the best scientific information available for fishery management decisions.

(2) *National Standard 3 (see § 600.320).* Reference points should generally be specified in terms of the level of stock aggregation for which the best scientific information is available (*also see* paragraph (e)(1)(iii) of this section). Also, scientific assessments must be based on the best information about the total range of the stock and potential biological structuring of the stock into biological sub-units, which may differ from the geographic units on which management is feasible.

(3) *National Standard 6 (see § 600.335).* Councils must build into the reference points and control rules appropriate consideration of risk, taking into account uncertainties in estimating harvest, stock conditions, life history parameters, or the effects of environmental factors.

(4) *National Standard 8 (see § 600.345).* National Standard 8 directs the Councils to apply economic and social factors towards sustained participation of fishing communities and to the extent practicable, minimize adverse economic impacts on such communities within the context of preventing overfishing and rebuilding overfished stocks as required under National Standard 1. Therefore, calculation of OY as reduced from MSY

should include economic and social factors, but the combination of management measures chosen to achieve the OY must principally be designed to prevent overfishing and rebuild overfished stocks.

(5) *National Standard 9 (see § 600.350).* Evaluation of stock status with respect to reference points must take into account mortality caused by bycatch. In addition, the estimation of catch should include the mortality of fish that are discarded.

(m) *Exceptions to requirements to prevent overfishing.* Exceptions to the requirement to prevent overfishing could apply under certain limited circumstances. Harvesting one stock at its optimum level may result in overfishing of another stock when the two stocks tend to be caught together (This can occur when the two stocks are part of the same fishery or if one is bycatch in the other's fishery). Before a Council may decide to allow this type of overfishing, an analysis must be performed and the analysis must contain a justification in terms of overall benefits, including a comparison of benefits under alternative management measures, and an analysis of the risk of any stock or stock complex falling below its MSST. The Council may decide to allow this type of overfishing if the fishery is not overfished and the analysis demonstrates that all of the following conditions are satisfied:

(1) Such action will result in long-term net benefits to the Nation;

(2) Mitigating measures have been considered and it has been demonstrated that a similar level of long-term net benefits cannot be achieved by modifying fleet behavior, gear selection/configuration, or other technical characteristic in a manner such that no overfishing would occur; and

(3) The resulting rate of fishing mortality will not cause any stock or stock complex to fall below its MSST more than 50 percent of the time in the long term, although it is recognized that persistent overfishing is expected to cause the affected stock to fall below its B_{msy} more than 50 percent of the time in the long term.

[FR Doc. E9–636 Filed 1–15–09; 8:45 am]

BILLING CODE 3510–22–P

Revisions to the National Standard 1 Guidelines:

Guidance on Annual Catch Limits and Other Requirements

January 2009

NOAA Fisheries Service
Office of Sustainable Fisheries
Silver Spring, MD

Note: This presentation provides only a summary of the National Standard 1 guidelines. Any discrepancies between this presentation and the National Standard 1 guidelines as published in the *Federal Register* on January 16, 2009 (74 FR 3178) will be resolved in favor of the *Federal Register.*

Statutory Requirements

National Standard (NS) 1

- "Conservation and management measures shall **prevent overfishing** while achieving, on a continuing basis, the **optimum yield** from each fishery for the United States fishing industry."
  - MSA Section 301(a)(1)

2007 MSA Amendments

- The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 *(MSRA)* added new requirements for annual catch limits (ACLs) and accountability measures (AMs).
- Fishery management plans shall "establish a mechanism for specifying annual catch limits in the plan (including a multiyear plan), implementing regulations, or annual specifications, at a level such that overfishing does not occur in the fishery, including measures to ensure accountability."

MSA Section 303(a)(15)

ACLs

- Exceptions to ACL requirement*:
  - Species with a life cycle of approximately one year, unless subject to overfishing
  - Stocks managed under an international agreement to which the U.S. is party
- Implementation in fishing year*:
  - 2010 for fisheries subject to overfishing
  - 2011 for all other fisheries
- May not exceed a Council's Scientific and Statistical Committee's (SSC) fishing level recommendation**

*MSA sec. 303 note, MSRA sec. 104(b)
**MSA sec. 302(h)(6)

New SSC requirements

- "Each scientific and statistical committee shall provide its Council ongoing scientific advice for fishery management decisions, including recommendations for
  - acceptable biological catch,
  - preventing overfishing,
  - maximum sustainable yield, and
  - achieving rebuilding targets, and
  - reports on stock status and health,
  - bycatch
  - habitat status
  - social and economic impacts of management measures, and
  - sustainability of fishing practices."

MSA Section 302(g)(1)(B)

For "overfished" stocks

- Effective July 12, 2009, within **2** years of an "overfished" or "approaching overfished" stock status notification, Councils (or Secretary for Atlantic HMS) must "prepare **and implement**" management measures to:
  - **Immediately** end overfishing
  - Rebuild affected stocks
    - Rebuilding time shall be "as short as possible"
    - "not exceed 10 years", unless biological or environmental circumstances, or management under an international agreement dictates otherwise

MSA Sec. 304(e)(3), MSRA sec. 104(c)

NMFS Objectives
in Revising the NS 1 Guidelines

Strong, Yet Flexible, Guidelines

- Ensure that the MSA mandate for ACLs and AMs to end and prevent overfishing is met and account for U.S. fisheries diversity:
  - Biological and ecological
  - Management approaches
  - Scientific knowledge
  - Monitoring capacity
  - Overlap in management jurisdiction
  - Resource users

Incorporate New Terms

- Define and provide guidance on the terms ACLs, AMs, and acceptable biological catch (ABC) that are required but not defined by MSA.
- Explain the relationship between ACLs, AMs, and ABC and other reference points such as the overfishing limit (OFL) and the annual catch target (ACT).

Consider Public Input

- Scoping: February – April 2007
  - Held 9 scoping sessions
- Proposed Guidelines: 73 FR 32526 (June 9, 2008)
- Public comment period: June 9 – September 22, 2008
  - Held 3 public meetings
  - Made presentations to each of the 8 Councils
  - Received over 150,000 comments
- Final Guidelines: 74 FR 3178 (January 16, 2009)

Themes From Comments Received (June 9th – September 22nd, 2008)

- Proposed definition framework (OFL ≥ ABC ≥ ACL ≥ ACT)
- Buffers between OFL and ABC
- Complexity of the guidelines
- Challenge of implementing ACLs and AMs by 2010 and 2011
- ACT and ACT control rule
- Analysis to support the action (i.e., Environmental Impact Statement)
- Ecosystem component species
- Spatial-temporal management as part of effective ACLs
- Specific guidelines for forage fish management
- Include a description of vulnerability to help classify stocks

See 74 FR 3178 (January 16, 2009) for full summary of comments and responses

Themes From Comments Received (continued)

- Addressing scientific and management uncertainty
- Use of catch shares or limited access privilege programs
- Encourage the use of sectors
- Support and opposition for the use of inseason AMs
- AMs for when the ACL is exceeded
- AMs for recreational fisheries
- ACLs and AMs for state-Federal fisheries
- Rebuilding provisions
- International fishing exception
- Mixed-stock exception

See 74 FR 3178 (January 16, 2009) for full summary of comments and responses

Changes from proposed to final NS1 guidance

Changes in final guidance

- ACTs and ACT control rules are optional accountability measures. For fisheries without inseason management control to prevent ACL from being exceeded, should utilize ACTs set below ACLs so catches do not exceed ACL.*
- If Council recommends OFL=ABC=ACL, Secretary may presume the proposal would not prevent overfishing, in the absence of sufficient analysis and justification. In most cases, expect ABC to be reduced from OFL to account for scientific uncertainty and reduce probability that overfishing might occur in a given year. **
- Clarification of statutory/mandatory provisions versus discretionary provisions.

*§ 600.310 (g)(2), **§ 600.310 (f)(3), **§ 600.310 (f)(5)(i)

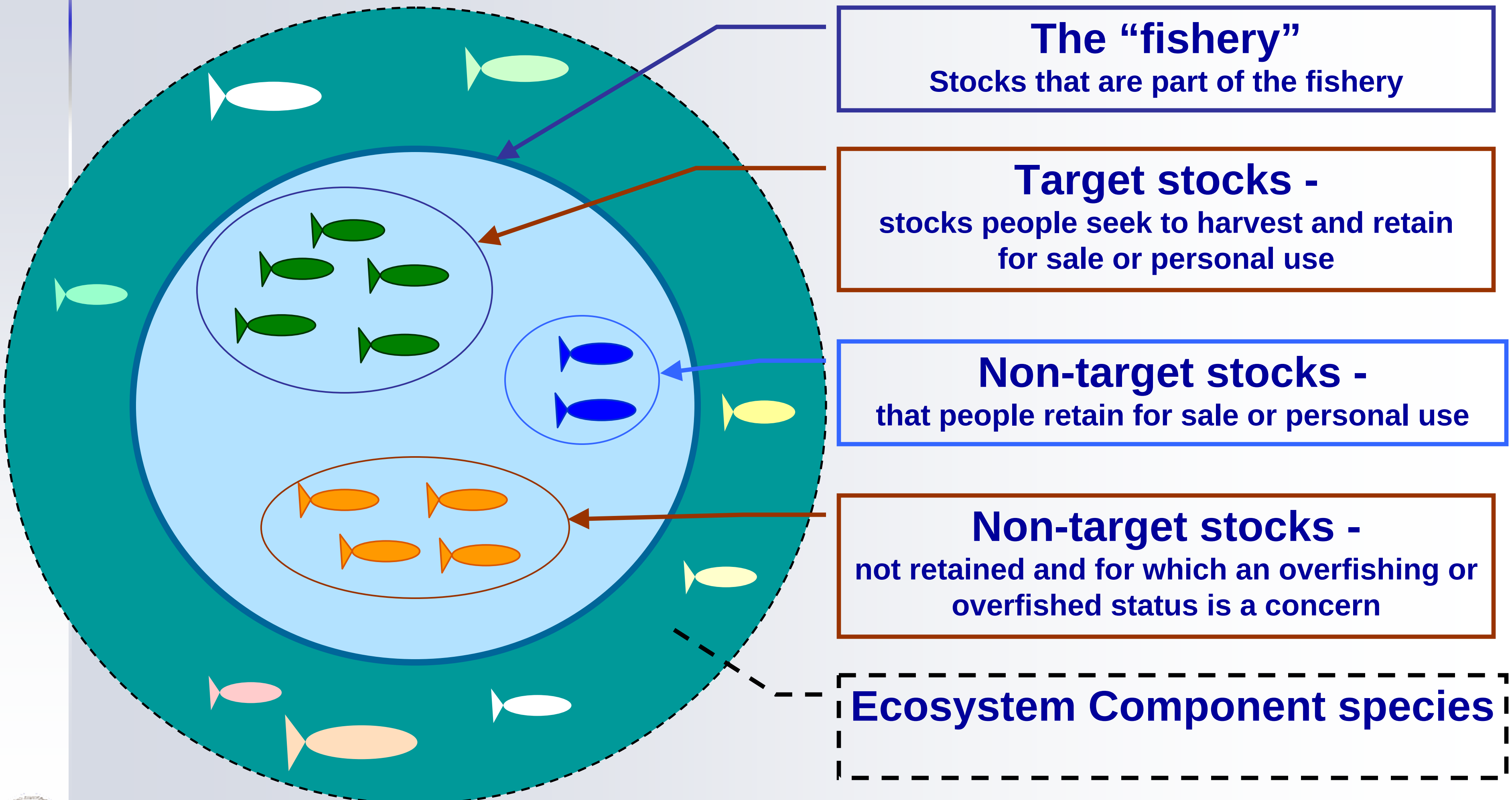
Major aspects of the NS1 guidelines

Stock classification in FMPs

- All stocks in FMP are considered "in the fishery" unless specified as ecosystem component (EC) species.
- EC classification is not required but is discretionary.
- To be considered for possible EC classification, species should, among other considerations:
  - Be a non-target species or non-target stock;
  - Not be determined to be subject to overfishing, approaching overfished, or overfished;
  - Not be likely to become subject to overfishing or overfished, according to the best available information, in the absence of conservation and management measures; and
  - Not generally be retained for sale or personal use.

§ 600.310 (d)(1)-(6)

Example of the kind of stocks that may fall into the two classifications.

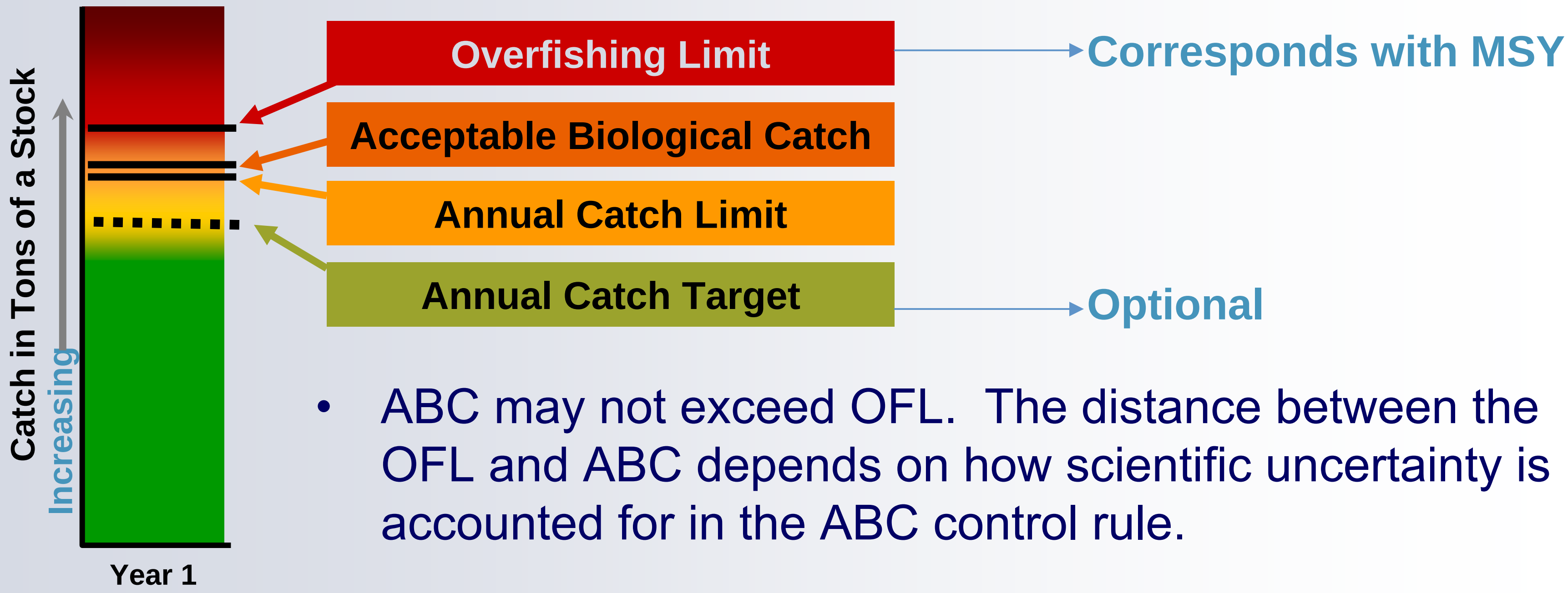


ACLs Apply to Stocks "in the Fishery"

- In practice, overfishing is determined at the stock or stock complex level. Therefore, ACLs should be applied at the stock or stock complex level.
- ACLs would apply only to stocks "in a fishery."
- ACLs would not apply to "ecosystem component species."

§ 600.310 (c)(4)
§ 600.310 (f)

Definition Framework
OFL ≥ ABC ≥ ACL



- ABC may not exceed OFL. The distance between the OFL and ABC depends on how scientific uncertainty is accounted for in the ABC control rule.
- The ACL may not exceed the ABC.
  - ABC is one of the fishing level recommendations under MSA section 302(h)(6).

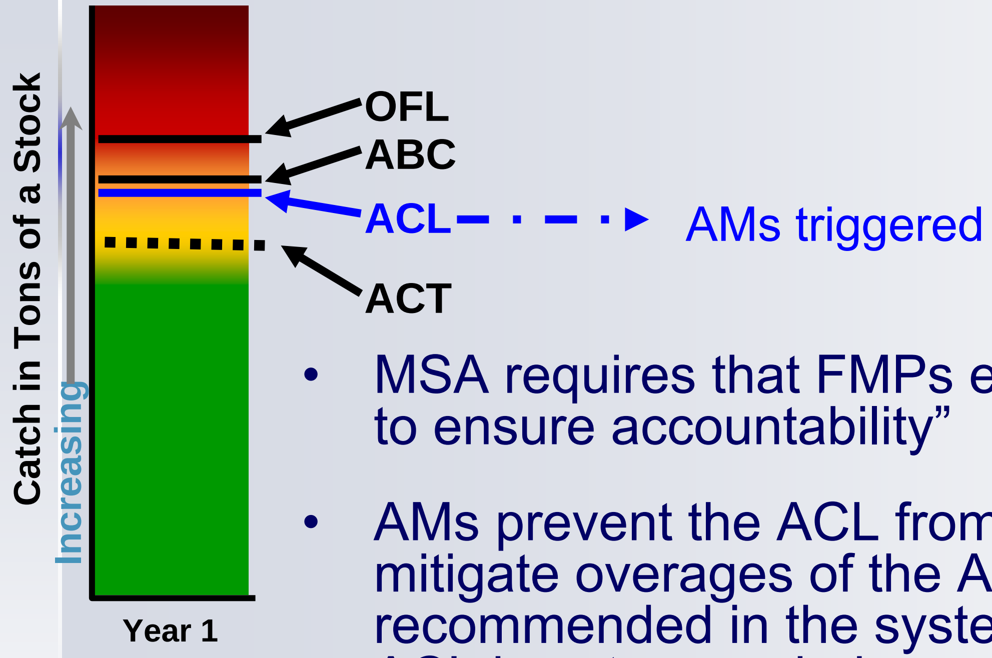
§ 600.310 (f)(1)-(7)

Approach for Setting Limits and AMs

- Councils must take an approach that considers uncertainty in **scientific** information and **management** control of the fishery.
- Scientific Uncertainty
  - ABC control rule: A specified approach to setting the ABC for a stock as a function of the scientific uncertainty in the estimate of OFL and any other scientific uncertainty. § 600.310 (f)(2)(iii)
  - Risk policy is part of ABC control rule: The determination of ABC should be based, when possible, on the probability that an actual catch equal to the stock's ABC would result in overfishing. This probability that overfishing will occur cannot exceed 50 percent and should be a lower value. § 600.310 (f)(4)
- Management Uncertainty
  - Address through a full range of AMs.
  - For fisheries without inseason management control to prevent the ACL from being exceeded, AMs should utilize ACTs that are set below ACLs so that catches do not exceed the ACL.

§ 600.310 (g)(2)

Accountability Measures (AMs)



- MSA requires that FMPs establish ACLs, "including measures to ensure accountability"
- AMs prevent the ACL from being exceeded and correct or mitigate overages of the ACL if they occur. ACTs are recommended in the system of accountability measures so that ACL is not exceeded.
- Two types of AMs:
  - Inseason measures to prevent exceeding the ACL
  - AMs for when the ACL is exceeded
    - Operational factors leading to an overage
    - Biological consequences to the stock, if any

§ 600.310 (g)(1)-(3)

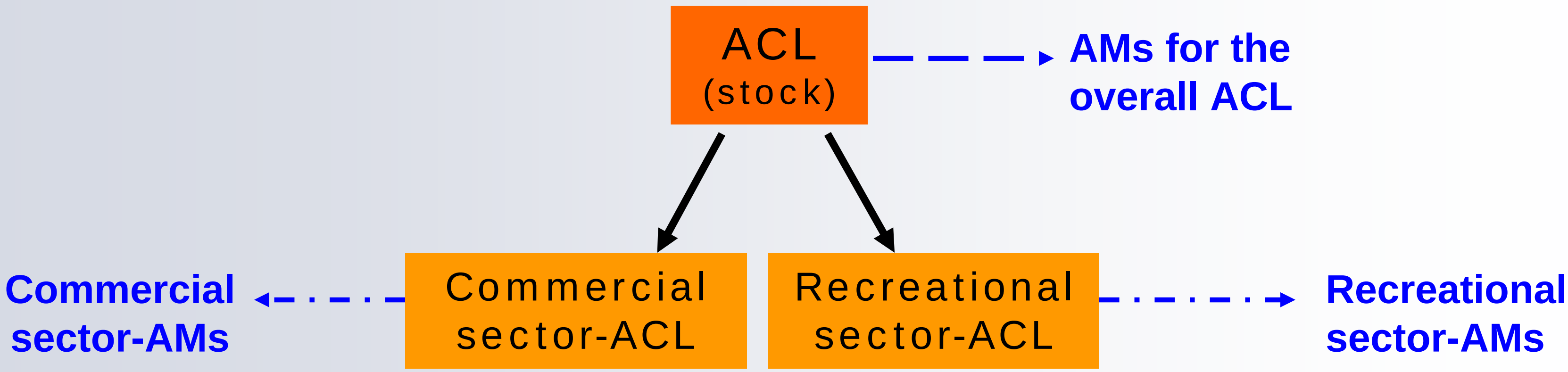
Performance Standards

- Because of scientific and management uncertainty, there is always a chance that overfishing could occur.
- The system of ACLs and AMs should be re-evaluated and modified if necessary, if the ACL is exceeded more than once in the last 4 years.
- A higher performance standard could be used if a stock is particularly vulnerable to the effects of overfishing.

§ 600.310 (g)(3)

ACLs & AMs for a Fishery Sector

- **Optional** to sub-divide a stock's ACL into "sector-ACLs".
- If the management measures for different sectors differ in the degree of management uncertainty, then sector ACLs may be necessary so that appropriate AMs can be developed for each sector.
- The sum of sector-ACLs must not exceed the overall ACL.
- For each sector-ACL, "sector-AMs" should be established.
- AMs at the stock level may be necessary.



§ 600.310 (f)(5)(ii)

State-Federal Fisheries

- ACL should be specified for the entire stock and may be further divided (e.g., Federal-ACL and state-ACL)
- AMs required for portion of fishery under Federal authority
- Goal should be to develop collaborative conservation and management strategies (including AMs) with Federal, state, tribal, and/or territorial fishery managers.

§ 600.310 (f)(5)(iii) & (g)(5)

ABC and ACL for Rebuilding Stocks

- For rebuilding stocks, the ABC and ACL should be set at lower levels during some or all stages of rebuilding than when a stock is rebuilt for two reasons:
  1. Overfishing should not occur, and
  2. Rebuilding at a rate commensurate with the stock's rebuilding plan should occur.
- ABC for overfished stocks: For overfished stocks and stock complexes, a rebuilding ABC must be set to reflect the annual catch that is consistent with the schedule of fishing mortality rates in the rebuilding plan.

§ 600.310 (f)(3)(ii)

AMs for Rebuilding Overfished Stocks

- If a stock is in a rebuilding plan and its ACL is exceeded, the AMs should include overage adjustments that reduce the ACL in the next fishing year by the full amount of the overage, unless the best scientific information available shows that a reduced overage adjustment, or no adjustment, is needed to mitigate the effects of the overage.
- This AM is important to increase the likelihood that the stock will continue to rebuild.

§ 600.310 (g)(3)

Summary of the Major Aspects of the NS1 Guidelines

- MSA requires:
  - ACLs and AMs to prevent overfishing,
  - ACLs not exceed fishing level recommendations of SSCs, and
  - ACLs and AMs in all managed fisheries, with 2 exceptions.
- NS1 guidelines:
  - ACLs and AMs for all stocks and stock complexes in a fishery, unless the 2 MSA exceptions apply.
  - Clearly account for both scientific and management uncertainty
  - AMs should prevent ACL overages, where possible, and always address overages, if they occur.
  - An optional "ecosystem component" category could allow flexibility in FMPs for greater ecosystem considerations.

Other Aspects of the NS1 Guidelines

Timeline for Implementing Rebuilding Plans After July 12, 2009

- For notifications that a stock or complex is **overfished or approaching an overfished condition,** a Council (or Secretary for Atlantic HMS) must prepare and implement management measures within 2 years of the notification.
- For timely implementation:
  - Councils should submit an FMP, FMP amendment, or proposed regulations within 15 months of notification.
  - This provides the Secretary 9 months to implement the measures, if approved.
- If the stock is overfished and overfishing is occuring, the rebuilding plan must end overfishing immediately.

§ 600.310 (j)(2)(ii)(B)

Establishing rebuilding time targets

- SSCs (or agency scientists or peer review processes in the case of Secretarial actions) shall provide recommendations for achieving rebuilding targets (see MSA sec. 302(g)(1)(B)).
- NS1 guidelines clarify calculation of **target time to rebuild (T_{target})** for stocks in rebuilding plans.

Minimum time for rebuilding (T_{min})

- **T_{target}** must be "as short as possible," taking into account factors set forth under MSA sec. 304(e)(4)(A)(i), and may not exceed 10 years, except as provided under sec. 304(e)(4)(A)(ii). See NS1 guidelines at § 600.310 (j)(3).
- T_{target} should be based on the **minimum time for rebuilding a stock (T_{min})** and the above factors.
- **T_{min}** is the amount of time the stock or complex is expected to take to rebuild to its MSY biomass level in the absence of any fishing mortality. In this context, the term "expected" means to have at least a 50% probability of attaining the B_{MSY}.

§ 600.310 (j)(3)(i)

Maximum Time Allowable for Rebuilding (T_{max})

- If T_{min} is ≤ 10 years, then T_{max} is 10 years.
- If T_{min} is > 10 years, then T_{max} is T_{min} + the length of time associated with one generation time for that stock or stock complex.
  - **Generation time** is the average length of time between when an individual is born and the birth of its offspring.
- T_{target} shall not exceed T_{max}, and should be calculated based on the factors described in § 600.310 (j)(3)

§ 600.310 (j)(3)(i)(A)-(E)

Action at the end of a rebuilding period if a stock is not yet rebuilt

- If a stock reaches the end of its rebuilding plan period and it is not yet determined to be rebuilt, then the rebuilding F should not be increased until the stock has been demonstrated to be rebuilt.
- If the rebuilding plan was based on a T_{target} that was less than T_{max}, and the stock is not rebuilt by T_{target}, rebuilding measures should be revised if necessary, such that the stock will be rebuilt by T_{max}.
- If the stock has not rebuilt by T_{max}, then the fishing mortality rate should be maintained at $F_{rebuild}$ or 75 percent of the MFMT, whichever is less.

§ 600.310 (j)(3)(ii)

International Overfishing - MSA section 304(i)

- Section 304(i) applies if the Secretary determines that a fishery is overfished or approaching overfished due to excessive international fishing pressure, and for which there are no management measures to end overfishing under an international agreement to which the U.S. is a party. Actions under section 304(i) include:
  - The Secretary, with Secretary of State, immediately takes action at the international level to end overfishing
  - Within 1 year, the Secretary and/or appropriate Council shall:
    - Recommend domestic regulations to address "relative impact" of U.S. fishing vessels
    - Recommend to Secretary of State and Congress, international actions to end overfishing and rebuild affected stocks, taking into account relative impact of vessels of other nations and vessels of the U.S.

§ 600.310 (k)

“Relative Impact”

- NMFS describes “relative impact”:
  - May include consideration of factors that include, but are not limited to: domestic and international management measures already in place, management history of a given nation, estimates of a nation’s landings or catch (including bycatch) in a given fishery, and estimates of a nation’s mortality contributions in a given fishery.
  - Information used to determine relative impact should be based upon the best available scientific information.

§ 600.310 (k)(3)

Forming Stock Complexes

- Stock complex = a group of stocks sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that the impact of management actions on the stocks is similar.
- May be formed for various reasons, including where:
  - stocks in a multispecies fishery cannot be targeted independent of one another and MSY cannot be defined on a stock-by-stock basis;
  - there is insufficient data to measure their status relative to SDC; or
  - it is not feasible for fishermen to distinguish individual stocks among their catch.
- The vulnerability of stocks to the fishery should be evaluated when establishing or reorganizing a complex.
- May be comprised of:
  - 1 or more indicator stocks, each with SDC and ACLs, and several other stocks;
  - several stocks without an indicator stock, with SDC and an ACL for the complex as a whole; or
  - 1 of more indicator stocks, each of which has SDC and management objectives, with an ACL for the complex as a whole (might be applicable to salmon species).

§ 600.310 (d)(8)

Indicator Stocks & Vulnerability

- An indicator stock is a stock with measurable SDC that can be used to help manage and evaluate more poorly known stocks that are in a stock complex. If one is used to evaluate the status of a complex, it should be representative of the typical status of each stock within the complex, due to similarity in vulnerability.
- A stock's vulnerability is a combination of its productivity, which depends upon its life history characteristics, and its susceptibility to the fishery.
  - Productivity – refers to capacity of the stock to produce MSY and to recover if the population is depleted
  - Susceptibility – potential for the stock to be impacted by the fishery, which includes direct captures, as well as indirect impacts to the fishery

§ 600.310 (d)(9) & (10)

Status Determination Criteria (SDC)

- SDC must be expressed in a way that enables the Council to monitor each stock or complex in the FMP, and determine annually, if possible, whether overfishing is occurring and whether the stock or complex is overfished.
- In specifying SDC, a Council must provide an analysis of how the SDC were chosen and how they relate to reproductive potential.
- Two approaches may be chosen for SDC to determine overfishing:
  - **Fishing mortality rate exceeds MFMT.** Exceeding the MFMT for a period of 1 year or more constitutes overfishing.
  - **Catch exceeds the OFL.** If the annual catch exceeds the annual OFL for 1 year or more, the stock or complex is considered subject to overfishing.

§ 600.310 (e)(2)(ii)

Fisheries Data

- In their FMPs, or associated public documents such as SAFE reports as appropriate, Councils must describe general data collection methods, as well as any specific data collection methods used for all stocks in the fishery, and EC species, including:
  - Sources of fishing mortality;
  - Description of the data collection and estimation methods used to quantify total catch mortality in each fishery; and
  - Description of the methods used to compile catch data from various catch data collection methods and how those data are used to determine the relationship between total catch at a given point in time and the ACL for stocks and stock complexes that are part of a fishery.

§ 600.310 (i)(1)-(3)

Mixed stock exception

- Exceptions to the requirement to prevent overfishing could apply under certain limited circumstances.
- Fishery must not be in overfished condition and analysis must be performed that demonstrates the below conditions are satisfied:
  - Will result in long-term net benefits to the Nation;
  - Mitigating measures have been considered and it has been demonstrated that a similar level of long-term net benefits cannot be achieved by modifying fleet behavior, gear selection/configuration, or other technical characteristic in a manner such that no overfishing would occur; and
  - The resulting rate of fishing mortality will not cause any stock or stock complex to fall below its MSST more than 50 percent of the time in the long term, although it is recognized that persistent overfishing is expected to cause the affected stock to fall below its Bmsy more than 50 percent of the time in the long term.

§ 600.310 (m)

Summary

- The NS1 guidelines provide guidance on the following topics:
- Rebuilding plans:
  - changing the timeline to prepare new rebuilding plans
  - guidance on how to establish rebuilding time targets
  - advice on action to take at the end of a rebuilding period if a stock is not yet rebuilt.
- Implementing MSA Section 304(i)
- Forming stock complexes and use of indicator stocks
- Two approaches for making overfishing status determinations
- Fisheries Data
- Mixed stock exception

Additional Information

- Additional information about ACLs and NS1 can be found at the following website:
  - http://www.nmfs.noaa.gov/msa2007/catchlimits.htm
- Public comments on the proposed revisions to the NS1 guidelines can be viewed at the Federal e-Rulemaking portal:
  - http://www.regulations.gov
  - You can search for documents regarding the NS1 guidelines under "Advanced docket search" using "0648-AV60" as the RIN keyword.

5.0 UPDATED STATUS OF THE HIGHLY MIGRATORY SPECIES MANAGEMENT UNIT SPECIES

This chapter contains a brief review of the stock status for each species with respect to the Council-adopted Control Rules. Section 5.**1** summarizes the adopted Control Rules and the Status Determination Criteria. In Section 5.**2**, a table of the recent and upcoming assessment efforts of various international scientific bodies responsible for assessing several of the stocks is presented. Section 5.**3** contains summaries or excerpts from the results of stock assessments conducted in 2007. The summaries are derived from the assessments or reports of working group meetings associated with the assessments and do not necessarily represent the conclusions of the Council's HMS Management Team or NMFS. In many cases there has been minimal outside review of the assessment. Nevertheless, they represent the best available information for those species in 2007 to compare to past and future work. A table summarizes the current stock status of the management unit species with respect to overfishing and overfished criteria. The conclusions presented in the table should be reasonably accurate, but should also be treated with caution. Assessments of stock status always involve assumptions, use of uncertain parameters, and particular interpretations of fishery statistics. There are no universally-accepted standards by which to determine confidence for particular assessments, and "ground-truthing" (i.e., comparing assessment estimates to actual population counts) will never be possible over the broad range occupied by highly migratory species. Furthermore, for most of these species, the scientific bodies developing the assessments have not agreed upon appropriate biological reference points for use in the context of managing fisheries. Therefore, explicit definitions for both overfished and sustainable exploitation levels are not currently available. Finally, Section 5.**4** provides some information on assessments that have already been produced in 2008 but may not yet be endorsed by the plenary bodies of the respective RFMOs. This information is provided so that readers can access the most recent publicly available assessments of the management unit species. However, keep in mind that these assessment results are preliminary until endorsed by the respective RFMOs and published in final form. These assessments will be reported on in the 2008 HMS SAFE Report (to be published in September 2009).

5.1 Control Rules for Management

The Control Rules and Status Determination Criteria implemented in the HMS FMP are based on the Technical Guidance for National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act (Restrepo, et al. 1998). The following is a summary of the Control Rules for Management adopted for the HMS FMP.

In general, a default maximum sustainable yield (MSY) control rule was adopted for most MUS, with an optimum yield (OY) target control rule for the vulnerable species (Figure 5–1).

For the less vulnerable species managed under the MSY Control Rule, the minimum stock size threshold (MSST), the minimum biomass at which recovery measures are to begin, is the ratio B_{MSST}/B_{MSY}. It specifies a lower biomass level that allows remedial action not to be triggered each time B drops below B_{MSY}, simply from natural variation. In terms of B_{MSY} the recommended level of B_{MSST} is:

$B_{MSST} = (1-M)B_{MSY}$ when M (natural mortality) ≤ 0.5, and
$B_{MSST} = 0.5B_{MSY}$ when $M > 0.5$

(i.e., whichever is greater). B_{MSST} must not be less than $B_{MIN} = 0.5B_{MSY}$ and should allow recovery back to B_{MSY} within 10 years when F (fishing mortality) is reduced to zero (to the extent possible).

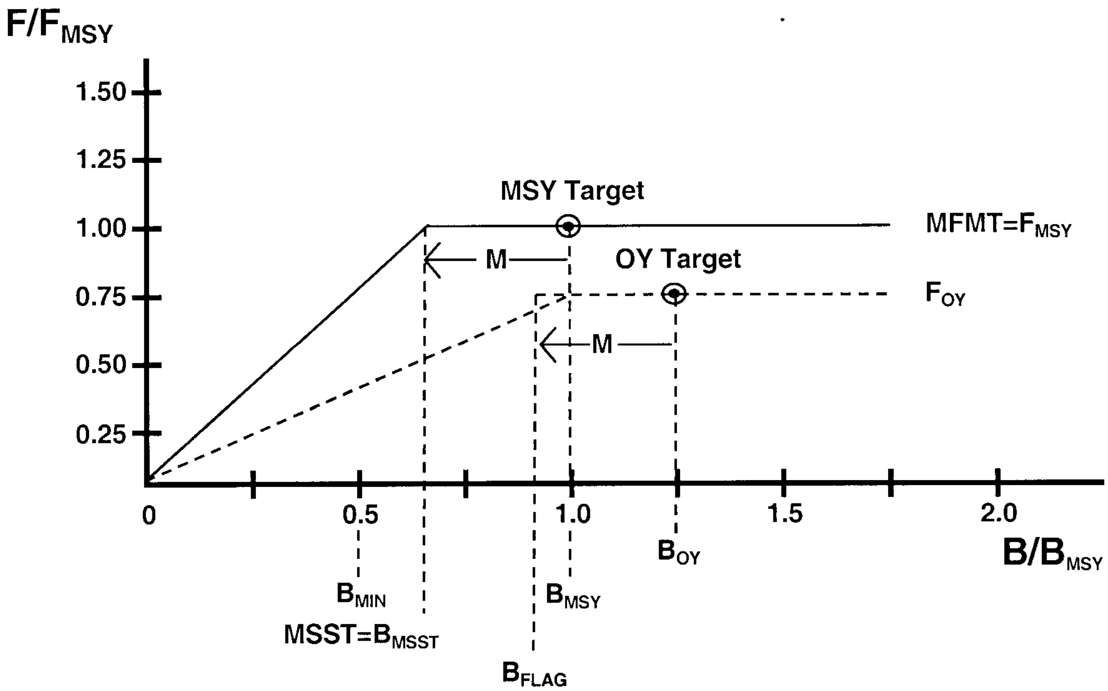


Table 5-1. General model of MSY and OY Control Rules, from Restrepo, et al. 1998.

For the vulnerable species, which in this FMP includes the pelagic sharks, bluefin tuna, and striped marlin, there is a Minimum Biomass Flag (B_{FLAG}) for the OY Control Rule equal to (1-M)B_{OY} or 0.5B_{OY} (whichever is greater). B_{FLAG}, which would then be equivalent to 1.25(B_{MSST}/B_{MSY}), serves as a warning call to halt biomass reduction that would jeopardize obtaining OY (which is defined as MSY reduced by relevant socioeconomic factors, ecological considerations, and fishery-biological constraints so as to provide the greatest long-term benefits to the Nation) on average. In this FMP, the OY for vulnerable species is set at 0.75MSY (or MSY proxy), and any harvest guideline is set equal to OY.

Rebuilding of overfished stocks is a unilateral requirement by the Magnuson-Stevens Act (MSA), but internationally-fished stocks require cooperative catch reductions among the fishing nations for this rebuilding to be effective. U.S. responsibility in the rebuilding, however, will be greater the more localized the stock and the greater the domestic take of the stock's production.

Table 5-2. Recent stock status with respect to management criteria.

Note that for most of these species, the scientific bodies developing the assessments do not have a consensus biological reference point for use in the context of managing the fisheries. Levels of *F* and *B* are provided based on the most recent analyses, but in many cases the analyses have not been updated for several years. Thus, those findings should be viewed cautiously for management purposes.

Species (stock)	F_{Recent}/F_{MSY} [1]	Overfishing? ($F/F_{MSY}>1.0$)	B_{Recent}/B_{MSY} [1]	B_{MSST}/B_{MSY}	Overfished? ($B_{Recent}<B_{MSST}$)	B_{FLAG} [2] ($1.25B_{MSST}/B_{MSY}$)	Assessment
TUNAS							
Albacore (NPO)	1.67–2.31[3]	Unknown[3]	Unknown[3]	0.7	Unknown[3]		ISC 2007a
Bluefin (NPO)	>1.0[4]	Unknown[4]	Unknown	0.75	Unknown	0.94	ISC 2006
Bigeye (EPO)	1.30[5]	Y	1.08[5]	0.6	N		IATTC, Aires-da-Silva and Maunder 2007
Bigeye (WCPO)	1.32[6]	Y	1.27[6]		N		WCPFC, Hampton, et al. 2006
Skipjack (EPO)	Unknown[7]	Unlikely[7]	Unknown[7]	0.5	Unlikely[7]		IATTC, Maunder and Deriso 2007
Skipjack (WCPO)	0.17[8]	N	3.01[8]		N		WCPFC, Langley, et al. 2005
Yellowfin (EPO)	1.14[5]	Y	0.96[5]	0.5	N		IATTC, Maunder 2007
Yellowfin (WCPO)	0.95[6]	Y	1.10[6]		N		WCPFC, Langley, et al. 2007
BILLFISHES							
Striped Marlin (NPO)	Unknown[9]	Unknown	Unknown	0.5	Unknown		ISC 2007b
Striped Marlin (EPO)	<1.0[10]	N	≥1.0		N	0.63	IATTC, Hinton and Maunder 2003
Swordfish (NWPO)	Unknown[11]	Unlikely	Unknown	0.61-0.8	Unlikely		ISC 2004
Swordfish (SEPO)	Unknown[12]	Unknown	>1.0		N		IATTC, Hinton and Maunder 2006
SHARKS							
C. Thresher (CA,OR,WA)	<1.0[13]	N	~1.10	0.77	N	0.96	NMFS, PFMC HMS plan development team 2002
Pelagic Thresher	Unknown[14]	Unknown	Unknown	0.85	Unknown	1.06	
Bigeye Thresher	Unknown[15]	Unknown	Unknown	0.78	Unknown	0.97	
Shortfin Mako	<1.0[16]	N	>1.0	0.71	N	0.89	NMFS, PFMC HMS plan development team 2002
Blue	<0.5[17]	N	>1.0	0.78	N	0.97	NMFS and NRIFSF Japan, Kleiber, et al. 2001
OTHER							
Dorado	Unknown[18]	Unknown	Unknown	0.5	Unknown		

Notes:

1 Measures of F_{MSY} and B_{MSY} are not available for all species. Various proxies for these values have been used in preparing this table. However, PFMC has not adopted the use of a particular proxy; hence the designation of Overfishing and Overfished should be considered preliminary.

2 For vulnerable species managed under the OY control rule only: bluefin tuna, striped marlin, and pelagic sharks.

3 Albacore results are based on a suite of F_{MSY} proxies ($F_{40\%}$, $F_{35\%}$, $F_{30\%}$ and $F_{0.1}$), the estimated level of recent (2002-2004) fishing pressure (F=0.75), and constant productivity (R = 27.375 million recruits. However, “Unknown” is indicated because of the lack of a PFMC reference point for management.

[4] Bluefin analyses indicated that F has exceeded F_{Max} 2-fold during the last 2 decades. However, "Unknown" is indicated because of the lack of a PFMC reference point for management.

[5] EPO bigeye and EPO yellowfin results are based on base-case assessments assuming no stock-recruitment relationships and estimated recent (2004-2005) fishing effort.

[6] WCPO bigeye and yellowfin results are based on the base-case assessments.

[7] Because of uncertainties in the estimates of growth and natural mortality, MSY-proxy reference points could not be calculated for EPO skipjack; however, based on a new model examining non-MSY based stock condition indicators, the IATTC does not consider there to be a need for management due increasing CPUE indices and high biomass estimates relative to historical levels.

[8] CWPO skipjack results are from the base-case assessment.

[9] MSY-proxy reference points were not be calculated for NP striped marlin; however, the declining biomass trend and the level of recent fishing effort relative to many commonly used MSY proxy reference points indicates overfishing may be occurring. The ISC recommended that F not be increased.

[10] Two production models demonstrate that the EPO striped marlin population is in good condition with fishing effort and landings in decline since the early 1990s.

[11] Standardized CPUEs from swordfish fisheries indicate declining trends in the northwest Pacific; however, the fisheries are causing, at worst, modest declines in abundance.

[12] Specific values for F/F_{AMSY} and B/B_{AMSY} are not available; however the assessment results indicate that stock biomass is well above the level which would support AMSY.

[13] U.S. west coast EEZ regional catch and CPUE demonstrated the population increasing from estimated low levels in the early 1990s. Recent (2000-03). West coast commercial landings average 318 mt, which is less than 0.75 × MSY proxy (MSY proxy = LMSY from the Population Growth Rate method).

[14] Status unknown, but catches are incidental and occur on the edge of the species' range, predominately during warm water years.

[15] Status unknown, but catches are incidental and occur on the edge of the species' range.

[16] Tentative results based on commercial landings and CPUE calculations. Recent (2000–03) west coast commercial landings average 70 mt, which is less than 0.75 × MSY proxy (MSY proxy = average landings 1981–99).

[17] Analyses demonstrated that for North Pacific blue shark, fishing pressure is 2 to 15 times below F_{MSY}. West coast catch is poorly documented because the fish are not landed.

[18] Status unknown, but dorado are highly productive and widely distributed throughout tropical/subtropical Pacific. Recent west coast landings average 16 mt.

Table 5-3. Stockwide and regional catches for HMS management unit species (x1,000 mt round weight), 2002–06.

Species (stock)	Stockwide Catch	U.S. West Coast Catch		Average Annual Fractional Catch
		Commercial	Recreational	
TUNAS				
Albacore (NPO)	62–105[1]	9–17	0.2–2.8	0.17
Bluefin (NPO)	19–27[1]	<0.2	0.03–0.3	<0.01
Bigeye (EPO)	111–132[2]	<0.05	<0.01	<0.01
Skipjack (EPO)	154–299[2]	0.05-0.5	0.01–0.1	<0.01
Yellowfin (EPO)	177–440[2]	0.08-0.5	0.1–0.3	<0.01
BILLFISHES				
Striped Marlin (EPO)	1.5–2.2[2]	<0.01[3]	0.02[4]	0.01
Swordfish (EPO)	13–20[2]	0.3–2.1	<0.01	0.07
SHARKS				
Common Thresher	Unknown	0.1–0.3	0.01–0.13	
Pelagic Thresher	Unknown	<0.01		
Bigeye Thresher	Unknown	≤0.01		
Shortfin Mako	Unknown	<0.03–0.08	0.02–0.09	
Blue (NPO)	Unknown	<0.06[3]	<0.01	
OTHER				
Dorado	4–11[5]	<0.01	0.02–0.26	0.01

Notes:
Data are from updated commercial (Table 4-4), CPFV (Table 4-51), and private recreational (Table 4-47) catches with weight conversions of 8.7 kg/albacore, 8.7 kg/bluefin, 10.0 kg/bigeye tuna, 3.0 kg/skipjack, 4.9 kg/yellowfin, 57.9 kg/striped marlin, 113 kg/swordfish, 29.2 kg/common thresher, 16.8 kg/mako, 8 kg/blue shark, and 5.6 kg/dorado.

1 International Scientific Committee Eighth Plenary Report Catch Tables, July 2008.
2 IATTC catch tables extracted 8/7/08.
3 Striped marlin and blue shark commercial catches include estimates from the drift gillnet observed catch.
4 Striped marlin recreational catch is estimated at 300 fish/year based on club records plus CPFV logbook recorded catch.
5 FAO Area 77 catch extracted from March 27, 2008 FAO global fishery production dataset.

Agenda Item D.3.a
Attachment 4
April 2009

Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species

Management Unit Species (Actively Managed)

Tunas:
- North Pacific albacore (*Thunnus alalunga*)
- yellowfin tuna (*Thunnus albacares*)
- bigeye tuna (*Thunnus obesus*)
- skipjack tuna (*Katsuwonus pelamis*)
- northern bluefin tuna (*Thunnus orientalis*)

Sharks:
- common thresher shark (*Alopias vulpinus*)
- pelagic thresher shark (*Alopias pelagicus*)
- bigeye thresher shark *(Alopias superciliosus*)
- shortfin mako or bonito shark (*Isurus oxyrinchus*)
- blue shark (*Prionace glauca*)

Billfish/Swordfish:
- striped marlin (*Tetrapturus audax*)
- swordfish (*Xiphias gladius*)

Other:
- dorado or dolphinfish (*Coryphaena hippurus*)

Species Included in the FMP for Monitoring Purposes

Sharks and Rays
Blue shark (*Prionace glauca*)
Whale shark (*Rincodon typus*)
Prickly shark (*Echinorrihinus cookie*)
Salmon shark (*Lamma ditropis*)
Leopard shark (*Triakis semifasciata*)
Hammerhead sharks (Sphyrnidae)
Soupfin shark (*Galeorhinus galeus*)
Silky shark (*Carcharhinus falciformis*)
Oceanic whitetip shark (*C. longimanus*)
Blacktip shark (*C. limbatus*)
Dusky shark (*C. obscurus*)
Sixgill shark (*Hexanchus griseus*)
Spiny dogfish (*Squalus acanthias*)

Pelagic stingray (*Dasyatis violacea*)
Manta/Mobula rays (Mobulidae)
Bat ray (*Myliobatis californica*)

Tunas and Mackerels
Black skipjack (*Euthynnus lineatus*)
Pacific bonito (*Sarda chiliensis*)
Wahoo (*Acathocybium solandri*)
Bullet mackerel (tuna) (*Auxis rochei*)
Frigate mackerel (tuna) (*A. thazard*)
Pacific mackerel (*Scomber japonicus*)

Billfishes and Swordfish
Blue marlin (*Makaira nigricans*)
Black marlin (*M. indica*)
Pacific sailfish (*Istophorus platypterus*)
Shortbill spearfish (*T. angustirostris*)

Jacks, Barracudas, and Pomfrets
Pacific moonfish (*Selene peruviana*)
Yellowtail (*Seriola lalandi*)
Jack mackerel (*Trachurus symmetricus*)
Rainbow runner (*Elegatis bipinnulata*)
Pacific pomfret (*Brama japonica*)
California barracuda (*Sphyraena argentea*)

Other Fishes
Pacific whiting (*Merluccius productus*)
Sebastes spp.
Lingcod (*Ophiodon elongates*)
Pacific saury (*Cololabis saira*)
Common mola (*Mola mola*)
Louvar (*Luvarus imperialis*)
Oarfish (*Regalecus glesne*)
Lancetfishes (Alepisauridae)
Triggerfishes (Balistidae)
Sablefish (*Anoplopoma fimbria*)
Escolar (*Lepidocybium flavobrunneum*)
Oilfish (*Ruvettus pretiosus*)
Opah (*Lampris guttatus*)
White seabass (*Atractoscion noblis*)
Northern anchovy (*Engraulis mordax*)
Pacific sardine (*Sardinops sagax*)
California sheephead (*Semicossyphys pulcher*)

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Albacore tuna: *Thunnus alalunga*.
Bluefin tuna: *Thunnus thynnus*.
Bigeye tuna: *Thunnus obesus*.
Skipjack tuna: *Katsuwonus pelamis*.
Yellowfin tuna: *Thunnus albacares.*
Blackfin tuna: *Thunnus atlanticus*.
Little tuna: *Euthynnus alletteratus*; *Euthynnus affinis*.
Southern bluefin tuna: *Thunnus maccoyii*.
Frigate mackerel: *Auxis thazard*; *Auxis rochei*.
Pomfrets: Family *Bramidae*.
Marlins: *Tetrapturus angustirostris*; *Tetrapturus belone*; *Tetrapturus pfluegeri*; *Tetrapturus albidus*; *Tetrapturus audax*; *Tetrapturus georgei*; *Makaira mazara*; *Makaira indica*; *Makaira nigricans*.
Sail-fishes: *Istiophorus platypterus*; *Istiophorus albicans*.
Swordfish: *Xiphias gladius*.
Sauries: *Scomberesox saurus*; *Cololabis saira*; *Cololabis adocetus*; *Scomberesox saurus scombroides*.
Dolphin: *Coryphaena hippurus*; *Coryphaena equiselis*.
Oceanic sharks: *Hexanchus griseus*; *Cetorhinus maximus*; Family *Alopiidae*; *Rhincodon typus*; Family *Carcharhinidae*; Family *Sphyrnidae*; Family *Isurida*.
Cetaceans: Family *Physeteridae*; Family *Balaenopteridae*; Family *Balaenidae*; Family *Eschrichtiidae*; Family *Monodontidae*; Family *Ziphiidae*; Family *Delphinidae*.

Draft Schedule for Council Action on HMS FMP Revised MSA National Standard 1 Guidelines (ACL) Amendment

Stage	Date
Final Rule published	January 2009
Council initial scoping	April 2009
Range of alternatives, preliminary analysis, draft amendment language	November 2009
Council final action: Adopt preferred alternative	April 2010
Secretarial approval	October 2010
Regulatory changes implemented, if needed	Early 2011

HIGHLY MIGRATORY SPECIES ADVISORY SUBPANEL REPORT ON FISHERY MANAGEMENT PLAN (FMP) AMENDMENTS TO IMPLEMENT ANNUAL CATCH LIMIT (ACL) REQUIREMENTS

The majority of the Highly Migratory Species Advisory Subpanel (HMSAS) understands that National Marine Fisheries Service (NMFS) has defined in National Standard 1 that HMS species that are internationally managed by RFMOs are exempt from Management Councils determining annual catch limits (ACLs) and accountability measures (AMs). If ACLs were required, a likely outcome is that U.S. fishers may be subject to more restrictive measures than ones being required of foreign fleets. NMFS believes that the intent of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) is not to unfairly penalize U.S. fishers for overfishing which is occurring predominantly at the international level. Applying ACL requirements to U.S. fishers on just the U.S. portion of the catch or quota while other nations fish without such additional measures will not end overfishing and would disadvantage U.S. fishers. The guidance given for the international exception allows the Councils to continue managing the U.S. portion of stocks under international agreements, while the U.S. delegation works with regional fishery management organizations (RFMOs) to end overfishing through international cooperation. NMFS has decided not to revise the international exception, and we support this decision. Between now and November 2009, we understand that the Highly Migratory Species Management Team (HMSMT) will determine which of the species in the Pacific Fishery Management Council (PFMC) HMS Fishery Management Plan (FMP) are under international management. We understand that other species in the HMS FMP that are not under international management need to be quantified as target stocks, non-target stocks, or ecosystem component species. We ask that the HMSMT is directed to include the HMSAS participation in the classification of the non-internationally managed stocks between now and November.

A minority of the HMSAS (Meghan Jeans, Ocean Conservancy) believe that the Council and NMFS have an obligation to implement the ACL and AM requirements of the reauthorized MSA as intended by Congress. The rules of statutory construction reveal that Congress did not intend to exempt internationally managed fisheries from the ACL and AM requirements; therefore the Council should amend the HMS FMP to reflect both the spirit and letter of the law. Should the Council and NMFS maintain the flawed legal interpretation embodied in the revised National Standard 1 guidelines, the alleged "international exemption" should be more narrowly construed to apply only to those stocks that are *actively* and *effectively* managed by RFMOs to which the U.S. is a party. Whether a stock is "effectively managed" should be evaluated based on whether the RFMO with jurisdiction over the stock or stock complex has established annual catch limits that are consistent, at a minimum, with the conservation objectives outlined in the MSA, including ending overfishing immediately and rebuilding overfished stocks in as short as time as possible. Application of the alleged exemption notwithstanding, it is important to note that stocks managed under an international agreement are not exempt from compliance with other management requirements, including the establishment of allowable biological catch.

PFMC
04/04/09

Agenda Item D.3.b
Supplemental HMSMT Report
April 2009

HIGHLY MIGRATORY SPECIES MANAGEMENT TEAM REPORT ON FISHERY MANAGEMENT PLAN (FMP) AMENDMENTS TO IMPLEMENT ANNUAL CATCH LIMIT (ACL) REQUIREMENTS

The Highly Migratory Species Management Team (HMSMT) discussed the final National Standard 1 (NS1) guidelines (Agenda Item D.3.a, Attachment 1) and indentified a general approach the Council could use to develop the necessary HMS fishery management plan (FMP) amendment. The HMSMT's discussion focused on three basic steps for producing a range of alternatives and preliminary analysis:

1. Review the species in the FMP and reclassify them into the suggested framework identified in the NS1 guidelines.
2. Identify criteria for applying the international exception to the annual catch limit (ACL) requirements and the set of stocks that may be eligible for the exception.
3. Provide guidance for setting ACLs and other required reference points.

Completing these three steps would likely involve work by Council staff, the HMSMT, the Science & Statistical Committee (SSC), and others from the National Marine Fisheries Service (NMFS) Southwest Fisheries Science Center. The HMSMT would also recommend some form of coordination with the Western Pacific Fishery Management Council and amendment of its Pelagics FMP.

Under the draft schedule for Council action, the initial range of alternatives and preliminary analysis would be prepared for Council review at the November meeting (Agenda Item D.3.a, Attachment 5).

1. Classifying stocks in the FMP

The FMP currently includes 13 management unit species, more than 50 monitored species, and 9 prohibited species. The management unit species are the major target and non-target stocks in west coast HMS fisheries and are subject to active management by the Council. Monitored species are those species that had a record of being caught in an HMS fishery and were not covered by another FMP or state management regime or were of special concern (e.g., life history makes them vulnerable to overfishing) at the time the plan was developed. The Council applied these criteria broadly with the purpose of "evaluat[ing] the impact of HMS fisheries on incidental and bycatch species . . ., and to track the effectiveness of bycatch reduction methods."[1] Prohibited species are species with special status that require additional rules for encounters (e.g., Pacific halibut).

In brief, reclassifying the FMP species into the new suggested framework will involve reviewing the FMP and determining:

[1] *See* section 3.0 of the FMP.

(A) which species are “in the fishery,” and then for the remaining species, deciding whether
(B) to designate them as ecosystem component species, or
(C) to not include the species in the FMP.

The guidelines state that, as a default, all stocks in an FMP are considered to be ‘‘in the fishery’’ unless they are identified as ecosystem component species through an FMP process.[2]

A. Stocks “in the fishery”

Stocks “in the fishery” are those target and non-target stocks that the Council, in its discretion, determines to be in need of conservation and management measures.[3] This category would likely include most, if not all, of the current management unit species, some monitored species, and possibly some of the prohibited species not covered by any other FMP (e.g., great white shark).

B. Ecosystem Component Species

The NS1 guidelines make the designation of ecosystem component species optional. In essence, ecosystem component species are non-target species for which overfishing is not a concern. The guidelines identify the following reasons why the Council may wish to designate ecosystem component species in the FMP:

> For data collection purposes; for ecosystem considerations related to specification of optimum yield for the associated fishery; as considerations in the development of conservation and management measures for the associated fishery; and/or to address other ecosystem issues.[4]

These purposes are consistent with the original rationale for including the monitored species in the FMP. Analysis of information gained since implementation of the FMP could inform the Council’s decision of whether to designate individual monitored species as ecosystem components, to move them to the “in the fishery” category, or to leave them out of either category.

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[2] 50 C.F.R. 600.310(d)(5).
[3] *See* section IV(A) in the Final Rule’s “Supplementary Information” section, (Agenda Item D.3.a, Attachment 1, p. 3179).
[4] § 600.310(d)(5)(D)(iii).

C. Other Reclassification Options

Again, the Council could potentially decide to take a species currently listed as a monitored species out of the FMP if new information and analysis shows the species is not in need of conservation and management or that there is little utility of including it as an ecosystem component species.

In addition, there are several stocks in the HMS FMP—including management unit, monitored, and prohibited species—that are also managed under one of the Council's other FMPs (e.g., groundfish) or in the Western Pacific Council's Pelagic FMP. The NS1 guidelines state that "[I]f a stock is identified in more than one fishery, Councils should choose which FMP will be the primary FMP in which management objectives,… the stock's overall ACL and other reference points for the stock are established."[5] However, while the ACL may be designated in another FMP, the HMS FMP could or should contain "conservation and management measures consistent with the primary FMP's management objectives for the stock."[6]

2. The Exception for Stocks "Subject to" International Management

The Magnuson-Stevens Reauthorization Act (MSRA) "international exception" to the ACL requirement has inspired lengthy discussions at all levels as to its possible scope and meaning. The final NS1 guidelines interpreted the exception to apply "to stocks or stock complexes subject to management under an international agreement."[7] There are several stocks in the HMS FMP that are potentially eligible for this exception because of their association with a regional fishery management organization (RFMO) or international agreement.

The HMSMT's discussion focused on the meaning of the phrase "subject to management." The most informative explanation of this phrase is found in the in the Final Rule's "Supplementary Information" section, in the response to Comment 78 (Attachment 1, p. 3198). This response states that the drafters of the guidelines looked to the MSRA's other provisions on international overfishing and concluded that:

> the intent of MSRA is to not unfairly penalize U.S. fishermen for overfishing which is occurring predominantly at the international level [and that there are many cases where] applying ACL requirements to U.S. fishermen on just the U.S. portion of the catch or quota, while other nations fished without such additional measures, would not lead to ending overfishing and could disadvantage U.S. fishermen.

In other words, there are instances where an ACL on U.S. fisheries may impact U.S. fishing industry with little or no corresponding benefit to the stock. This NS1 guideline interpretation is intended to permit the Council "to continue managing the U.S. portion of stocks under international agreements, while the U.S. delegation works with RFMOs to end overfishing through international cooperation." At the same time, the response to Comment 78 also states that:

[5] 50 C.F.R. § 600.310(d)(7).
[6] Id.
[7] 50 C.F.R. § 600.310(h)(2)(ii). Section 3(24) of the MSA defines an "international fishery agreement" as ''any bilateral or multilateral treaty, convention, or agreement which relates to fishing and to which the United States is a party.''

The guidelines do not preclude Councils or NMFS from applying ACLs or other catch limits to stocks under international agreements, if such action was deemed to be appropriate and consistent with MSA and other statutory mandates.

The HMSMT would suggest that the preliminary analysis identify factors the Council could use to aid its decision on whether to apply the international exception to the numerous species in the FMP that are under the jurisdiction of RFMO or part of some form of international agreement. These factors would be designed to help identify those circumstances where an ACL may be “appropriate and consistent with the MSA and other statutory mandates.” Potential factors to look at include the “relative impact” of U.S. vessels to the stock (i.e., the potential effectiveness of an ACL at preventing overfishing) and the nature of international management (e.g., whether there are active management measures in place, the quality of monitoring, available information on stock status and vulnerability to overfishing).

3. Considerations for setting ACLs

Once stocks in the FMP are reclassified, the guidelines then spell out the set of reference points, ACLs, and other measures required for the stocks in each category. In short, ACLs will be needed for those species “in the fishery” that do not qualify for the international exception. The FMP will not need to specify ACLs for species that qualify for the international exception; however, it will still need to identify status determination criteria (SDC) and maximum sustainable yield (MSY). The HMSMT understands that the SSC will speak to the process of determining ACLs in their statement on this agenda item.

HMSMT Recommendations

- Provide feedback on a process, the HMSMT’s role, and a schedule for identifying a reasonable range of alternatives for preliminary analysis.
- Provide specific guidance on how the international exception should be analyzed.
- Consider identifying a process for coordination with the Western Pacific Council.

PFMC
04/04/09

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON FISHERY MANAGEMENT PLAN (FMP) AMENDMENTS TO IMPLEMENT ANNUAL CATCH LIMIT (ACL) REQUIREMENTS

Dr. Alec MacCall (NMFS) briefed the Scientific and Statistical Committee (SSC) on activities of the National Marine Fisheries Service (NMFS) National Standards 1 Working Group (NS1WG). The NS1WG has focused on implementation issues associated with the new annual catch limit (ACL) requirements.

Several aspects of the Council's Highly Migratory Species Fishery Management Plan (HMS FMP) will require amendment to comply with the new ACL requirements, namely:

- The FMP's control rules need modification to establish a scientific uncertainty buffer, i.e. a reduction in F (or catch) from that associated with estimated F_{MSY} to ensure that overfishing does not occur according to a Council-specified probability.
- Additional buffers may be needed to reflect economic, social, and/or ecological considerations.
- An explicit list of the species covered by the FMP that will require ACLs needs to be developed.

The conceptual development work needed to address Items 1 and 2 has commonality with other Council FMPs, e.g. the Groundfish and Coastal Pelagics Species FMPs. The SSC is willing to be fully engaged in this process as it develops for HMS as well as for other Council FMPs.

However, Item 3 involves considerations that are unique to the HMS FMP owing to the MSA's "ACL international exception." Although there is some ambiguity in the MSA language, the exception appears to alleviate the need for Council ACLs for species managed by the international regional fishery management organizations (RFMO) of which the U.S. is a member, e.g., Inter-American Tropical Tuna Commission (IATTC) or Western and Central Pacific Fisheries Commission (WCPFC).

The HMS FMP includes 62 species or species groups – 13 are "actively managed" while the others are "monitored." The SSC suggests the following process for dealing with Item 3, above.

a. Start with the complete list of species included in the FMP.
b. Eliminate those species more appropriately covered by another Council FMP or those found only in state waters and managed by a state management plan.
c. Identify and eliminate the Ecosystem Component Species.
d. Identify and eliminate the species that fall under the MSA's ACL international exception.
e. For each of the remaining species, ACLs will need to be determined.

The HMSMT – working in conjunction with Council staff, the SSC HMS Subcommittee, and perhaps the WPFMC – may be best suited for developing the list of Council ACL species (following the process outlined in the previous paragraph). Upon completion, the SSC could review this work.

The SSC notes that due to the aforementioned ambiguity in the MSA language, Step d, above, may require guidance from the Council. Some HMS are being actively assessed and managed by RFMOs (e.g. yellowfin and bigeye tunas). Other species – while clearly covered under the RFMO treaties – do not undergo regular stock assessment and are not being actively managed (e.g. several shark species). With respect to the latter group, the Council:

f. may want to be proactive and develop ACLs for these species independent of the RFMOs; or
g. due to workload and/or jurisdictional concerns, may want to eliminate them from the Council's ACL species list, and request (via NMFS/State Department) that the RFMOs provide ACL-like scientific buffers directly to the Council.

Depending upon the Council's guidance regarding the ACL international exception, the number of HMS requiring Council ACLs may be few or may be substantial. In either case, however, the species that comprise the Council ACL group (Item e, above) will most likely be "data poor" with respect to stock assessment and management. Development and evaluation of new stock assessment methods for these data-poor stocks may be necessary. The SSC expects to be fully engaged in this process.

Finally, the draft schedule for HMS FMP amendment (Agenda Item D.3.a, Attachment 5) calls for full implementation in early 2011. This should be workable if the Council's ACL list contains only a few species, but meeting the schedule may be challenging if the list is moderate to large. Additionally, the SSC notes that for HMS that are currently subject to overfishing (yellowfin and bigeye tunas), ACLs may be required in 2010. Meeting this requirement will require close coordination with the RFMOs that conduct the assessments and actively manage these stocks.

PFMC
04/05/09

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April 1, 2009

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

RE: Agenda Item D.3 –FMP Amendments to Implement Annual Catch Limit (ACL) Requirements

Dear Mr. Hansen and Council members:

On behalf of Ocean Conservancy and our nearly 200,000 members and activists nationwide, we respectfully submit the following comments regarding the revisions to the Highly Migratory Species (HMS) Fishery Management Plan (FMP) to address the annual catch limit (ACL) and accountability measure (AM) requirements of the reauthorized Magnuson-Stevens Fishery Conservation and Management Act (MSA). While we look forwarding to working with the Council as it moves forward with an HMS FMP amendment to implement new MSA requirements and management guidelines, these comments specifically relate to the application of the ACL and AM requirements to "international fisheries." Despite agency assertions to the contrary, Congress did not intend to exempt "international fisheries" from the ACL and AM requirements. As such, we recommend that the Council amend the HMS FMP to reflect these statutory requirements, as well as key components of management guidelines.

The flagship conservation requirement of the MSA, National Standard One, states that "conservation and management measures shall *prevent* overfishing." 16 U.S.C. §1851(a)(1) (emphasis added). Yet, twelve years after passage of the Sustainable Fisheries Act, which was *also* supposed to prevent overfishing for *all* managed stocks, overfishing continues to plague fisheries across the United States and abroad. As you know, the MSA, as amended in 2007 by the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (MSRA), includes new fishery management provisions designed to end overfishing in all fisheries and help ensure that it does not reoccur, including a requirement that FMPs include annual catch limits for all fisheries and accountability measures to ensure limits are not exceeded. 16 U.S.C. §1853(a)(15). In January, the National Marine Fisheries Service (NMFS) finalized revisions to the National Standard One (NS 1) guidelines that will help guide this Council in effectively and fully implementing important MSA provisions. While the Pacific Council has been largely supportive of domestic and international efforts to end overfishing of highly migratory species in the Pacific region, implementation of the new MSA provisions and the NS1 guidelines is critical to ensuring that measures truly end and prevent overfishing, that catch stays within prescribed catch limits, that rebuilding goals are met, and that optimum yield (OY) is achieved.

We urge the Council to thoroughly analyze the HMS FMP to determine the specific changes that must be made in order to comply with the MSA and the NS1 guidelines. We look forward to working with you to ensure that the key components of the NS1 guidelines are included in the FMP. We are immediately concerned, however, that the Council may be moving forward with an HMS FMP amendment under the assumption that all "international fisheries" are exempted from the ACL and AM requirements of the MSA.

We believe the NS1 guidelines fundamentally misinterpret section 104(b) of the MSRA as exempting stocks managed under an international agreement in which the United States participates ("international fisheries") from the MSRA's ACL and AM requirements. See §600.310(h)(2)(ii). Congress included a provision in the MSRA that exempted species with a life cycle of approximately one year or less from ACL and AM requirements of the MSA (MSRA §104(b)(2)), and set out effective dates for implementing the ACL and AM requirements (MSRA §104(b)(1)). Regarding international fisheries, this provision merely allows for different effective dates for ACLs and AMs than those for domestic fisheries, and was not intended to exempt international fisheries from ACL and AM requirements.

Section 104(b) of the MSRA states:

> (b)The amendment made by subsection (a)(10) [which created section 303(a)(15) of the MSA, the ACL/AM provision]—
>
> > (1) shall, unless otherwise provided for under an international agreement, take effect—
> >
> > > (A) in fishing year 2010 for fisheries determined by the Secretary to be subject to overfishing; and
> > >
> > > (B) in fishery year 2011 for all other fisheries; and
> >
> > (2) shall not apply to a fishery for species that have a life cycle of approximately 1 year unless the Secretary has determined the fishery is subject to overfishing of that species; and
> >
> > (3) shall not limit or otherwise affect the requirements of section 301(a)(1) or 304(e) of the MSA.

Paragraph (1) refers to the effective dates of the provision. Paragraph (2), on the other hand, is a clear exemption for fisheries with an annual life cycle. Had Congress intended to exempt international fisheries, it would have included that exception in paragraph (2) along with the one-year life cycle species, or created an additional paragraph for international fisheries. The correct interpretation is that paragraph (1) refers to the timing of implementation of the new ACL/AM requirements while paragraph two addresses exemptions. In other words, the ACL requirements of the MSA shall take effect in 2010 or 2011, unless an international agreement to which the U.S. is a party provides for another effective date.

Assuming for purposes of argument that the agency's faulty legal interpretation is maintained, the provision at the very least must be interpreted to apply only to those stocks that are *actively* managed by international commissions to which the U.S. is a party AND when the RFMO with jurisdiction over the stock or stock complex has established annual catch limits that are consistent, at a minimum, with the conservation objectives outlined in the MSA, including ending overfishing immediately and rebuilding overfished stocks in as short as time as possible. In many instances, RFMOs are unable to reach an agreement on conservation and management measures. For example, there are currently no internationally agreed upon conservation measures for bigeye or yellowfin tuna in the eastern Pacific Ocean. As such, it would be contrary to the intent of the law to exempt bigeye and yellowfin from the ACL requirements where no international management exists.

Moreover, there still remains substantial ambiguity as to what constitutes a stock or stock complex "subject to management under an international agreement" and would therefore be "exempt" from the ACL and AM requirements. For instance, the Antigua Convention for the IATTC defines "[f]ish stocks covered by this Convention" as "stocks of tunas and tuna-like species and other species of fish taken by vessels fishing for tunas and tuna-like species in the Convention Area." Convention for the Strengthening of the Inter-American Tropical Tuna Commission Established by the 1949 Convention Between the United States of America and the Republic of Costa Rica ("Antigua Convention"), Section I, Article I(1). We are concerned that the agency's interpretation of the MSRA, coupled with a lack of definitional specificity could mean that anything and everything that is caught by vessels subject to IATTC management jurisdiction may be excluded from the ACL requirement. Likewise, the Western and Central Pacific Fisheries Commission (WCPFC) Convention defines HMS as those species listed in Annex I to the United Nations Convention on the Law of the Sea (UNCLOS). If Annex I were used as the basis for determining the applicability of the "international exception", then all HMS FMP management unit species would be exempted from the ACL and AM requirements. This overly broad exemption is contrary to both the letter and spirit of the law.

Already, U.S. fishermen targeting HMS off the west coast are arguing that "non-target fish" (i.e., opah and dorado) that are often caught and retained for sale should be exempt from the ACL and AM requirements because even though they are not *actively* managed by the IATTC, they are *subject to* the management of the IATTC as defined in the Convention. This interpretation represents a significant loophole and potential avenue by which those seeking relief from regulations and constraints on catch can argue that individual stocks are exempt from the ACL and AM requirements.

Application of the alleged exemption notwithstanding, it is also worth noting that stocks managed under an international agreement are not exempt from compliance with other management requirements, including the establishment of allowable biological catch (ABC).

Once again, we look forwarding to working with the Council to develop and implement measures that are consistent with the ACL and AM requirements of the MSRA. As part of this initial scoping period, we hope that the Council will take a broad and inclusive view of which HMS MUS are to subject to these statutory requirements to ensure that the HMS FMP complies with both the spirit and the letter of the law.

Sincerely,

Meghan Jeans
Pacific Fish Conservation Manager

Agenda Item D.4
Situation Summary
April 2009

INTERNATIONAL REGIONAL FISHERY MANAGEMENT ORGANIZATION (RFMO) MATTERS

The Inter-American Tropical Tuna Commission (IATTC) will hold its annual meeting June 1-12, 2009, in San Diego, California. Agenda Item D.4.a, Attachment 1 is a letter from Dr. Donald McIsaac to National Marine Fisheries Service Northwest Region Regional Administrator (and U.S. Commissioner) Rod McInnis conveying the Council's recommendations in advance of the 2008 IATTC annual meeting. The lack of agreement on conservation measures for bigeye and yellowfin tuna has been an ongoing concern since the last resolution on this matter expired at the end of 2007. The IATTC was unable to adopt a new resolution at their 2008 meeting. Agenda Item D.4.a, Attachments 2 and 3 are slightly-modified versions of stock assessment reports prepared for the 9th Stock Assessment Review Meeting held during May 12-16, 2008. (Summaries are attached to printed materials; full documents available online.) Most of these include data through 2007. The next Stock Assessment Review Meeting is scheduled for May 12-15, 2009, in Del Mar, California.

Executive Director Donald McIsaac will report on the Western and Central Pacific Fisheries Commission (WCPFC) Fifth Annual Meeting, which took place in Busan, Korea, December 8-12, 2008. Agenda Item D.4.b, Attachment 1 is a letter sent to Council members summarizing the meeting activities and its outcome. Attachment 2 contains the Conservation and Management Measures adopted at the meeting.

Dr. McIsaac will also present an update of the process to finalize a memorandum of understanding (MOU) between the Pacific, Western Pacific, and North Pacific Councils and the Departments of State and Commerce regarding Council participation in U.S. delegations to RFMOs and associated advisory committees. Part of the Magnuson-Stevens Reauthorization Act directed the Federal departments to reach this MOU with the Councils. Council Executive Directors and departmental representatives have been working on the substance of the MOU for the past two years.

Council Action:

Decide on Signing the MOU and Make Recommendations to the Inter-American Tropical Tuna Commission.

Reference Materials:

1. Agenda Item D.4.a, Attachment 1: Letter from Donald McIsaac to Rod McInnis Containing Recommendations for the U.S. Delegation to the Inter-American Tropical Tuna Commission.
2. Agenda Item D.4.a, Attachment 2: Status Of Yellowfin Tuna in the Eastern Pacific Ocean in 2007 and Outlook for the Future. **(Entire Document on CD and Web Only)**
3. Agenda Item D.4.a, Attachment 3: Status Of Bigeye Tuna in the Eastern Pacific Ocean in 2007 and Outlook for the Future. **(Entire Document on CD and Web Only)**
4. Agenda Item D.4.b, Attachment 1: Letter from Donald McIsaac to Donald Hansen Regarding Western and Central Pacific Fisheries Commission Fifth Annual Meeting Report.

5. Agenda Item D.4.b, Attachment 2: Conservation and Management Measures Adopted at the Western and Central Pacific Fisheries Commission Fifth Annual Meeting **(Entire Document on CD and Web Only)**

Agenda Order:

a. Agenda Item Overview — Kit Dahl
b. Report on the Fifth Regular Session of the Western and Central Pacific Fisheries Commission — Don McIsaac
c. Status of Memorandum of Understanding (MOU) on Council Participation in RFMO Delegations and Advisory Bodies — Don McIsaac
d. Reports and Comments of Management Entities and Advisory Bodies
c. Public Comment
d. **Council Action:** Determine Council Action with regard to the MOU and Recommendations to the Inter-American Tropical Tuna Commission

PFMC
03/24/09

Pacific Fishery Management Council

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Donald K. Hansen, Chairman Donald O. McIsaac, Executive Director

April 18, 2008

Mr. Rodney McInnis
Regional Administrator, Southwest Region
National Marine Fisheries Service
501 W Ocean Blvd., Ste. 4200
Long Beach, CA 90802-4213

Re: Recommendations for the U.S. Delegation to the Inter-American Tropical Tuna Commission

Dear Mr. McInnis, Rod

At their April 7–12, 2008, meeting the Council made three recommendations for the U.S. delegation to the Inter-American Tropical Tuna Commission (IATTC) to consider when developing positions to be taken at the IATTC's 78th meeting, June 23–27, 2008.

First, the Council is concerned that the IATTC has been 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. The Council urges the U.S. delegation to advocate vigorously for conservation and management measures sufficient to end overfishing on these two stocks. However, the Council notes that U.S. west coast coastal purse seine vessels occasionally target yellowfin tuna on those infrequent occasions when they occur off of Southern California. Their catches represent a very small proportion of total catches in the Eastern Pacific Ocean, but are an important economic opportunity for this fleet. Noting that any effective conservation and management measures would likely require a seasonal closure for purse seine vessels, the Council asks that the U.S. delegation work with the IATTC to explore the implications of an exemption for smaller, Class I-V vessels (well volume less than 426 m^3) for the success of conservation and management measures. While an exemption for U.S. vessels alone may not impede successfully ending overfishing, we recognize that any such exemption would likely be applicable to vessels in these size classes from all member nations, potentially increasing the number of exempted vessels too much. One approach would be to model an exemption after the formula in C-06-02 used to limit catches of bigeye tuna by longline vessels. An exemption would be based on historical catch by vessels in these size categories for each nation. If catches were below a certain level, then the nation's Class I-V vessels would be exempted from the closure up to some small catch limit. For example, the U.S. fleet averaged less than 500 mt catch of yellowfin tuna in 2001–05, so an exemption based on a value of that general magnitude, along with a requirement that the national fleet not exceed some amount of catch, could be a workable formula. This would depend on the number of other nations potentially qualifying for such an exemption, and the overall level of catch that could ensue. IATTC scientific staff should conduct such an evaluation.

Second, we recommend the U.S. delegation emphasize to IATTC our growing concern about the status of the striped marlin stock in the North Pacific. A stock assessment published by the International Scientific Committee for Tuna and Tuna-like Species in 2007, based on the assumption that striped marlin is a single stock in the North Pacific, concluded that the stock is substantially depleted from historic levels. The IATTC has not conducted a striped marlin stock assessment since 2003. The U.S. should encourage the IATTC to conduct a new stock assessment as a basis for considering whether conservation and management measures are necessary. Any such stock assessment should critically evaluate available information on stock structure in order to determine whether an Eastern Pacific Ocean stock should be managed separately or as part of a single North Pacific stock.

Third, the Council notes that the U.S. has complied with Resolution C-05-02 by defining historical levels of fishing effort by U.S. vessels on the North Pacific albacore stock and demonstrating that effort has not increased. However, it does not appear that other nations have complied with the resolution in a similarly transparent way. We recommend the U.S. delegation request the IATTC emphasize that member nations formally demonstrate compliance with the resolution. Furthermore, in bilateral discussions, we recommend the U.S. encourage member nations to openly communicate how they are complying with the requirements of the resolution.

Clearly, the Council shares your concern about the status of the highly migratory species stocks in the IATTC arena. Addressing potential unsustainable fishing effort on these stocks requires international success on the difficult task of achieving consensus on effective management measures. The Council asks you to convey the views expressed in this letter to the U.S. delegation and the IATTC. We also stand ready to assist as necessary in this important matter.

Sincerely,

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

CRD:kam

cc: Council Members
Mr. David Hogan
Mr. Peter Flournoy
Ms. Rebecca Lent
Mr. Bill Robinson
Ms. Kitty Simonds
Mr. Paul Dalzell

STATUS OF YELLOWFIN TUNA IN THE EASTERN PACIFIC OCEAN IN 2007 AND OUTLOOK FOR THE FUTURE

by

Mark N. Maunder and Alexandre Aires-da-Silva

CONTENTS

1. SUMMARY

This report presents the most current stock assessment of yellowfin tuna (*Thunnus albacares*) in the eastern Pacific Ocean (EPO). An age-structured, catch-at-length analysis (A-SCALA) was used in the assessment, which is based on the assumption that there is a single stock of yellowfin in the EPO. Yellowfin are distributed across the Pacific Ocean, but the bulk of the catch is made in the eastern and western regions. The purse-seine catches of yellowfin are relatively low in the vicinity of the western boundary of the EPO. The movements of tagged yellowfin are generally over hundreds, rather than thousands, of kilometers, and exchange between the eastern and western Pacific Ocean appears to be limited. This is consistent with the fact that longline catch-per-unit-of-effort (CPUE) trends differ among areas. It is likely that there is a continuous stock throughout the Pacific Ocean, with exchange of individuals at a local level, although there is some genetic evidence for local isolation. Movement rates between the EPO and the western Pacific cannot be estimated with currently-available tagging data.

The stock assessment requires substantial amounts of information, including data on retained catches, discards, fishing effort, and the size compositions of the catches of the various fisheries. Assumptions have been made about processes such as growth, recruitment, movement, natural mortality, fishing mortality, and stock structure. The assessment for 2008 differs from that of 2007 in the following ways. The catch and length-frequency data for the surface fisheries have been updated to include new data for 2007 (except the first quarter) and revised data for 2000-2006 and the first quarter of 2007. New or updated longline catch data are available for Chinese Taipei (2004-2006) and Japan (2003-2006).

In general, the recruitment of yellowfin to the fisheries in the EPO is variable, with a seasonal component. This analysis and previous analyses have indicated that the yellowfin population has experienced two, or possibly three, different productivity regimes (1975-1982, 1983-2001, and 2002-2006) corresponding to low, high, and intermediate levels of recruitment. The productivity regimes correspond to regimes in biomass, higher-productivity regimes producing greater biomasses. A stock-recruitment relationship is also supported by the data from these regimes, but the evidence is weak, and is probably an artifact of the apparent regime shifts. The analysis indicates that strong cohorts entered the fishery during 1998-2001, and that these cohorts increased the biomass during 1999-2001. However, these cohorts have now moved through the population, so the biomass decreased during 2002-2007. The biomass in 2005-2008 was at levels similar to those prior to 1985.

The average weights of yellowfin taken from the fishery have been fairly consistent over time, but vary

substantially among the different fisheries. In general, the floating-object, unassociated, and pole-and-line fisheries capture younger, smaller yellowfin than do the dolphin-associated and longline fisheries. The longline fisheries and the dolphin-associated fishery in the southern region capture older, larger yellowfin than do the northern and coastal dolphin-associated fisheries.

Significant levels of fishing mortality have been estimated for the yellowfin fishery in the EPO. These levels are highest for middle-aged yellowfin. Most of the yellowfin catch is taken in sets associated with dolphins, and, accordingly, this method has the greatest impact on the yellowfin population, although it has almost the least impact per unit of weight captured of all fishing methods.

Historically, the spawning biomass ratio (ratio of the spawning biomass to that of the unfished population, SBR) of yellowfin in the EPO was below the level corresponding to the maximum sustainable yield (MSY) during the lower productivity regime of 1975-1983, but above that level for most of the following years, except for the recent period (2003-2007). The increase in the SBR in 1984 is attributed to the regime change, and the recent decrease may be a reversion to an intermediate productivity regime. The two different productivity regimes may support two different MSY levels and associated SBR levels. The SBR at the start of 2008 is estimated to be above the level corresponding to the MSY. The effort levels are estimated to be less than those that would support the MSY (based on the current distribution of effort among the different fisheries), but recent catches are substantially below the MSY.

If a stock-recruitment relationship is assumed, the outlook is more pessimistic, and current biomass is estimated to be below the level corresponding to the MSY.

The current average weight of yellowfin in the catch is much less than the critical weight. The MSY calculations indicate that, theoretically at least, catches could be increased if the fishing effort were directed toward longlining and purse-seine sets on yellowfin associated with dolphins. This would also increase the SBR levels.

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

Under current levels of fishing mortality, it is predicted that the biomass will increase and then decrease but remain above the current level, and that the SBR will follow a similar trend, remaining above the level corresponding to the MSY. A comparison of the biomass and SBR predicted with and without the restrictions from Resolutions C-04-09 and C-06-02 suggests that, without the restrictions, they would be at lower levels than at present, and would decline to about the level corresponding to the MSY.

These simulations were carried out, using the average recruitment for the 1975-2007 period. If they had been carried out using the average recruitment for the 1983-2001 period, the projected trend in SBR and catches would have been more positive. Conversely, if they had been carried out using the average recruitment for the 2002-2006 period, the projected trend in SBR and catches would have been more negative.

Key results

1. The results are similar to the previous assessments, except that the current effort is less than that corresponding to MSY.
2. There is uncertainty about recent and future recruitment and biomass levels.
3. The recent fishing mortality rates are close to those corresponding to the MSY.
4. Increasing the average weight of the yellowfin caught could increase the MSY.
5. There have been two, and possibly three, different productivity regimes, and the levels of MSY and the biomasses corresponding to the MSY may differ between the regimes. The population may have recently switched from the high to an intermediate productivity regime.

6. The results are more pessimistic if a stock-recruitment relationship is assumed.

2. DATA

Catch, effort, and size-composition data for January 1975-December 2007, plus biological data, were used to conduct the stock assessment of yellowfin tuna, *Thunnus albacares*, in the eastern Pacific Ocean (EPO). The data for 2007, which are preliminary, include records that had been entered into the IATTC databases by 15 April 2007. All data are summarized and analyzed on a quarterly basis.

2.1. Definitions of the fisheries

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

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

2.2. Catch and effort data

To conduct the stock assessment of yellowfin tuna, the catch and effort data in the IATTC databases are stratified according to the fishery definitions described in Section 2.1 and shown in Table 2.1. "Landings" is catch landed in a given year even if the fish were not caught in that year. Catch that is taken in a given year and not discarded at sea is termed retained catch. Throughout the document the term "catch" will be used to reflect either total catch (discards plus retained catch) or retained catch, and the reader is referred to the context to determine the appropriate definition.

All three of these types of data are used to assess the stock of yellowfin. Removals by Fisheries 10-12 are simply retained catch (Table 2.1). Removals by Fisheries 1-4 are retained catch plus some discards resulting from inefficiencies in the fishing process (see Section 2.2.3) (Table 2.1). The removals by Fisheries 5-9 are retained catch, plus some discards resulting from inefficiencies in the fishing process and from sorting the catch. Removals by Fisheries 13-16 are only discards resulting from sorting the catch taken by Fisheries 1-4 (see Section 2.2.2) (Table 2.1).

New and updated catch and effort data for the surface fisheries (Fisheries 1-10 and 13-16) have been incorporated into the current assessment. New catch and effort data for 2007 (except the first quarter, which were used in the previous assessment) and updated data for earlier years are used for the surface fisheries.

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

Updates and new catch and effort data for the longline fisheries (Fisheries 11 and 12) have also been incorporated into the current assessment. New or updated catch data were available for Chinese Taipei (2004-2006) and Japan (2003-2006).

The amount of longlining effort was estimated by dividing standardized estimates of the catch per unit of effort (CPUE) from the Japanese longline fleet into the total longline landings. Estimates of standardized CPUE were obtained using a delta-lognormal generalized linear model (Stefansson 1996) that took into account latitude, longitude, and numbers of hooks between floats (Hoyle and Maunder 2006b).

2.2.1. Catch

A substantial proportion of the longline catch data for 2007 were not available, so effort data were assumed (see Section 2.2.2), and the catch was estimated by the stock assessment model. Therefore, the total 2007 longline catch is a function of the assumed 2007 longline effort, the estimated number of yellowfin of catchable size in the EPO in 2007, and the estimated selectivities and catchabilities for the longline fisheries. Catches for the longline fisheries for the recent years for which the data were not available were set equal to the last year for which catch data were available.

Trends in the catch of yellowfin in the EPO during each quarter from January 1975 to March 2007 are shown in Figure 2.2. It should be noted that there were substantial surface and longline fisheries for yellowfin prior to 1975 (Shimada and Schaefer 1956; Schaefer 1957; Okamoto and Bayliff 2003). The majority of the catch has been taken by purse-seine sets on yellowfin associated with dolphins and in unassociated schools. One main characteristic of the catch trends is the increase in catch taken since about 1993 by purse-seine sets on fish associated with floating objects, especially FADs in Fisheries 1 and 2. However, this is a relatively small part of the total catch.

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

2.2.2. Effort

New effort data for 2007 (except the first quarter, which was used in the previous assessment) and updated data for earlier years are used for the surface fisheries.

A complex algorithm, described by Maunder and Watters (2001), was used to estimate the amount of fishing effort, in days fished, exerted by purse-seine vessels. The longline effort data for yellowfin have been estimated from standardized CPUE data, as follows. Detailed data on catch, effort, and hooks between floats by latitude and longitude from the Japanese longline fleet, provided by Mr. Adam Langley of the Secretariat of the Pacific Community, were used in a generalized linear model with a delta lognormal link function to produce an index of standardized CPUE (E.J. Dick, NOAA Santa Cruz, personal communication); see Stefansson (1996) for a description of the method and Hoyle and Maunder (2006b) for more detailed information. The Japanese effort data were scaled by the ratio of the Japanese catch to the total catch to compensate for the inclusion of catch data from the other nations into the assessment. This allows inclusion of all the longline catch data into the assessment, while using only the Japanese effort data to provide information on relative abundance.

Effort information from the Japanese longlining operations conducted in the EPO during 2007 was not available for this assessment. The longline effort exerted during each quarter of 2007 was assumed to be equal to the estimated effort exerted during the corresponding quarter of 2006. No longline catch data were input for 2007 (see above).

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

2.2.3). Fishing effort for longliners (Fisheries 11 and 12) is in standardized units.

2.2.3. Discards

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

Estimates of discards resulting from inefficiencies in the fishing process are added to the retained catches (Table 2.1). No observer data are available to estimate discards prior to 1993, and it is assumed that there were no discards due to inefficiencies before that time. There are periods for which observer data are not sufficient to estimate the discards, in which case it is assumed that the discard rate (discards/retained catches) is equal to the discard rate for the same quarter in the previous year or, if not available, a proximate year.

Discards that result from the process of sorting the catches are treated as separate fisheries (Fisheries 13-16), and the catches taken by these fisheries are assumed to be composed only of fish that are 2-4 quarters old (see Figure 4.5). Maunder and Watters (2001) provide a rationale for treating such discards as separate fisheries. The discard rate prior to 1993 is assumed to be the average rate observed in each fishery after this time. Estimates of the amounts of fish discarded during sorting are made only for fisheries that take yellowfin associated with floating objects (Fisheries 2-5) because sorting is infrequent in the other purse-seine fisheries.

Time series of discards as proportions of the retained catches for the surface fisheries that catch yellowfin in association with floating-objects are presented in Figure 2.4. It is assumed that yellowfin are not discarded from longline fisheries (Fisheries 11 and 12).

2.3. Size-composition data

The fisheries of the EPO catch yellowfin of various sizes. The average size composition of the catch from each fishery defined in Table 2.1 is shown in Figure 4.2. Maunder and Watters (2001) describe the sizes of yellowfin caught by each fishery. In general, floating-object, unassociated, and pole-and-line fisheries catch smaller yellowfin, while dolphin-associated and longline fisheries catch larger ones. New purse-seine length-frequency data were included for the last three quarters of 2007, and revised data for 2000-2005 and the first quarter of 2007.

New longline length-frequency data for 2005 for the Japanese fleet, and updated data for that fleet for 2002-2004, were included. Size composition data for the other longline fleets are not used in the assessment.

The length frequencies of the catches during 2007 from the four floating-object fisheries were similar to those observed over the entire modeling period (compare Figures 4.2 and 4.8a). The appearance, disappearance, and subsequent reappearance of strong cohorts in the length-frequency data is a common phenomenon for yellowfin in the EPO. This may indicate spatial movement of cohorts or fishing effort, limitations in the length-frequency sampling, or fluctuations in the catchability of the fish. Bayliff (1971) observed that groups of tagged fish have also disappeared and then reappeared in this fishery, which he attributed to fluctuations in catchability.

2.4. Auxiliary data

Age-at-length estimates (Wild 1986) calculated from otolith data were integrated into the stock assessment model in 2005 (Hoyle and Maunder 2006a) to provide information on mean length at age and variation in length at age. His data consisted of ages, based on counts of daily increments in otoliths, and lengths for 196 fish collected between 1977 and 1979. The sampling design involved collection of 15 yellowfin in each 10-cm interval in the length range of 30 to 170 cm. The model has been altered to take this sampling scheme into account (see Section 3.1.1).

3. ASSUMPTIONS AND PARAMETERS

3.1. Biological and demographic information

3.1.1. Growth

The growth model is structured so that individual growth increments (between successive ages) can be estimated as free parameters. These growth increments for all ages were highly constrained to be similar to a Richards growth curve. The Richards growth equation, $L_t = L_\infty \left(1 - \frac{\exp\left(-K\left(t - t_0\right)\right)}{b}\right)^b$, fitted to data from Wild (1986) was used as the prior (Figure 3.1) (L_∞ = 185.7 cm, annual K= 0.761, t_0 = 1.853 years, b = -1.917). The growth increments are also constrained so that the mean length is a monotonically increasing function of age. The size at which fish are first recruited to the fishery must be specified, and it is assumed that yellowfin are recruited to the discard fisheries (Fisheries 13-16) when they are 30 cm long and two quarters old.

Expected asymptotic length (L_∞) cannot be reliably estimated from data such as those of Wild (1986) that do not include many old fish. However, Hoyle and Maunder (2007) found that the results were insensitive to the value of L_∞.

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

This assessment used the approach first employed by Hoyle and Maunder (2006a) to estimate variation in length at age from the data. Both the sampling scheme and the fisheries and time periods in which data were collected were taken into account. The mean lengths of older yellowfin were assumed to be close to those indicated by the growth curve of Wild (1986).

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

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

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

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

3.1.2. Recruitment and reproduction

The A-SCALA method allows a Beverton-Holt (1957) stock-recruitment relationship to be specified. The Beverton-Holt curve is parameterized so that the relationship between spawning biomass and recruitment is determined by estimating the average recruitment produced by an unexploited population (virgin recruitment) and a parameter called steepness. Steepness is defined as the fraction of virgin recruitment that is produced if the spawning stock size is reduced to 20% of its unexploited level, and it controls how quickly recruitment decreases when the size of the spawning stock is reduced. Steepness can vary between 0.2 (in which case recruitment is a linear function of spawning stock size) and 1.0 (in which case recruitment is independent of spawning stock size). In practice, it is often difficult to estimate steepness because of lack of contrast in spawning stock size, high inter-annual (and inter-quarter) variation in recruitment, and confounding with long-term changes in recruitment, due to environmental effects not included in the model that affect spawning stock size. The base case assessment assumes that there is no relationship between stock size and recruitment. This assumption is the same as that used in the previous assessments. The influence of a Beverton-Holt stock-recruitment relationship is investigated in a sensitivity analysis.

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

An assumption is made about the way that recruitment can vary around its expected level, as determined from the stock-recruitment relationship. This assumption is used to penalize the temporal recruitment deviates. It is assumed that the logarithm of the quarterly recruitment deviates is normally distributed with a standard deviation of 0.6.

Yellowfin are assumed to be recruited to the discard fisheries in the EPO at about 33 cm (about 2 quarters old) (Section 3.1.1). At this size (age), the fish are vulnerable to capture by fisheries that catch fish in association with floating objects (*i.e.* they are recruited to Fisheries 13-16).

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

3.1.3. Movement

The evidence of yellowfin movement within the EPO is summarized by Maunder and Watters (2001) and new research is contained in Schaefer *et al.* (2007). Schaefer *et al.* (2007) found that movements of yellowfin tuna released off southern Baja California, including those at liberty in excess of one year, are geographically confined. Therefore, the level of mixing between this area and others in the EPO should be expected to be very low. This result is consistent with the results of various tagging studies (conventional and archival) of tropical tunas throughout the Pacific. This indicates that fishery-wide controls of effort or catch will most likely be ineffective to prevent localized depletions of these stocks (Schaefer *et al.* 2007). For the purposes of the current assessment, it is assumed that movement does not affect the stock assessment results. However, given the results of Schaefer *et al*. (2007), investigation of finer spatial scale or separate sub-stocks should be considered.

3.1.4. Natural mortality

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

3.1.5. Stock structure

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

3.2. Environmental influences

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

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

4. STOCK ASSESSMENT

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

The A-SCALA method was first used to assess yellowfin in the EPO in 2000 (Maunder and Watters, 2001), and was modified and used for subsequent assessments. The following parameters have been estimated for the current stock assessment of yellowfin in the EPO:

1. recruitment to the fishery in every quarter from the first quarter of 1975 through the first quarter of 2008;
2. quarterly catchability coefficients for the 16 fisheries that take yellowfin from the EPO;
3. selectivity curves for 12 of the 16 fisheries (Fisheries 13-16 have an assumed selectivity curve);
4. initial population size and age-structure;
5. mean length at age (Figure 3.1);
6. parameters of a linear model relating the standard deviations in length at age to the mean lengths at age.

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

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

Yield and catchability estimates for estimations of the average maximum sustainable yield (MSY) or future projections were based on estimates of quarterly fishing mortality for 2005-2007. The sensitivity of estimates of key management quantities to this assumption was tested.

There is uncertainty in the results of the current stock assessment. This uncertainty arises because the observed data do not perfectly represent the population of yellowfin in the EPO. Also, the stock assessment model may not perfectly represent the dynamics of the yellowfin population nor of the fisheries that operate in the EPO. Uncertainty is expressed as approximate confidence intervals and coefficients of variation (CVs). The confidence intervals and CVs have been estimated under the assumption that the stock assessment model perfectly represents the dynamics of the system. Since it is unlikely that this assumption is satisfied, these values may underestimate the amount of uncertainty in the results of the current assessment.

4.1. Indices of abundance

CPUEs have been used as indices of abundance in previous assessments of yellowfin in the EPO (*e.g.* Anonymous 1999). It is important to note, however, that trends in the CPUE will not always follow trends in the biomass or abundance. There are many reasons why this could be the case. For example, if, due to changes in technology or targeting, a fishery became more or less efficient at catching yellowfin while the biomass was not changing, the CPUEs would increase or decrease despite the lack of trend in biomass. Fisheries may also show hyper- or hypo-stability, in which the relationship between CPUE and abundance is non-linear (Hilborn and Walters 1992; Maunder and Punt 2004). The CPUEs of the 16 fisheries defined for the current assessment of yellowfin in the EPO are shown in Figure 4.1. Trends in longline CPUE are based only on the Japanese data. As mentioned in Section 2.2.2, CPUE for the longline fisheries was standardized using general linear modeling. Discussions of historical catch rates can be found in Maunder and Watters (2001, 2002), Maunder (2002a), Maunder and Harley (2004, 2005), and Hoyle and Maunder (2006a), but trends in CPUE should be interpreted with caution. Trends in estimated biomass are discussed in Section 4.2.3.

4.2. Assessment results

Below we describe important aspects of the base case assessment (1 below) and changes for the sensitivity analyses (2 below):

1. Base case assessment: steepness of the stock-recruitment relationship equals 1 (no relationship

between stock and recruitment), species-composition estimates of surface fishery catches scaled back to 1975, delta-lognormal general linear model standardized CPUE, and assumed sample sizes for the length-frequency data.

2. Sensitivity to the steepness of the stock-recruitment relationship. The base case assessment included an assumption that recruitment was independent of stock size, and a Beverton-Holt stock-recruitment relationship with a steepness of 0.75 was used for the sensitivity analysis.

The results of the base case assessment are described in the text, and the stock-recruitment relationship sensitivity analysis is described in the text, with figures and tables presented in Appendix A1.

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

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

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

4.2.1. Fishing mortality

There is variation in fishing mortality exerted by the fisheries that catch yellowfin in the EPO, with fishing mortality being higher before 1984, during the lower productivity regime (Figure 4.3a), and since 2003. Fishing mortality changes with age (Figure 4.3b). The fishing mortalities for younger and older yellowfin are low. There is a peak at around ages of 14-15 quarters, which corresponds to peaks in the selectivity curves for fisheries on unassociated and dolphin-associated yellowfin (Figures 4.3b and 4.4). The fishing mortality of young fish has not greatly increased in spite of the increase in effort associated with floating objects that has occurred since 1993 (Figure 4.3b).

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

Selectivity curves estimated for the 16 fisheries defined in the stock assessment of yellowfin are shown in Figure 4.4. Purse-seine sets on floating objects select mostly yellowfin that are about 4 to 14 quarters old

(Figure 4.4, Fisheries 1-4). Purse-seine sets on unassociated schools of yellowfin select fish similar in size to those caught by sets on floating objects (about 5 to 15 quarters old, Figure 4.4, Fisheries 5 and 6), but these catches contain greater proportions of fish from the upper portion of this range. Purse-seine sets on yellowfin associated with dolphins in the northern and coastal regions select mainly fish 7 to 15 quarters old (Figure 4.4, Fisheries 7 and 8). The dolphin-associated fishery in the south selects mainly yellowfin 12 or more quarters old (Figure 4.4, Fishery 9). Longline fisheries for yellowfin also select mainly older individuals about 12 or more quarters old (Figure 4.4, Fisheries 11 and 12). Pole-and-line gear selects yellowfin about 4 to 8 quarters old (Figure 4.4, Fishery 10).

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

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

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

The ability of purse-seine vessels to capture yellowfin in dolphin-associated sets has been less variable in the northern and coastal areas than in the other fisheries (Figure 4.5a, Fisheries 7 and 8). The catchability in the southern fishery (Fishery 9) is more variable. All three dolphin-associated fisheries have had greater-than-average catchability during most of 2001-2005. However, catchability was estimated to decrease during 2006 and 2007.

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

The ability of longline vessels to capture yellowfin has been more variable in the northern fishery (Fishery 11), which catches fewer yellowfin, than in the southern fishery (Fishery 12). Catchability in the northern fishery has been very low since the late 1990s.

The catchabilities of small yellowfin by the discard fisheries (Fisheries 13-16) are shown in Figure 4.5b.

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

4.2.2. Recruitment

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

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

A sensitivity analysis was carried out, fixing the Beverton-Holt (1957) steepness parameter at 0.75 (Appendix A). This means that recruitment is 75% of the recruitment from an unexploited population when the population is reduced to 20% of its unexploited level. Given the information currently available, the hypothesis of two regimes in recruitment is as plausible as an effect of population size on recruitment. The results when a stock-recruitment relationship is used are described in Section 4.5.

The estimated time series of yellowfin recruitment is shown in Figure 4.7, and the estimated annual total recruitment in Table 4.1. The large recruitment that entered the discard fisheries in the third quarter of 1998 (6 months old) was estimated to be the strongest cohort of the 1975-2003 period. A sustained period of high recruitment was estimated for mid-1999 until the end of 2000. A large recruitment is estimated for 2007, but there is considerable uncertainty in the estimate. The assessment model has shown a tendency to overestimate recent recruitment strengths in the last few assessments.

Another characteristic of the recruitment, which was also apparent in previous assessments, is the regime change in the recruitment levels, starting during the second quarter of 1983. The recruitment was, on average, consistently greater after 1983 than before. This change in recruitment levels produces a similar change in biomass (Figure 4.9a). There is an indication that the recruitments in five recent years (2002-2006) were at low levels, similar to those prior to 1983, perhaps indicating a change back to a low productivity regime.

The confidence intervals for recruitment are relatively narrow, indicating that the estimates are fairly precise, except for that of the most recent year (Figure 4.7). The standard deviation of the estimated recruitment deviations (on the logarithmic scale) is 0.60, which is equal to the 0.6 assumed in the penalty applied to the recruitment deviates. The estimates of uncertainty are surprisingly small, considering the inability of the model to fit modes in the length-frequency data (Figure 4.8). These modes often appear, disappear, and then reappear.

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

4.2.3. Biomass

Biomass is defined as the total weight of yellowfin that are 1.5 or more years old. The trends in the biomass of yellowfin in the EPO are shown in Figure 4.9a, and estimates of the biomass at the beginning of each year in Table 4.1. Between 1975 and 1983 the biomass of yellowfin declined to about 250,000 metric tons (t); it then increased rapidly during 1983-1986, and reached about 540,000 t in 1986. During 1986-1999 it remained relatively constant at about 450,000-550,000 t; it then peaked in 2001 and subsequently declined to levels similar to those prior to 1984. The confidence intervals for the biomass estimates are relatively narrow, indicating that the biomass is well estimated.

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

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

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

4.2.4. Average weights of fish in the catch

The overall average weights of the yellowfin caught in the EPO predicted by the analysis have been consistently around 12 to 22 kg for most of the 1975-2007 period, but have differed considerably among fisheries (Figures 4.11). The average weight was high during the 1985-1992 period, when the effort for the floating-object and unassociated fisheries was less (Figure 2.3). The average weight was also high in 1975-1977 and in 2001-2004. The average weight of yellowfin caught by the different gears varies widely, but remains fairly consistent over time within each fishery (Figure 4.11). The lowest average weights (about 1 kg) are produced by the discard fisheries, followed by the pole-and-line fishery (about 4-5 kg), the floating-object fisheries (about 5-10 kg for Fishery 3, 10 kg for Fisheries 2 and 4, and 10-15 kg for Fishery 1), the unassociated fisheries (about 15 kg), the northern and coastal dolphin-associated fisheries (about 20-30 kg), and the southern dolphin-associated fishery and the longline fisheries (each about 40-50 kg).

4.3. Comparisons to external data sources

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

4.4. Diagnostics

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

4.4.1. Residual plots

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

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

The observed proportion of fish caught in a length class is assumed to be normally distributed around the predicted proportion, with the standard deviation equal to the binomial variance, based on the observed proportions, divided by the square of the sample size (Maunder and Watters 2003a). Previous analyses have indicated that the length-frequency residuals appear to be less than the assumed standard deviation .

4.4.2. Parameter correlation

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

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

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

4.4.3. Retrospective analysis

Retrospective analysis is a useful method to determine how consistent a stock assessment method is from one year to the next. Inconsistencies can often highlight inadequacies in the stock assessment method. The estimated biomass and SBR (defined in Section 3.1.2) from the previous assessment and the current assessment are shown in Figure 4.12a and 4.12b. However, data differ between these assessments, so differences may be expected (see Section 4.6). Retrospective analyses are usually carried out by repeatedly eliminating one year of data from the analysis while using the same stock assessment method and assumptions. This allows the analyst to determine the change in estimated quantities as more data are included in the model. Estimates for the most recent years are often uncertain and biased. Retrospective analysis and the assumption that more data improves the estimates can be used to determine if there are consistent biases in the estimates. Retrospective analysis carried out by Maunder and Harley (2004) suggested that the peak in biomass in 2001 had been consistently underestimated, but the 2005 assessment estimated a slightly lower peak in 2001. The assessment model has shown a tendency to overestimate recent recruitment strengths in the last few assessments, indicating a possible retrospective pattern in recruitment estimates.

4.5. Sensitivity to assumptions

Sensitivity analyses were carried out to investigate the incorporation of a Beverton-Holt (1957) stock-recruitment relationship (Appendix A1).

The base case analysis assumed no stock-recruitment relationship, and an alternative analysis was carried out with the steepness of the Beverton-Holt stock-recruitment relationship fixed at 0.75. This implies that when the population is reduced to 20% of its unexploited level, the expected recruitment is 75% of the recruitment from an unexploited population. As in previous assessments, (Maunder and Watters 2002, Hoyle and Maunder 2006a) the analysis with a stock-recruitment relationship fits the data better than the analysis without the stock-recruitment relationship. However, the regime shift could also explain the result, since the period of high recruitment is associated with high spawning biomass, and vice versa. When a Beverton-Holt stock-recruitment relationship (steepness = 0.75) is included, the estimated biomass (Figure A1.1) and recruitment (Figure A1.2) are almost identical to those of the base case assessment.

Several other sensitivity analyses have been carried out in previous assessments of yellowfin tuna.

Increasing the sample size for the length frequencies based on iterative re-weighting to determine the effective sample size gave similar results, but narrower confidence intervals (Maunder and Harley 2004). The use of cannery and landings data to determine the surface fishery catch and different size of the selectivity smoothness penalties (if set at realistic values) gave similar results (Maunder and Harley 2004). The results were not sensitive to the value for the asymptotic length parameter of the Richards growth curve or to the link function used in the general linear model (GLM) standardization of the longline effort data (Hoyle and Maunder 2007).

4.6. Comparison to previous assessments

The estimated biomass and SBR trajectories are similar to those from the previous assessment presented by Maunder (2007) (Figure 4.12). These results are also similar to those obtained using cohort analysis (Maunder 2002b). This indicates that estimates of absolute biomass are robust to the assumptions that have been changed as the assessment procedure has been updated. The estimate of the recent biomass is lower in the current assessment.

4.7. Summary of the results from the assessment model

In general, the recruitment of yellowfin to the fisheries in the EPO is variable, with a seasonal component. This analysis and previous analyses have indicated that the yellowfin population has experienced two, or possibly three, different productivity regimes (1975-1983, 1984-2000, and 2001-2006). The productivity regimes correspond to regimes in biomass, higher-productivity regimes producing greater biomass levels. A stock-recruitment relationship is also supported by the data from these regimes, but the evidence is weak, and is probably an artifact of the apparent regime shifts. The analysis indicates that strong cohorts entered the fishery during 1998-2000, and that these cohorts increased the biomass during 1999-2000. However, these cohorts have now moved through the population, so the biomass decreased during 2001-2007. The biomass in 2005-2008 was at levels similar to those prior to 1985.

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

Significant levels of fishing mortality have been estimated for the yellowfin fishery in the EPO. These levels are highest for middle-aged yellowfin. Most of the yellowfin catch is taken in schools associated with dolphins, and, accordingly, this method has the greatest impact on the yellowfin population, although it has almost the least impact per unit of weight captured of all fishing methods.

5. STATUS OF THE STOCK

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

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

1. S_{MSY}, the spawning biomass corresponding to the MSY;
2. F_{MSY}, the fishing mortality corresponding to the MSY;
3. S_{min}, the minimum spawning biomass seen in the modeling period.

Maintaining tuna stocks at levels that will permit the MSY is the management objective specified by the

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

5.1. Assessment of stock status based on spawning biomass

The spawning biomass ratio, SBR, defined in Section 3.1.2, is useful for assessing the status of a stock. The SBR has been used to define reference points in many fisheries. Various studies (*e.g.* Clark 1991, Francis 1993, Thompson 1993, Mace 1994) suggest that some fish populations can produce the MSY when the SBR is in the range of about 0.3 to 0.5, and that some fish populations are not able to produce the MSY if the spawning biomass during a period of exploitation is less than about 0.2. Unfortunately, the types of population dynamics that characterize tuna populations have generally not been considered in these studies, and their conclusions are sensitive to assumptions about the relationship between adult biomass and recruitment, natural mortality, and growth rates. In the absence of simulation studies that are designed specifically to determine appropriate SBR-based reference points for tunas, estimates of SBR_t can be compared to an estimate of SBR for a population that is producing the MSY ($SBR_{MSY} = S_{MSY}/S_{F=0}$).

Estimates of quarterly SBR_t for yellowfin in the EPO have been computed for every quarter represented in the stock assessment model (the first quarter of 1975 to the second quarter of 2007). Estimates of the spawning biomass during the period of harvest (S_t) are discussed in Section 4.2.3 and presented in Figure 4.9b. The equilibrium spawning biomass after a long period with no harvest ($S_{F=0}$) was estimated by assuming that recruitment occurs at an average level expected from an unexploited population. SBR_{MSY} is estimated to be about 0.34.

At the beginning of 2008 the spawning biomass of yellowfin in the EPO had increased relative to 2006, which was probably its lowest level since 1983. The estimate of SBR at the beginning of 2008 was about 0.36, with lower and upper 95% confidence limits of 0.29 and 0.43, respectively (Figure 5.1a). The current assessment's estimate of SBR_{MSY} (0.34) is similar to the previous assessment (Figure 4.12b).

In general, the SBR estimates for yellowfin in the EPO are reasonably precise. The relatively narrow confidence intervals around the SBR estimates suggest that for most quarters during 1985-2003 the spawning biomass of yellowfin in the EPO was greater than S_{MSY} (see Section 5.3). This level is shown as the dashed horizontal line drawn at 0.34 in Figure 5.1a. For most of the early period (1975-1984) and the most recent period (2005-2007), however, the spawning biomass was estimated to be less than S_{MSY}. The spawning biomass at the start of 2008 is estimated to be above the level corresponding to MSY.

5.2. Assessment of stock status based on MSY

MSY is defined as the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions. MSY calculations are described by Maunder and Watters (2001). The calculations differ from those of Maunder and Watters (2001) in that the present calculations include the Beverton-Holt (1957) stock-recruitment relationship when applicable. To calculate MSY, the current fishing mortality rate is scaled so that it maximizes the catch. The value *F* multiplier scales the "current" fishing mortality, which is taken as the average over 2005-2007. The value *F*scale uses the fishing mortality in the year of interest. Therefore, *F*scale for the most recent year may not be the same as the *F* multiplier.

At the beginning of 2008, the biomass of yellowfin in the EPO appears to have been above the level corresponding to the MSY, and the recent catches have been substantially below the MSY level (Table 5.1).

If the fishing mortality is proportional to the fishing effort, and the current patterns of age-specific selectivity (Figure 4.4) are maintained, the current (average of 2005-2007) level of fishing effort is below that estimated to produce the MSY. The effort at MSY is 113% of the current level of effort. Due to reduced fishing mortality in 2007, repeating the calculations based on a fishing mortality averaged over 2005-2006 indicates that current effort would have to be increased by 6% to reach effort at MSY. It is important to note that the curve relating the average sustainable yield to the long-term fishing mortality (Figure 5.2, upper panel) is very flat around the MSY level. Therefore, changes in the long-term levels of effort will only marginally change the long-term catches, while considerably changing the biomass. The spawning stock biomass changes substantially with changes in the long-term fishing mortality (Figure 5.2, lower panel). Decreasing the effort would increase CPUE and thus might also reduce the cost of fishing. Reducing fishing mortality below the level at MSY would provide only a marginal decrease in the long-term average yield, with the benefit of a relatively large increase in the spawning biomass.

The apparent regime shift in productivity that began in 1984 suggests alternative approaches to estimating the MSY, as different regimes will give rise to different values for the MSY (Maunder and Watters 2001).

The estimation of the MSY, and its associated quantities, is sensitive to the age-specific pattern of selectivity that is used in the calculations. To illustrate how MSY might change if the effort is reallocated among the various fisheries (other than the discard fisheries) that catch yellowfin in the EPO, the previously-described calculations were repeated, using the age-specific selectivity pattern estimated for groups of fisheries. If the management objective is to maximize the MSY, the age-specific selectivity of the longline fisheries will perform the best, followed by that of the dolphin-associated fisheries, the unassociated fisheries, and finally the floating-object fisheries (Table 5.2a). If an additional management objective is to maximize the S_{MSY}, the order is the same. The age-specific selectivity of the purse-seine fisheries alone gives slightly less than the current MSY (Table 5.2c). It is not plausible, however, that the longline fisheries, which would produce the greatest MSYs, would be efficient enough to catch the full MSYs predicted. On its own, the effort by the purse-seine fishery for dolphin-associated yellowfin would have to doubled to achieve the MSY.

If it is assumed that all fisheries but one are operating, and that each fishery maintains its current pattern of age-specific selectivity, the MSY would be increased by removing the floating-object or unassociated fisheries, and reduced by removing the dolphin-associated or longline fisheries (Table 5.2b). If it is assumed that all fisheries are operating, but either the purse-seine or the longline fisheries are adjusted to obtain MSY, the purse-seine fisheries would have to be increased by 7%, or the longline fisheries 37-fold. If it is also assumed that there is a stock-recruitment relationship, the MSY would be achieved with lower effort levels (Table 5.2c).

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

The historical status of the population with respect to both the SBR and fishing mortality reference points is shown in Figure 5.1b. The fishing mortality has generally been below that corresponding to the MSY, except for the period before 1984 and during 2003-2005 (Figure 4.12c).

5.3. Summary of stock status

Historically, the SBR of yellowfin in the EPO was below the level corresponding to the MSY during the lower productivity regime of 1975-1983 (Section 4.2.1), but above that level for most of the following years, except for the recent period (2003-2007). The 1984 increase in the SBR is attributed to the regime change, and the recent decrease may be a reversion to an intermediate productivity regime. The two different productivity regimes may support two different MSY levels and associated SBR levels. The SBR at the start of 2008 is estimated to be above the level corresponding to the MSY. The effort levels are estimated to be less than those that would support the MSY (based on the current distribution of effort among the different fisheries), but recent catches are substantially below MSY.

If a stock-recruitment relationship is assumed, the outlook is more pessimistic, and current biomass is estimated to be below the level corresponding to the MSY.

The current average weight of yellowfin in the catch is much less than the critical weight. The MSY calculations indicate that, theoretically, at least, catches could be increased if the fishing effort were directed toward longlining and purse-seine sets on yellowfin associated with dolphins. This would also increase the SBR levels.

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

6. SIMULATED EFFECTS OF FUTURE FISHING OPERATIONS

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

A method based on the normal approximation to the likelihood profile (Maunder *et al.* 2006) , which considers both parameter uncertainty and uncertainty about future recruitment, has been applied. A substantial part of the total uncertainty in predicting future events is caused by uncertainty in the estimates of the model parameters and current status, so this should be considered in any forward projections. Unfortunately, the appropriate methods are often not applicable to models as large and computationally-intense as the yellowfin stock assessment model. Therefore, we have used a normal approximation to the likelihood profile that allows for the inclusion of both parameter uncertainty and uncertainty about future recruitment. This method is implemented by extending the assessment model an additional 5 years with effort data equal to that assumed for the projection period (see below). No catch or length-frequency data are included for these years. The recruitments for the five years are estimated as in the assessment model with a lognormal penalty with a standard deviation of 0.6. Normal approximations to the likelihood profile are generated for SBR, surface catch, and longline catch.

6.1. Assumptions about fishing operations

6.1.1. Fishing effort

Several future projection studies were carried out to investigate the influence of different levels of fishing effort on the biomass and catch. The projected fishing mortality was based on the quarterly averages during 2005-2007.

The scenarios investigated were:

1. Quarterly fishing mortality for each year in the future equal to the quarterly average for 2005-2007, which reflects the reduced effort due to the conservation measures of Resolutions C-04-09 and C-06-02;
2. Quarterly fishing mortality for each year in the future and for 2004-2007 was set equal to the fishing mortality in scenario 1, adjusted for the effect of the conservation measures. For the adjustment, the fishing mortality for the purse-seine fishery in the fourth quarter was increased by 85%, and that for the southern longline fishery by 39%.

6.2. Results of the simulation

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

These simulations were carried out using the average recruitment for the 1975-2007 period. If they had been carried out using the average recruitment for the 1984-2001 period, the projected trend in SBR and catches would have been more positive. Conversely, if they had been carried out with the average recruitment for the 2002-2006 period, the projected trend in SBR and catches would have been more negative.

6.2.1. Current effort levels

Under current levels of fishing mortality (2005-2007), the biomass is predicted to increase and then decrease, but remain above the current level (Figure 6.1), and the SBR is predicted to follow a similar trend. The SBR is predicted to remain above the level corresponding to the MSY (Figure 6.2). However, the confidence intervals are wide, and there is a moderate probability that the SBR will be substantially above or below this level. It is predicted that the surface catches will increase, while the longline catches will remain about the same (Figure 6.3).

6.2.2. No management restrictions

Resolutions C-04-09 and C-06-02 called for restrictions on purse-seine effort and longline catches for 2004-2007: a 6-week closure during the third or fourth quarter of the year for purse-seine fisheries, and longline catches not to exceed 2001 levels. To assess the utility of these management actions, we projected the population forward five years, assuming that these conservation measures had not been implemented.

Comparison of the biomass and SBR predicted with and without the restrictions from the resolutions show some difference (Figures 6.4 and 6.5). The simulations suggest that, without the restrictions, biomass and SBR would have declined to slightly lower levels than seen at present, and would decline to about the level corresponding to MSY.

6.3. Summary of the simulation results

Under current levels of effort fishing mortality, the biomass is predicted to increase, and then decrease, but remain above the current level, and the SBR is predicted to follow a similar trend. The SBR is predicted to remain above the level corresponding to the MSY. A comparison of the biomass and SBR predicted with and without the restrictions from Resolutions C-04-09 and C-06-02 suggests that, without the restrictions, they would be at lower levels than those seen at present, and would decline to about the level corresponding to MSY.

These simulations were carried out using the average recruitment for the 1975-2007 period. If they had been carried out using the average recruitment for the 1983-2001 period, the projected trend in SBR and catches would have been more positive. Conversely, if they had been carried out using the average recruitment for the 2002-2006 period, the projected trend in SBR and catches would have been more negative.

7. FUTURE DIRECTIONS

7.1. Collection of new and updated information

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

7.2. Refinements to the assessment model and methods

The IATTC staff is considering changing to the *Stock Synthesis II* (SS2) general model (developed by Richard Methot at the U.S. National Marine Fisheries Service) for its stock assessments, based on the outcome of the workshop on stock assessment methods held in November 2005. Preliminary assessments for yellowfin and bigeye tuna were conducted in SS2 and presented at a workshop on management strategies held in November 2006. The current bigeye assessment was conducted using SS2, and the IATTC staff intends to conduct the next yellowfin assessment using SS2, once the growth curve in SS2 is made flexible enough to model the growth of yellowfin appropriately.

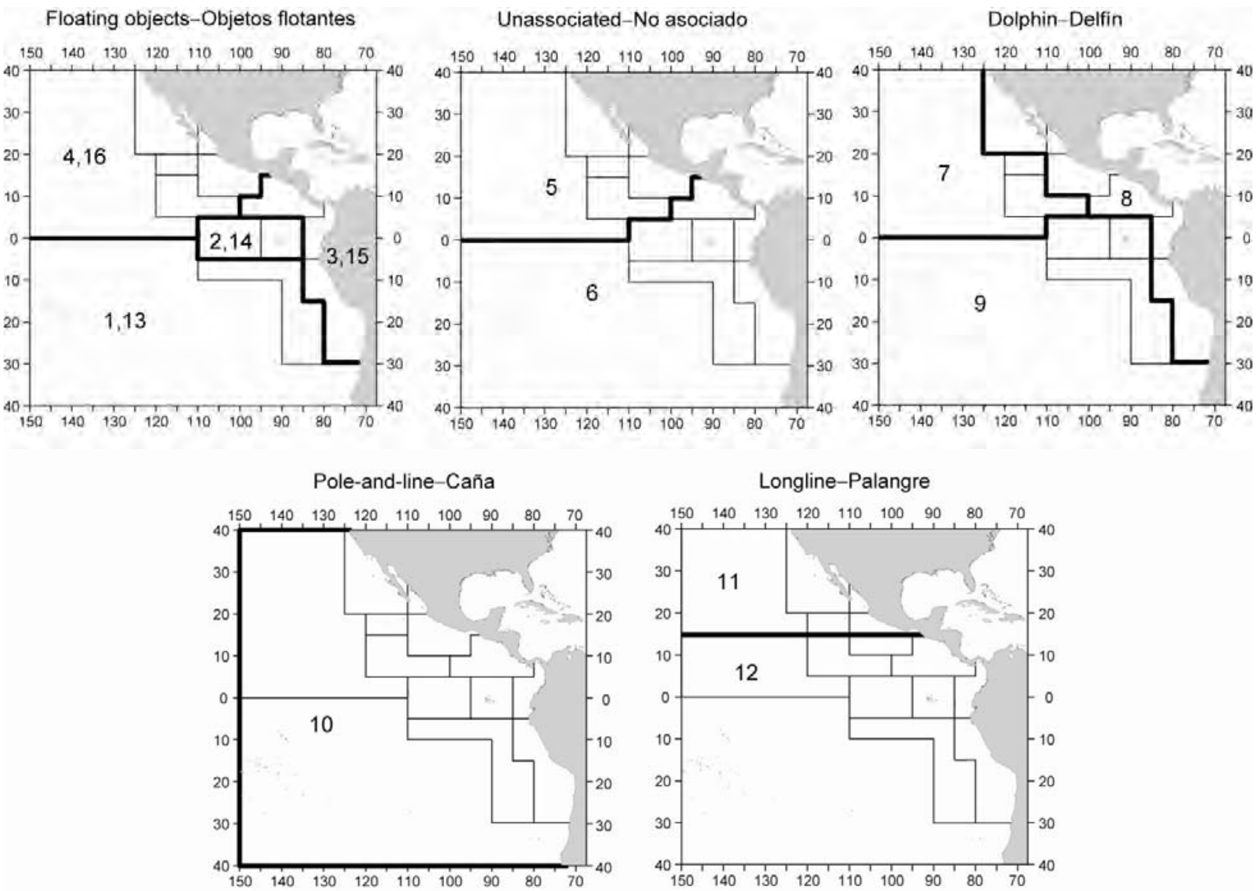

FIGURE 2.1. Spatial extents of the fisheries defined by the IATTC staff for the stock assessment of yellowfin tuna in the EPO. The thin lines indicate the boundaries of 13 length-frequency sampling areas, the bold lines the boundaries of each fishery defined for the stock assessment, and the bold numbers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

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

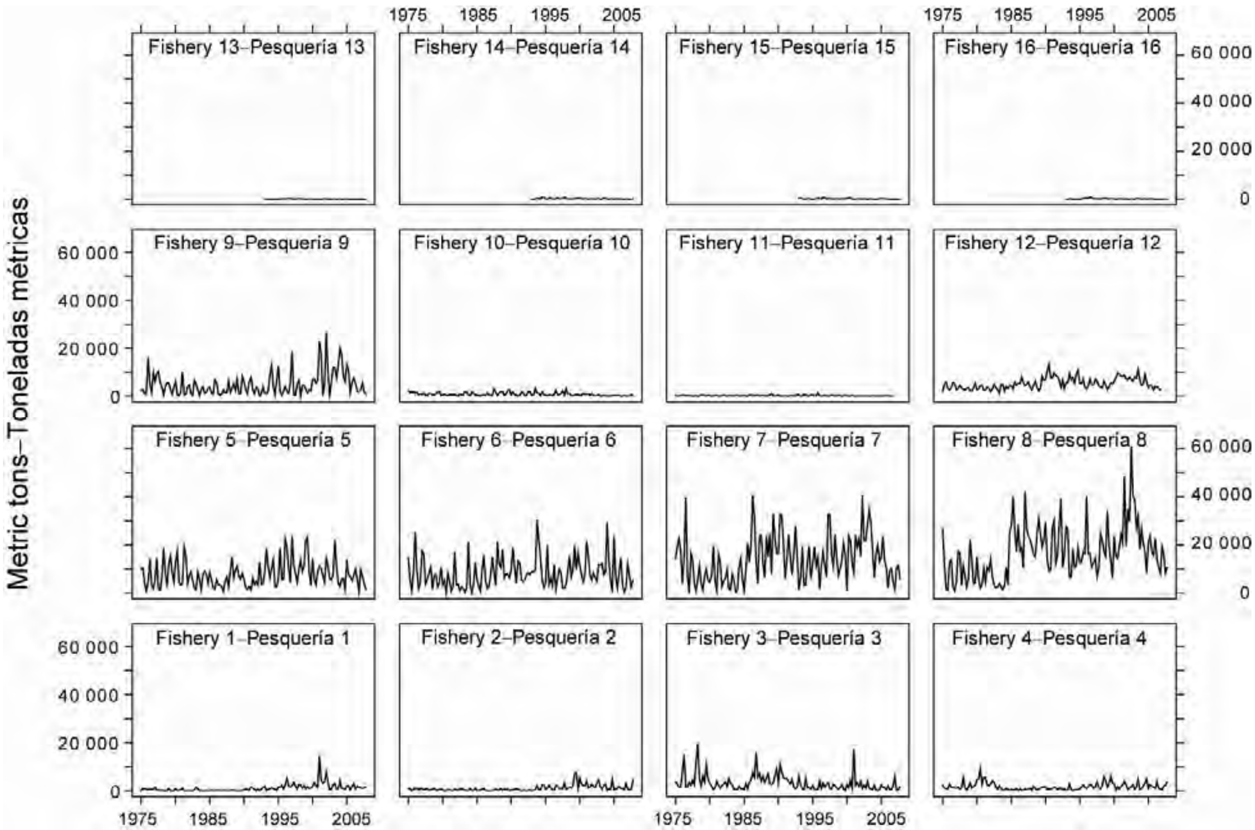

FIGURE 2.2. Catches by the fisheries defined for the stock assessment of yellowfin tuna in the EPO (Table 2.1). Since the data were analyzed on a quarterly basis, there are four observations of catch for each year. Although all the catches are displayed as weights, the stock assessment model uses catches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

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

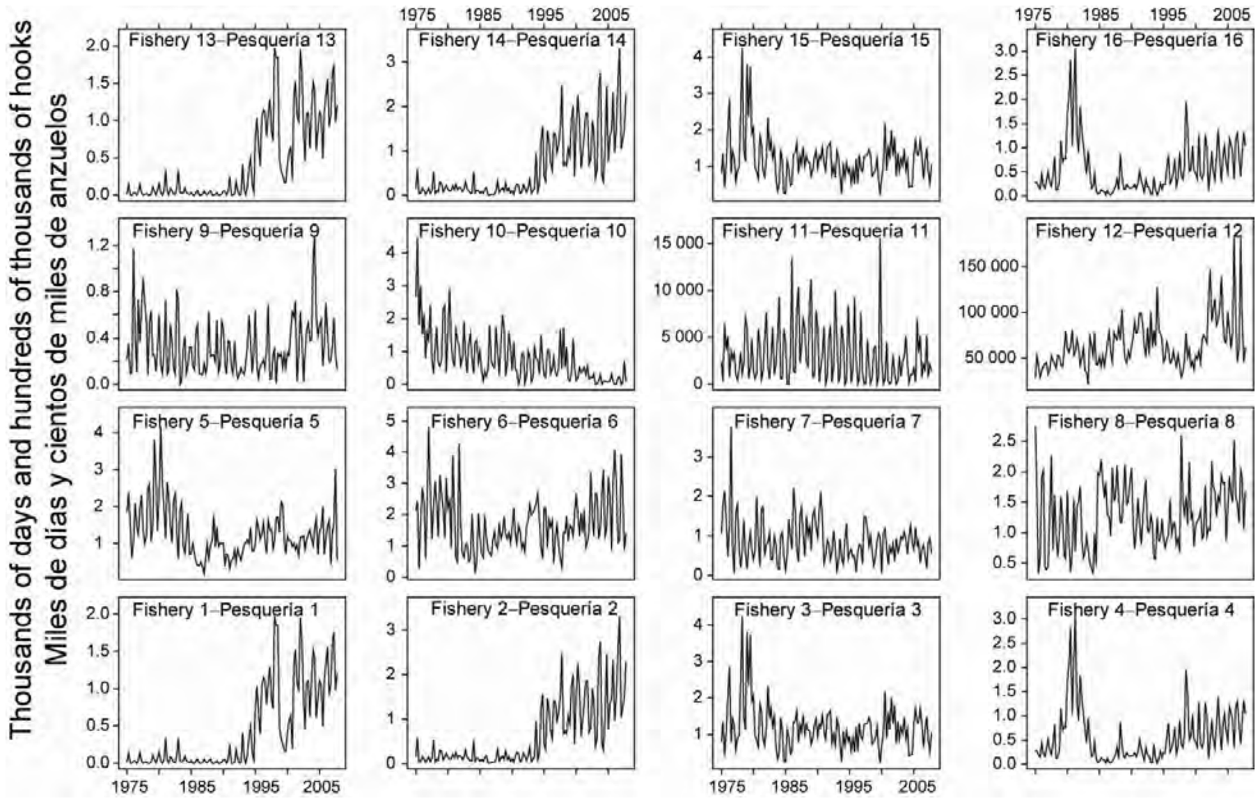

FIGURE 2.3. Fishing effort exerted by the fisheries defined for the stock assessment of yellowfin tuna in the EPO (Table 2.1). Since the data were summarized on a quarterly basis, there are four observations of effort for each year. The effort for Fisheries 1-10 and 13-16 is in days fished, and that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

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

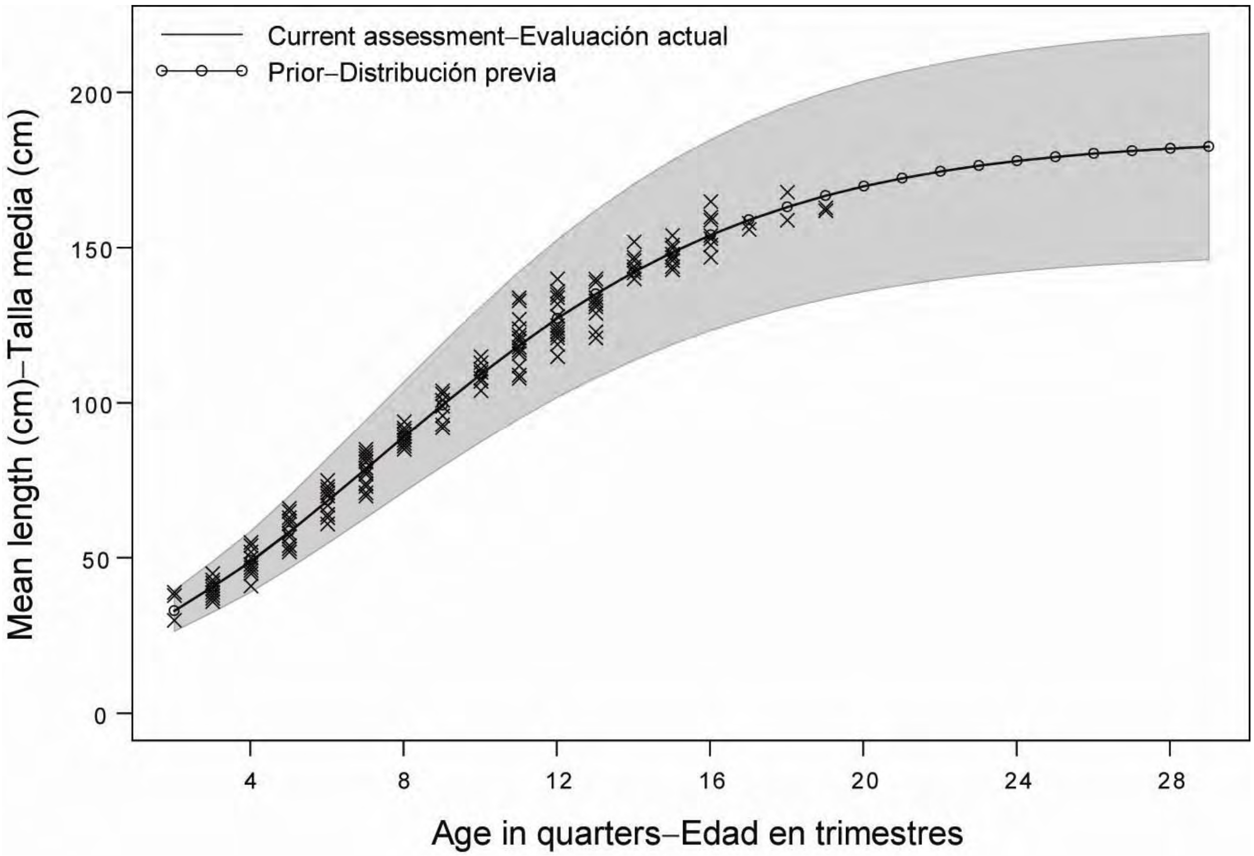

FIGURE 3.1. Growth curve estimated for the assessment of yellowfin tuna in the EPO (solid line). The connected points represent the mean length-at-age prior used in the assessment. The crosses represent length-at-age data from otoliths (Wild 1986). The shaded region represents the variation in length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

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

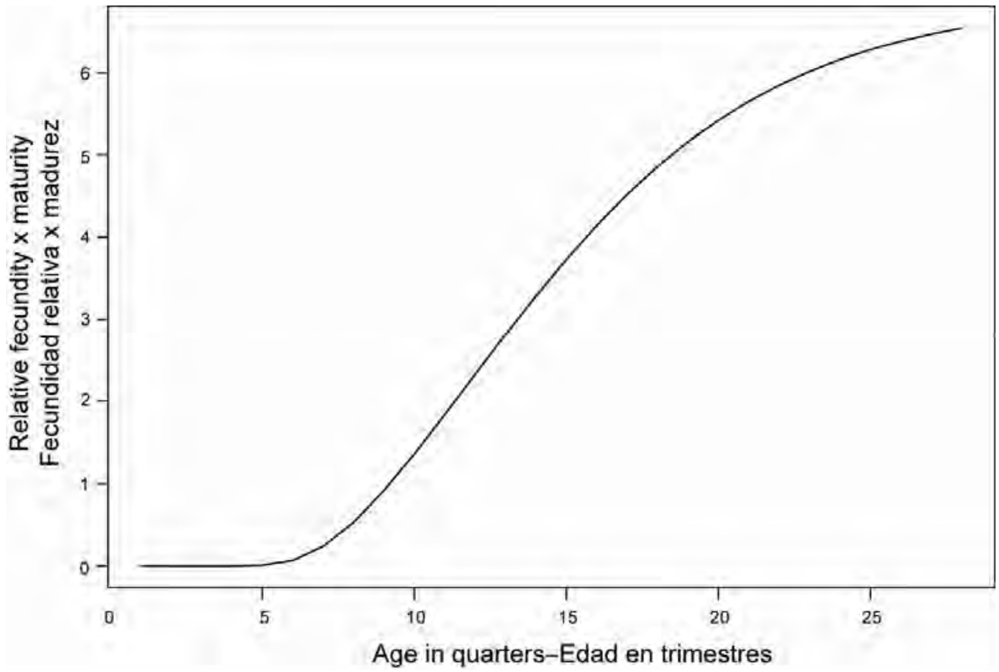

FIGURE 3.2. Relative fecundity-at-age curve (from Schaefer 1998) used to estimate the spawning biomass of yellowfin tuna in the EPO.
FIGURA 3.2. Curva de madurez relativa por edad (de Schaefer 1998) usada para estimar la biomasa reproductora del atún aleta amarilla en el OPO.

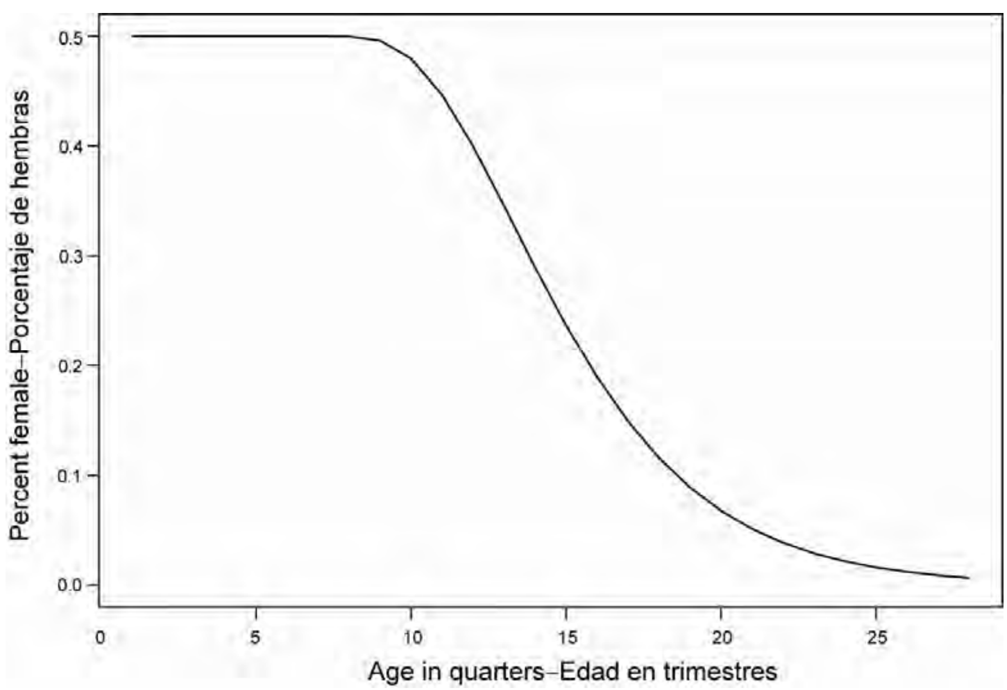

FIGURE 3.3. Sex ratio curve (from Schaefer 1998) used to estimate the spawning biomass of yellowfin tuna in the EPO.
FIGURA 3.3. Curva de proporciones de sexos (de Schaefer 1998) usada para estimar la biomasa reproductora de atún aleta amarilla en el OPO.

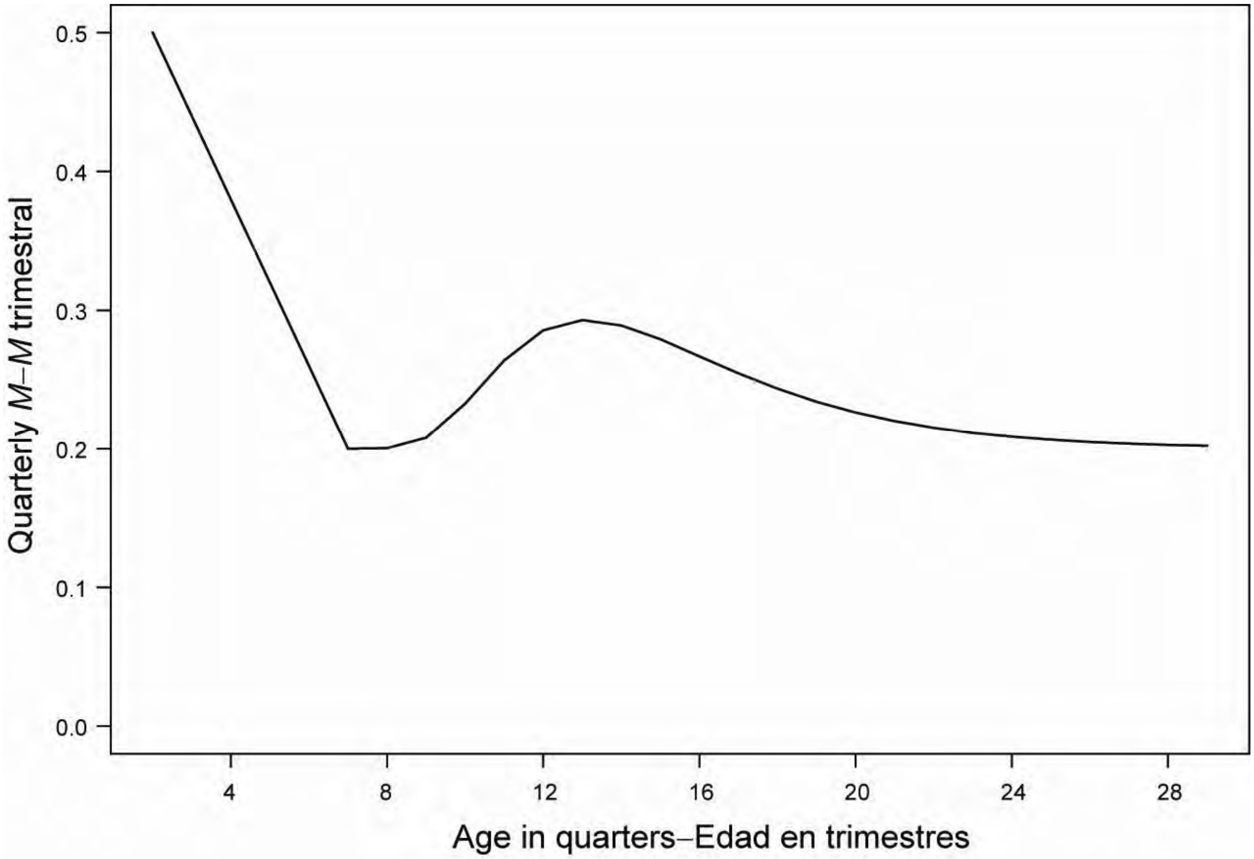

FIGURE 3.4. Natural mortality (*M*) rates, at quarterly intervals, used for the assessment of yellowfin tuna in the EPO. Descriptions of the three phases of the mortality curve are provided in Section 3.1.4.
FIGURA 3.4. Tasas de mortalidad natural (*M*), a intervalos trimestrales, usadas para la evaluación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

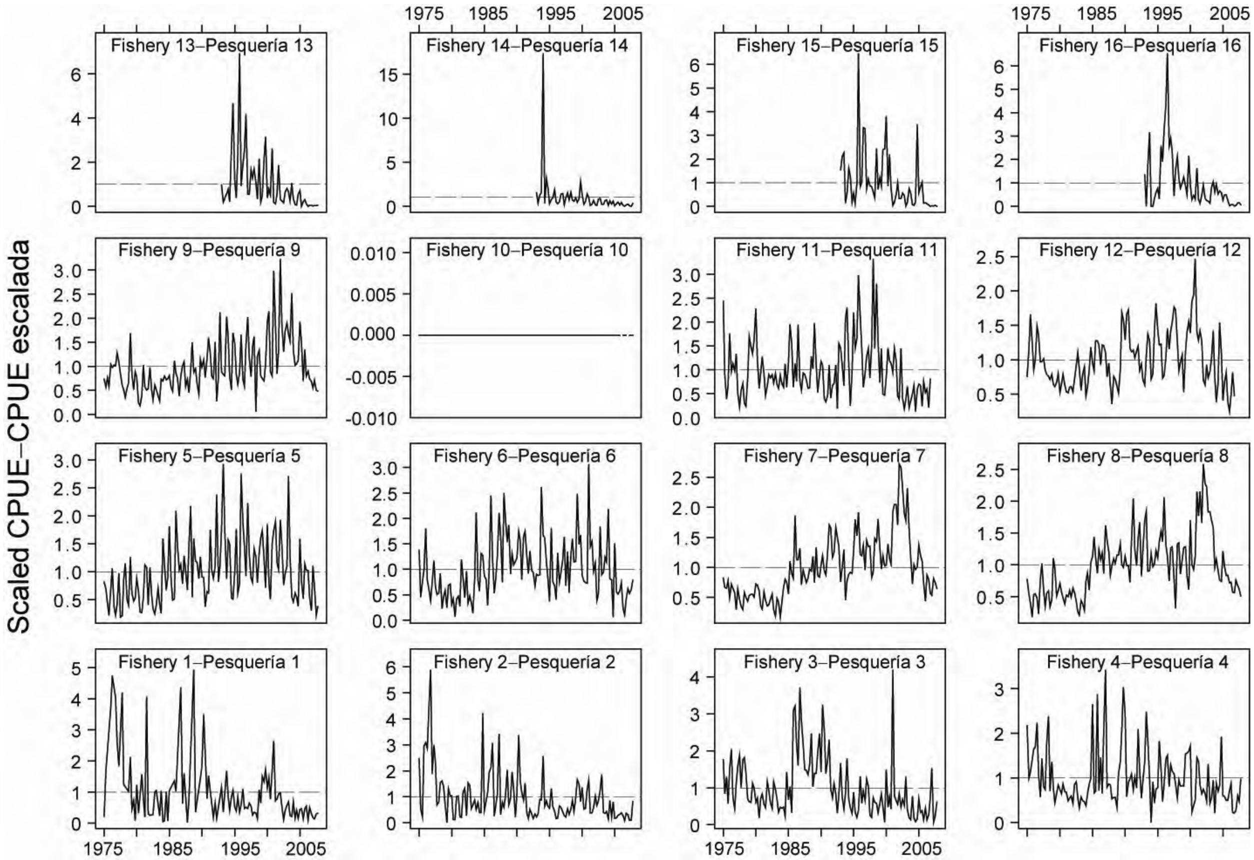

FIGURE 4.1. CPUEs for the fisheries defined for the stock assessment of yellowfin tuna in the EPO (Table 2.1). Since the data were summarized on a quarterly basis, there are four observations of CPUE for each year. The CPUEs for Fisheries 1-10 and 13-16 are in kilograms per day fished, and those for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

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

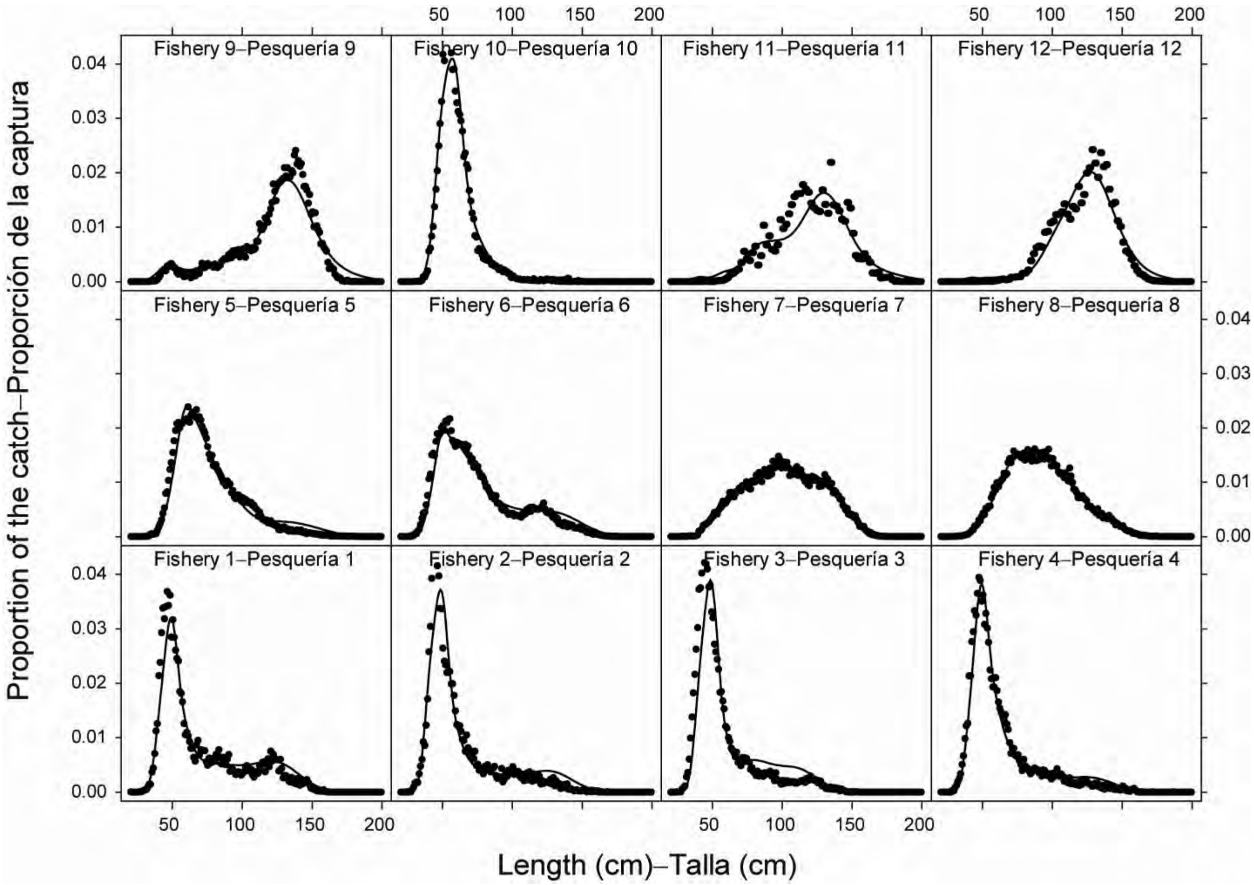

FIGURE 4.2. Average observed (dots) and predicted (curves) size compositions of the catches taken by the fisheries defined for the stock assessment of yellowfin tuna in the EPO.

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

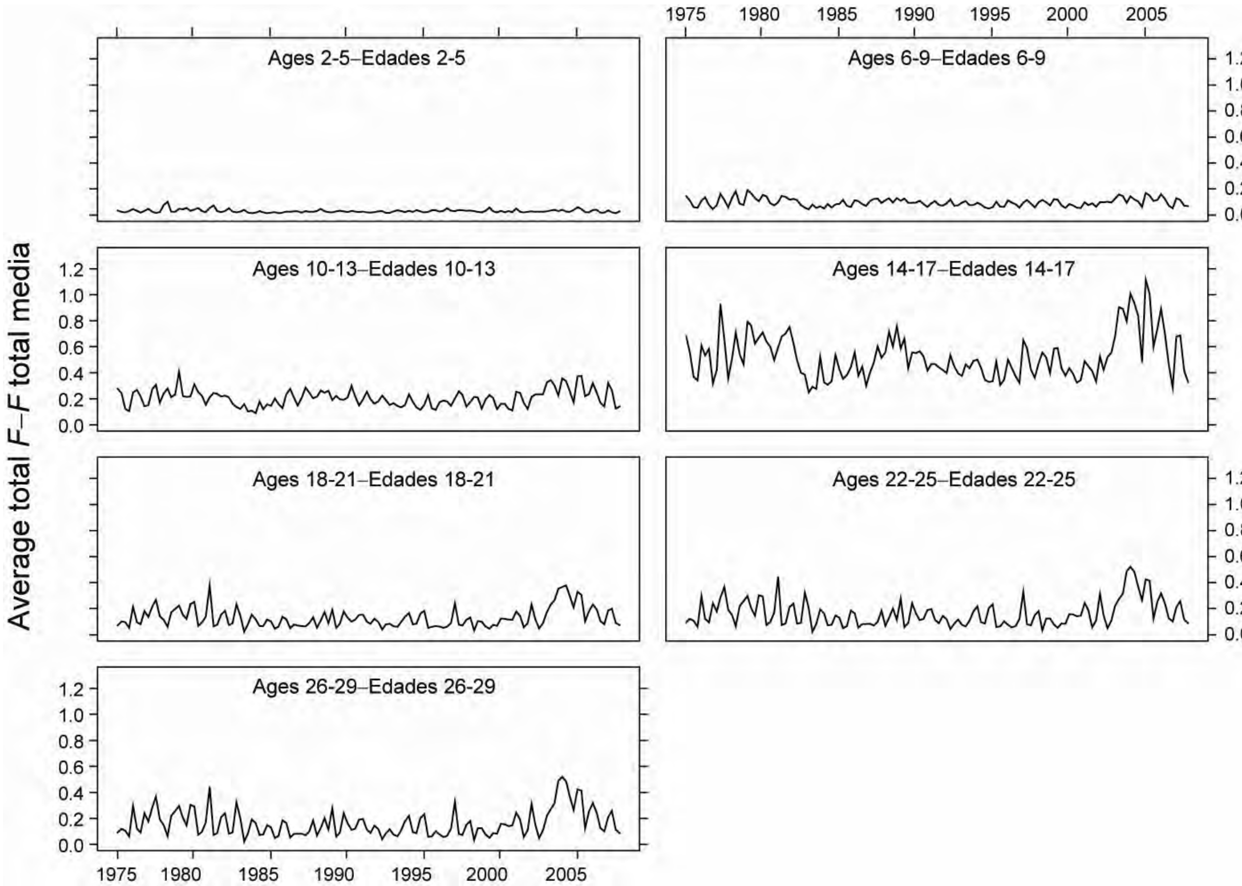

FIGURE 4.3a. Average quarterly fishing mortality (*F*) at age, by all gears, of yellowfin tuna recruited to the fisheries of the EPO. Each panel illustrates an average of four quarterly fishing mortality vectors that affected the fish within the range of ages indicated in the title of each panel. For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

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

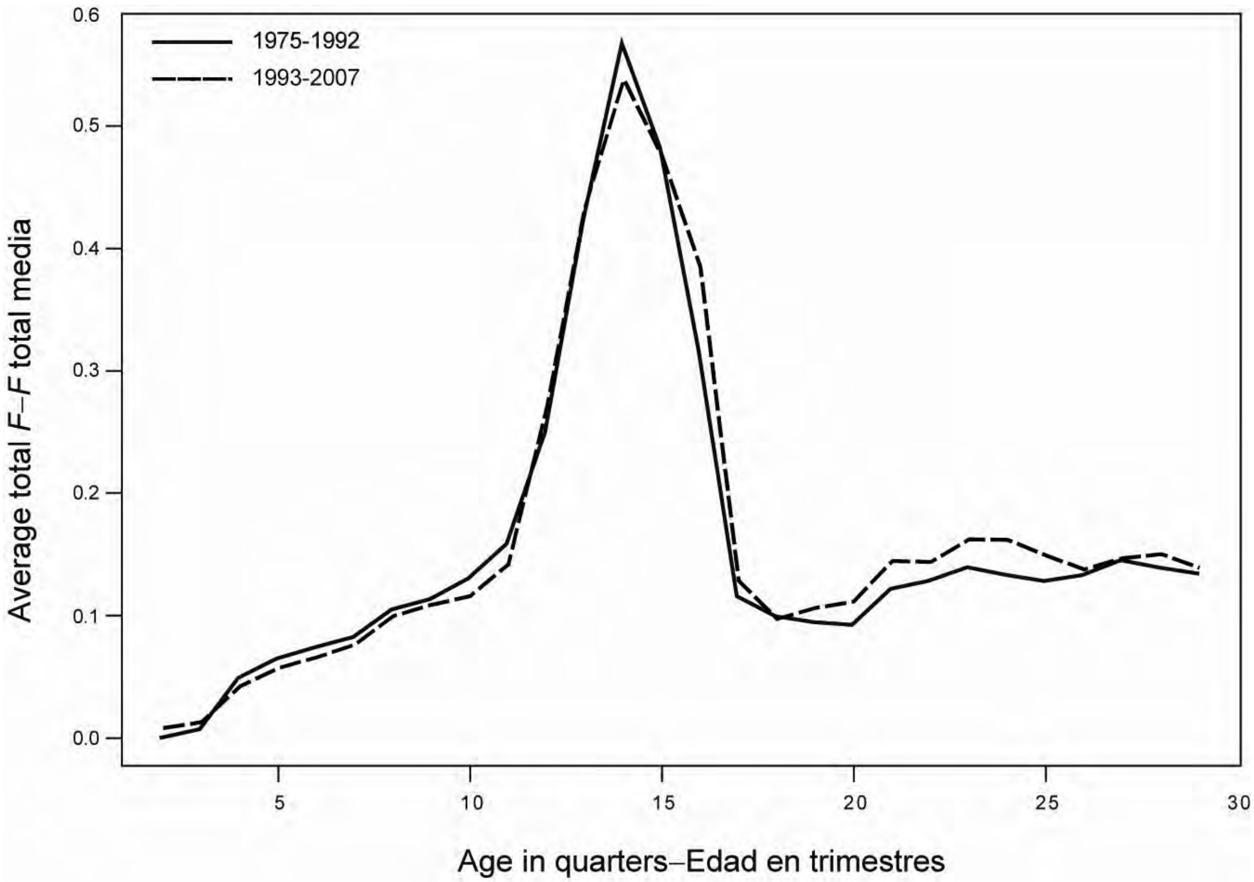

FIGURE 4.3b. Average quarterly fishing mortality (*F*) of yellowfin tuna by age in the EPO, by all gears. The estimates are presented for two periods, before and after the increase in effort associated with floating objects.

FIGURA 4.3b. Mortalidad por pesca (*F*) trimestral media de atún aleta amarilla por edad en el OPO, por todas las artes. Se presentan estimaciones para dos períodos, antes y después del aumento del esfuerzo asociado con objetos flotantes.

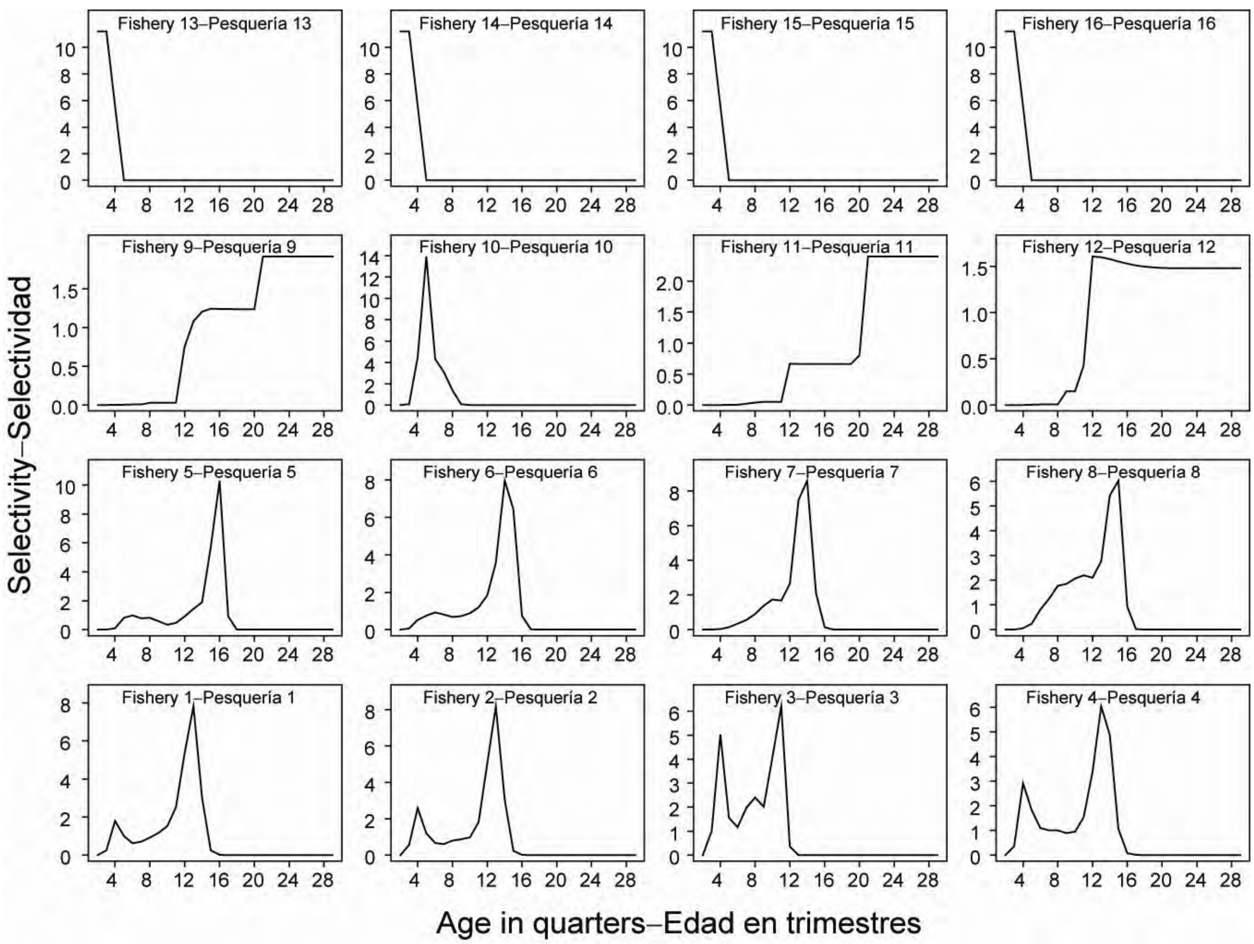

FIGURE 4.4. Selectivity curves for the 16 fisheries that take yellowfin tuna in the EPO. The curves for Fisheries 1-12 were estimated with the A-SCALA method, and those for Fisheries 13-16 are based on assumptions. Note that the vertical scales of the panels are different.

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

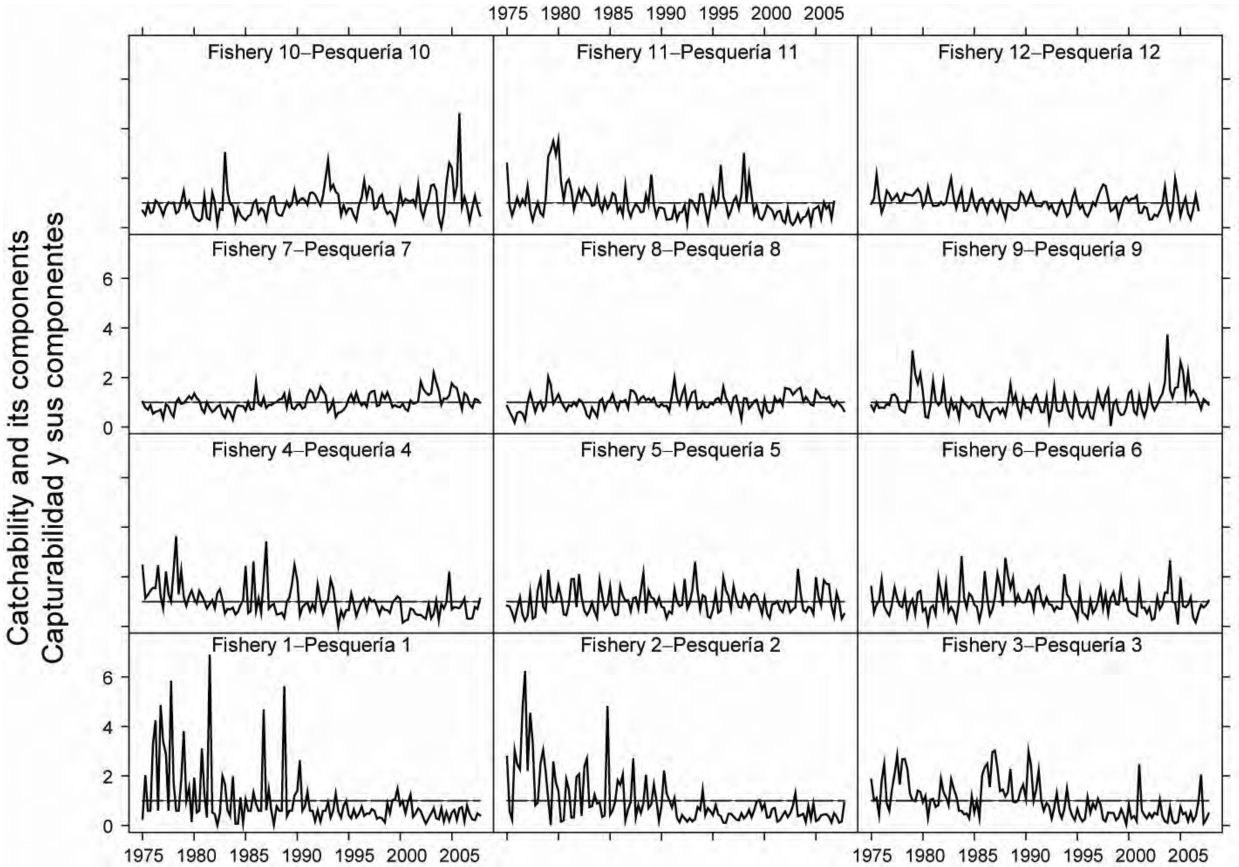

FIGURE 4.5a. Trends in catchability (*q*) for the 12 retention fisheries that take yellowfin tuna in the EPO. The estimates are scaled to average 1.

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

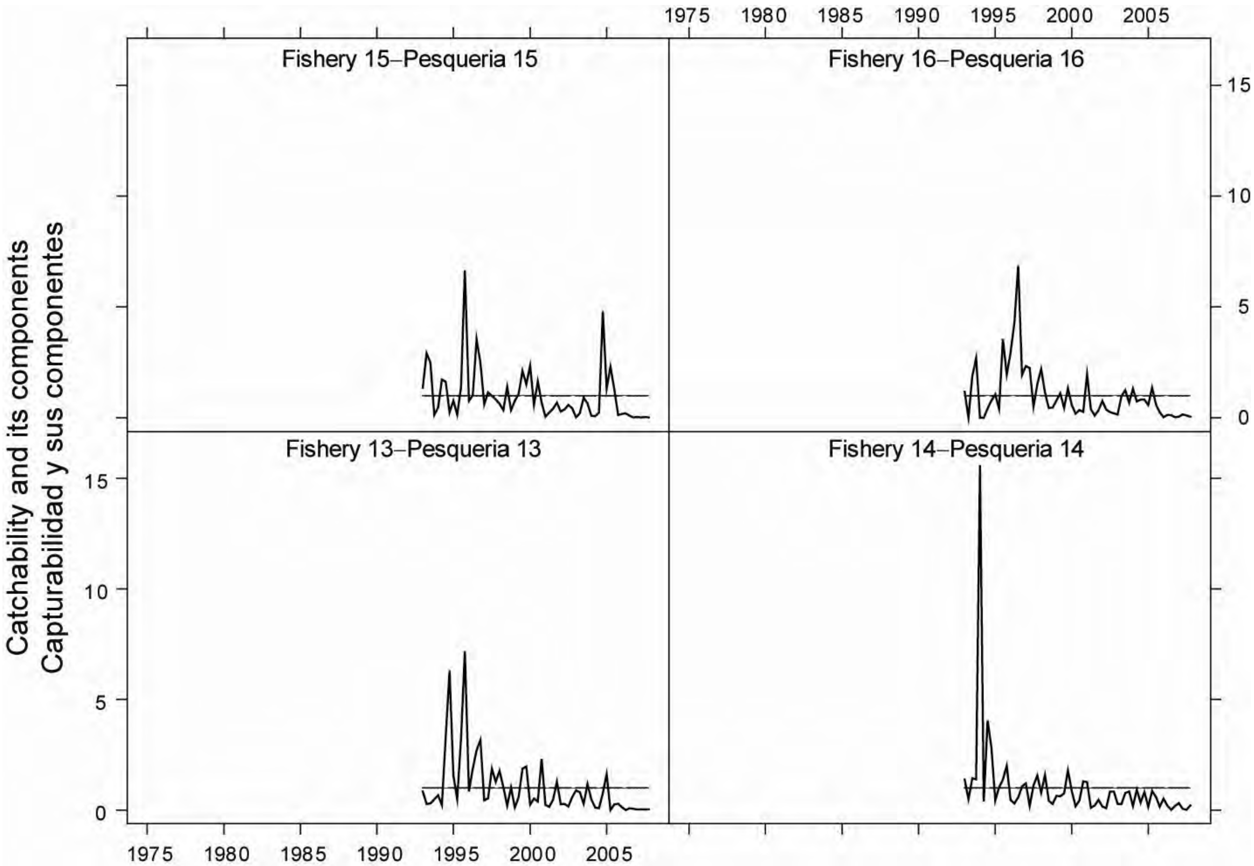

FIGURE 4.5b. Trends in catchability (*q*) for the four discard fisheries that take yellowfin tuna in the EPO. The estimates are scaled to average 1.

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

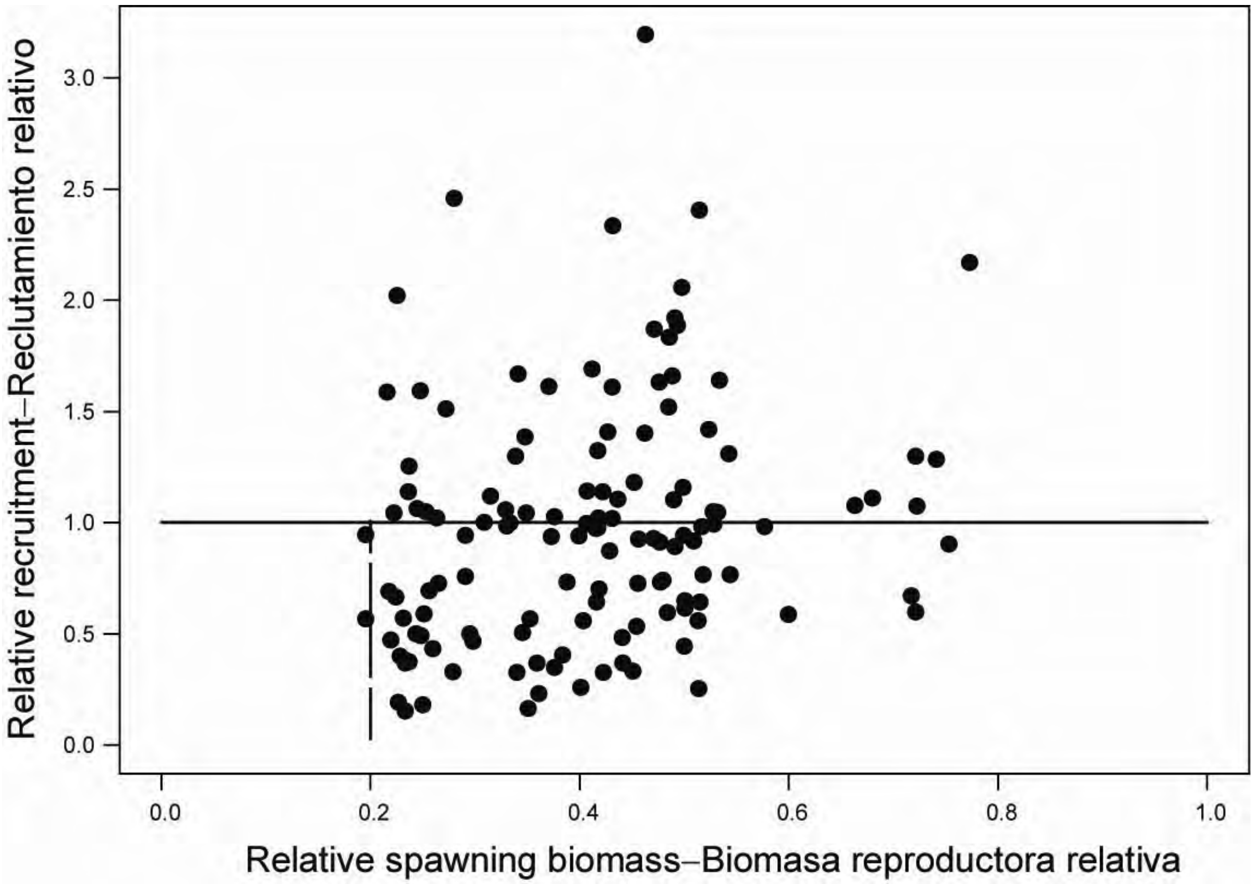

FIGURE 4.6. Estimated relationship between recruitment of yellowfin tuna and spawning biomass. The recruitment is scaled so that the average recruitment is equal to 1.0. The spawning biomass is scaled so that the average unexploited spawning biomass is equal to 1.0.
FIGURA 4.6. Relación estimada entre el reclutamiento y la biomasa reproductora del atún aleta amarilla. Se escala el reclutamiento para que el reclutamiento medio equivalga a 1,0, y la biomasa reproductora para que la biomasa reproductora media no explotada equivalga a 1,0.

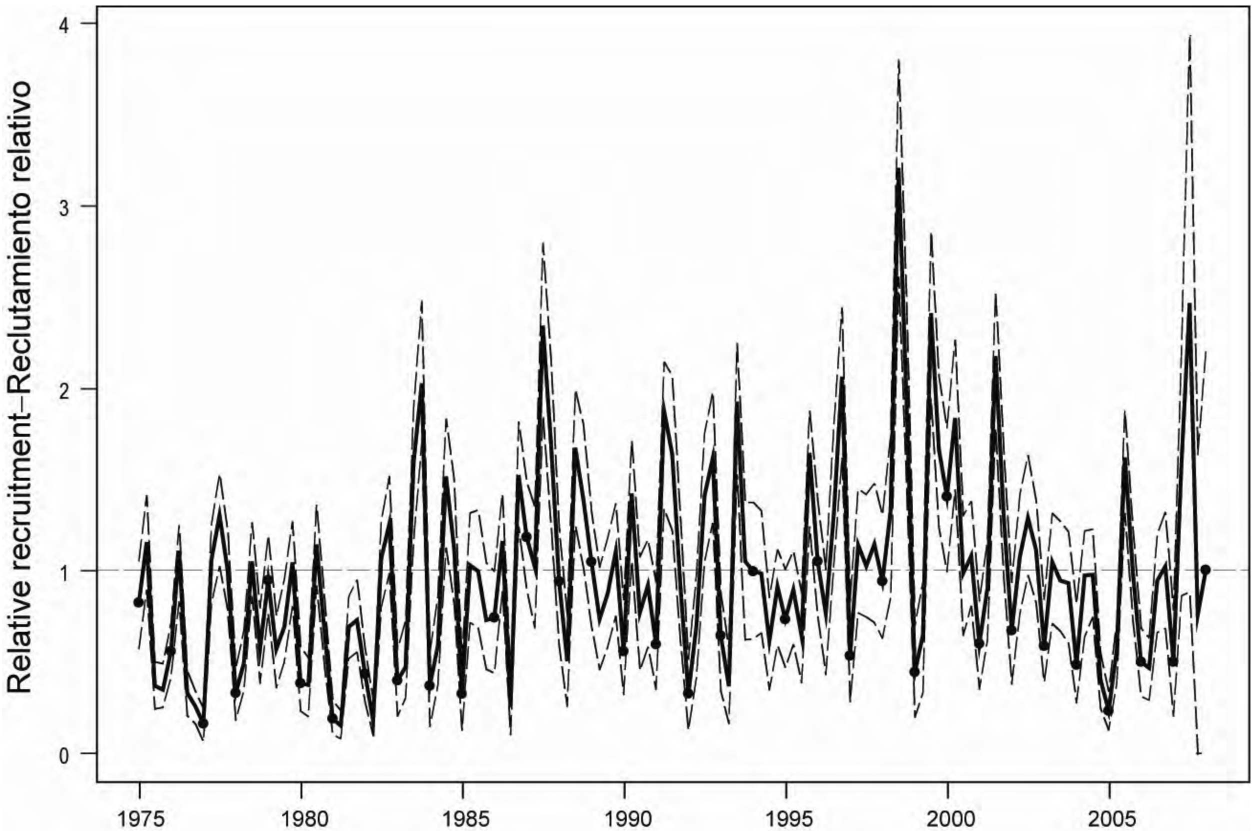

FIGURE 4.7. Estimated recruitment of yellowfin tuna to the fisheries of the EPO. The estimates are scaled so that the average recruitment is equal to 1.0. The bold line illustrates the maximum likelihood estimates of recruitment, and the shaded area indicates the approximate 95% confidence intervals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

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

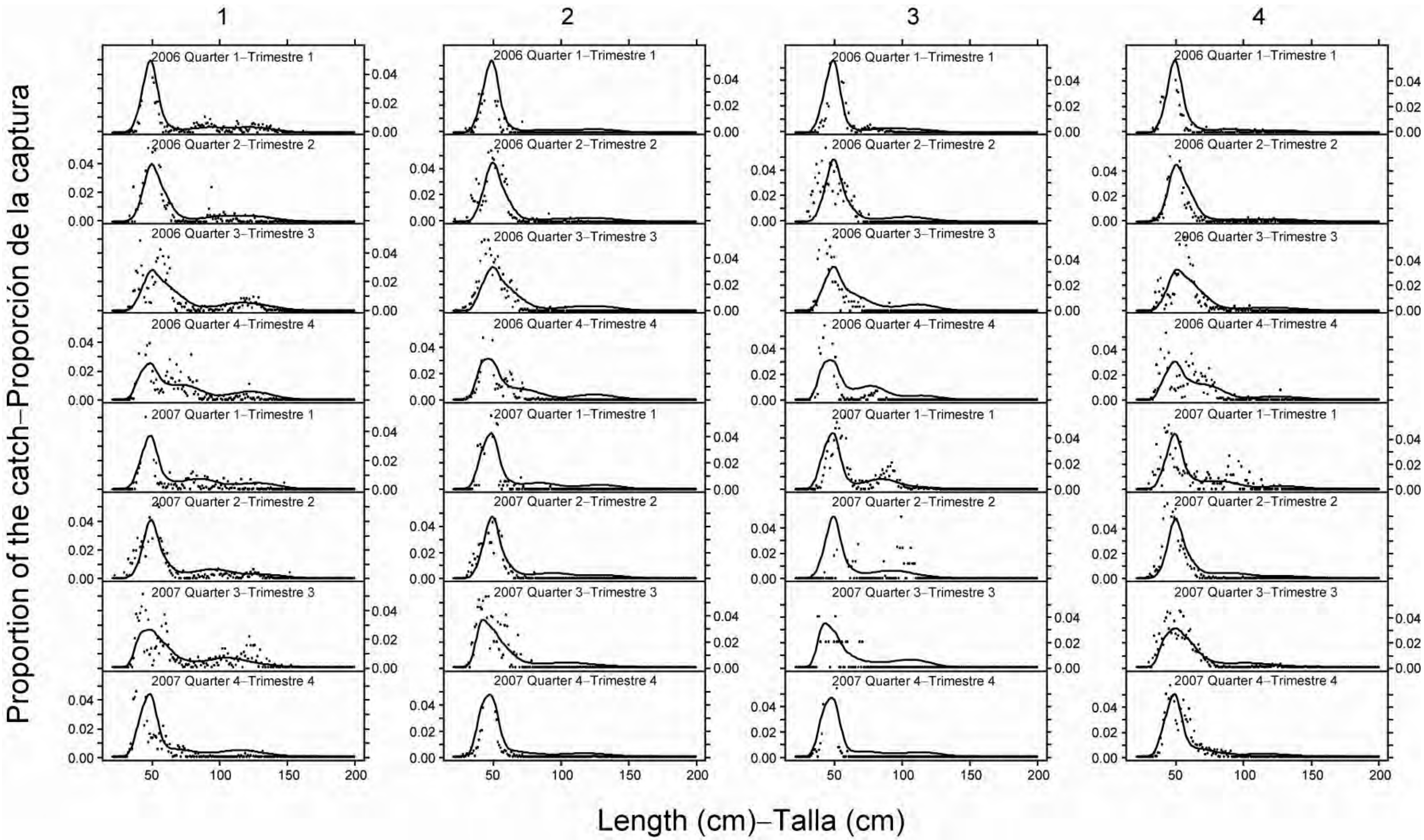

FIGURE 4.8a. Observed (dots) and predicted (curves) size compositions of the recent catches of yellowfin by the fisheries that take tunas in association with floating objects (Fisheries 1-4).
FIGURA 4.8a. Composiciones por tamaño observadas (puntos) y predichas (curvas) de las capturas recientes de aleta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

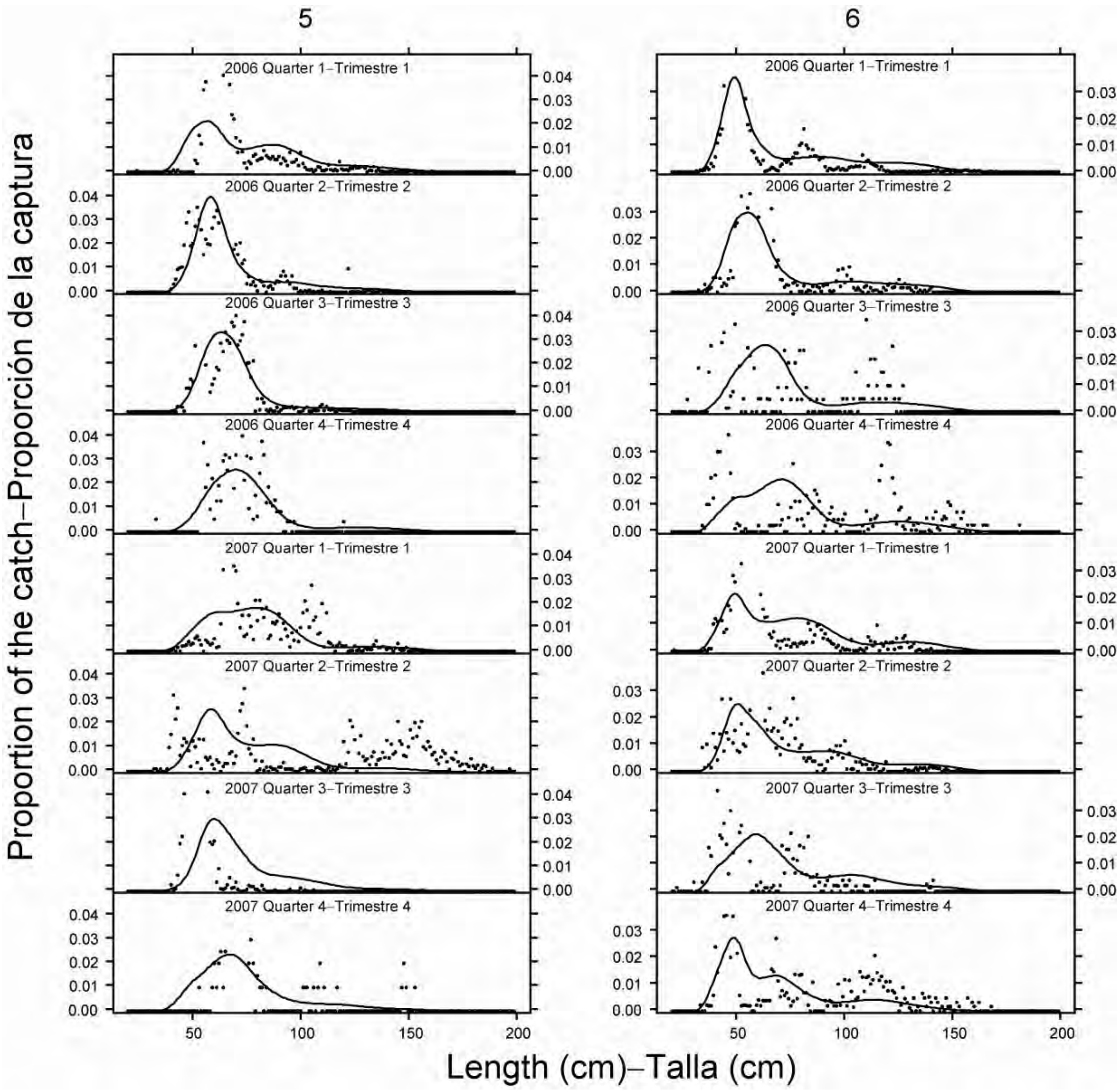

FIGURE 4.8b. Observed (dots) and predicted (curves) size compositions of the recent catches of yellowfin tuna by the fisheries that take tunas in unassociated schools (Fisheries 5 and 6).

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

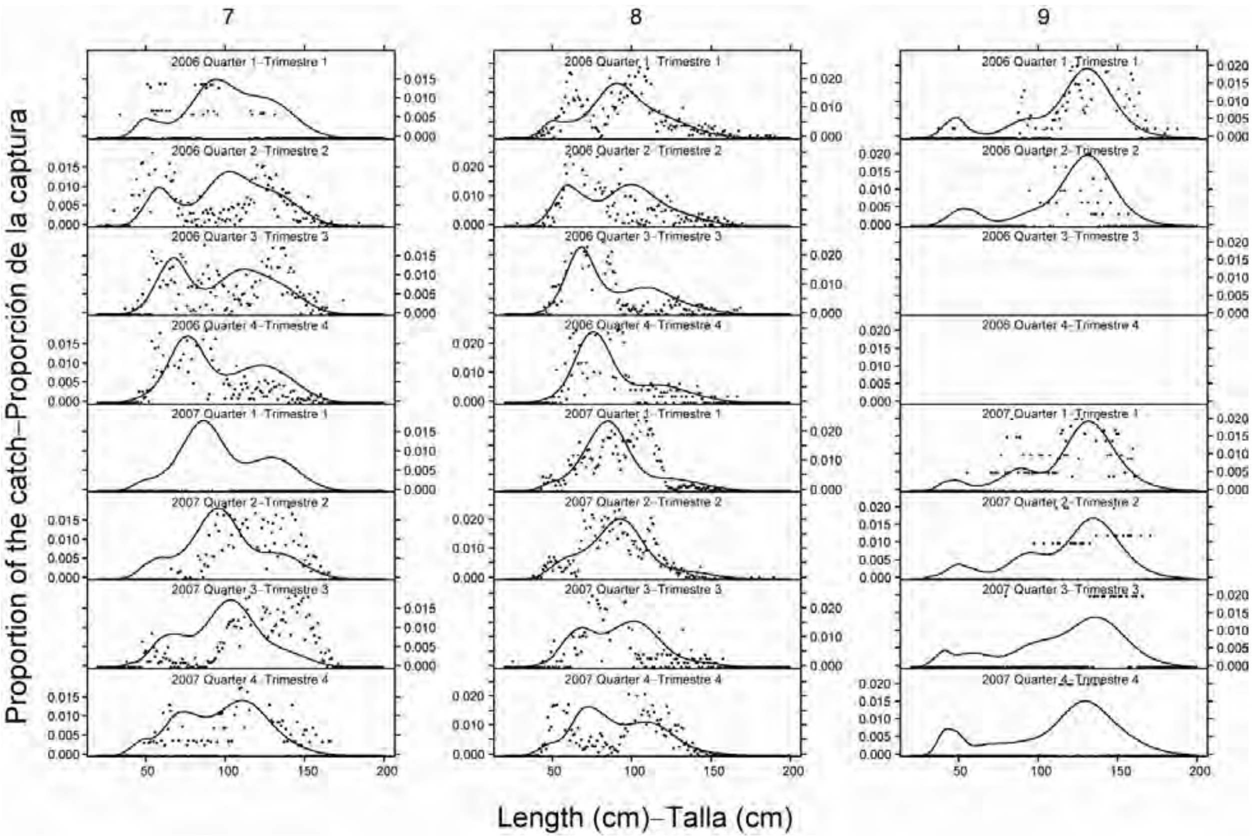

FIGURE 4.8c. Observed (dots) and predicted (curves) size compositions of the recent catches of yellowfin tuna by the fisheries that take tunas in association with dolphins (Fisheries 7-9).

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

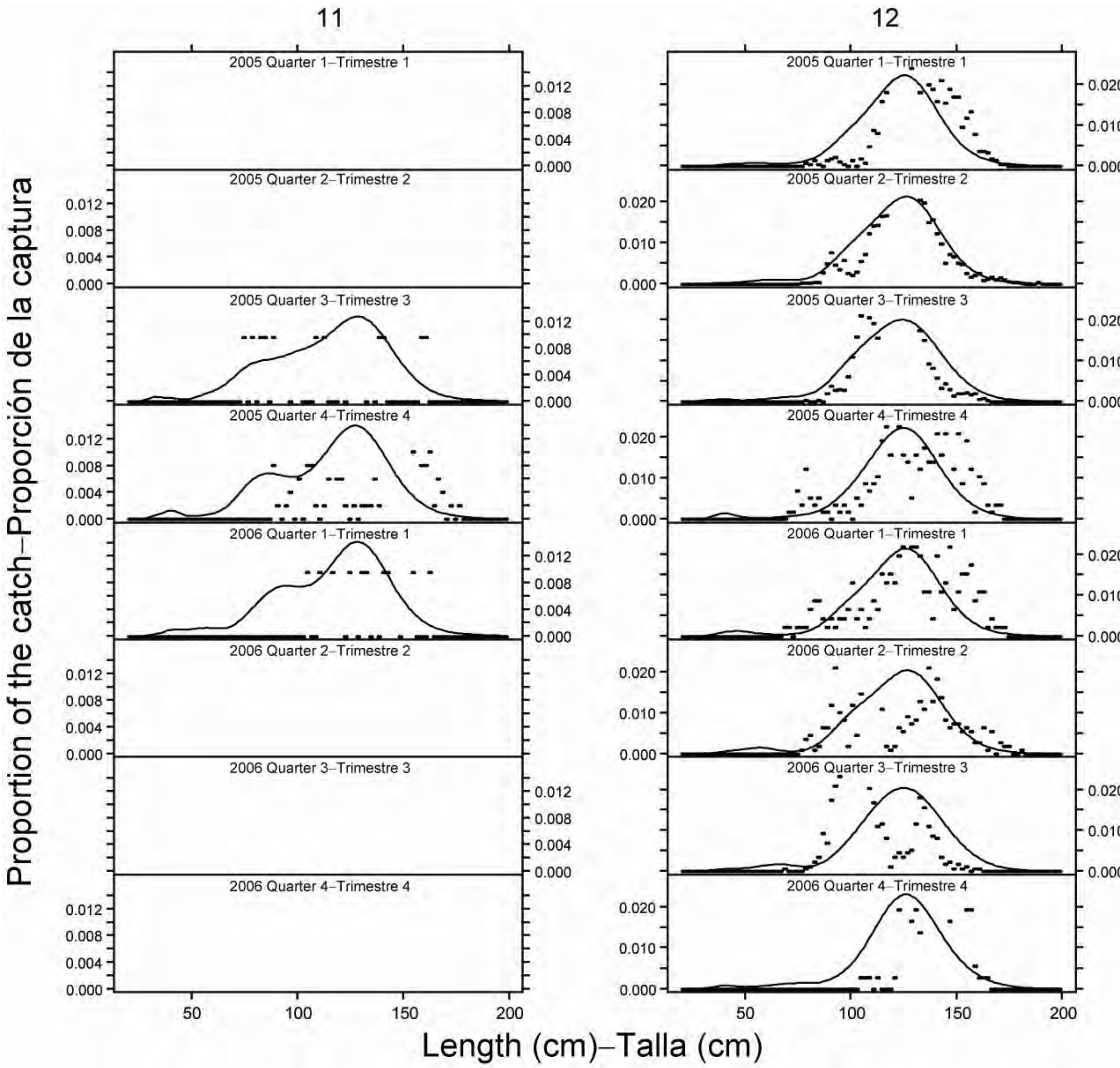

FIGURE 4.8d. Observed (dots) and predicted (curves) size compositions of the recent catches of yellowfin tuna by the longline fisheries (Fisheries 11-12).

FIGURA 4.8d. Composición por talla observada (puntos) y predicha (curvas) de las capturas recientes de atún aleta amarilla por las pesquerías palangreras (Pesquerías 11 y 12).

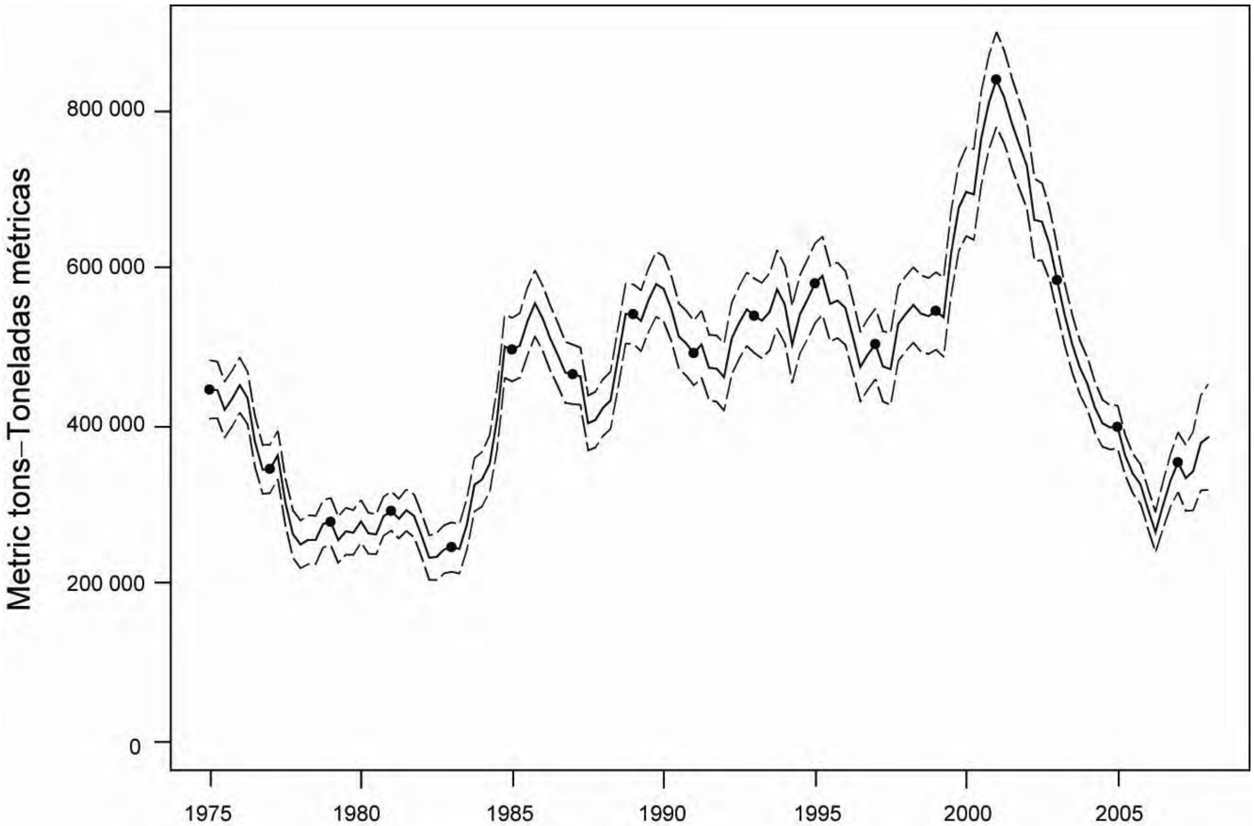

FIGURE 4.9a. Estimated biomass of yellowfin tuna in the EPO. The bold line illustrates the maximum likelihood estimates of the biomass, and the thin dashed lines the approximate 95% confidence intervals around those estimates. Since the assessment model represents time on a quarterly basis, there are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

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

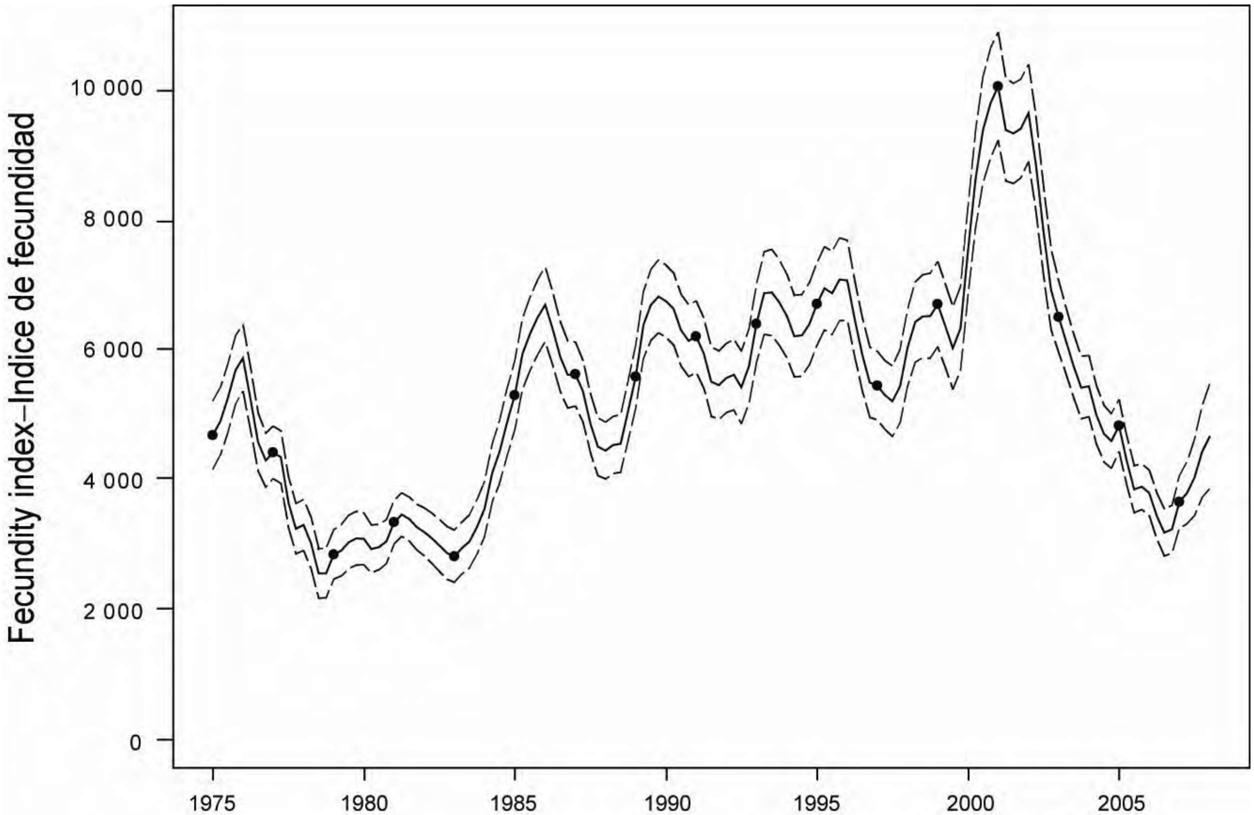

FIGURE 4.9b. Estimated relative spawning biomass of yellowfin tuna in the EPO. The bold line illustrates the maximum likelihood estimates of the biomass, and the thin dashed lines the approximate 95% confidence intervals around those estimates. Since the assessment model represents time on a quarterly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

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

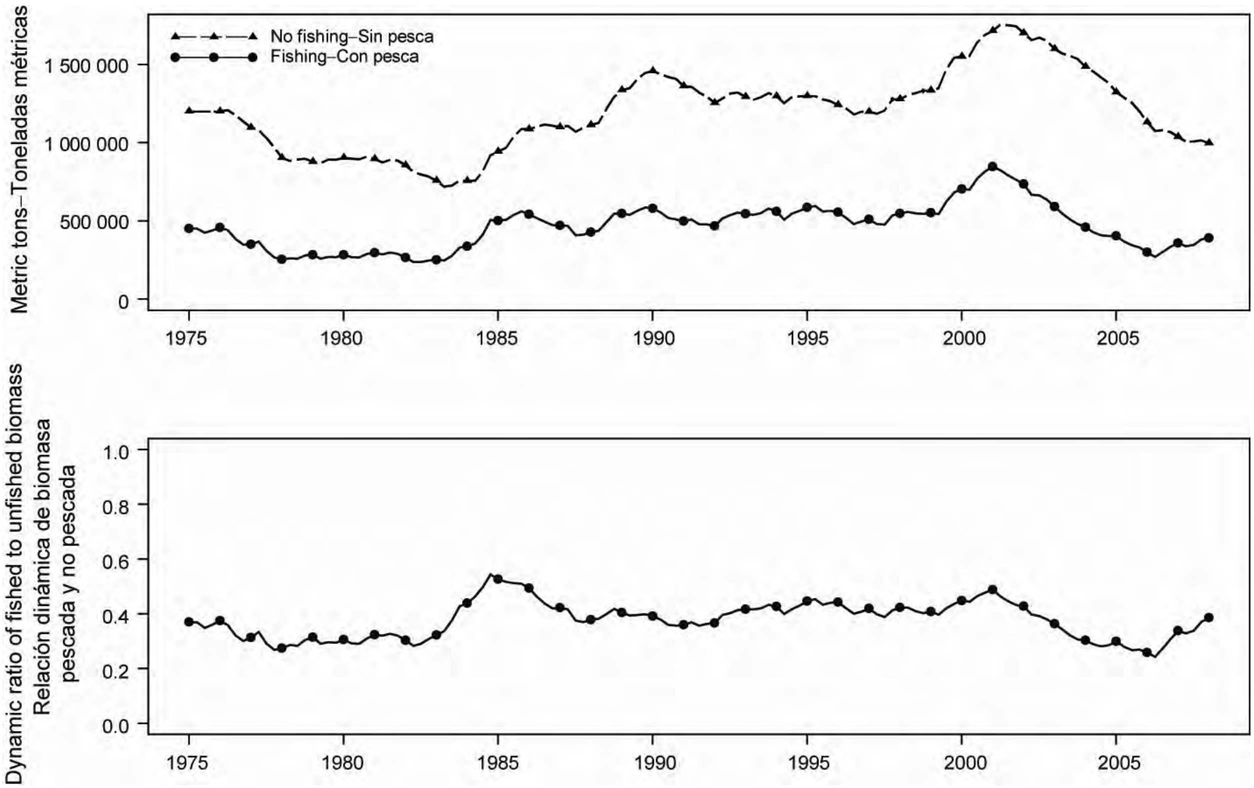

FIGURE 4.10a. Biomass trajectory of a simulated population of yellowfin tuna that was never exploited ("no fishing") and that predicted by the stock assessment model ("fishing").
FIGURA 4.10a. Trayectoria de la biomasa de una población simulada de atún aleta amarilla que nunca fue explotada ("sin pesca") y aquélla predicha por el modelo de evaluación de la población ("con pesca").

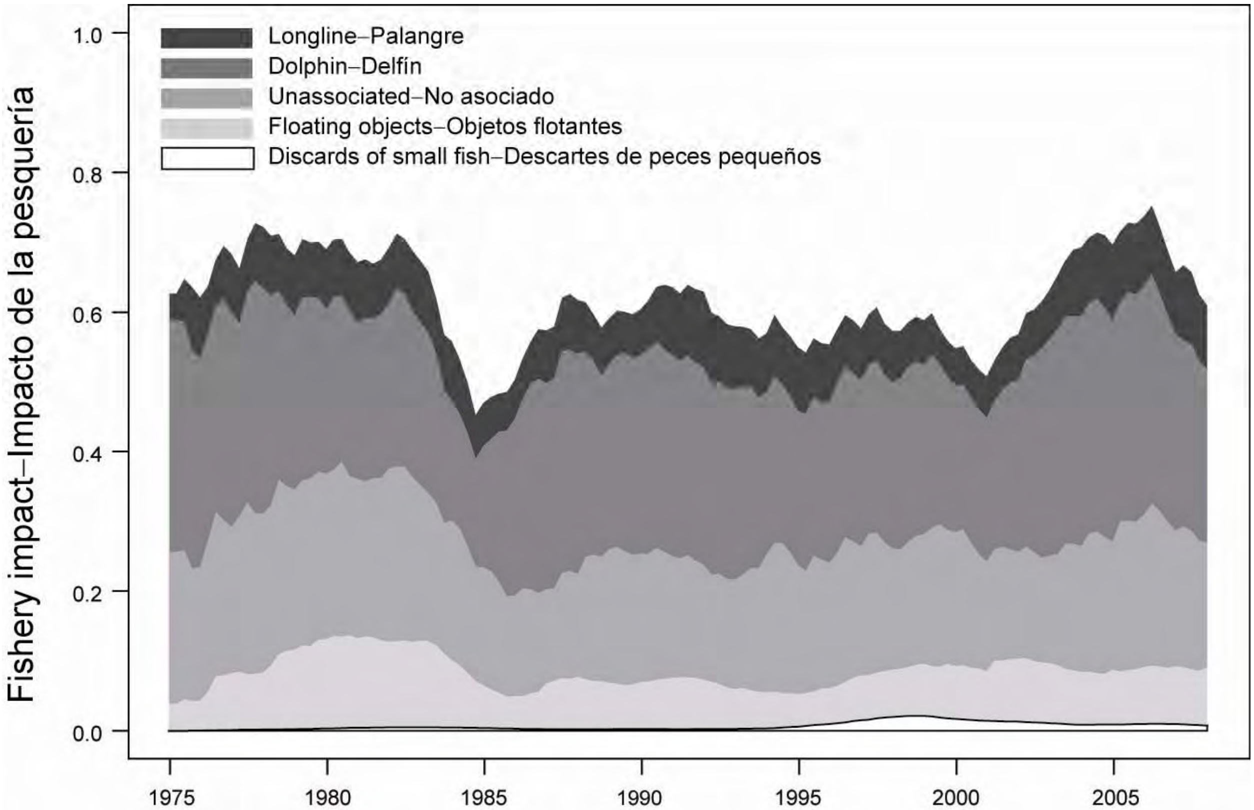

FIGURE 4.10b. Comparison of the relative impacts of the major fisheries on the biomass of yellowfin tuna in the EPO.

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

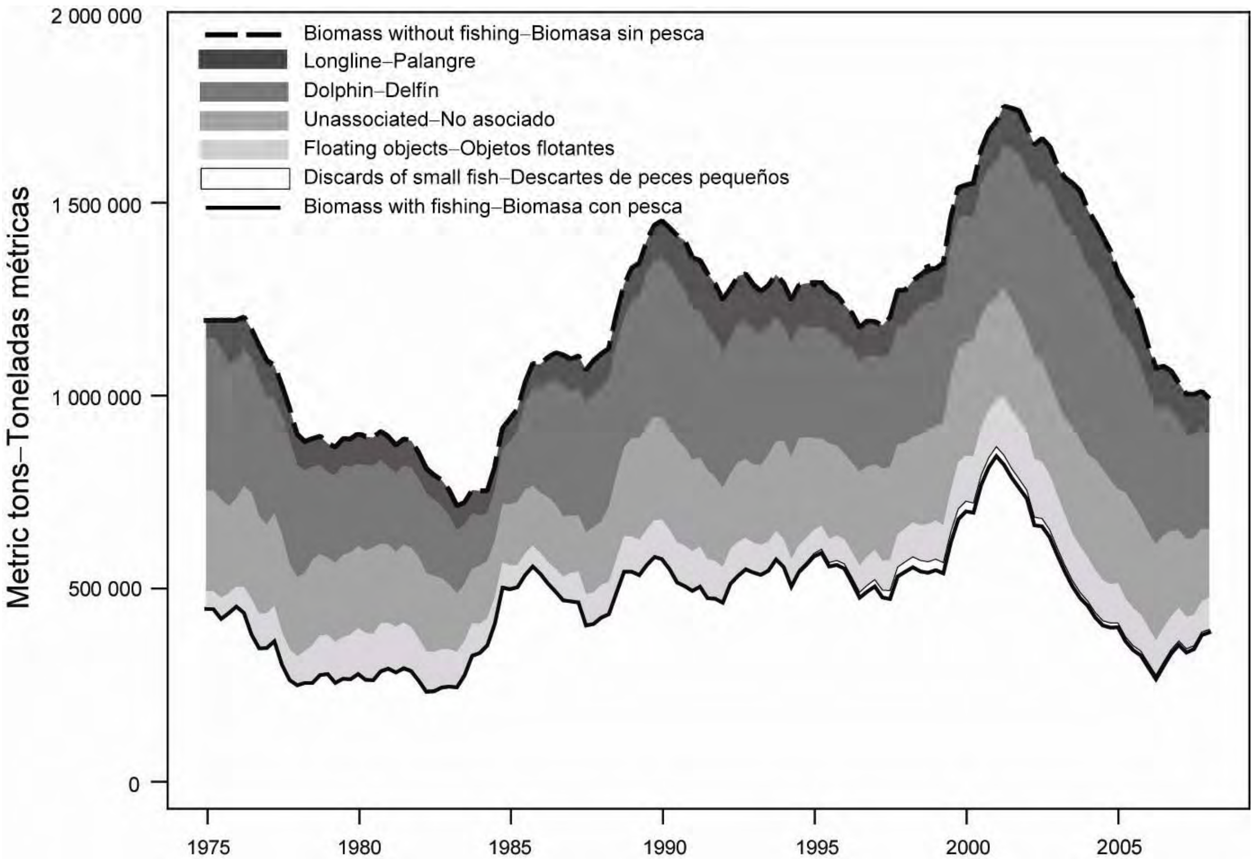

FIGURE 4.10c. Biomass trajectory of a simulated population of yellowfin tuna that was never exploited (dashed line) and that predicted by the stock assessment model (solid line). The shaded areas between the two lines show the portions of the fishery impact attributed to each fishing method.

FIGURA 4.10c. Trayectoria de la biomasa de una población simulada de atún aleta amarilla que nunca fue explotada (línea de trazos) y aquélla predicha por el modelo de evaluación (línea sólida). Las áreas sombreadas entre las dos líneas representan la porción del impacto de la pesca atribuida a cada método de pesca.

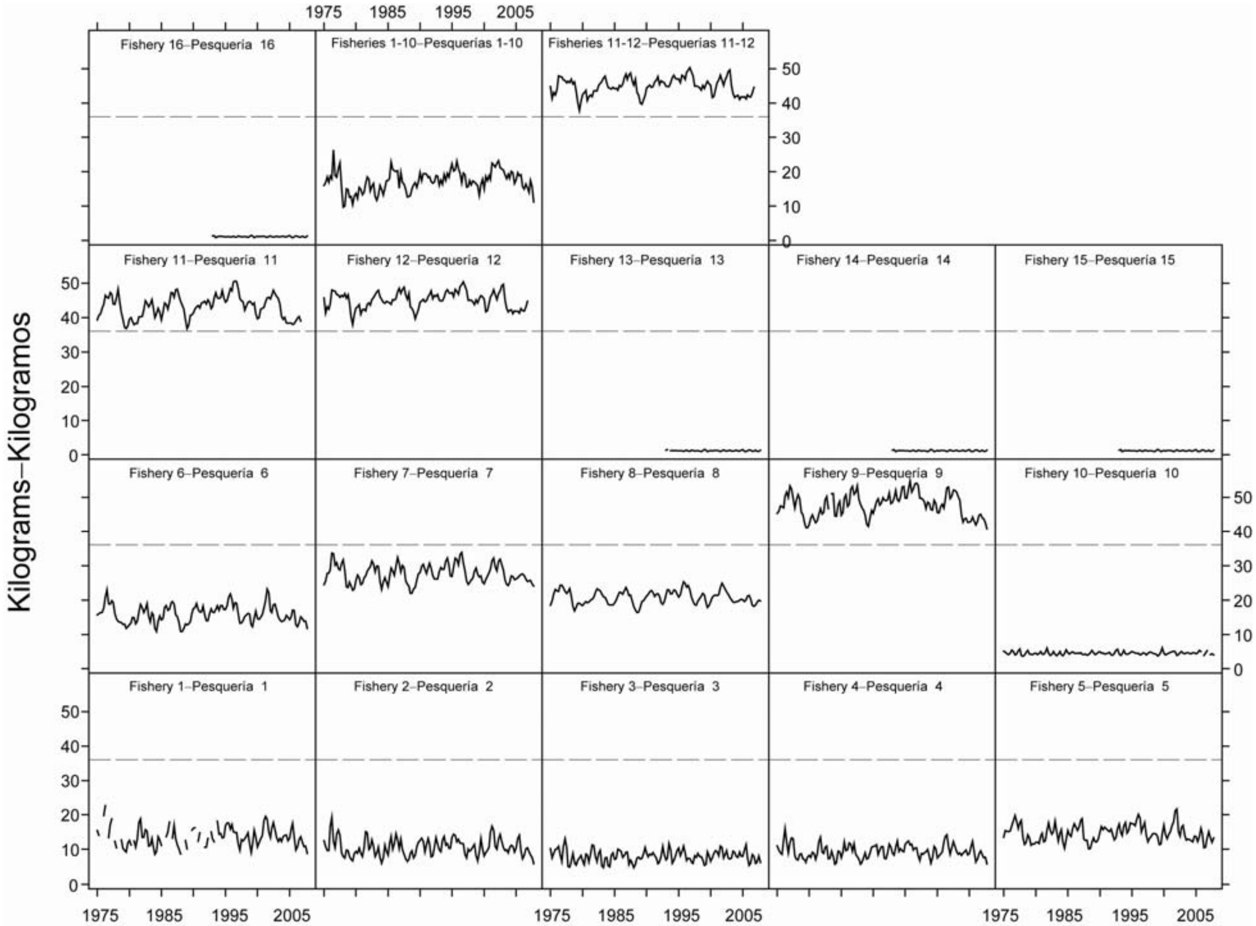

FIGURE 4.11. Estimated average weights of yellowfin tuna caught by the fisheries of the EPO. The time series for "Fisheries 1-10" is an average of Fisheries 1 through 10, and that for "Fisheries 11-12" is an average of Fisheries 11 and 12. The dashed line identifies the critical weight (35.2 kg).

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

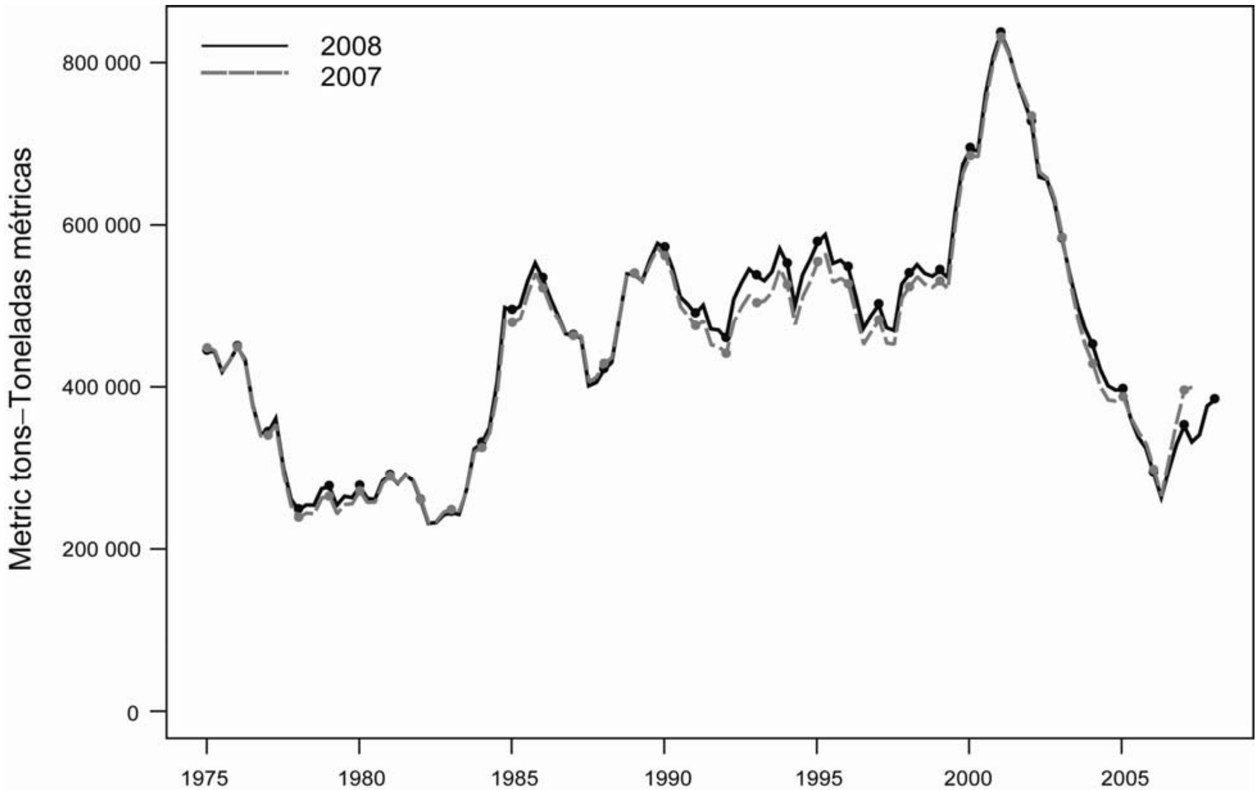

FIGURE 4.12a. Comparison of estimated biomasses of yellowfin tuna in the EPO from the most recent previous assessment and the current assessment.
FIGURA 4.12a. Comparación de la biomasa estimada de atún aleta amarilla en el OPO de la evaluación previa más reciente y de la evaluación actual.

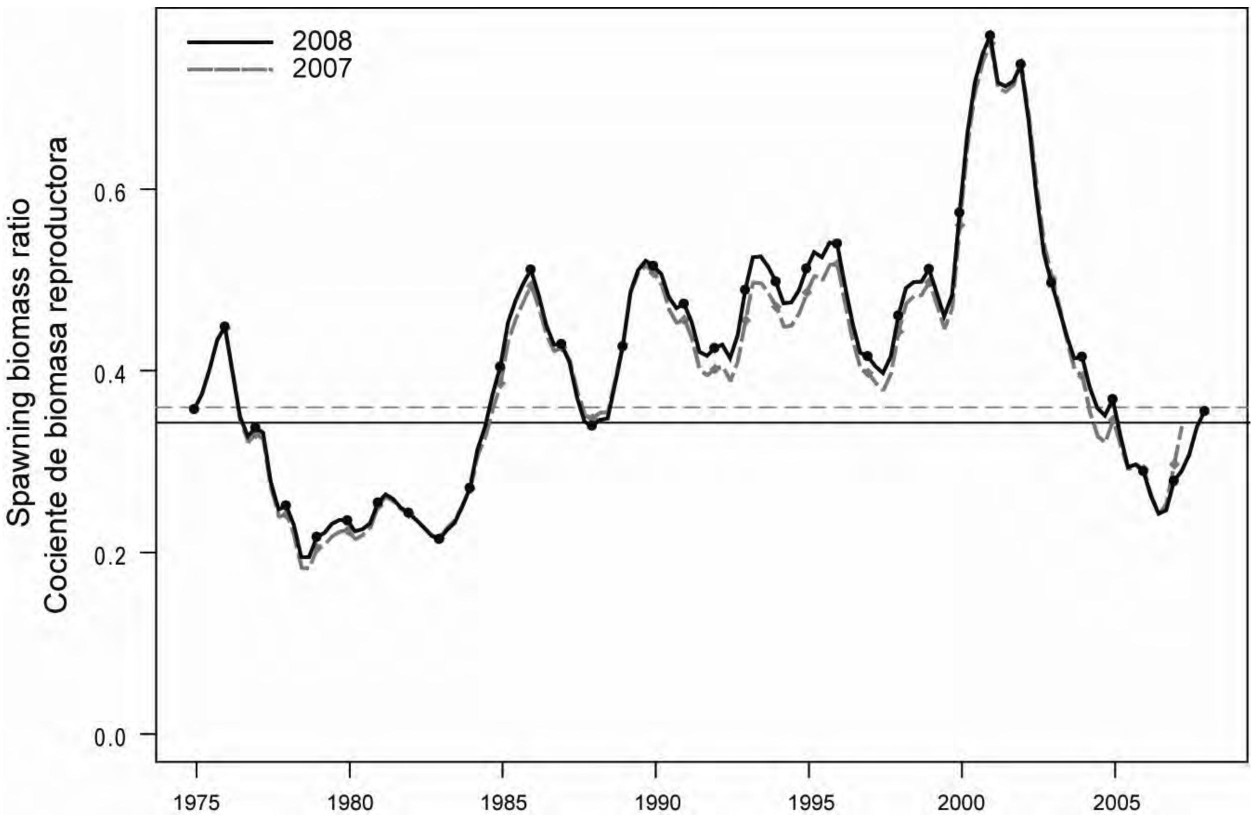

FIGURE 4.12b. Comparison of estimated spawning biomass ratios (SBRs) of yellowfin tuna from the current assessment with the most three recent previous assessments. The horizontal lines identify the SBRs at MSY.

FIGURA 4.12b. Comparación del cociente de biomasa reproductora (SBR) estimado de atún aleta amarilla de la evaluación actual y las tres evaluaciones previas más recientes. Las líneas horizontales identifican el SBR en RMS.

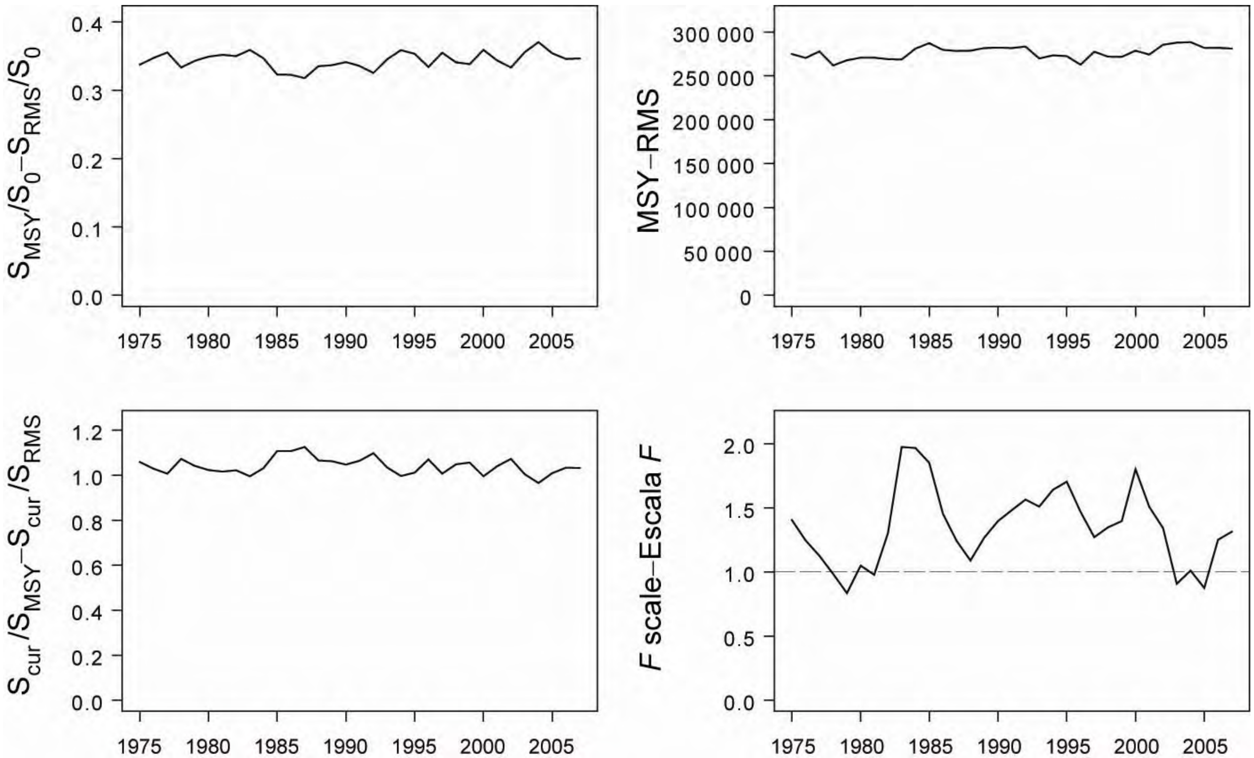

FIGURE 4.12c. Estimates of MSY-related quantities calculated using the average age-specific fishing mortality for each year (*i.e.* the values for 2006 are calculated using the average age-specific fishing mortality in 2006 scaled by the quantity *F*scale, which maximizes the equilibrium yield). (S_{cur} is the spawning biomass at the start of the second quarter of 2007). See the text for definitions.

FIGURA 4.12c. Estimaciones de cantidades relacionadas con el RMS calculadas a partir de la mortalidad por pesca media por edad para cada año (o sea, se calculan los valores de 2006 usando la mortalidad por pesca media por edad escalada por la cantidad *F*scale, que maximiza el rendimiento de equilibrio). (S_{cur} es la biomasa reproductora al principio del segundo trimestre de 2007). Ver definiciones en el texto.

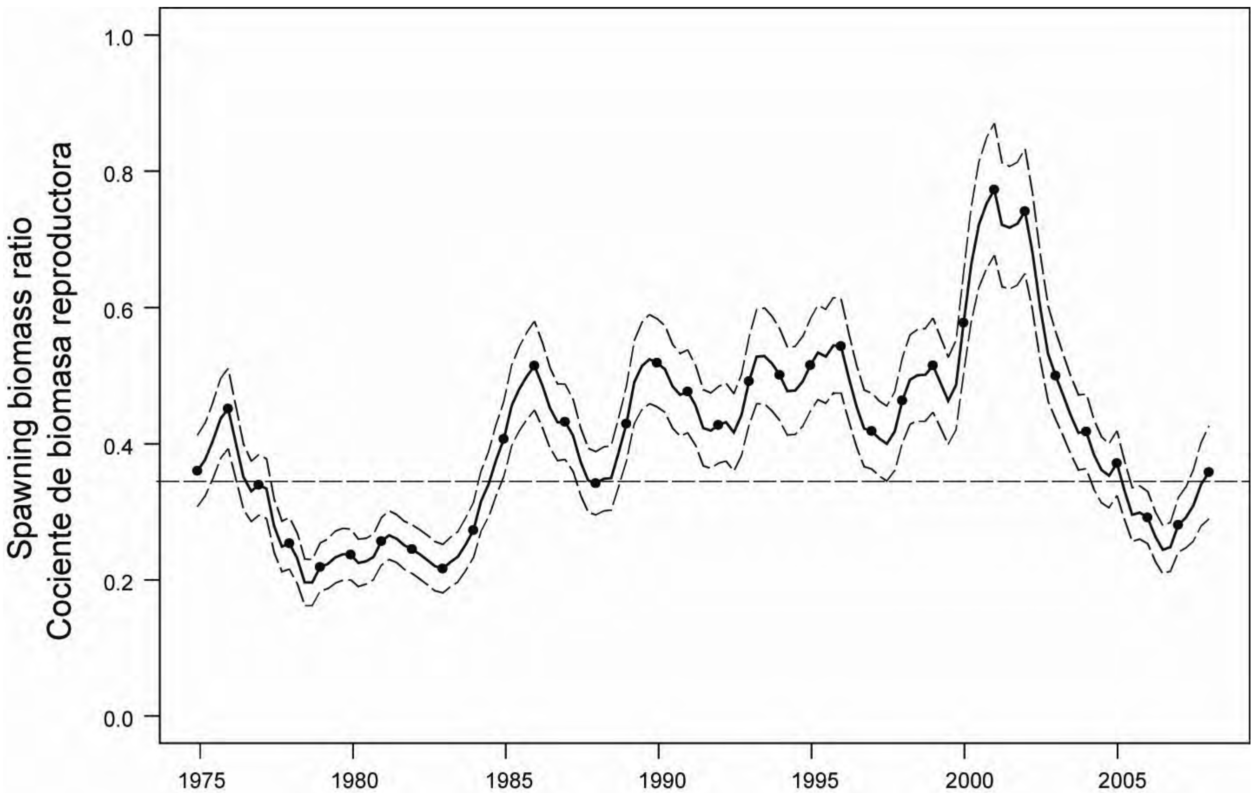

FIGURE 5.1a. Estimated spawning biomass ratios (SBRs) for yellowfin tuna in the EPO. The thin dashed lines represent approximate 95% confidence intervals. The dashed horizontal line identifies the SBR at MSY.

FIGURA 5.1a. Cocientes de biomasa reproductora (SBR) estimados del atún aleta amarilla en el OPO. Las líneas delgadas de trazos representan los intervalos de confianza de 95% aproximados. La línea de trazos horizontal identifica el SBR en RMS.

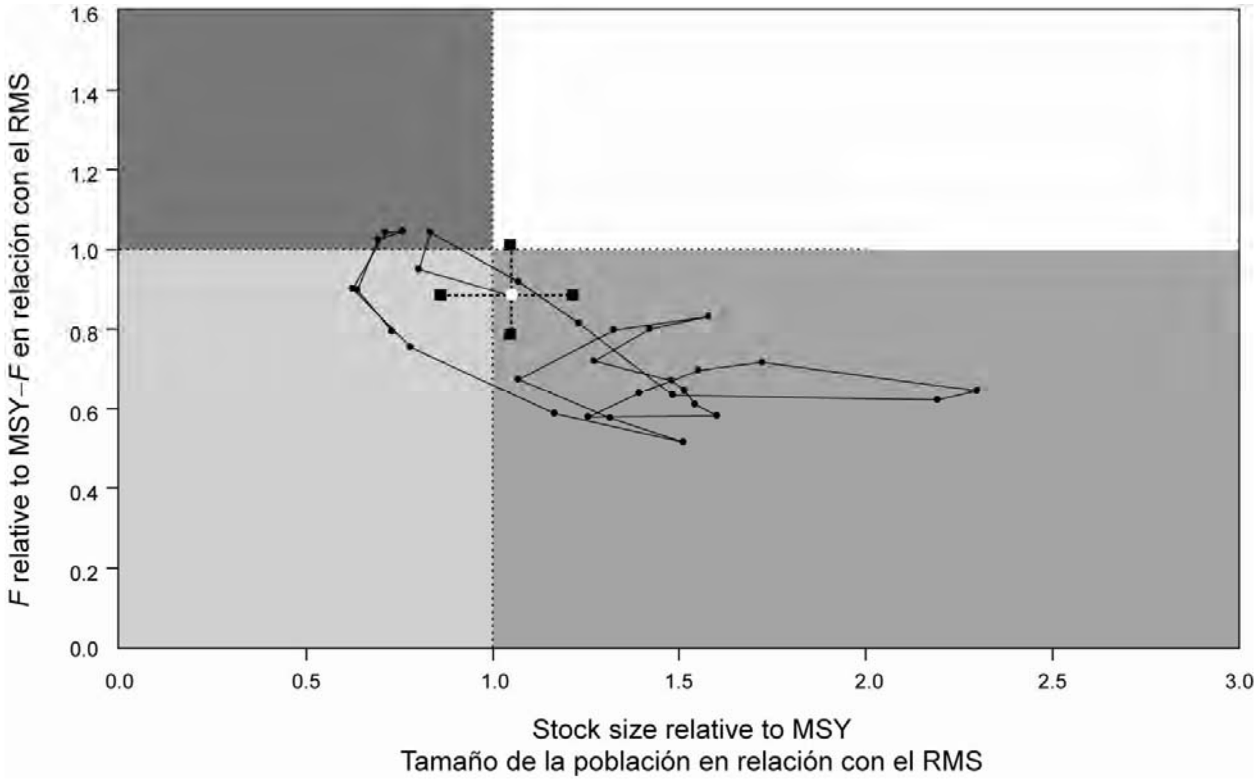

FIGURE 5.1b. Phase plot of the time series of estimates for stock size and fishing mortality relative to their MSY reference points. Each dot is based on the average exploitation rate over three years; the large red dot indicates the most recent estimate. The squares represent approximate 95% confidence intervals.
FIGURA 5.1b. Gráfica de fase de la serie de tiempo de las estimaciones del tamaño de la población y la mortalidad por pesca en relación con sus puntos de referencia de RMS. Cada punto se basa en la tasa de explotación media de tres años; el punto rojo grande indica la estimación valor más reciente. Los puntos cuadrados representan los intervalos de confianza de 95% aproximados.

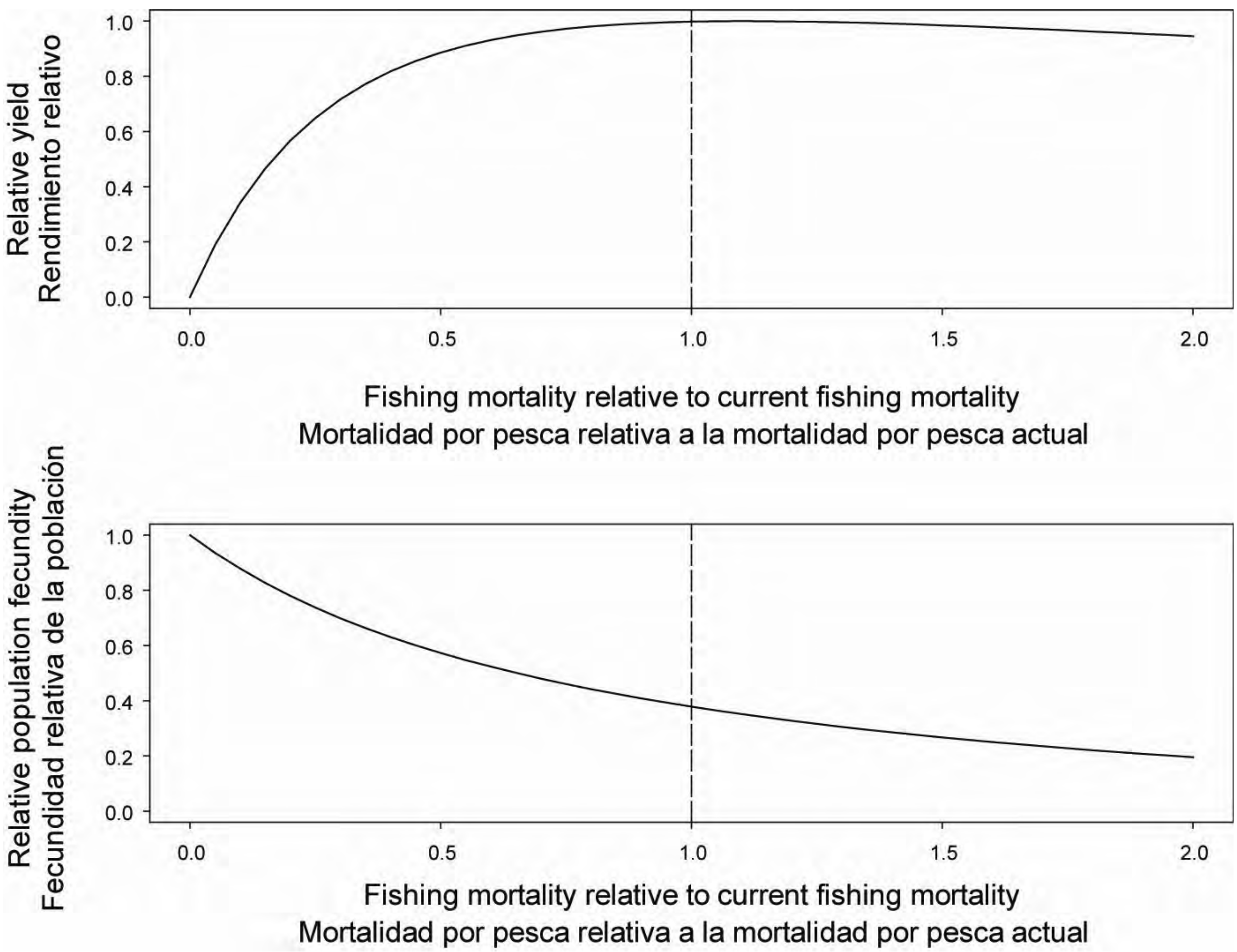

FIGURE 5.2. Predicted effects of long-term changes in fishing effort on the yield (upper panel) and spawning biomass (lower panel) of yellowfin tuna under average environmental conditions, constant recruitment, and the current age-specific selectivity pattern of all fisheries combined. The yield estimates are scaled so that the MSY is at 1.0, and the spawning biomass estimates so that the spawning biomass is equal to 1.0 in the absence of exploitation.

FIGURA 5.2. Efectos predichos de cambios a largo plazo en el esfuerzo de pesca sobre el rendimiento (recuadro superior) y la biomasa reproductora (recuadro inferior) del atún aleta amarilla, bajo condiciones ambientales medias, reclutamiento constante, y el patrón actual de selectividad por edad de todas las pesquerías combinadas. Se escalan las estimaciones de rendimiento para que el RMS esté en 1,0, y las de biomasa reproductora para que ésta equivalga a 1,0 en ausencia de explotación.

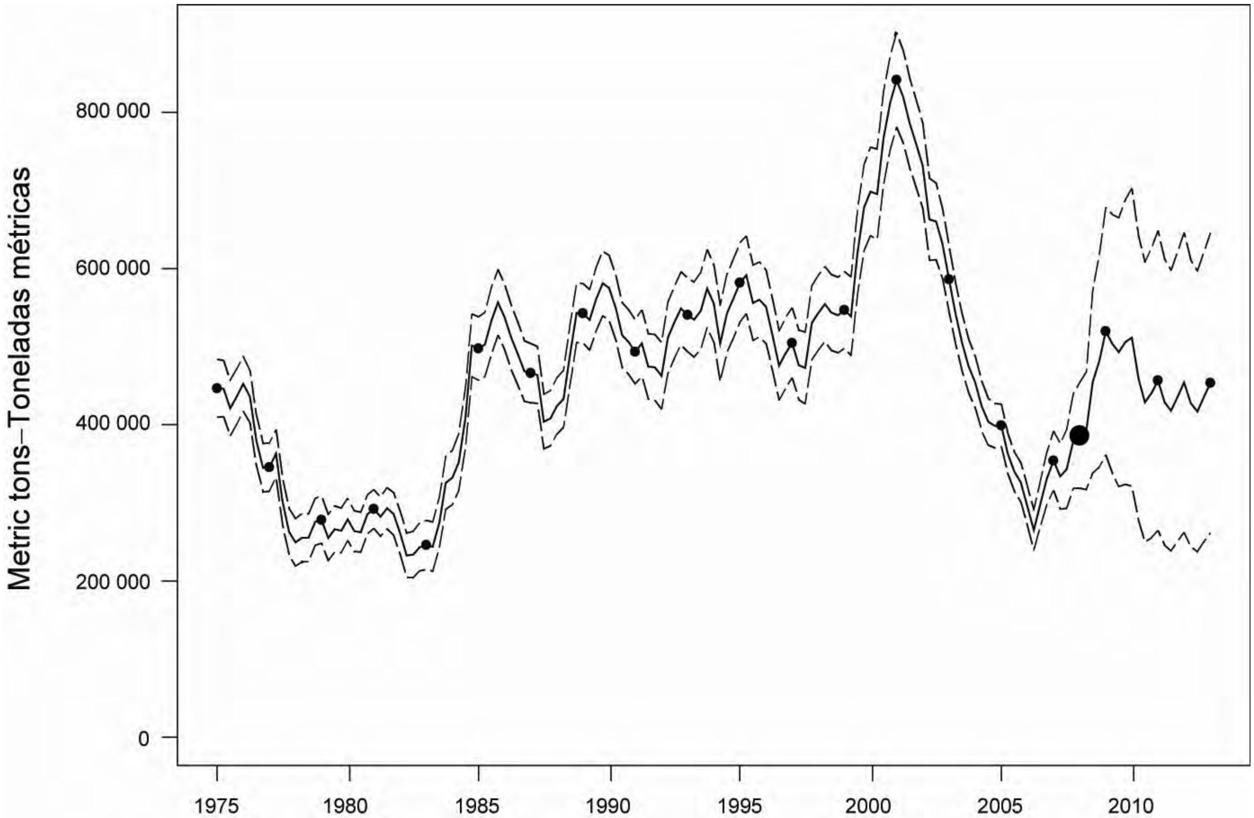

FIGURE 6.1. Biomasses projected for yellowfin tuna in the EPO during 2008-2012 under current effort. The thin dashed lines represent the 95% confidence intervals. The estimates after 2008 indicate the biomasses predicted if the fishing mortality continues at the average of that observed during 2005-2007, and average environmental conditions occur during the next 5 years.

FIGURA 6.1. Biomasa predicha de atún aleta amarilla en el OPO durante 2008-2012 con el esfuerzo actual. Las líneas delgadas de trazos representan los intervalos de confianza de 95%. Las estimaciones a partir de 2008 señalan la biomasa predicha si la mortalidad por pesca continúa en el nivel medio observado durante 2005-2007, y con condiciones ambientales promedio en los 5 años próximos.

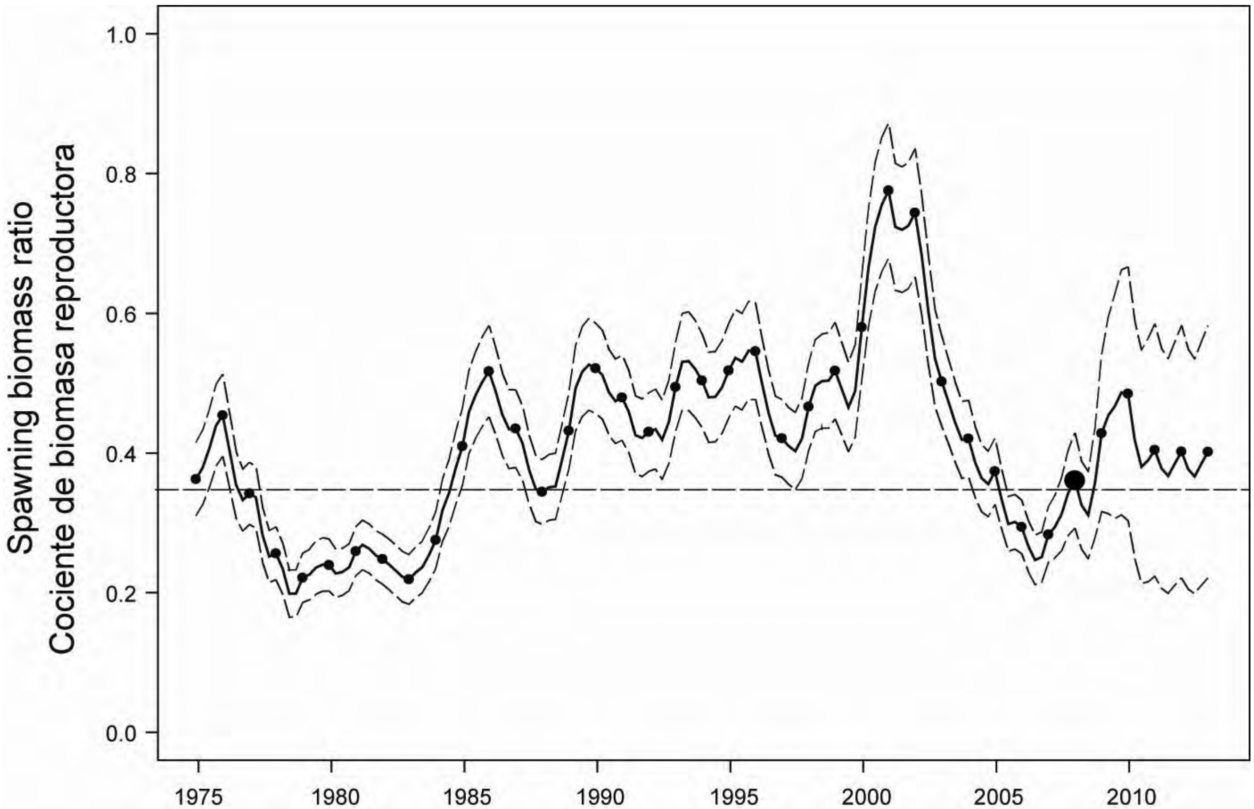

FIGURE 6.2. Spawning biomass ratios (SBRs) for 1975-2007 and SBRs projected during 2008-2012 for yellowfin tuna in the EPO. The dashed horizontal line identifies SBR_{MSY} (Section 5.3), and the thin dashed lines represent the 95% confidence intervals of the estimates. The estimates after 2008 indicate the SBR predicted if the fishing mortality continues at the average of that observed during 2005-2007, and average environmental conditions occur during the next 5 years.

FIGURA 6.2. Cocientes be biomasa reproductora **(**SBR) de 1975-2007 y SBR proyectados durante 2008-2012 para el atún aleta amarilla en el OPO. La línea de trazos horizontal identifica el SBR_{RMS} (Sección 5.3), y las líneas delgadas de trazos representan los intervalos de confianza de 95% de las estimaciones. Las estimaciones a partir de 2008 señalan el SBR predicho si la mortalidad por pesca continúa en el nivel medio observado durante 2005-2007 y con condiciones ambientales promedio en los 5 años próximos.

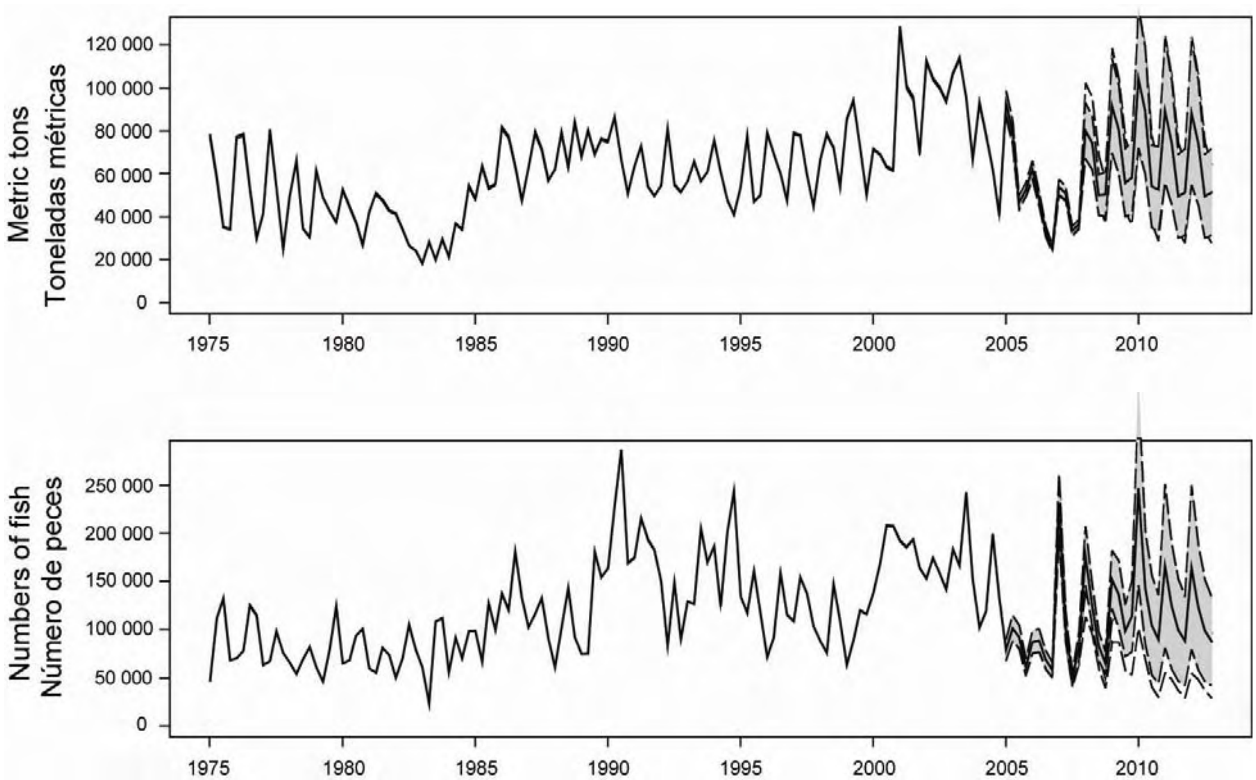

FIGURE 6.3. Catches of yellowfin tuna during 1975-2007 and simulated catches of yellowfin tuna during 2008-2012 by the purse-seine and pole-and-line fleets (upper panel) and the longline fleet (lower panel). The thin dashed lines represent the estimated 95% confidence limits of the estimates. The estimates after 2007 indicate the catches predicted if the fishing mortality continues at the average of that observed during 2005-2007, and average environmental conditions occur during the next 5 years.

FIGURA 6.3. Capturas de atún aleta amarilla durante 1975-2007 y capturas simuladas de atún aleta amarilla durante 2008-2012 por las flotas de cerco y caña (recuadro superior) y la flota palangrera (recuadro inferior). Las líneas delgadas de trazos representan los intervalos de confianza de 95% de las estimaciones. Las estimaciones a partir de 2007 señalan las capturas predichas si la mortalidad por pesca continúa en el promedio del nivel observado durante 2005-2007, y con condiciones ambientales medias en los 5 años próximos.

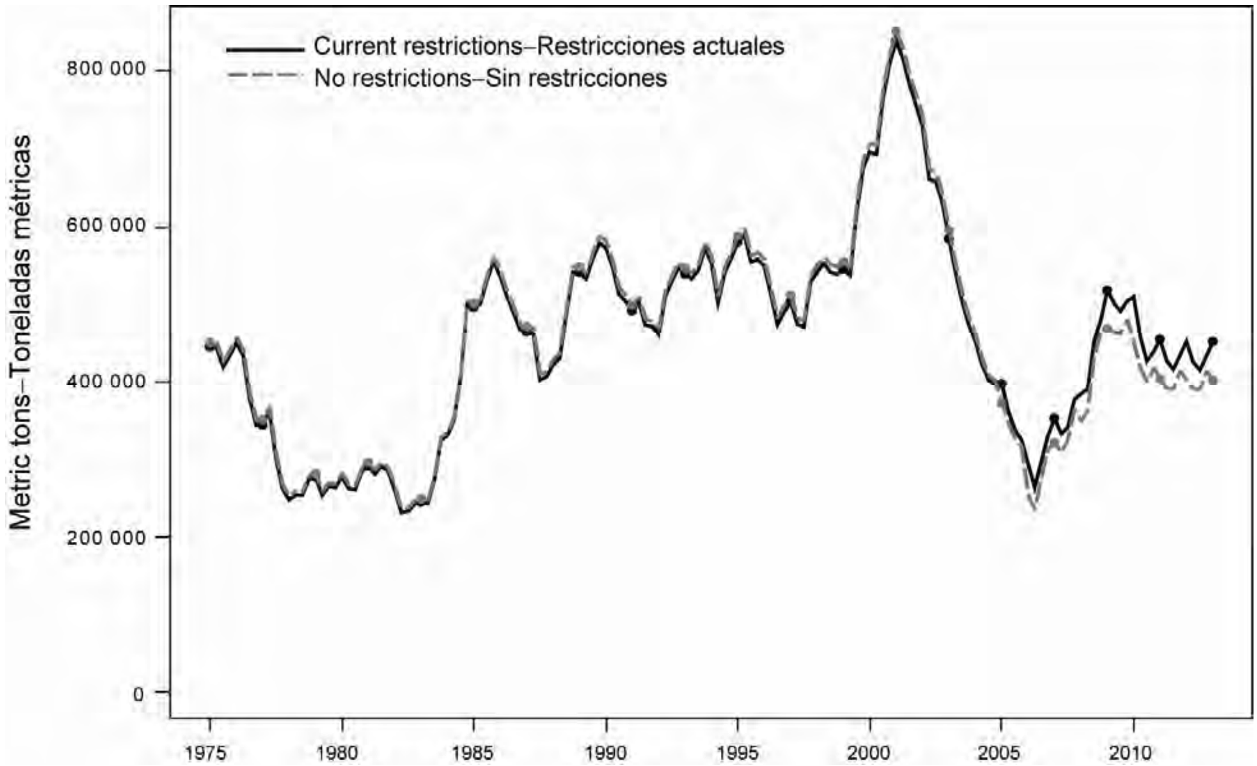

FIGURE 6.4. Biomass projected for yellowfin tuna in the EPO during 2005-2013 under Resolutions C-04-09 and C-06-02, and under effort projected without the resolutions.

FIGURA 6.4. Proyección de la biomasa de atún aleta amarilla en el OPO durante 2005-2013, bajo las Resoluciones C-04-09 y C-06-02, y con el esfuerzo proyectado sin las resoluciones.

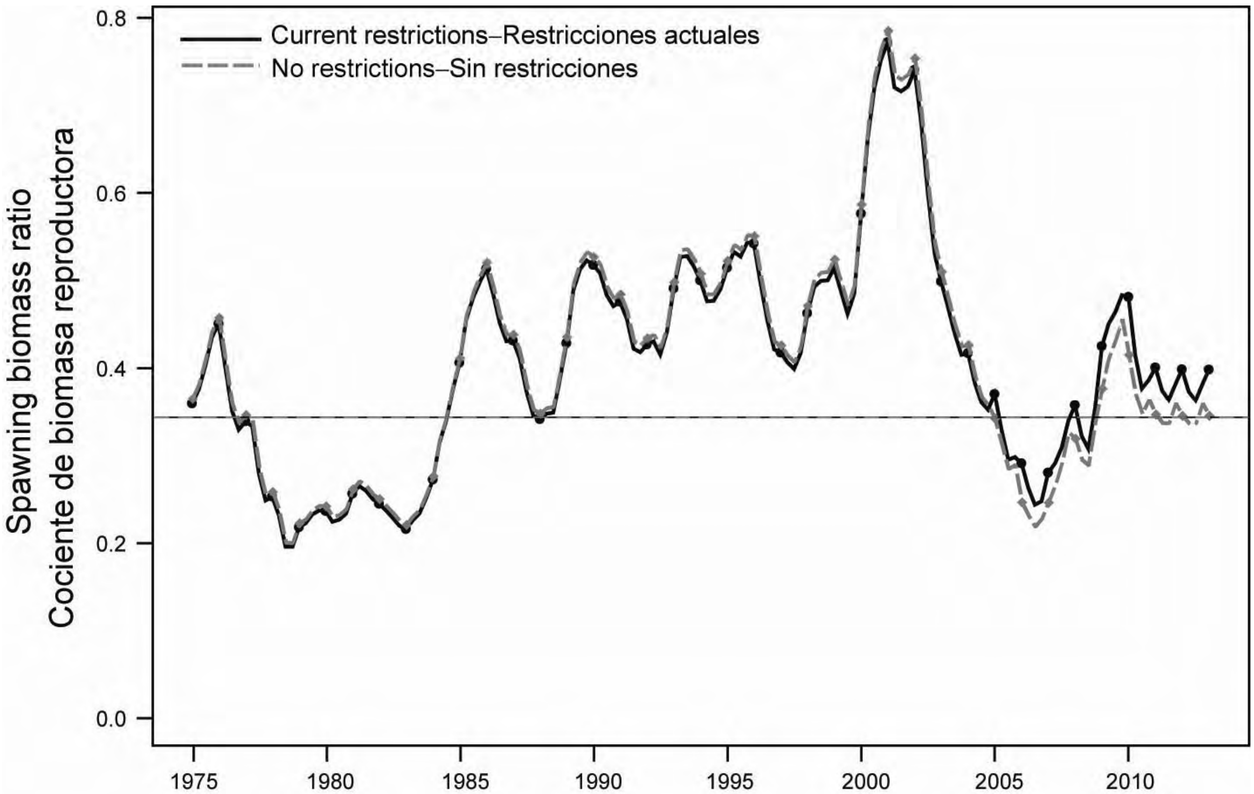

FIGURE 6.5. Spawning biomass ratios (SBRs) projected for yellowfin tuna in the EPO during 2005-2013 under Resolutions C-04-09 and C-06-02, and under effort projected without the Resolutions. The horizontal line (at 0.37) identifies SBR_{MSY} (Section 5.3).

FIGURA 6.5. Cocientes de biomasa reproductora (SBR) de atún aleta amarilla en el OPO proyectados durante 2005-2013, bajo las Resoluciones C-04-09 y C-06-02, y con el esfuerzo proyectado sin las resoluciones. La línea horizontal (en 0.38) identifica SBR_{RMS} (Sección 5.3).

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

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

Fishery	**Gear type**	**Set type**	**Years**	**Sampling areas**	**Catch data**
Pesquería	**Tipo de arte**	**Tipo de lance**	**Año**	**Zonas de muestreo**	**Datos de captura**
1	PS	OBJ	1975-2007	11-12	retained catch + discards from inefficiencies in fishing process–captura retenida + descartes por ineficacias en el proceso de pesca
2	PS	OBJ	1975-2007	7, 9	
3	PS	OBJ	1975-2007	5-6, 13	
4	PS	OBJ	1975-2007	1-4, 8, 10	
5	PS	NOA	1975-2007	1-4, 8, 10	retained catch + discards–captura retenida + descartes
6	PS	NOA	1975-2007	5-7, 9, 11-13	
7	PS	DEL	1975-2007	2-3, 10	
8	PS	DEL	1975-2007	1, 4-6, 8, 13	
9	PS	DEL	1975-2007	7, 9, 11-12	
10	LP		1975-2007	1-13	retained catch only— captura retenida solamente
11	LL		1975-2007	N of-de 15°N	
12	LL		1975-2007	S of-de 15°N	
13	PS	OBJ	1993-2007	11-12	discards of small fish from size-sorting the catch by Fishery 1–descartes de peces pequeños de clasificación por tamaño en la Pesquería 1
14	PS	OBJ	1993-2007	7, 9	discards of small fish from size-sorting the catch by Fishery 2–descartes de peces pequeños de clasificación por tamaño en la Pesquería 2
15	PS	OBJ	1993-2007	5-6, 13	discards of small fish from size-sorting the catch by Fishery 3–descartes de peces pequeños de clasificación por tamaño en la Pesquería 3
16	PS	OBJ	1993-2007	1-4, 8, 10	discards of small fish from size-sorting the catch by Fishery 4–descartes de peces pequeños de clasificación por tamaño en la Pesquería 4

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

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

Year Año	Total recruitment Reclutamiento total	Biomass of age-1.5+ fish Biomasa de peces de edad 1.5+	Relative spawning biomass Biomasa reproductora relativa
1975	114,444	446,742	0.47
1976	95,744	452,388	0.58
1977	149,444	345,700	0.44
1978	103,651	249,422	0.33
1979	137,895	278,246	0.28
1980	108,846	278,712	0.31
1981	74,865	292,245	0.33
1982	124,490	261,217	0.32
1983	190,245	246,023	0.28
1984	152,489	332,510	0.35
1985	130,630	497,627	0.53
1986	156,136	537,416	0.67
1987	264,530	466,116	0.56
1988	191,059	423,918	0.44
1989	159,516	542,701	0.55
1990	155,640	575,129	0.67
1991	213,508	493,254	0.62
1992	171,988	462,779	0.55
1993	169,155	540,737	0.64
1994	148,736	555,343	0.65
1995	166,150	581,959	0.67
1996	220,183	551,002	0.70
1997	162,990	504,760	0.54
1998	312,177	543,030	0.60
1999	219,089	547,056	0.67
2000	225,099	698,714	0.75
2001	211,166	841,411	1.00
2002	176,001	731,587	0.96
2003	148,982	586,082	0.65
2004	120,449	454,463	0.54
2005	144,313	399,137	0.48
2006	124,520	295,340	0.38
2007	225,527	354,047	0.36
2008		386,284	0.46

TABLE 4.2. Estimates of the average sizes of yellowfin tuna. The ages are expressed in quarters after hatching.
TABLA 4.2. Estimaciones del tamaño medio de atún aleta amarilla. Se expresan las edades en trimestres desde la cría.

Age (quarters)	Average length (cm)	Average weight (kg)	Age (quarters)	Average length (cm)	Average weight (kg)
Edad (trimestres)	**Talla media (cm)**	**Peso medio (kg)**	**Edad (trimestres)**	**Talla media (cm)**	**Peso medio (kg)**
2	33.06	0.7	16	154.22	80.98
3	40.76	1.33	17	159.06	89.08
4	48.92	2.34	18	163.25	96.52
5	58.32	4.03	19	166.84	103.22
6	68.47	6.61	20	169.89	109.16
7	78.72	10.16	21	172.48	114.38
8	89.2	14.95	22	174.67	118.92
9	99.43	20.9	23	176.51	122.83
10	109.28	27.97	24	178.06	126.18
11	118.64	36.04	25	179.35	129.03
12	127.37	44.87	26	180.43	131.44
13	135.18	53.92	27	181.33	133.47
14	142.29	63.16	28	182.08	135.18
15	148.64	72.28	29	182.7	136.61

TABLE 5.1. MSY and related quantities for the base case and the stock-recruitment relationship sensitivity analysis, based on average fishing mortality (*F*) for 2005-2007. The quantities are also given based on average *F* for 2005-2006. B_{recent} and B_{MSY} are defined as the biomass of fish 2+ quarters old at the start of the second quarter of 2007 and at MSY, respectively, and S_{recent} and S_{MSY} are defined as indices of spawning biomass (therefore, they are not in metric tons). C_{recent} is the estimated total catch from the second quarter of 2006 through the first quarter of 2007.
TABLA 5.1. RMS y cantidades relacionadas para el caso base y los análisis de sensibilidad a la relación población-reclutamiento, basados en la mortalidad por pesca (*F*) media de 2005-2007. Se presentan también las cantidades basadas en la *F* media de 2005-2006. Se definen B_{recent} y B_{RMS} como la biomasa de peces de 2+ trimestres de edad al principio del segundo trimestre de 2007 y en RMS, respectivamente, y S_{recent} y S_{RMS} como los índices de biomasa reproductora (por lo tanto, no se expresan en toneladas métricas). C_{recent} es la captura total estimada desde el segundo trimestre de 2006 hasta el primer trimestre de 2007, inclusive.

	Base case Caso base	**h = 0.75**	**Average *F* *F* promedio 2005-2006**
MSY–RMS	281,902	290,236	282,043
B_{MSY} –B_{RMS}	400,484	530,326	399,405
S_{MSY} —S_{RMS}	4,489	6,224	4,474
C_{recent}/MSY—C_{recent}/RMS	0.68	0.67	0.68
B_{recent}/B_{MSY} –B_{recent}/B_{RMS}	0.96	0.72	0.97
S_{recent}/S_{MSY} –S_{recent}/S_{RMS}	1.04	0.74	1.04
$S_{MSY}/S_{F=0}$ –$S_{RMS}/S_{F=0}$	0.34	0.40	0.34
F multiplier—Multiplicador de *F*	1.13	0.77	1.06

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

Fishery	MSY	B_{MSY}	S_{MSY}	$B_{\text{MSY}}/B_{F=0}$	$S_{\text{MSY}}/S_{F=0}$	F multiplier
Pesquería	**RMS**	B_{RMS}	S_{RMS}	$B_{\text{RMS}}/B_{F=0}$	$S_{\text{RMS}}/S_{F=0}$	**Multiplicador de** F
All—Todas	281,902	400,484	4,489	0.34	0.34	1.13
OBJ	212,479	308,808	3,377	0.26	0.26	9.26
NOA	260,293	395,167	4,558	0.33	0.35	3.70
DEL	306,525	397,836	4,213	0.33	0.32	2.56
LL	358,755	461,893	4,962	0.39	0.38	47.19

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

Fishery	MSY	B_{MSY}	S_{MSY}	$B_{\text{MSY}}/B_{F=0}$	$S_{\text{MSY}}/S_{F=0}$	F multiplier
Pesquería	**RMS**	B_{RMS}	S_{RMS}	$B_{\text{RMS}}/B_{F=0}$	$S_{\text{RMS}}/S_{F=0}$	**Multiplicador de** F
All—Todas	281,902	400,484	4,489	0.34	0.34	1.13
No OBJ	291,443	408,154	4,533	0.34	0.35	1.35
No NOA	290,590	407,747	4,524	0.34	0.35	1.61
No DEL	259,384	403,265	4,702	0.34	0.36	2.08
No LL	277,741	396,828	4,442	0.33	0.34	1.19

TABLE 5.2c. Estimates of the MSY and its associated quantities, obtained by assuming that each fishery maintains its current pattern of age-specific selectivity (Figure 4.4), and by adjusting the effort to obtain MSY. Either all gears are adjusted, one fishery only is adjusted while the other is set to zero, or one fishery is adjusted while the other remains at its current level. The estimates of the MSY and B_{MSY} are expressed in metric tons.

TABLA 5.2c. Estimaciones del RMS y sus cantidades asociadas, obtenidas suponiendo que cada pesquería mantiene su patrón actual de selectividad por edad (Figure 4.4) y ajustando el esfuerzo para obtener el RMS. Se ajustan todas las artes de pesco, o se ajusta solamente una pesquería y se fija la otra en cero, o se ajusta una pesquería y la otra sigue en su nivel actual. Se expresan las estimaciones de RMS y B_{RMS} en toneladas métricas.

	All gears	**Purse-seine only**	**Longline only**	**Purse-seine adjusted**	**Longline adjusted**
	Todas artes	**Cerco solamente**	**Palangre solamente**	**Cerco ajustado**	**Palangre ajustado**
Steepness—Inclinación = 1 (Base case-Caso base)					
MSY—RMS	281,902	277,741	358,755	281,367	307,647
B_{MSY}—B_{RMS}	400,484	396,828	461,893	414,427	320,750
S_{MSY}—S_{RMS}	4,489	4,442	4,962	4,686	3,138
B_{MSY}/B_0—B_{RMS}/B_0	0.34	0.33	0.39	0.35	0.27
S_{MSY}/S_0—S_{RMS}/S_0	0.34	0.34	0.38	0.36	0.24
F multiplier—Multiplicador de *F*	1.13	1.19	47.19	1.07	37.46
Steepness—Inclinación = 0.75					
MSY—RMS	290,236	285,335	376,352	292,627	287,643
B_{MSY}—B_{RMS}	530,326	528,075	577,587	553,679	391,912
S_{MSY}—S_{RMS}	6,224	6,173	6,727	6,534	4,367
B_{MSY}/B_0—B_{RMS}/B_0	0.37	0.37	0.41	0.39	0.28
S_{MSY}/S_0—S_{RMS}/S_0	0.40	0.40	0.43	0.42	0.28
F multiplier—Multiplicador de *F*	0.77	0.82	22.99	0.71	5.32

Appendices—Anexos

APPENDIX A: SENSITIVITY ANALYSIS FOR THE STOCK-RECRUITMENT RELATIONSHIP
ANEXO A: ANÁLISIS DE SENSIBILIDAD A LA RELACIÓN POBLACIÓN-RECLUTAMIENTO

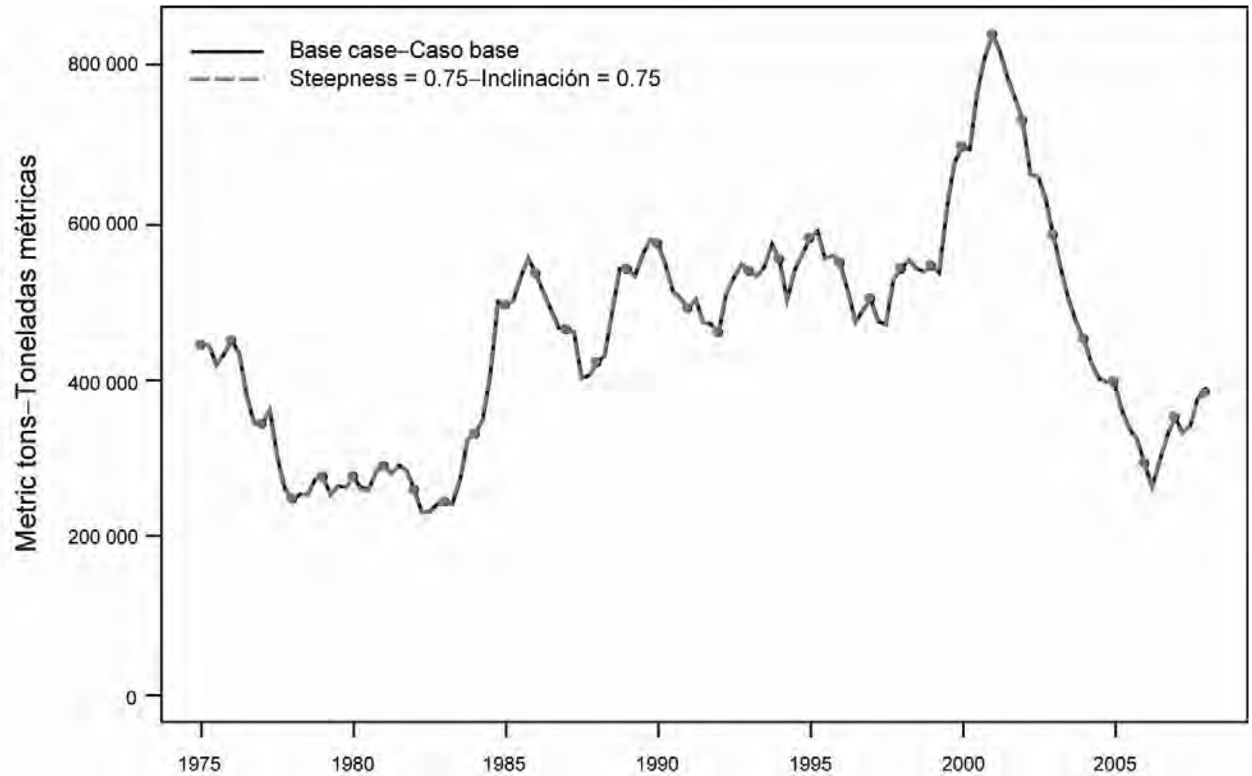

FIGURE A.1. Comparison of the estimates of biomass of yellowfin tuna from the analysis without a stock-recruitment relationship (base case) and with a stock-recruitment relationship (steepness = 0.75).
FIGURA A.1. Comparación de las estimaciones de la biomasa de atún aleta amarilla del análisis sin relación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

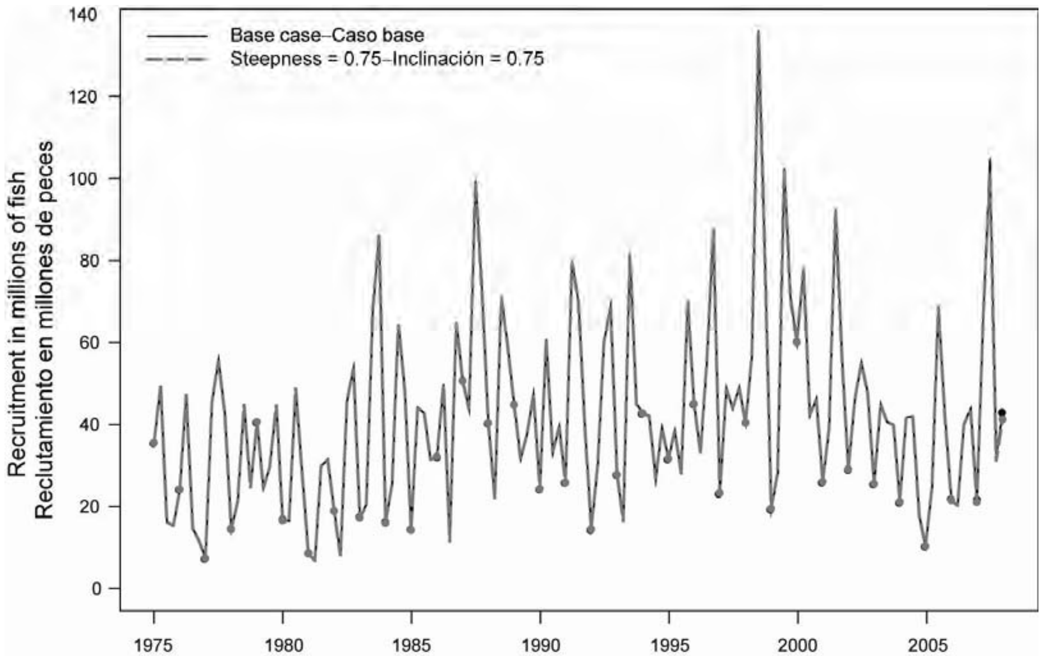

FIGURE A.2. Comparison of estimates of recruitment of yellowfin tuna from the analysis without a stock-recruitment relationship (base case) and with a stock-recruitment relationship (steepness = 0.75).
FIGURA A.2. Comparación de las estimaciones de reclutamiento de atún aleta amarilla del análisis sin relación población-reclutamiento (caso base) y con relación población-reclutamiento (inclinación = 0,75).

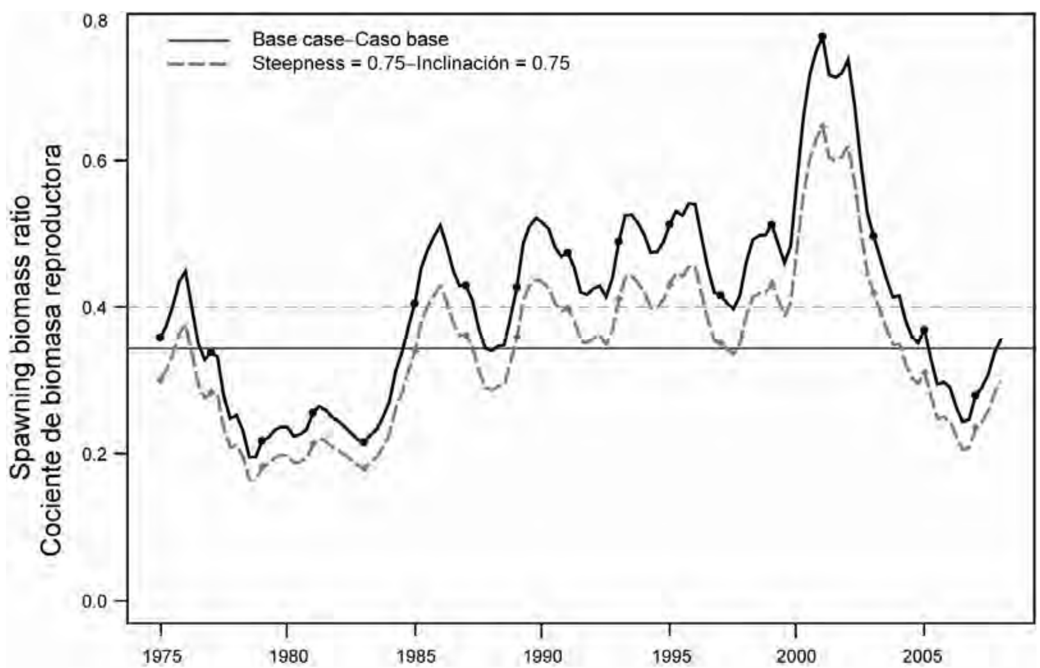

FIGURE A.3a. Comparison of estimates of the spawning biomass ratio (SBR) of yellowfin tuna from the analysis without a stock-recruitment relationship (base case) and with a stock-recruitment relationship (steepness = 0.75). The horizontal lines represent the SBRs associated with MSY for the two scenarios.
FIGURA A.3a. Comparación de las estimaciones del cociente de biomasa reproductora (SBR) de atún aleta amarilla del análisis sin (caso base) y con relación población-reclutamiento (inclinación = 0,75). Las líneas horizontales representan el SBR asociado con el RMS para los dos escenarios.

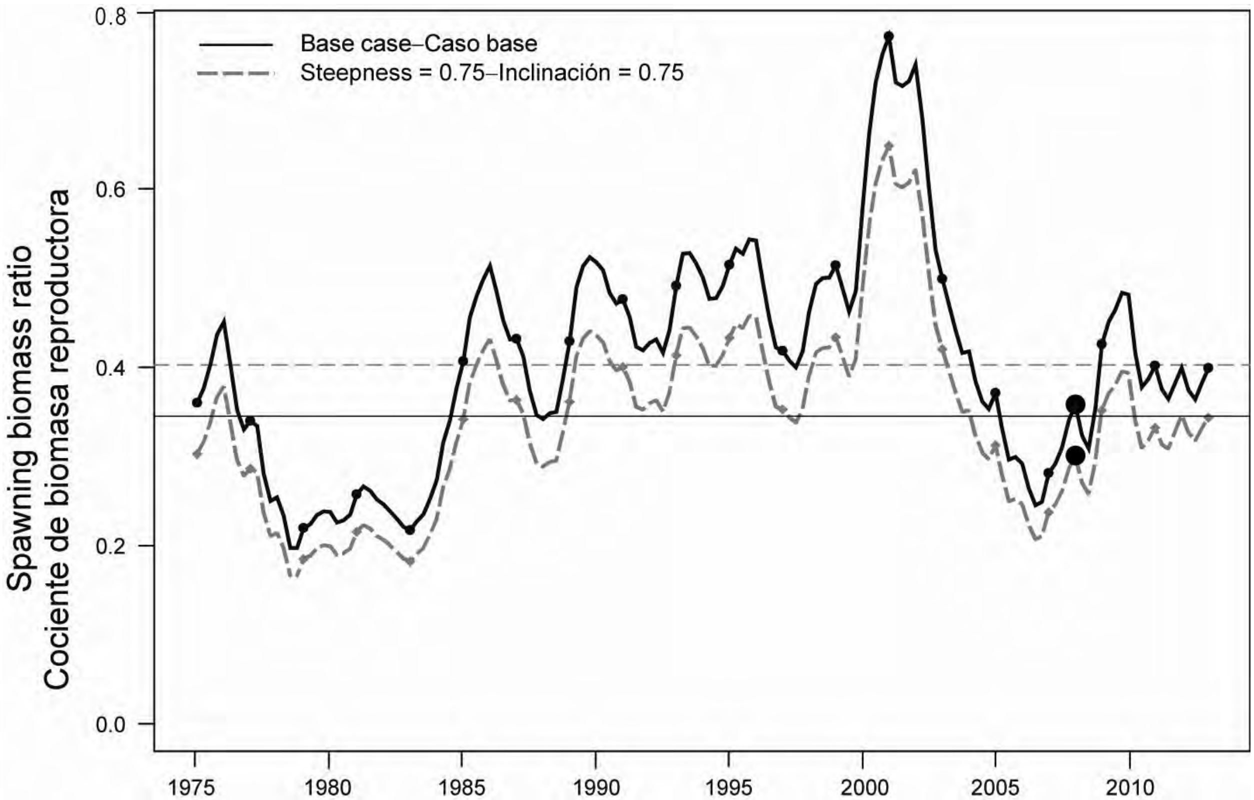

FIGURE A.3b. Comparison of estimates of the spawning biomass ratios (SBRs) projected during 2008-2013 for yellowfin tuna from the analysis without (base case) and with (steepness = 0.75) a stock-recruitment relationship. The horizontal lines represent the SBRs associated with MSY for the two scenarios.

FIGURA A.3b. Comparación de las estimaciones del cociente de biomasa reproductora (SBR) de atún aleta amarilla durante 2008-2013 del análisis sin (caso base) y con (inclinación = 0,75) una relación población-reclutamiento. Las líneas horizontales representan el SBR asociado con el RMS para los dos escenarios.

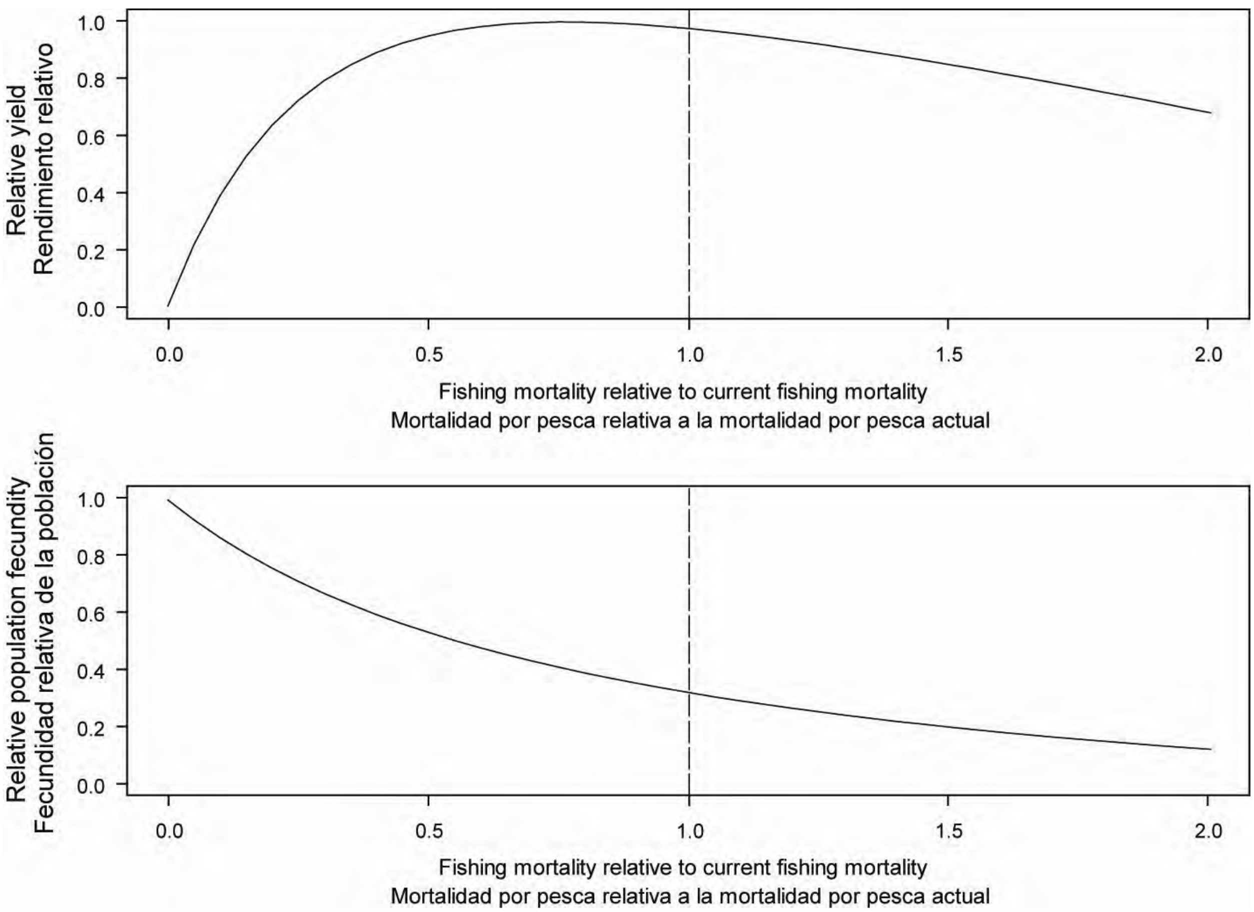

FIGURE A.4. Relative yield (upper panel) and the associated spawning biomass ratio (lower panel) of yellowfin tuna when the stock assessment model has a stock-recruitment relationship (steepness = 0.75).
FIGURA A.4. Rendimiento relativo (recuadro superior) y el cociente de biomasa reproductora asociado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

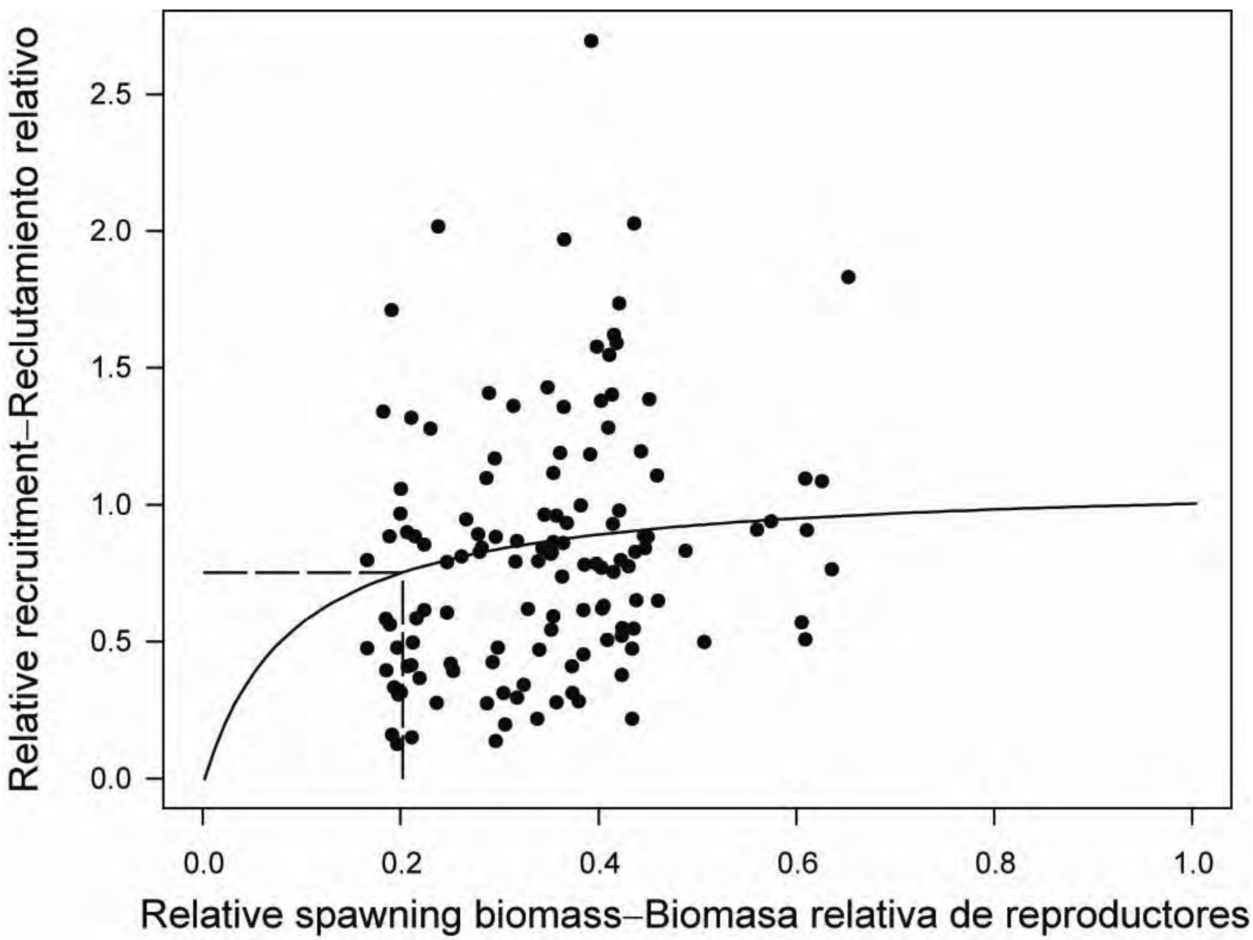

FIGURE A.5. Recruitment plotted against spawning biomass of yellowfin tuna when the analysis has a stock-recruitment relationship (steepness = 0.75).

FIGURA A.5. Reclutamiento graficado contra biomasa reproductora de atún aleta amarilla cuando el análisis incluye una relación población-reclutamiento (inclinación = 0,75).

APPENDIX B: ADDITIONAL RESULTS FROM THE BASE CASE ASSESSMENT

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

ANEXO B: RESULTADOS ADICIONALES DE LA EVALUACION DEL CASO BASE

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

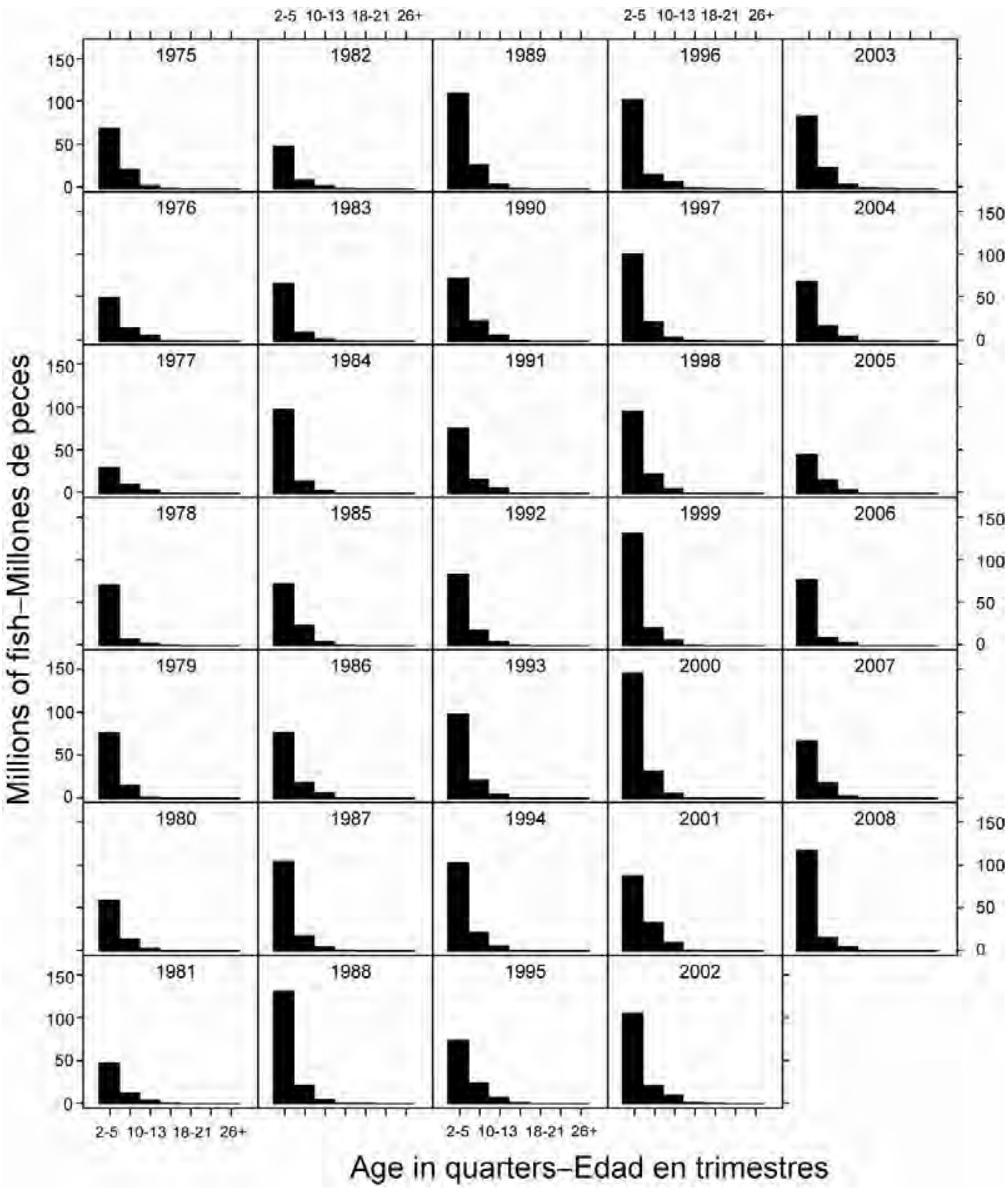

FIGURE B.1. Estimated numbers of yellowfin tuna present in the EPO on January 1 of each year.
FIGURA B.1. Número estimado de atunes aleta amarilla presentes en el OPO el 1 de enero de cada año.

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

Year	Age in quarters—Edad en trimestres						
Año	2-5	6-9	10-13	14-17	18-21	22-25	26+
1975	0.1353	0.4398	1.2080	1.9906	0.3053	0.3594	0.3593
1976	0.1958	0.4488	1.2114	1.8056	0.6246	0.7895	0.7879
1977	0.2540	0.4984	1.2176	1.7920	0.8133	0.9407	0.9420
1978	0.3561	0.6355	1.2993	2.1678	0.5187	0.5870	0.5878
1979	0.2551	0.7006	1.7628	2.6919	0.7733	0.9531	0.9523
1980	0.2148	0.5188	1.4321	2.2090	0.6212	0.6963	0.6942
1981	0.2928	0.5046	1.1953	2.0784	0.8731	1.0119	1.0091
1982	0.1658	0.4296	1.0375	2.0607	0.5970	0.6971	0.6968
1983	0.1391	0.2251	0.7750	0.8861	0.3909	0.4833	0.4827
1984	0.1122	0.2812	0.7409	0.9669	0.3646	0.4451	0.4444
1985	0.0953	0.3947	0.8816	1.2262	0.3343	0.3823	0.3823
1986	0.1336	0.4718	1.1340	1.3740	0.3101	0.3868	0.3860
1987	0.1463	0.5328	1.3005	1.1472	0.3243	0.3594	0.3601
1988	0.1969	0.5222	1.3269	1.7163	0.3983	0.4419	0.4429
1989	0.1355	0.4842	1.0610	1.7283	0.5377	0.6868	0.6856
1990	0.1455	0.4103	1.1874	1.6206	0.4803	0.5445	0.5444
1991	0.1453	0.4132	1.0383	1.3850	0.4641	0.5481	0.5471
1992	0.1580	0.4373	1.0619	1.3132	0.2933	0.3270	0.3267
1993	0.1534	0.3900	0.9575	1.3463	0.3200	0.3465	0.3473
1994	0.1150	0.3256	1.0397	1.4313	0.5007	0.5965	0.5956
1995	0.1107	0.2940	0.8658	0.9784	0.4195	0.5061	0.5043
1996	0.1361	0.3970	0.8785	1.5281	0.2452	0.2702	0.2704
1997	0.1556	0.4163	1.1710	1.9020	0.5782	0.7385	0.7364
1998	0.1686	0.4103	0.9842	1.5064	0.3671	0.4515	0.4508
1999	0.1771	0.4285	1.0702	1.8994	0.2256	0.2569	0.2570
2000	0.1095	0.3119	0.8601	1.2065	0.4805	0.5745	0.5743
2001	0.1712	0.3622	1.1377	1.4116	0.5205	0.6726	0.6706
2002	0.1451	0.4910	1.1447	1.3856	0.5699	0.7420	0.7393
2003	0.1921	0.6255	1.8508	2.4975	0.9689	1.0859	1.0878
2004	0.1643	0.5385	1.7254	3.3270	1.4271	1.8529	1.8514
2005	0.2634	0.6628	1.7725	3.6479	1.1377	1.4090	1.4067
2006	0.1545	0.5302	1.3250	2.8573	0.7217	0.9191	0.9170
2007	0.1403	0.4529	1.4326	2.0955	0.6337	0.7289	0.7278

CONDICIÓN DEL ATÚN ALETA AMARILLA EN EL OCÉANO PACÍFICO ORIENTAL EN 2007 Y PERSPECTIVAS PARA EL FUTURO

by

Mark N. Maunder y Alexandre Aires-da-Silva

ÍNDICE

1. RESUMEN

Este informe presenta la evaluación más actual de la población de atún aleta amarilla (*Thunnus albacares*) en el Océano Pacífico oriental (OPO). Se usó un modelo estadístico que incluye la estructura por edad y se ajusta a la captura por talla, A-SCALA (del inglés *age-structured statistical catch-at-length analysis*) para la evaluación, que 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 relativamente bajas cerca del límite occidental del OPO. 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 las tendencias de la captura por unidad de esfuerzo (CPUE) palangrera, que varían 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. La evaluación para 2008 es diferente de la de 2007 en los aspectos siguientes. Se actualizaron los datos de captura y frecuencia de talla de las pesquerías de superficie para incluir datos nuevos de 2007 (excepto el primer trimestre) y datos revisados de 2000-2006 y el primer trimestre de 2007. Se dispone de datos nuevos o actualizados de captura de las pesquerías palangreras de Taipei Chino (2004-2006) y Japón (2003-2006).

En general, el reclutamiento del atún aleta amarilla a las pesquerías en el OPO es variable, con un componente estacional. Este análisis y los análisis previos indican que la población de aleta amarilla ha pasado por dos, o tal vez tres, regímenes de productividad distintos (1975-1982, 1983-2001, y 2002-2006)), correspondientes a niveles de reclutamiento bajo, alto, e intermedio. Los regímenes de productividad corresponden a regímenes en biomasa; los regímenes de productividad mayor producen niveles de biomasa mayores. Una relación población-reclutamiento es asimismo apoyada por los datos de estos regímenes, pero la evidencia es débil, y es probablemente un artefacto de los cambios de régimen aparentes. El análisis indica que cohortes fuertes ingresaron a la pesquería durante 1998-2001, y que

estas cohortes incrementaron la biomasa durante 1999-2001, pero ahora estas cohortes han pasado por la población, por lo que la biomasa disminuyó durante 2002-2007. La biomasa en 2005-2008 estuvo en niveles similares a aquéllos anteriores a 1985.

El peso promedio del atún aleta amarilla capturado en la pesquería ha sido bastante consistente con el tiempo, pero varía sustancialmente entre las distintas pesquerías. En general, las pesquerías sobre objetos flotantes, no asociadas, y cañera capturan aletas amarillas más jóvenes y pequeños que las pesquerías asociadas con delfines y palangreras. Las pesquerías palangreras y la pesquería asociada con delfines en la región sur capturan aletas amarillas de mayor tamaño y edad que las pesquerías asociadas con delfines del norte y costera.

Han sido estimados niveles importantes de mortalidad por pesca para la pesquería de aleta amarilla en el OPO. Son máximos para el aleta amarilla de edad mediana. La mayor parte de la captura de la especie proviene de lances asociados con delfines, y, por lo tanto, este método ejerce el mayor impacto sobre la población de aleta amarilla, aunque tiene casi el menor impacto por unidad de peso capturada de todos los métodos de pesca.

Históricamente, el SBR (el cociente de la biomasa reproductora actual a la de la población no explotada, *spawning biomass ratio* en inglés) de aleta amarilla en el OPO estuvo por debajo del nivel correspondiente al rendimiento máximo sostenible (RMS) durante el régimen de productividad baja de 1975-1983, pero por encima de dicho nivel durante la mayor parte de los años subsiguientes, excepto el período reciente (2003-2007). Se atribuye el incremento 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 distintos regímenes de reclutamiento soporten dos distintos niveles de RMS y de los SBR asociados. Se estima que el SBR al principio de 2008 es superior al nivel correspondiente al RMS. Se estima que los niveles de esfuerzo están por debajo de aquéllos que soportarían el RMS (a partir de la distribución actual del esfuerzo entre las varias pesquerías), pero las capturas recientes han sido sustancialmente inferiores al RMS.

Si se supone una relación población-reclutamiento, las perspectivas son más pesimistas, y se estima que la biomasa actual es inferior al nivel correspondiente al RMS basadas en la mortalidad por pesca media de 2004-2006 son similares a aquéllas basadas en la mortalidad por pesca media de 2004-2005 (Tabla 5.1). La cantidad por la cual se tendría que reducir la mortalidad por pesca para soportar el RMS es menor cuando se usa la mortalidad por pesca media de 2004-2006.

El peso medio actual del aleta amarilla en la captura es mucho menor que el peso crítico. Los cálculos del RMS.

El RMS ha sido estable durante el período de la evaluación, lo cual sugiere que el patrón general de selectividad no ha variado mucho con el tiempo. En cambio, el nivel general de esfuerzo de pesca ha variado con respecto al multiplicador de RMS.

Con los niveles actuales de mortalidad por pesca, se predice que la biomasa aumentará y luego disminuirá, pero permanecerá por encima del nivel actual, y que el SBR seguirá una tendencia similar, permaneciendo por encima del nivel correspondiente al RMS. Una comparación de la biomasa y el SBR predichos con y sin las restricciones de las Resoluciones C-04-09 y C-06-02 sugiere que, sin las restricciones, estarían en niveles más bajos que los que se observan actualmente, y disminuirían a aproximadamente el nivel correspondiente al RMS.

Estas simulaciones fueron realizadas usando el reclutamiento promedio del período de 1975-2006. De haber sido realizadas usando el reclutamiento promedio del período de 1983-2001, la tendencia proyectada del SBR y las capturas hubiera sido más positiva. A la inversa, de haber sido realizadas usando el reclutamiento medio de 2002-2006, la tendencia proyectada del SBR y las capturas hubiera sido más negativa.

Resultados clave

1. Los resultados son similares a las seis evaluaciones previas, excepto que el esfuerzo actual es inferior a aquél correspondiente al RMS .
2. Existe incertidumbre acerca de los niveles recientes y futuros de reclutamiento y biomasa.
3. Las tasas recientes de mortalidad por pesca son cercanas a aquéllas correspondientes al RMS.
4. Un aumento del peso medio del aleta amarilla capturado podría incrementar el RMS.
5. Hubo dos, o posiblemente tres, distintos regímenes de productividad, y los niveles de RMS y la biomasa correspondiente al RMS podrían ser diferentes para los dos regímenes. Es posible que la población haya cambiado recientemente del régimen de productividad alta a uno de productividad intermedia.
6. Los resultados son más pesimistas si se supone una relación población-reclutamiento.

2. DATOS

Se usaron datos de captura, esfuerzo, y composición por tamaño de enero de 1975 a diciembre de 2007, más datos biológicos, para llevar a cabo la evaluación de la población de atún aleta amarilla (*Thunnus albacares*) en el OPO. Los datos de 2007, de carácter preliminar, incluyen registros incorporados en la base de datos de la CIAT al 15 de abril de 2007. Se resumen y analizan los datos por trimestre.

2.1. Definiciones de las pesquerías

Se definen 16 pesquerías para la evaluación de la población de atún aleta amarilla. Se definen sobre la base de tipo de arte (red de cerco, caña, y palangre), tipo de lance cerquero (sobre atunes asociados con objetos flotantes, no asociados, y asociados con delfines), y zona de la CIAT de muestreo de frecuencia de tallas o latitud. En la Tabla 2.1 se definen las pesquerías de aleta amarilla, y en la Figura 2.1 se ilustra su extensión espacial y también los límites de las zonas de muestreo de frecuencia de tallas.

En general, se definen las pesquerías para que, con el tiempo, ocurran pocos cambios en la composición por tamaño de la captura. Se estratifican además las definiciones de las pesquerías cerqueras sobre objetos flotantes para distinguir de forma gruesa entre lances realizados principalmente sobre dispositivos agregadores de peces (plantados) (Pesquerías 1-2, 4, 13-14, y 16) y lances sobre mezclas de objetos flotantes naturales (que también incluyen desperdicios y otros objetos artificiales) y plantados (Pesquerías 3 y 15).

2.2. Datos de captura y esfuerzo

Para realizar la evaluación de la población de atún aleta amarilla, se estratifican los datos de captura y esfuerzo en la base de datos de la CIAT conforme a las definiciones de pesquerías descritas en la Sección 2.1 y presentadas en la Tabla 2.1. “Descargas” significa captura descargada en un año dado, aun si el pescado no fue capturado en ese año. La captura capturada en un año dado y que no es descartada en el mares denominada captura retenida. En este documento, se usa el término “captura” para reflejar la captura total (descartes más captura retenida) o la captura retenida; el contexto determina la definición apropiada.

Se usan los tres tipos de datos para evaluar la población de aleta amarilla. Las extracciones por las Pesquerías 10-12 son simplemente captura retenida (Tabla 2.1). Las extracciones por las Pesquerías 1-4 son captura retenida, más algunos descartes que resultan de ineficacias en el proceso de pesca (Sección 2.2.3) (Tabla 2.1). Las extracciones por las Pesquerías 5-9 son captura retenida, más algunos descartes que resultan de ineficacias en el proceso de pesca y de clasificación de la captura. Las extracciones por las Pesquerías 13-16 son solamente descartes que resultan de la clasificación de la captura de las Pesquerías 1-4 (Sección 2.2.2) (Tabla 2.1).

Se incorporaron en la presente evaluación datos de captura y esfuerzo nuevos y actualizados de las pesquerías de superficie (Pesquerías 1-10 y 13-16). Se usaron para las pesquerías de superficie datos nuevos de captura y esfuerzo de 2007 (excepto el primer trimestre, que fueron usados en la evaluación previa), y los datos de años anteriores.

Se usó el método de composición por especies (Tomlinson 2002) para estimar las capturas de las pesquerías de superficie. Comparaciones de las estimaciones de captura de diferentes fuentes señalan diferencias consistentes entre los datos de las enlatadoras y las descargas y los resultados del muestreo de composición por especies. La comparación de los dos conjuntos de resultados es compleja, ya que los datos de enlatadoras y descargas son tomados a nivel de viaje, mientras que las muestras de composición por especie son tomadas a nivel de bodega, y representan solamente un pequeño subconjunto de los datos. Las diferencias en las estimaciones de captura podrían ser debidas a las proporciones de atunes pequeños en la captura, diferencias en la identificación del pescado en las enlatadoras, o hasta a sesgos introducidos en el algoritmo de composición por especies al determinar la composición por especies en estratos para los cuales no se dispone de muestras de composición por especie. En la presente evaluación, calculamos factores de escala medios trimestrales y por pesquería para 2000-2005 y los aplicamos a las estimaciones de enlatadoras y descargas de 1975-1999. Harley y Maunder (2005) compararon las estimaciones de captura de patudo obtenidas del muestreo de capturas con las estimaciones de captura obtenidas de datos de enlatadoras. Maunder y Watters (2001) presentan una breve explicación del método usado para estimar el esfuerzo de pesca por artes de superficie (red de cerco y caña).

Se incorporaron también en la evaluación actual actualizaciones y nuevos datos de captura y esfuerzo de las pesquerías palangreras (Pesquerías 11 y 12). Se dispuso de datos de captura nuevos o actualizados de Taipei Chino (2004-2006) y Japón (2003-2006).

Se estimó la cantidad de esfuerzo palangrero dividiendo las estimaciones estandarizadas de la captura por unidad de esfuerzo (CPUE) de la flota palangrera japonesa en las descargas palangreras totales. Se obtuvieron estimaciones de la CPUE estandarizada con un modelo lineal generalizado delta logarítmico normal (Stefansson 1996) que tomó en cuenta latitud, longitud, y número de anzuelos entre flotadores (Hoyle y Maunder 2006b).

2.2.1. Captura

No se dispuso de una proporción sustancial de los datos de captura palangrera en 2007, por lo que se supusieron los datos de esfuerzo (ver la Sección 2.2.2) y se estimó la captura con el modelo de evaluación de la población. Por lo tanto, la captura palangrera total en 2007 es una función del esfuerzo supuesto de 2007, los números estimados de aleta amarilla de talla capturable en el OPO en 2007, y la selectividad y capturabilidad estimadas para las pesquerías palangreras. Se fijaron las capturas de las pesquerías palangreras en los años recientes para los cuales no se dispuso de datos iguales a las capturas del último año para el cual se dispuso de datos.

En la Figura 2.2 se ilustran las tendencias en la captura de atún aleta amarilla en el OPO durante cada trimestre entre enero de 1975 y marzo de 2007. Cabe destacar que existían pesquerías sustanciales de superficie y palangreras de aleta amarilla antes de 1975 (Shimada y Schaefer 1956; Schaefer 1957; Okamoto y Bayliff 2003). La mayoría de la captura proviene de lances cerqueros sobre aletas amarillas asociados con delfines o en cardúmenes no asociados. Maunder y Watters (2001, 2002) y Maunder (2002) describieron la captura de aleta amarilla en el OPO entre 1975 y 2001. Una característica principal de las tendencias de la captura es el aumento en la captura desde aproximadamente 1993 en lances cerqueros sobre objetos flotantes, especialmente los plantados en las Pesquerías 1 y 2, pero esto es una porción relativamente pequeña de la captura total.

Aunque los datos de captura un la Figura 2.2 están expresados en peso, se usaron capturas en número de peces para tomar en cuenta la mayoría de las capturas palangreras de aleta amarilla en la evaluación de las poblaciones.

2.2.2. Esfuerzo

Para las pesquerías de superficie, se usan datos de esfuerzo nuevos de 2007 (excepto el primer trimestre, que fueron usados en la evaluación previa) y datos actualizados de años anteriores.

Se usó un algoritmo complejo, descrito por Maunder y Watters (2001), para estimar la cantidad de esfuerzo de pesca, en días de pesca, ejercido por buques cerqueros. Los datos de esfuerzo palangrero de aleta amarilla fueron estimados a partir de datos de CPUE estandarizada, de la forma siguiente. Los datos detallados sobre la captura, esfuerzo, y anzuelos entre flotadores, por latitud y longitud, de la flota palangrera japonesa, provistos por el Sr. Adam Langley, de la Secretaría de la Comunidad del Pacífico, fueron usados en un modelo lineal generalizado con una función de enlace delta logarítmica normal para producir un índice de CPUE estandarizada (E.J. Dick, NOAA Santa Cruz, comunicación personal; ver Stefansson (1996) para una descripción del método, y Hoyle y Maunder (2006b) para información más detallado. Se escalaron los datos de esfuerzo japonés por el cociente de la captura japonesa a la captura total para compensar la inclusión de datos de captura de las otras naciones en la evaluación. Esto permite incluir todos los datos de captura palangrera en la evaluación, pero usar solamente los datos de esfuerzo japonés como base para la información sobre abundancia relativa.

No se dispuso de información de esfuerzo de la pesca palangrera japonesa en el OPO en durante 2007 para la presente evaluación. Se supuso que el esfuerzo palangrero ejercido en cada trimestre de 2007 fue igual al esfuerzo estimado ejercido en el trimestre correspondiente en 2006. No se incluyeron datos de captura palangrera de 2006 (ver arriba).

En la Figura 2.3 se ilustran las tendencias en la cantidad de esfuerzo de pesca ejercido por las 16 pesquerías definidas para la evaluación de la población de atún aleta amarilla en el OPO. Se expresa el esfuerzo de pesca de artes de superficie (Pesquerías 1-10 y 13-16) en días de pesca. El esfuerzo de pesca en las Pesquerías 13-16 es igual a aquél en las Pesquerías 1-4 (Figura 2.3) porque las capturas de las Pesquerías 13-16 se derivan de las de las Pesquerías 1-4 (ver Sección 2.2.3). Se expresa el esfuerzo palangrero (Pesquerías 11 y 12) en unidades estandarizadas.

2.2.3. Descartes

Para los propósitos de la evaluación de la población, se supone que los buques cerqueros descartan aleta amarilla de sus capturas debido a ineficacias en el proceso de pesca (cuando la captura de un lance no cabe en las bodegas disponibles del buque), o porque los pescadores seleccionan solamente el pescado de más de un cierto tamaño. En ambos casos de estima la cantidad de aleta amarilla descartada con información reunida por observadores de la CIAT o nacionales, aplicando métodos descritos por Maunder y Watters (2003a). Sin considerar el motivo por el descarte, se supone que muere todo el pescado descartado. Maunder y Watters (2001) describen cómo se incorporan los descartes en la evaluación del aleta amarilla. En la presente evaluación no se suavizan las tasas de descarte con el tiempo, lo cual debería permitir una mejor representación del reclutamiento en el modelo.

Se añaden a las capturas retenidas estimaciones de los descartes que resultan de ineficacias en el proceso de pesca (Tabla 2.1). No se dispone de datos de observadores para estimar los descartes antes de 1993, y se supone que no hubo descartes debidos a ineficacias antes de ese año. Hay períodos para los cuales los datos de observadores son insuficientes para estimar los descartes, en cual caso se supone que la tasa de descarte (descartes/capturas retenidas) es igual a la tasa de descarte del mismo trimestre en el año anterior o, si no se dispone de ésta, del año más cercano.

Se tratan los descartes que resultan del proceso de clasificar las capturas como pesquerías separadas (Pesquerías 13-16), y se supone que las capturas de estas pesquerías consisten solamente de peces de 2-4 trimestres de edad (Figura 4.5). Maunder y Watters (2001) explican los motivos por tratar estos descartes como pesquerías separadas. Se supone que la tasa de descarte antes de 1993 es la tasa promedio observada en cada pesquería a partir de ese año. Se hacen estimaciones de la cantidad de pescado descartado durante la clasificación solamente para las pesquerías que capturan aleta amarilla asociado con objetos flotantes (Pesquerías 2-5) porque la clasificación es infrecuente en las otras pesquerías de cerco.

En la Figura 2.4 se presentan series de tiempo de los descartes como proporción de las capturas retenidas de las pesquerías de superficie que capturan aleta amarilla en asociación con objetos flotantes. Se supone que no se descarta aleta amarilla en las pesquerías palangreras (Pesquerías 11 y 12).

2.3. Datos de composición por tamaño

Las pesquerías del OPO capturan atún aleta amarilla de varios tamaños. En la Figura 4.2 se ilustra la composición por tamaño media de la captura de cada pesquería definida en la Tabla 2.1. Maunder y Watters (2001) describen el tamaño de los aletas amarillas capturados por cada pesquería. En general, los aletas amarillas capturados por las pesquerías sobre objetos flotantes, atunes no asociados, y cañeras son de tamaño menor, mientras que aquéllos capturados por las pesquerías asociadas con delfines y palangreras son más grandes. Se incluyeron datos de frecuencia de talla de la captura cerquera nuevos de los tres últimos trimestres de 2007 y datos revisados de 2000-2005 y el primer trimestre de 2007.

Se incluyeron datos nuevos de frecuencia de talla de 2005 de la flota japonesa de palangre, y datos actualizados de 2002-2004 de dicha flota. No se usaron en la evaluación datos de composición por talla de las otras flotas palangreras.

Las frecuencias de talla de las capturas durante 2007 de las cuatro pesquerías sobre objetos flotantes fueron similares a aquéllas observadas durante el período entero del modelo (compárense las Figuras 4.2 y 4.8a). La aparición, desaparición, y reaparición subsiguiente de cohortes fuertes en los datos de frecuencia de talla es un fenómeno común para el aleta amarilla en el OPO. Esto podría indicar desplazamientos espaciales de las cohortes o del esfuerzo de pesca, limitaciones en el muestreo de frecuencias de talla, o fluctuaciones en la capturabilidad de los peces. Bayliff (1971) observó que grupos de peces marcados también han desaparecido y luego vuelto a aparecer en esta pesquería, y lo atribuyó a fluctuaciones en la capturabilidad.

2.4. Datos auxiliares

Se integraron en el modelo de evaluación en 2005 (Hoyle y Maunder 2006a) estimaciones de talla por edad (Wild 1986) calculadas a partir de datos de otolitos para proveer información sobre la talla media por edad y la variación en la talla por edad. Sus datos consistieron de las edades, basadas en conteos de incrementos diarios en los otolitos, y tallas de 196 peces capturados entre 1977 y 1979. El diseño de muestreo contempló la colección de 15 aletas amarillas en cada intervalo de 10 cm entre 30 y 170 cm. Se modificó el modelo para tomar en cuenta este esquema de muestreo (ver Sección 3.1.1).

3. SUPUESTOS Y PARÁMETROS

3.1. Información biológica y demográfica

3.1.1. Crecimiento

Se estructura el modelo de crecimiento para permitir estimar los incrementos individuales de crecimiento (entre edades sucesivas) como parámetros libres. Estos incrementos fueron altamente restringidos para que sean similares a una curva de crecimiento de Richards. Se usó la ecuación de crecimiento de Richards $L_t = L_\infty \left(1 - \frac{\exp\left(-K\left(t - t_0\right)\right)}{b}\right)^b$ ajustada a los datos de Wild (1986) como distribución previa (Figura 3.1) (L_∞ = 185,7 cm, K anual = 0,761, t_0 = 1,853 años, b = -1,917). Los incrementos de crecimiento fueron asimismo restringidos para que la talla media sea una función de la edad que aumenta monotónicamente. El tamaño al cual los peces son reclutados a la pesquería por primera vez necesita ser especificado, y se supone que el aleta amarilla es reclutado a las pesquerías de descarte (Pesquerías 13-16) cuando mide 30 cm y es de dos trimestres de edad.

La talla asintótica esperada (L_∞) no puede ser estimada de forma fiable a partir de datos, tales como aquéllos de Wild (1986), que no incluyan muchos peces viejos, pero Hoyle y Maunder (2007) descubrieron que los resultados no eran sensibles al valor de L_∞.

Un componente importante del crecimiento usado en los modelos estadísticos de captura por talla y edad es la variación en la talla por edad. La información de edad y talla contiene información sobre la variación de la talla por edad además de información sobre la talla por edad promedio. Desgraciadamente, como en el caso de los datos tomados por Wild (1986), el objetivo del muestreo normalmente es obtener pescados de un amplio rango de tallas. Por lo tanto, esta muestra podría representar la población en la variación de la edad por talla, pero no variación de la talla por edad. No obstante, se puede elaborar la verosimilitud apropiada mediante la aplicación de probabilidad condicional.

En la presente evaluación se usó el método usado por primera vez por Hoyle y Maunder (2006a) para estimar la variación en la talla por edad a partir de los datos. Tanto el esquema de muestreo como las pesquerías y períodos de los que se obtuvieron los datos fueron tomados en cuenta. Se supuso que la talla media de aletas amarillas de mayor edad es cercana a aquéllas indicadas por la curva de crecimiento de Wild (1986).

Se usó la siguiente relación peso-talla, de Wild (1986), para convertir tallas a pesos en la presente evaluación:

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

donde w = peso en kilogramos y l = talla en centímetros.

Un conjunto inédito más extenso de datos de talla y peso produce una relación ligeramente diferente, pero el incluir este conjunto alternativo de datos en el modelo de evaluación produce resultados esencialmente idénticos.

3.1.2. Reclutamiento y reproducción

El modelo A-SCALA permite especificar una relación población-reclutamiento de Beverton-Holt (1957). Se parametriza la curva de Beverton-Holt para que la relación entre la biomasa reproductora y el reclutamiento sea determinada mediante la estimación del reclutamiento medio producido por una población no explotada (reclutamiento virgen) y un parámetro denominado inclinación. Se define la inclinación como la fracción del reclutamiento virgen que se produce si se reduce el tamaño de la población reproductora al 20% de su nivel no explotado, y controla la rapidez con la que disminuye el reclutamiento cuando se reduce el tamaño de la población reproductora. La inclinación puede variar entre 0,2 (en cual caso el reclutamiento es una función lineal del tamaño de la población reproductora) y 1,0 (en cual caso el reclutamiento es independiente del tamaño de la población reproductora). En la práctica, es a menudo difícil estimar la inclinación, debido a falta de contraste en el tamaño de la población reproductora, alta variación interanual (e intertrimestral) en el reclutamiento, y confusión con cambios a largo plazo en el reclutamiento, debidos a efectos ambientales no incluidos en el modelo, que afectan el tamaño de la población reproductora. La evaluación del caso base supone que no hay ninguna relación entre el tamaño de la población y el reclutamiento. Este supuesto es el mismo que se usó en las evaluaciones previas. Se investiga la influencia de una relación población-reclutamiento de Beverton-Holt en un análisis de sensibilidad.

Se supone que el atún aleta amarilla puede ser reclutado a la población pescable durante cada trimestre del año. Hennemuth (1961) reportó que hay dos picos de desove de aleta amarilla en el OPO, pero en el presente estudio se supone que el reclutamiento puede ocurrir más de dos veces al año, porque peces individuales pueden desovar casi cada día si la temperatura del agua es adecuada (Schaefer 1998).

Se hace un supuesto acerca de cómo el reclutamiento puede variar alrededor de su nivel esperado, determinado a partir de la relación población-reclutamiento. Se usa este supuesto para penalizar los desvíos temporales del reclutamiento. Se supone que el logaritmo de los desvíos trimestrales del reclutamiento está distribuido normalmente, con una desviación estándar de 0,6.

Se supone que el aleta amarilla es reclutado a las pesquerías de descarte en el OPO a los 30 cm (aproximadamente 2 trimestres de edad) (Sección 3.1.1). A este tamaño (edad), los peces son vulnerables a la captura por pesquerías que capturan peces en asociación con objetos flotantes (es decir, son reclutados a las Pesquerías 13-16).

Se estima el potencial de desove de la población a partir del número de peces, la proporción de hembras, el porcentaje de hembras que son maduras, la fecundidad por camada, y la frecuencia de desove (Schaefer 1998). Se estiman estas cantidades (excepto el número de peces) para cada clase de edad con base en la talla media a edad arrojada por la ecuación de crecimiento de Richards ajustada a los datos de otolitos de Wild (1986). Maunder y Watters (2002) describen el método, pero usando la curva de crecimiento de von Bertalanffy. Estas cantidades fueron estimadas de nuevo al investigar la sensibilidad a distintas curvas de crecimiento. Se usa el potencial de desove de la población en la relación población-reclutamiento y para determinar los cocientes de biomasa reproductora (el cociente de la biomasa reproductora a la biomasa reproductora de la población no explotada; SBR, de *spawning biomass ratio*). En las Figuras 3.2 y 3.3 se ilustran la fecundidad relativa por edad y la proporción de sexos por edad, respectivamente.

3.1.3. Desplazamientos

La evidencia acerca de los desplazamientos del atún aleta amarilla dentro del OPO es resumida por Maunder y Watters (2001) y Schaefer *et al.* (2007) contiene nuevas investigaciones. Schaefer *et al.* (2007) descubrieron que los desplazamientos de atunes aleta amarilla liberados frente al sur de Baja California, incluyendo aquéllos en libertad más de un año, están confinados geográficamente. Por lo tanto, se esperaría que el nivel de mezcla entre esta zona y otras en el OPO fuera muy bajo. Este resultado es consistente con los resultados de varios estudios de marcado (convencionales y archivadores) de atunes tropicales en el Pacífico. Esto indica que controles de esfuerzo o captura aplicados pesquerías enteras probablemente no serán efectivas para prevenir mermas locales de estas poblaciones (Schaefer *et al.* 2007). Para los propósitos de la presente evaluación, se supone que los desplazamientos no afectan los resultados de la evaluación, pero en vista de los resultados de Schaefer *et al.* (2007), se debería considerar una investigación a escala espacial más fina o de subpoblaciones separadas.

3.1.4. Mortalidad natural

Para la presente evaluación de la población, se supone que, a medida que envejece el aleta amarilla, la tasa de mortalidad natural (M) cambia. Este supuesto es similar al que se hizo en evaluaciones previas, para las cuales se supuso que la tasa de mortalidad natural de las hembras aumenta después de que alcanzan la edad de 30 meses (por ejemplo, Anónimo 1999: 233). No se tratan por separado los machos y las hembras en la presente evaluación, y se considera M como una sola tasa para ambos sexos combinados. En la Figura 3.4 se grafican los valores de M trimestral usados en la presente evaluación de la población. Se estimaron estos valores aplicando los supuestos arriba descritos, ajustando los datos de proporción de sexos por talla (Schaefer 1998), y comparando los valores con aquéllos estimados para el aleta amarilla en el Pacífico occidental y central (Hampton 2000; Hampton y Fournier 2001). Maunder y Watters (2001) describen en detalle la forma de estimar la tabla de mortalidad natural por edad para el aleta amarilla en el OPO.

3.1.5. Estructura de la población

Se ha estudiado el intercambio de aleta amarilla entre el OPO y el Pacífico central y occidental mediante el análisis de datos sobre marcado, características morfométricas, capturas por unidad de esfuerzo, tamaño del pescado capturado, etc. (Suzuki *et al*. 1978), y parece que la mezcla de peces entre el OPO y las zonas más al oeste no es extensa. Por lo tanto, para los propósitos de la presente evaluación, se supone que existe una sola población, con poca o ninguna mezcla con las poblaciones del Pacífico central y occidental.

3.2. Influencias ambientales

El reclutamiento del aleta amarilla en el OPO suele ser mayor después de eventos de El Niño (Joseph y Miller 1989). Evaluaciones previas de la población incluyeron el supuesto que las condiciones oceanográficas pudieran afectar el reclutamiento de atún aleta amarilla en el OPO (Maunder y Watters 2001, 2002; ver descripción de la metodología en Maunder y Watters 2003b). Este supuesto es apoyado por observaciones de que el desove del aleta amarilla depende de la temperatura (Schaefer 1998). A fin de incorporar la posibilidad de un efecto ambiental sobre el reclutamiento de aleta amarilla en el OPO, se incorporó una variable de temperatura en modelos de evaluación previos, para determinar si existe una relación estadísticamente significativa entre dicha variable y las estimaciones de reclutamiento. Las evaluaciones previas (Maunder y Watters 2001, 2002) demostraron que las estimaciones de reclutamiento son esencialmente idénticas con y sin la inclusión de los datos ambientales. Maunder (2002a) correlacionó el reclutamiento con la serie de tiempo ambiental fuera del modelo de evaluación; como candidatos de variable, usó la temperatura superficial del mar (TSM) en una zona compuesta de dos cuadrángulos, uno delineado por 20°N-10°S y 100°O-150°O y el otro por 10°N-10°S y 85°O-100°O, el número total de zonas de 1° x 1° con TSM media ≥24°C, y el Índice de Oscilación del Sur. Se relacionaron estos datos al reclutamiento, ajustado al período de cría. Sin embargo, no se descubrió ninguna relación con estas variables. No se efectuó una investigación usando variables ambientales en esta evaluación.

En evaluaciones previas se supuso también que las condiciones oceanográficas afectan la eficacia de las distintas pesquerías descritas en la Sección 2.1 (Maunder y Watters 2001, 2002). Se reconoce generalmente que dichas condiciones afectan el comportamiento de las artes de pesca, y se investigaron varios índices ambientales diferentes. No obstante, se descubrió que solamente la TSM para la pesquería palangrera del sur fue significativa. Por lo tanto, debido al uso de CPUE palangrera estandarizada, no se investigaron los efectos ambientales sobre la capturabilidad en esta evaluación.

4. EVALUACIÓN DE LA POBLACIÓN

Se usan A-SCALA, un modelo estadístico que incluye la estructura por edad y se ajusta a la captura por talla, (Maunder y Watters 2003a), e información contenida en los datos de captura, esfuerzo, composición por talla, y biológicos para evaluar la condición del atún aleta amarilla en el OPO. El modelo A-SCALA se basa en el método descrito por Fournier *et al*. (1998). El término "estadístico" indica que el método reconoce implícitamente que los datos provenientes de pesquerías no representan perfectamente la población; hay incertidumbre en los conocimientos de la dinámica del sistema y de la relación entre los datos observados y la población real. El modelo usa etapas temporales trimestrales para describir la dinámica de la población. Se estiman los parámetros del modelo de evaluación de la población comparando las capturas y composiciones por tamaño predichas con datos obtenidos de la pesquería. Una vez estimados los parámetros, se usa el modelo para estimar cantidades útiles para la ordenación de la población.

Se usó el modelo A-SCALA por primera vez para evaluar el atún aleta amarilla en el OPO en 2000 (Maunder y Watters, 2001), y se modificó y usó para las evaluaciones subsiguientes. Se estimaron los parámetros siguientes para la evaluación actual de la población de aleta amarilla del OPO:

1. reclutamiento a la pesquería en cada trimestre desde el primer trimestre de 1975 hasta el primer trimestre de 2008, inclusive;
2. coeficientes trimestrales de capturabilidad para las 16 pesquerías que capturan aleta amarilla del OPO;
3. curvas de selectividad para 12 de las 16 pesquerías (las Pesquerías 13-16 tienen curvas de selectividad supuestas);
4. tamaño y estructura por edad iniciales de la población;
5. talla media por edad (Figura 3.1);

6. parámetros de un modelo lineal que relaciona las desviaciones estándar en la talla por edad con la talla media por edad.

Se supone que se conocen los parámetros siguientes para la evaluación actual de la población de atún aleta amarilla en el OPO:

1. fecundidad de hembras por edad (Figura 3.2);
2. proporción de sexos por edad (Figura 3.3);
3. mortalidad natural por edad (Figura 3.4);
4. curvas de selectividad para las pesquerías de descarte (Pesquerías 13-16);
5. inclinación de la relación población-reclutamiento (inclinación = 1 para la evaluación del caso base).

Las estimaciones de rendimiento y capturabilidad para las estimaciones del rendimiento máximo sostenible promedio (RMS) o las proyecciones a futuro se basaron en estimaciones trimestrales de la mortalidad por pesca de 2004-2007. Se probó la sensibilidad de las estimaciones de cantidades de ordenación clave a este supuesto.

Hay incertidumbre en los resultados de la evaluación actual de la población. Esta incertidumbre resulta de que los datos observados no representan perfectamente la población de aleta amarilla en el OPO. Además, el modelo de evaluación de la población podría no representar perfectamente la dinámica de la población de aleta amarilla ni de las pesquerías que operan en el OPO. Se expresa la incertidumbre como intervalos de confianza aproximados y coeficientes de variación (CV). Los intervalos de confianza y CV fueron estimados bajo el supuesto que el modelo de evaluación de la población representa perfectamente la dinámica del sistema. Ya que es poco probable que se satisfaga este supuesto, estos valores podrían subestimar el nivel de incertidumbre en los resultados de la evaluación actual.

4.1. Índices de abundancia

Se han usado las CPUE como índices de abundancia en evaluaciones anteriores del atún aleta amarilla en el OPO (por ejemplo, Anónimo 1999). Sin embargo, es importante notar que las tendencias en la CPUE no siempre siguen las tendencias en biomasa o abundancia. Hay muchas razones por esto; por ejemplo, si, debido a cambios en la tecnología o en las especies objetivo, la eficacia de captura de aleta amarilla de una pesquería aumentara o disminuyera, sin que la biomasa cambiara las CPUE aumentarían o disminuirían a pesar de la falta de tendencia en la biomasa. Las pesquerías pueden también mostrar hiperestabilidad o hipoestabilidad, donde la relación entre CPUE y abundancia no es lineal (Hilborn y Walters 1992; Maunder y Punt 2004). En la Figura 4.1 se ilustran las CPUE de las 16 pesquerías definidas en esta evaluación del aleta amarilla en el OPO. Las tendencias en la CPUE palangrera se basan en los datos japoneses únicamente. Tal como se mencionó en la Sección 2.2.2, se estandarizó la CPUE de las pesquerías palangreras usando un modelo lineal general. En Maunder y Watters (2001, 2002), Maunder (2002a), Maunder y Harley (2004, 2005), y Hoyle y Maunder (2006a), se comentan las tasas históricas de captura, pero se deben interpretar las tendencias en la CPUE con cautela. En la Sección 4.2.3 se comentan las tendencias en la biomasa estimada.

4.2. Resultados de la evaluación

A continuación se describen aspectos importantes de la evaluación del caso base (1) y los cambios para los análisis de sensibilidad (2-4):

1. Evaluación del caso base: inclinación de la relación población-reclutamiento igual a 1 (ninguna relación entre población y reclutamiento), estimaciones de composición por especie de las capturas de las pesquerías de superficie escaladas a 1975, CPUE estandarizada con un modelo lineal generalizado delta logarítmico normal, y tamaños de muestra supuestos para los datos de frecuencia de talla.

2. Sensibilidad a la inclinación de la relación población-reclutamiento. La evaluación del caso base incluyó un supuesto que el reclutamiento fue independiente del tamaño de la población, y una relación población-reclutamiento de Beverton-Holt con una inclinación de 0,75 fue usada para el análisis de sensibilidad.

En el texto se describen los resultados de la evaluación del caso base, y el análisis de sensibilidad a la relación población-reclutamiento es descrito en el texto, con figuras y tablas en el Anexo A1.

El ajuste del modelo A-SCALA a los datos de captura y de composición por tamaño para las 16 pesquerías que capturan atún aleta amarilla en el OPO es bastante bueno. Se constriñe el modelo de evaluación para ajustarlo a las series de tiempo de capturas realizadas por cada pesquería casi perfectamente, y las 16 series de tiempo de capturas de aleta amarilla predichas son casi idénticas a aquéllas graficadas en la Figura 2.2. Es importante predecir los datos de captura con exactitud, porque es difícil estimar la biomasa si no se dispone de estimaciones fidedignas de la cantidad total de pescado extraído de la población.

Es asimismo importante predecir los datos de composición por tamaño con la mayor precisión posible, pero en la práctica es más difícil predecir la composición por tamaño que la captura total. Es importante predecir estos datos con precisión porque contienen la mayor parte de la información necesaria para modelar el reclutamiento y el crecimiento, y por ende para estimar el impacto de la pesca sobre la población. En la Sección 2.3 se describe la distribución por tamaño de la captura de cada pesquería. En la Figura 4.2 se resumen los pronósticos de las composiciones por tamaño de atún aleta amarilla capturado por las Pesquerías 1-12. Esta figura ilustra simultáneamente las composiciones por tamaño medias observadas y predichas de las capturas de estas doce pesquerías. (No se dispone de datos de composición por tamaño para peces descartados, por lo que se excluye a las Pesquerías 13-16 de esta discusión.) Las predicciones de la composición por tamaño para las pesquerías con datos de composición por tamaño son buenas, aunque las de algunas pesquerías muestran picos más bajos que la composición por tamaño observada (Figura 4.2). El modelo suele también predecir demasiado aleta amarilla grande en ciertas las pesquerías. Sin embargo, el ajuste a los datos de frecuencia de talla para períodos de tiempo individuales muestra mucha más variación (Figura 4.8).

Es probable que los resultados presentados en las secciones siguientes cambien en evaluaciones futuras porque (1) datos futuros podrían proporcionar evidencias contrarias a estos resultados, y (2) es posible que cambien los supuestos y constreñimientos usados en el modelo de evaluación. Cambios futuros afectarán más probablemente las estimaciones absolutas de la biomasa y del reclutamiento en los últimos años.

4.2.1. Mortalidad por pesca

Hay variación en la mortalidad por pesca ejercida causada por las pesquerías que capturan atún aleta amarilla en el OPO, con una mortalidad por pesca mayor antes de 1984, durante el régimen de productividad baja (Figura 4.3a) y desde 2003. La mortalidad por pesca cambia con la edad (Figura 4.3b). La mortalidad por pesca de los aletas amarillas jóvenes y viejos es baja. Ocurre un pico alrededor de las edades de 14-15 trimestres, que corresponde a los picos en las curvas de selectividad de las pesquerías de aleta amarilla asociado con delfines y no asociado (Figuras 4.3b y 4.4). La mortalidad por pesca de peces jóvenes no ha aumentado mucho a pesar del aumento en el esfuerzo asociado con objetos flotantes que ha ocurrido desde 1993 (Figura 4.3b).

Las tasas de mortalidad por pesca varían con el tiempo porque la cantidad de esfuerzo ejercido por cada pesquería cambia con el tiempo, porque distintas pesquerías capturan aleta amarilla de distintas edades (el efecto de selectividad), y porque la eficacia de varias pesquerías cambia con el tiempo (el efecto de capturabilidad). Se trató el primer efecto (cambios en el esfuerzo) en la Sección 2.2.1 (ver también Figura 2.3); en lo siguiente se comentan los dos últimos.

En la Figura 4.4 se ilustran las curvas de selectividad estimadas para las 16 pesquerías definidas en la evaluación de la población de aleta amarilla. Los lances cerqueros sobre objetos flotantes seleccionan principalmente aleta amarilla de unos 3 a 8 trimestres de edad (Figura 4.4, Pesquerías 1-4), con peces ligeramente mayores seleccionados en la región de altura del sur (Pesquería 1). Los lances cerqueros sobre aletas amarillas en cardúmenes no asociados seleccionan peces de tamaño similar a los que se capturan en lances sobre objetos flotantes (5-15 trimestres, Figura 4.4, Pesquerías 5 y 6), pero estas capturas contienen proporciones mayores de peces de la porción superior de este rango. Los lances cerqueros sobre aletas amarillas asociados con delfines en las regiones norte y costera seleccionan principalmente peces de 7 a 15 trimestres de edad (Figura 4.4, Pesquerías 7 y 8). La pesquería asociada con delfines en el sur selecciona principalmente aleta amarilla de 12 trimestres o más de edad (Figura 4.4, Pesquería 9). Las pesquerías palangreras de aleta amarilla también seleccionan principalmente ejemplares mayores, de (unos 12 trimestres o más (Figura 4.4, Pesquerías 11 y 12). La pesquería cañera selecciona aletas amarillas de unos 4 a 8 trimestres (Figura 4.4, Pesquería 10). L

Se supone que los descartes que resultan de la clasificación de capturas cerqueras de aleta amarilla capturado en asociación con objetos flotantes están compuestos únicamente de aletas amarillas reclutados a la pesquería tres trimestres o menos (edad 2-4 trimestres, Figura 4.4, Pesquerías 13-16). (En la Sección 2.2.3 se presenta información adicional sobre cómo se tratan los descartes.)

La capacidad de los buques cerqueros de capturar atún aleta amarilla en asociación con objetos flotantes ha disminuido generalmente con el tiempo (Figura 4.5a, Pesquerías 1-4). Estas pesquerías demuestran también una variación temporal elevada en la capturabilidad. Cambios en la tecnología de pesca y en el comportamiento de los pescadores podrían haber reducido la capturabilidad del aleta amarilla durante este período.

La capacidad de los buques cerqueros de capturar atún aleta amarilla en cardúmenes no asociados también fue altamente variable (Figura 4.5a, Pesquerías 5 y 6).

La capacidad de los buques cerqueros de capturar atún aleta amarilla en lances sobre delfines fue menos variable en las zonas norte y costera que en las otras pesquerías (Figura 4.5a, Pesquerías 7 y 8). La capturabilidad en la pesquería del sur (Pesquería 9) es más variable. La capturabilidad en las tres pesquerías asociadas con delfines fue mayor al promedio durante la mayor parte de 2001-2005, pero se estimó que la capturabilidad disminuiría durante 2006 y 2007.

La capacidad de los barcos cañeros de capturar atún aleta amarilla ha sido altamente variable (Figura 4.5a, Pesquería 10). Hubo múltiples períodos de capturabilidad alta y baja.

La capacidad de barcos palangreros de capturar atún aleta amarilla ha sido más variable en la pesquería del norte (Pesquería 11), que captura menos aleta amarilla, que en la del sur (Pesquería 12). La capturabilidad en la pesquería del norte ha sido muy baja desde fines de los años 1990.

En la Figura 4.5b se ilustra la capturabilidad de atún aleta amarilla pequeño por las pesquerías de descarte (Pesquerías 13-16).

En evaluaciones previas, la capturabilidad para la pesquería palangrera del sur mostró una correlación altamente significativa con la TSM (Maunder y Watters 2002). A pesar de ser significativa, la correlación entre TSM y capturabilidad en esa pesquería no pareció ser un buen indicador de capturabilidad (Maunder y Watters 2002), y por lo tanto no fue incluida en la presente evaluación.

4.2.2. Reclutamiento

En una evaluación anterior, la abundancia del atún aleta amarilla reclutado a las pesquerías en el OPO pareció estar correlacionada con las anomalías de las TSM en el momento de cría de esos peces (Maunder y Watters 2001). Sin embargo, la inclusión de un componente estacional en el reclutamiento explicó la mayor parte de la variación que podía ser explicada por las TSM (Maunder y Watters 2002). No se investigó ninguna serie de tiempo ambiental para la presente evaluación.

Dentro del rango de biomasas predichas ilustradas en la Figura 4.9, la abundancia de reclutas de aleta amarilla parece estar relacionada con la biomasa de producción de huevos potencial relativa en el momento de desove (Figura 4.6). La relación aparente entre biomasa y reclutamiento se debe a un cambio aparente de régimen en la productividad (Tomlinson 2001). El aumento en la productividad causó un aumento en el reclutamiento, que a su vez aumentó la biomasa. Por tanto, a largo plazo, reclutamiento superior al promedio está relacionado con biomasa superior al promedio y reclutamiento inferior al promedio con biomasa inferior al promedio. .

Se realizó un análisis de sensibilidad, fijando el parámetro de inclinación de Beverton-Holt (1957) en 0,75 (Anexo A). Esto significa que el reclutamiento es el 75% del reclutamiento de una población no explotada cuando la población está reducida al 20% de su nivel no explotado. Con la información actualmente disponible, la hipótesis de dos regímenes en el reclutamiento es al menos igual de verosímil que un efecto del tamaño de población sobre el reclutamiento. En la Sección 4.5 se describen los resultados cuando se usa una relación población-reclutamiento.

En la Figura 4.7 se ilustra la serie de tiempo estimada del reclutamiento de aleta amarilla, y en la Tabla 4.1 el reclutamiento total anual estimado. Se estimó que el reclutamiento grande que ingresó a las pesquerías de descarte en el tercer trimestre de 1998 (a la edad de 6 meses) es la cohorte más fuerte del período de 1975-2003. Se estima que el reclutamiento en 2007 será grande, pero la estimación es considerablemente incierta. El modelo de evaluación ha mostrado una tendencia de sobreestimar la fuerza de los reclutamientos recientes en las últimas pocas evaluaciones.

Otra característica del reclutamiento también aparente en evaluaciones previas, es el cambio de régimen en los niveles de reclutamiento, a partir del segundo trimestre de 1983. El reclutamiento fue, en promedio, consistentemente mayor después de 1983 que antes. Este cambio en el nivel de reclutamiento produce un cambio similar en biomasa (Figura 4.9a). Hay una indicación que el reclutamiento en los cinco últimos años (2002-2006) fue bajo, en niveles similares a aquéllos anteriores a 1983, indicando tal vez un cambio a un régimen de reclutamiento bajo.

Los intervalos de confianza para el reclutamiento son relativamente estrechos, indicando que las estimaciones son bastante precisas, excepto la del año más reciente (Figura 4.7). La desviación estándar de las desviaciones estimadas del reclutamiento (en la escala logarítmica) es 0,60, igual al 0,6 supuesto en la pena aplicada a los desvíos de reclutamiento. Las estimaciones de incertidumbre son sorprendentemente pequeñas, considerando que el modelo es incapaz de ajustar modas en los datos de frecuencia de talla (Figura 4.8). Estas modas a menudo aparecen, desaparecen, y luego vuelven a aparecer.

Las estimaciones de los reclutamientos más recientes son altamente inciertas, tal como señalan los grandes intervalos de confianza (Figura 4.7). Además, las pesquerías sobre objetos flotantes, que capturan los peces más jóvenes, responden de solamente una pequeña porción de la captura total de aleta amarilla.

4.2.3. Biomasa

Se define la biomasa como el peso total de atún aleta amarilla de 1,5 años o más de edad. En la Figura 4.9a se ilustran las tendencias en la biomasa de aleta amarilla en el OPO, y en la Tabla 4.1 estimaciones de la biomasa al principio de cada año. Entre 1975 y 1983 la biomasa disminuyó a unas 250.000 toneladas. Luego aumentó rápidamente durante 1983-1986, alcanzando unas 540.000 toneladas en 1986. Durante 1986-1999 permaneció relativamente constante en unas 450.000 a 550.000 toneladas, luego alcanzó un pico en 2001, y posteriormente disminuyó a niveles similares a aquéllos antes de 1984. Los intervalos de confianza de las estimaciones de biomasa son relativamente estrechos, indicando que las estimaciones son bastante precisas.

Se define la biomasa reproductora como la producción total relativa de huevos de todos los peces en la población. En la Figura 4.9b se ilustra la tendencia estimada en biomasa reproductora, y en la Tabla 4.1 estimaciones de la biomasa reproductora al principio de cada año. Generalmente, la biomasa reproductora ha seguido tendencias similares a las de la biomasa, descritas en el párrafo anterior. Los intervalos de confianza de las estimaciones de biomasa reproductora indican asimismo que son bastante precisas.

Parece que las tendencias en la biomasa de atún aleta amarilla pueden ser explicadas por las tendencias en mortalidad por pesca y reclutamiento. Se usa un análisis de simulación para ilustrar la influencia de la pesca y el reclutamiento sobre las tendencias de la biomasa (Maunder y Watters 2001). En la Figura 4.10a se ilustran las trayectorias de biomasa simulada con y sin pesca. La gran diferencia entre las dos trayectorias indica que la pesca ejerce un efecto importante sobre la biomasa de aleta amarilla en el OPO. El gran aumento en biomasa durante 1983-1984 fue causado inicialmente por un aumento en el tamaño medio (Anónimo 1999), seguido por un aumento en el reclutamiento medio (Figura 4.7), pero una presión de pesca incrementada impidió a la biomasa aumentar más durante 1986-1990.

En las Figuras 4.10b y 4.10c se ilustra el impacto de cada tipo de pesquería principal sobre la población de aleta amarilla. Las estimaciones de la biomasa en ausencia de pesca fueron computadas de la forma descrita, y luego se estimó la trayectoria de la biomasa fijando el esfuerzo de cada grupo de pesquerías a su vez a cero. Se deriva el impacto sobre la biomasa de cada grupo de pesquerías en cada intervalo de tiempo como esta trayectoria de la biomasa menos la trayectoria de la biomasa cuando todas las pesquerías están activas. Cuando se suman los impactos de las pesquerías individuales calculados con este método, son mayores que el impacto combinado calculado para cuando todas las pesquerías están activas, por lo que se escalan los impactos de tal forma que la suma de los impactos individuales equivalga al impacto estimado cuando todas las pesquerías están activas. Se grafican estos impactos como una proporción de la biomasa no explotada (Figura 4.10b) y en biomasa absoluta (Figura 4.10c).

4.2.4. Peso promedio de los peces en la captura

El peso medio general del atún aleta amarilla capturado en el OPO predicho por el análisis ha permanecido consistente alrededor de los 12 a 22 kg durante la mayor parte del período de 1975-2007, pero ha variado considerablemente entre pesquerías (Figura 4.11). El peso medio fue alto durante 1985-1992, cuando el esfuerzo de las pesquerías sobre objetos flotantes y cardúmenes no asociados fue menor (Figura 2.3). El peso medio fue asimismo alto en 1975-1977 y en 2001-2004. El peso medio de los aletas amarillas capturados por las distintas artes varía mucho, pero permanece bastante consistente dentro de cada pesquería (Figura 4.11). El peso medio más bajo (alrededor de 1 kg) es producido por las pesquerías de descarte, seguidas por la pesquería cañera (unos 4-5 kg), las pesquerías sobre objetos flotantes (unos 5-10 kg para la Pesquería 3, 10-15 kg para las Pesquerías 2 y 4, y 10-15 kg para la Pesquería 1), las pesquerías no asociadas (unos 15 kg), las pesquerías sobre delfines del norte y costera (unos 20-30 kg), y la pesquería sobre delfines del sur y las pesquerías palangreras (unos 40-50 kg en cada caso).

4.3. Comparaciones con fuentes externas de datos

No se usaron datos externos para fines de comparación en la evaluación actual.

4.4. Diagnósticos

Presentamos los diagnósticos en tres secciones; (1) gráficos de residuales, (2) correlaciones de parámetros, y (3) análisis retrospectivo.

4.4.1. Gráficos de residuales

Los gráficos de residuales indican las diferencias entre las observaciones y las predicciones del modelo. Los residuales deberían presentar características similares a los supuestos usados en el modelo. Por ejemplo, si la función de verosimilitud está basada en una distribución normal y supone una desviación estándar de 0,2, los residuales deberían estar distribuidos normalmente con una desviación estándar de aproximadamente 0,2.

En la Figura 4.5a se grafican las desviaciones anuales estimadas del esfuerzo, un tipo de residual en la evaluación que representa cambios temporales en la capturabilidad, como función de tiempo. Se supone que estos residuales están distribuidos normalmente (el residual es exponenciado antes de multiplicar por el esfuerzo, por lo que la distribución es en realidad logarítmica normal) con un promedio de cero y una desviación estándar dada. Una tendencia en los residuales indica que el supuesto que la CPUE es proporcional a la abundancia es violado. La evaluación supone que la pesquería palangrera del sur (Pesquería 12) provee la información más razonable sobre abundancia (desviación estándar (de) = 0,2) mientras que las pesquerías asociadas con delfines y no asociadas tienen menos información (de = 0,3), las pesquerías sobre objetos flotantes, cañera, y palangrera del norte tienen información mínima (de = 0,4), y las pesquerías de descarte carecen de información (de = 2). Por lo tanto, es menos probable una tendencia en la pesquería palangrera del sur (Pesquería 12) que en las otras pesquerías. Las tendencias en las desviaciones del esfuerzo son estimaciones de las tendencias en capturabilidad (ver Sección 4.2.1). La Figura 4.5a no señala ninguna tendencia general en las desviaciones del esfuerzo en la pesquería palangrera del sur, pero hay algunos residuales consecutivos que son todos mayores o todos menores que el promedio. Las desviaciones estándar de los residuales son mayores que las supuestas. Estos resultados indican que la evaluación asigna más peso a la información de CPUE de lo que debería talla. Los residuales de esfuerzo para las pesquerías sobre objetos flotantes muestran una tendencia descendente con el tiempo, mientras que los de las pesquerías asociadas con delfines del norte y costera muestran tendencias ligeramente ascendentes con el tiempo. Estas tendencias podrían estar relacionadas con tendencias verdaderas en la capturabilidad.

Se supone que la proporción observada de peces capturados en una clase de talla está distribuida normalmente alrededor de la proporción predicha con la desviación estándar igual a la varianza binomial, basada en las proporciones observadas, dividida por el cuadrado del tamaño de la muestra (Maunder y Watters 2003a). Análisis previos indicaron que los residuales de frecuencia de talla parecen ser menores que la desviación estándar supuesta.

4.4.2. Correlaciones de parámetros

A menudo, cantidades tales como estimaciones recientes de desvíos del reclutamiento y mortalidad por pesca pueden estar altamente correlacionadas. Esta información indica una superficie de solución plana, lo cual implica que estados de naturaleza alternativos tenían verosimilitudes similares.

Existe una correlación negativa entre los desvíos del esfuerzo actuales estimados para cada pesquería y los desvíos del reclutamiento estimados demorados para representar cohortes que entran a cada pesquería. La correlación negativa es más obvia para las pesquerías de descarte. Los desvíos de esfuerzo anteriores están positivamente correlacionados con estos desvíos del reclutamiento.

La biomasa reproductora actual está positivamente correlacionada con los desvíos del reclutamiento demorados para representar cohortes que entran a la población de biomasa reproductora. Esta correlación es mayor que en estimaciones anteriores de la biomasa reproductora. Se observan correlaciones similares para el reclutamiento y la biomasa reproductora.

4.4.3. Análisis retrospectivo

El análisis retrospectivo es un método útil para determinar la consistencia de un método de evaluación de poblaciones de un año al siguiente. Inconsistencias pueden a menudo señalar insuficiencias en el método de evaluación. En las Figuras 4.12a y 4.12b se ilustra la biomasa estimada y el SBR (definido en la Sección 3.1.2) de las evaluaciones previas y la evaluación actual. Sin embargo, los datos de las distintas evaluaciones son diferentes, por que diferencias serían de esperar (ver Sección 4.6). Normalmente se realizan los análisis retrospectivos mediante la eliminación repetida de un año de datos del análisis pero sin cambiar el método de evaluación de población ni los supuestos. Esto permite determinar el cambio en las cantidades estimadas a medida que se incluyen más datos en el modelo. Las estimaciones de los años más recientes son a menudo inciertas y sesgadas. El análisis retrospectivo y el supuesto que más datos mejoran las estimaciones pueden ser usados para determinar si hay sesgos consistentes en las estimaciones. Análisis retrospectivos realizados por Maunder y Harley (2004) sugirieron que el pico en la biomasa en 2001 fue consistentemente subestimado, pero la evaluación de 2005 estimó un pico ligeramente menor en 2001. El modelo de evaluación ha mostrado una tendencia de sobreestimar la fuerza de los reclutamientos recientes en las últimas pocas evaluaciones, lo cual indica un posible patrón retrospectivo en las estimaciones del reclutamiento.

4.5. Sensibilidad a supuestos

Se realizaron análisis de sensibilidad a fin de investigar la incorporación de una relación población-reclutamiento de Beverton-Holt (1957) (Anexo A1).

El análisis del caso base no supuso ninguna relación población-reclutamiento, y un análisis alternativo con la inclinación de la relación población-reclutamiento de Beverton-Holt fijada en 0,75. Esto implica que cuando la población está reducida al 20% de su nivel no explotado, el reclutamiento esperado es el 75% del reclutamiento de una población no explotada. Al igual que en evaluaciones previas (Maunder y Watters 2002, Hoyle y Maunder 2006a), el análisis con una relación población-reclutamiento se ajusta a los datos mejor que el análisis sin la relación. No obstante, el cambio de régimen podría también explicar el resultado, ya que el período de reclutamiento alto está asociado con una biomasa reproductora alta, y viceversa. Cuando se incluye una relación población-reclutamiento de Beverton-Holt (inclinación = 0,75), la biomasa estimada (Figura A1.1) y el reclutamiento (Figura A1.2) son casi idénticos a los de la evaluación del caso base.

Varios otros análisis de sensibilidad han sido realizados en evaluaciones previas del atún aleta amarilla. Un aumento del tamaño de la muestra de las frecuencias de talla basado en una reponderación iterativa para determinar el tamaño de muestra efectivo produjo resultados similares, pero con intervalos de confianza más estrechos (Maunder y Harley 2004). El uso de datos de enlatadora y descargas para determinar la captura de la pesquería de superficie y distintos tamaños de las penas de suavidad de selectividad (si se fijan en valores realistas) produjeron resultados similares (Maunder y Harley 2004). Los resultados no fueron sensibles al valor del parámetro de talla asintótica de la curva de crecimiento de Richards ni a la función de vínculo usada en la estandarización del modelo lineal general (MLG) de los datos de esfuerzo palangrero (Hoyle y Maunder 2007).

4.6. Comparación con evaluaciones previas

Las trayectorias de la biomasa estimada y el SBR son muy similares a aquéllas de las evaluaciones previas presentadas por Maunder (2007) (Figura 4.12). Estos resultados son asimismo similares a aquéllos obtenidos con análisis de cohortes (Maunder 2002b). Esto indica que las estimaciones de biomasa absoluta son robustas a los supuestos que fueron cambiados al actualizar el procedimiento de evaluación. La estimación de la biomasa reciente es más baja en la evaluación actual.

4.7. Resumen de los resultados del modelo de evaluación

En general, el reclutamiento de atún aleta amarilla a las pesquerías en el OPO es variable, con un componente estacional. El presente análisis y los anteriores indican que la población de aleta amarilla ha pasado por dos, o posiblemente tres, regímenes distintos de productividad (1975-1983, 1984-2000, y 2001-2006). Los regímenes de productividad corresponden a regímenes en biomasa: los regímenes de productividad alto producen niveles de biomasa mayores. Una relación población-reclutamiento es también apoyada por los datos de estos dos regímenes, pero la evidencia es tenue y es probablemente un artefacto de los cambios aparentes de régimen. El análisis indica que cohortes fuertes ingresaron a la pesquería durante 1998-2000, y que incrementaron la biomasa durante 1999-2000, pero ahora ya pasaron por la población, por lo que la biomasa disminuyó durante 2001-2007. La biomasa en 2005-2008 estuvo en niveles similares a aquéllos anteriores a 1985.

El peso medio del atún aleta amarilla capturado en la pesquería ha sido bastante consistente con el tiempo, pero varía sustancialmente entre las distintas pesquerías (Figura 4.11). En general, las pesquerías sobre objetos flotantes (Pesquerías 1-4), no asociadas (Pesquerías 5 y 6), y cañera (Pesquería 10) capturan aletas amarillas de menor edad y tamaño que las pesquerías asociadas con delfines (Pesquerías 7-9) y palangreras (Pesquerías 11 y 12). Las pesquerías palangreras y asociada con delfines en la región del sur

(Pesquería 9) capturan aletas amarillas de mayor edad y tamaño que las pesquerías asociadas con delfines del norte (Pesquería 7) y costera (Pesquería 8).

Han sido estimados niveles significativos de mortalidad por pesca para la pesquería de aleta amarilla en el OPO, con los niveles más altos correspondientes a peces de edad mediana. La mayoría de la captura de aleta amarilla proviene de lances asociados con delfines, y, por consiguiente, este método tiene el mayor impacto sobre la población de la especie, aunque tiene casi el menor impacto por unidad de peso capturado de todos los métodos de pesca.

5. CONDICIÓN DE LA POBLACIÓN

Se evalúa la condición de la población de atún aleta amarilla en el OPO considerando cálculos basados en la biomasa reproductora, rendimiento por recluta, y RMS.

Se están desarrollando ampliamente como lineamientos para la ordenación de pesquerías puntos de referencia precautorios del tipo contemplado en el Código de Conducta de FAO para la Pesca Responsable y el Acuerdo de Naciones Unidas sobre Poblaciones de Peces. La CIAT no ha adoptado puntos de referencia objetivo ni límite para las poblaciones de las que responde, pero en las subsecciones siguientes se describen unos puntos de referencia posibles. Posibles candidatos de puntos de referencia son:

1. S_{RMS}, la biomasa reproductora correspondiente al RMS;
2. F_{RMS}, la mortalidad por pesca correspondiente al RMS;
3. S_{min}, la biomasa reproductora mínima observada en el período del modelo.

Mantener las poblaciones de atunes en niveles que permitirán el RMS es el objetivo especificado por la Convención de la CIAT. El punto de referencia S_{min} se basa en la observación que la población se ha recuperado de este tamaño en el pasado (por ejemplo, los niveles estimados en 1983). En octubre de 2003 se celebró en La Jolla, California (EE.UU.) una reunión técnica sobre puntos de referencia, que produjo (1) un conjunto de recomendaciones generales sobre el uso de puntos de referencia e investigación, (2) recomendaciones específicas para las evaluaciones de poblaciones de la CIAT. Se incorporaron varias de estas recomendaciones en la presente evaluación. Se proseguirá el desarrollo de puntos de referencia consistentes con el enfoque precautorio en la ordenación de la pesca.

5.1. Evaluación de la condición de la población basada en biomasa reproductora

El cociente de la biomasa reproductora (SBR, definido en la Sección 3.1.2) es útil para evaluar la condición de una población.

Se ha usado el SBR para definir puntos de referencia en muchas pesquerías. Varios estudios (Clark 1991, Francis 1993, Thompson 1993, Mace 1994, entre otros) sugieren que algunas poblaciones de peces pueden producir el RMS cuando el SBR está alrededor de 0,3 a 0,5, y que algunas poblaciones de peces no pueden producir el RMS si la biomasa reproductora durante un período de explotación es menos que 0,2. Desgraciadamente, los tipos de dinámica de poblaciones característica de los atunes generalmente no han sido considerados en estos estudios, y sus conclusiones son sensibles a supuestos sobre la relación entre la biomasa adulta y el reclutamiento, la mortalidad natural, y las tasas de crecimiento. A falta de estudios de simulación diseñados específicamente para determinar puntos de referencia apropiados basados en SBR para atunes, se pueden comparar las estimaciones de SBR_t a una estimación del SBR para una población que está produciendo el RMS ($SBR_{RMS} = S_{RMS}/S_{F=0}$).

Se computaron estimaciones de SBR_t trimestral para el aleta amarilla en el OPO para cada trimestre representado en el modelo de evaluación de la población (del primer trimestre de 1975 al segundo trimestre de 2007). En la Sección 4.2.3 se presentan estimaciones de la biomasa reproductora durante el período de pesca (S_t), ilustradas en las Figura 4.9b. Se estimó la biomasa reproductora de equilibrio al cabo de un largo período sin pesca ($S_{F=0}$) suponiendo que el reclutamiento ocurre al nivel promedio esperado de una población no explotada. Se estima el SBR_{RMS} en aproximadamente 0,34.

Al principio de 2008, la biomasa reproductora de atún aleta amarilla en el OPO había aumentado con respecto a 2006, probablemente su nivel más bajo desde 1989. El SBR estimado al principio de 2008 fue aproximadamente 0,36, con límites de confianza de 95% inferior y superior de 0,29 y 0,43, respectivamente (Figura 5.1a). La estimación de SBR_{RMS} de la evaluación actual (0,34) es similar a aquélla de la evaluación previa (Figura 4.12b).

En general, las estimaciones del SBR para el aleta amarilla en el OPO son bastante precisas. Los intervalos de confianza relativamente estrechos de las estimaciones del SBR sugieren que en la mayoría de los trimestres durante 1985-2003 la biomasa reproductora de aleta amarilla en el OPO fue mayor que S_{RMS} (Sección 5.3), representado por la línea de trazos en 0,34 en la Figura 5.1a. No obstante, se estima que durante la mayor parte del período temprano (1975-1984) y el período más reciente (2005-2007), la biomasa reproductora fue menos que S_{RMS}. Se estima que la biomasa reproductora al principio de 2008 estuvo por encima del nivel correspondiente al RMS.

5.2. Evaluación de la condición de la población basada en el RMS

Se define el RMS como la mayor captura o rendimiento promedio a largo plazo que puede ser tomada de una población o de un complejo de poblaciones bajo las condiciones ecológicas y ambientales actuales

Los cálculos del RMS son descritos por Maunder y Watters (2001). Los cálculos son diferentes de aquéllos de Maunder y Watters (2001) en el sentido que incluyen la relación población-reclutamiento de Beverton-Holt (1957) en casos aplicables. Para calcular el RMS, la tasa actual de mortalidad por pesca es escalada para que maximice la captura. El valor multiplicador de *F* escala la mortalidad por pesca "actual", considerada el promedio de 2005-2007. El valor escala*F* usa la mortalidad por pesca en el año de interés. Por lo tanto, la escala*F* del año más reciente no es necesariamente igual al multiplicador *F*.

Al principio de 2008, la biomasa de atún aleta amarilla en el OPO parece haber estado por encima del nivel correspondiente al RMS, y las capturas recientes han sido sustancialmente inferiores al nivel de RMS (Tabla 5.1).

Si la mortalidad por pesca es proporcional al esfuerzo de pesca, y se mantienen los patrones actuales de selectividad por edad (Figura 4.4), el nivel de esfuerzo de pesca actual (promedio de 2005-2007) es inferior a aquél que se estima produciría el RMS. El esfuerzo en RMS es 113% del nivel de esfuerzo actual. Debido a la mortalidad por pesca reducida en 2007, una repetición de los cálculos basados en una mortalidad por pesca promediada para 2005-2006 indica que el esfuerzo actual necesitaría ser incrementado un 6% para alcanzar el esfuerzo en RMS. Es importante notar que la curva que relaciona el rendimiento promedio sostenible con la mortalidad por pesca (Figura 5.2, recuadro superior) es muy plana alrededor del nivel de RMS. Por consiguiente, cambios a los niveles de esfuerzo a largo plazo cambiarán las capturas a largo plazo tan sólo marginalmente, pero la biomasa considerablemente. La biomasa de la población reproductora cambia sustancialmente con cambios en la mortalidad por pesca a largo plazo (Figura 5.2, recuadro inferior). Reducir el esfuerzo incrementaría la CPUE y por lo tanto posiblemente reduciría también el costo de la pesca. Reducir la mortalidad por pesca por debajo del nivel de RMS causaría una reducción marginal en el rendimiento medio a largo plazo, con el beneficio de un aumento relativamente grande en la biomasa reproductora.

El cambio aparente en el régimen de productividad que comenzó en 1984 sugiere enfoques alternativos a la estimación del RMS, ya que regímenes distintos darán lugar a valores distintos del RMS (Maunder y Watters 2001).

La estimación del RMS, y sus cantidades asociadas, es sensible al patrón de selectividad por edad que se usa en los cálculos. A fin de ilustrar cómo cambiaría el RMS si se distribuyera el esfuerzo de otra forma entre las distintas pesquerías (aparte de las pesquerías de descarte) que capturan aleta amarilla en el OPO, se repitieron los mismos cálculos usando el patrón de selectividad por edad estimado para grupos de pesquerías. Si el objetivo de la ordenación es maximizar el RMS, la selectividad por edad de las pesquerías palangreras tendrá el mejor desempeño, seguida por aquélla de las pesquerías asociadas con delfines, las pesquerías no asociadas, y finalmente las pesquerías sobre objetos flotantes (Tabla 5.2). Si un objetivo adicional de la ordenación es incrementar el S_{RMS} al máximo, el orden es el mismo. La selectividad por edad de las pesquerías cerqueras por sí sola produce un poco menos que el RMS actual (Tabla 5.2c). Sin embargo, no es verosímil que las pesquerías palangreras, que producirían los RMS máximos, serían lo suficientemente eficaces como para capturar la totalidad de los RMS predichos. Por sí sólo, el esfuerzo de la pesquería cerquera de aleta amarilla asociado con delfines tendría que ser duplicado para lograr el RMS.

Si se supone que todas las pesquerías menos una están operando, y que cada pesquería mantiene su patrón actual de selectividad por edad, el RMS aumentaría si se eliminaran las pesquerías sobre objetos flotantes o no asociadas, y disminuiría si se eliminaran las pesquerías asociadas con delfines o palangreras (Tabla 5.2b). Si se supone que operan todas las pesquerías, pero se ajusta la pesquería cerquera o palangrera para obtener el RMS, las pesquerías cerqueras necesitarían ser incrementadas un 7%, o las palangreras 37 veces. Si se supone también que existe una relación población-reclutamiento, se lograría el RMS con niveles de esfuerzo más bajos (Tabla 5.2c).

El RMS y S_{RMS} han sido muy estables durante el período abarcado por el modelo (Figura 4.12c). Esto sugiere que el patrón general de selectividad no ha variado mucho con el tiempo. En cambio, el nivel general de esfuerzo de pesca ha variado con respecto a la escala *F*.

En la Figura 5.1b se ilustra la condición histórica de la población con respecto a los puntos de referencia tanto de SBR como de mortalidad por pesca. La mortalidad por pesca ha estado generalmente por debajo de aquélla correspondiente al RMS, excepto durante el período antes de 1984 y durante 2003-2005 (Figura 4.12c).

5.3. Resumen de la condición de la población

Históricamente el SBR de atún aleta amarilla en el OPO estuvo por debajo del nivel correspondiente al RMS durante el régimen de productividad baja de 1975-1983 (Sección 4.2.1), pero por encima del mismo durante la mayor parte de los años siguientes, excepto el período reciente (2003-2007). Se atribuye el aumento en el SBR en 1984 al cambio de régimen, y la disminución reciente podría indicar una reversión al régimen de reclutamiento intermedio. Los dos regímenes de productividad podrían soportar dos niveles distintos de RMS y de SBR asociados. Se estima que el SBR al principio de 2008 estuvo por encima del nivel correspondiente al RMS. Se estima que los niveles de esfuerzo están por debajo de los que soportarían el RMS (con base en la distribución actual de esfuerzo entre las varias pesquerías), pero las capturas recientes han sido sustancialmente inferiores al RMS.

Si se supone una relación población-reclutamiento, el pronóstico es más pesimista, y se estima que la biomasa actual está por debajo del nivel correspondiente al RMS

El peso medio actual del aleta amarilla en la captura es muy inferior al peso crítico. Los cálculos de RMS indican que, en teoría al menos, las capturas podrían ser incrementadas mucho si se dirigiera el esfuerzo de pesca hacia la pesca con palangre y lances cerqueros sobre aletas amarillas asociados con delfines. Esto aumentaría también los niveles de SBR.

El RMS ha sido estable durante el período de la evaluación, lo cual sugiere que el patrón general de selectividad no ha variado mucho con el tiempo. No obstante, el nivel general de esfuerzo de pesca ha variado con respecto al multiplicador de RMS.

6. EFECTOS SIMULADOS DE OPERACIONES DE PESCA FUTURAS

Se realizó un estudio de simulación para lograr una mejor comprensión de cómo, en el futuro, cambios hipotéticos en la cantidad de esfuerzo de pesca ejercido por la flota de superficie podrían simultáneamente afectar la población de atún aleta amarilla en el OPO y las capturas de aleta amarilla por las distintas pesquerías. Se construyeron varios escenarios hipotéticos para definir cómo las distintas pesquerías que capturan aleta amarilla en el OPO operarían en el futuro, y también para definir la dinámica futura de la población de aleta amarilla. En las Secciones 6.1 y 6.2 se describen los supuestos en los que se basan estos escenarios.

Se aplicó un método, basado en la aproximación normal al perfil de verosimilitud (Maunder *et al.* 2006), que considera tanto la incertidumbre en los parámetros como la incertidumbre acerca del reclutamiento futuro. Una parte sustancial de la incertidumbre total en la predicción de eventos futuros es causada por incertidumbre en las estimaciones de los parámetros del modelo y la condición actual, que debería por lo tanto ser considerada en cualquier proyección a futuro. Desgraciadamente, los métodos apropiados son a menudo no aplicables a modelos tan grandes e intensos en computación como el modelo de evaluación de la población de aleta amarilla. Por lo tanto, usamos una aproximación normal al perfil de verosimilitud que permite la inclusión de incertidumbre tanto en los parámetros como acerca del reclutamiento futuro. Este método es aplicado mediante la extensión del modelo de evaluación cinco años adicionales con datos de esfuerzo iguales a aquéllos supuestos para el período de proyección (ver más adelante). Se estiman los reclutamientos para los cinco años igual que en el modelo de evaluación con una pena logarítmica normal con una desviación estándar de 0.6. Se generan aproximaciones normales al perfil de verosimilitud para SBR, captura de superficie, y captura palangrera.

6.1. Supuestos sobre las operaciones de pesca

6.1.1. Esfuerzo de pesca

Se realizaron varios estudios de proyección a futuro a fin de investigar el efecto de distintos niveles de esfuerzo de pesca sobre la biomasa de la población y la captura. La mortalidad por pesca proyectada se basó en los promedios trimestrales durante 2005-2007.

Los escenarios investigados fueron:

1. La mortalidad por pesca trimestral de cada año en el futuro fue fijado igual al promedio trimestral de 2005-2007, lo cual refleja el esfuerzo reducido debido a las medidas de conservación de las Resoluciones C-04-09 y C-06-02;
2. La mortalidad por pesca trimestral de cada año en el futuro y de 2004-2007 fue fijado igual la mortalidad por pesca en el escenario 1 ajustado para el efecto de las medidas de conservación. Para el ajuste, la mortalidad por pesca de la pesquería cerquera en el cuarto trimestre fue incrementado un 85%, y aquélla de la pesquería palangrera del sur un 39%.

6.2. Resultados de la simulación

Se usaron las simulaciones para predecir los niveles futuros del SBR, la biomasa total, la captura total tomada por las pesquerías de superficie primarias que presuntamente seguirían faenando en el OPO (Pesquerías 1-10), y la captura total tomada por la flota palangrera (Pesquerías 11 y 12). Hay probablemente más incertidumbre en los niveles futuros de estas variables que lo que sugieren los resultados presentados en las Figuras 6.1-6.5. El nivel de incertidumbre es probablemente subestimado porque las simulaciones fueron realizadas bajo el supuesto que el modelo de evaluación de la población describe correctamente la dinámica del sistema, y porque no se toma en cuenta la variación en la capturabilidad.

Estas simulaciones fueron realizadas usando el reclutamiento promedio del período de 1975-2007. De haber sido realizadas con el reclutamiento promedio del período de 1984-2001, la tendencia proyectada del SBR y las capturas hubiera sido más positiva. A la inversa, de haber sido realizadas con el reclutamiento medio de 2002-2006, la tendencia proyectada del SBR y las capturas hubiera sido más negativa.

6.2.1. Niveles actuales de esfuerzo

Con los niveles actuales de mortalidad por pesca (2005-2007), se predice que la biomasa aumentará y luego disminuirá, pero que permanecerá por encima del nivel actual (Figura 6.1), y que el SBR seguirá una tendencia similar, permaneciendo por encima del nivel correspondiente al RMS (Figura 6.2). No obstante, los intervalos de confianza son anchos, y existe una probabilidad moderada que el SBR esté sustancialmente por encima o por debajo de dicho nivel. Se predice que las capturas, tanto de superficie como palangreras, seguirán trayectorias similares, con un aumento de las capturas de superficie en 2007-2008 y luego una vuelta a los niveles de 2005 durante el período de la proyección (Figura 6.3).

6.2.2. Pesca sin restricciones

Las Resoluciones C-04-09 y C-06-02 establecieron restricciones del esfuerzo cerquero y las capturas palangreras en 2004-2007: una veda de seis semanas durante el tercer o cuarto trimestre para las pesquerías de cerco, y que las capturas palangreras no rebasen aquéllas de 2001. A fin de evaluar la utilidad de estas acciones de ordenación, proyectamos la población cinco años al futuro, suponiendo que estas medidas de conservación no fueron aplicadas.

Una comparación de la biomasa y el SBR predichos con y sin las restricciones de la resolución indica cierta diferencia (Figuras 6.4 y 6.5). Las simulaciones sugieren que, sin las restricciones, la biomasa y el SBR han disminuido a niveles ligeramente más bajos que aquéllos observados en la actualidad, y disminuirían a aproximadamente el nivel correspondiente al RMS.

6.3. Resumen de los resultados de la simulación

Con los niveles actuales de mortalidad por pesca, se predice que la biomasa aumentará y luego disminuirá, pero permanecerá por encima del nivel actual, y que el SBR seguirá una tendencia similar, permaneciendo por encima del nivel correspondiente al RMS. Una comparación de la biomasa y el SBR predichos con y sin las restricciones de las Resoluciones C-04-09 y C-06-02 sugiere que, sin las restricciones, estarían en niveles más bajos que los que se observan actualmente, y disminuirían a aproximadamente el nivel correspondiente al RMS.

Estas simulaciones fueron realizadas, usando el reclutamiento promedio del período de 1975-2007. De haber sido realizadas con el reclutamiento promedio del período de 1983-2001, la tendencia proyectada del SBR y las capturas hubiera sido más positiva. A la inversa, de haber sido realizadas con el reclutamiento medio de 2002-2006, la tendencia proyectada del SBR y las capturas hubiera sido más negativa.

7. DIRECCIONES FUTURAS

7.1. Colección de información nueva y/o actualizada

El personal de la CIAT piensa continuar su recolección de datos de captura, esfuerzo, y composición por tamaño de las pesquerías que capturan atún aleta amarilla en el OPO. En la próxima evaluación de la población se incorporarán datos nuevos y actualizados.

7.2. Refinamientos de modelos y/o métodos de evaluación

El personal de la CIAT está considerando cambiar al modelo general *Stock Synthesis II* (SS2, elaborado por Richard Methot en el Servicio Nacional de Pesquerías Marinas de EE.UU.) para sus evaluaciones de poblaciones, con base en el resultado de la reunión técnica sobre métodos de evaluación de poblaciones celebrada en noviembre de 2005. Se realizaron evaluaciones preliminares de los atunes aleta amarilla y patudo en SS2, y fueron presentadas en una reunión sobre estrategias de ordenación celebrada en noviembre de 2006. La evaluación actual del patudo fue realizada con SS2, y el personal de la CIAT piensa realizar la próxima evaluación del aleta amarilla con SS2, una vez que se haga la curva de crecimiento en SS2 suficientemente flexible para modelar apropiadamente el crecimiento del aleta amarilla.

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STATUS OF BIGEYE TUNA IN THE EASTERN PACIFIC OCEAN IN 2007 AND OUTLOOK FOR THE FUTURE

by

Alexandre Aires-da-Silva and Mark N. Maunder

CONTENTS

1. SUMMARY

This report presents the current stock assessment of bigeye tuna (*Thunnus obesus*) in the eastern Pacific Ocean (EPO). As in the last assessment, this assessment was conducted using Stock Synthesis II (SS2; Methot 2005). The assessment reported here is based on the assumption that there is a single stock of bigeye in the EPO, and that there is no exchange of fish between the EPO and the western and central Pacific Ocean.

The stock assessment requires a substantial amount of information. Data on retained catch, discards, catch per unit of effort (CPUE), used as indices of abundance, and size compositions of the catches from several different fisheries have been analyzed. Several assumptions regarding processes such as growth, recruitment, movement, natural mortality, and fishing mortality, have also been made. Catch, CPUE, and length-frequency data for the surface fisheries have been updated to include new data for 2007 and revised data for 2003-2006.

Analyses were carried out to assess the sensitivity of results to: 1) a stock-recruitment relationship; 2) use of the southern longline CPUE data only; 3) using two time blocks for the size selectivities of the floating-object fisheries, separated by the implementation in 2001 of IATTC Resolution C-00-08, which prohibited discards of tunas in the EPO.

There have been important changes in the amount of fishing mortality caused by the fisheries that catch bigeye tuna in the EPO. On average, since 1993 the fishing mortality of bigeye less than about 15 quarters old has increased substantially, and that of fish more than about 15 quarters old has increased slightly. The increase in the fishing mortality of the younger fish was caused by the expansion of the fisheries that catch tuna in association with floating objects.

Over the range of spawning biomasses estimated by the base case assessment, the abundance of bigeye recruits appears to be unrelated to the spawning potential of adult females at the time of hatching.

There are several important features in the estimated time series of bigeye recruitment. First, estimates of recruitment before 1993 are very uncertain, as the floating-object fisheries were not catching significant amounts of small bigeye. There was a period of above-average recruitment in 1995-1998, followed by a period of below-average recruitment in 1999-2000. The recruitments have been above average since 2000, and were particularly large in 2005. The most recent recruitment is very uncertain, due to the fact that recently-recruited bigeye are represented in only a few length-frequency samples. The extended

period of relatively large recruitments in 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 level of about 626 thousand metric tons (t) in 1986, after which it decreased to an historic low of 270 thousand t at the beginning of 2007. Spawning biomass has generally followed a trend similar to that for the biomass of 3+-quarter-olds, but lagged by 1-2 years. There is uncertainty in the estimated biomasses of both 3+-quarter-old bigeye and spawners. Nevertheless, it is apparent that fishing has reduced the total biomass of bigeye in the EPO. The biomasses of both 3+-quarter-old fish and spawners were estimated to have increased slightly in recent years.

The estimates of recruitment and biomass are only moderately sensitive to the steepness of the stock-recruitment relationship.

When only the CPUE data for the southern longline fishery were used, the estimates of biomass are greater than in the base case, but the trends are similar. The recruitment time series is very similar to that of the base case assessment. The recruitment estimates, however, are slightly different in 2007, for which CPUE data for the southern longline fishery are not available.

When two time blocks were applied to the size selectivity of the floating object fisheries, the estimated biomasses and recruitment estimates were very similar to those obtained for the base case assessment.

At the beginning of January 2008, the spawning biomass of bigeye tuna in the EPO was near the historic low level. At that time the spawning biomass ratio (the ratio of the spawning biomass at that time to that of the unfished stock; SBR) was about 0.17, which is about 10% less than the level corresponding to the maximum sustainable yield (MSY).

Recent catches are estimated to have been about the MSY level. If fishing mortality (F) is proportional to fishing effort, and the current patterns of age-specific selectivity are maintained, the level of fishing effort corresponding to the MSY is about 82% of the current (2005-2007) level of effort. The MSY 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 floating-object fishery that began in 1993, the MSY was greater than the current MSY and the fishing mortality was less than F_{MSY}.

All four scenarios considered suggest that, at the beginning of 2008, the spawning biomass (S) was below S_{MSY}. MSY and the 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 all scenarios considered, fishing mortality is well above F_{MSY}.

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 that support MSY unless fishing mortality levels are greatly reduced or recruitment is above average for several consecutive years.

The effects of IATTC Resolutions C-04-09 and C-06-02, adopted in 2004 and 2006, respectively, are estimated to be insufficient to allow the stock to remain at levels that would support the MSY.

These simulations are based on the assumption that selectivity and catchability patterns will not change in the future. Changes in targeting practices or increasing catchability of bigeye as abundance declines (*e.g.* density-dependent catchability) could result in differences from the outcomes predicted here.

2. DATA

Catch, effort, and size-composition data for January 1975 through December 2007 were used to conduct the stock assessment of bigeye tuna, *Thunnus obesus*, in the eastern Pacific Ocean (EPO). The data for 2007, which are preliminary, include records that had been entered into the IATTC databases as of mid-

March 2008. All data are summarized and analyzed on a quarterly basis.

2.1. Definitions of the fisheries

Fifteen fisheries are defined for the stock assessment of bigeye tuna. These fisheries are defined on the basis of gear type (purse seine, pole and line, and longline), purse-seine set type (on floating objects, unassociated schools, and dolphins), time period, IATTC length-frequency sampling area or latitude, and unit of longline catch (numbers caught or catch in weight).

The bigeye fisheries are defined in Table 2.1, and the spatial extent of each fishery and the boundaries of the length-frequency sampling areas are shown in Figure 2.1.

In general, fisheries are defined so that, over time, there is little change in the average size composition of the catch. Fishery definitions for purse-seine sets on floating objects are also stratified to provide a rough distinction between sets made mostly on flotsam (Fishery 1), sets made mostly on fish-aggregating devices (FADs) (Fisheries 2-3, 5, 10-11, and 13), and sets made on a mixture of flotsam and FADs (Fisheries 4 and 12). It is assumed that it is appropriate to pool data relating to catches by pole-and-line gear and by purse-seine vessels setting on dolphins and unassociated schools (Fisheries 6 and 7). Relatively few bigeye are captured by the first two methods, and the data from Fisheries 6 and 7 are dominated by information on catches from unassociated schools of bigeye. Given this latter fact, Fisheries 6 and 7 will be referred to as fisheries that catch bigeye in unassociated schools in the remainder of this report.

In previous assessments, two longline fisheries with catch data in numbers were assumed (Fisheries 8 and 9). However, the catch data reported by the longline fisheries are a mixture of catch in numbers and weight records. Since SS2 has the flexibility of including catch data in either numbers or weight, two additional longline fisheries that report catch in weight were defined (Fisheries 14 and 15).

2.2. Catch

To conduct the stock assessment of bigeye tuna, the catch and effort data in the IATTC databases are stratified according to the fishery definitions described in Section 2.1 and presented in Table 2.1. The three definitions relating to catch data used in previous reports (landings, discards, and catch) are described by Maunder and Watters (2001). The terminology in this report is consistent with the standard terminology used in other IATTC reports. Catches taken in a given year are assigned to that year even if they were not landed until the following year. Catches are assigned to two categories, retained catches and discards. Throughout the document the term "catch" will be used to reflect either total catch (discards plus retained catch) or retained catch, and the reader is referred to the context to determine the appropriate definition.

Three types of catch data are used to assess the stock of bigeye tuna (Table 2.1). Removals by Fisheries 1 and 8-9 are simply retained catch. Removals by Fisheries 2-5 and 7 are retained catch, plus some discards resulting from inefficiencies in the fishing process (see Section 2.2.3). Removals by Fisheries 10-13 are discards resulting only from sorting the catch taken by Fisheries 2-5 (see Section 2.2.1).

Updated and new catch data for the surface fisheries (Fisheries 1-7 and 10-13) have been incorporated into the current assessment. The species-composition method (Tomlinson 2002) was used to estimate catches of the surface fisheries. We calculated average scaling factors for 2000-2007 by dividing the total catch for all years and quarters for the species composition estimates by the total catch for all years and quarters for the standard estimates and applied these to the cannery and unloading estimates for 1975-1999. For Fisheries 1, 6, and 7 we used the average over Fisheries 2-5, for Fisheries 2 and 3 we used the average over Fisheries 2 and 3, and for Fisheries 4 and 5 we used the average over Fisheries 4 and 5. Harley and Maunder (2005) provide a sensitivity analysis that compares the results from the stock assessment using the species composition estimates of purse-seine fishery landings with the results from the stock assessment using cannery unloading estimates. Watters and Maunder (2001) provide a brief description of the method that is used to estimate surface fishing effort.

New or updated catch data for the longline fisheries (Fisheries 8-9 and 14-15) are available for Chinese Taipei (2004-2006) and Japan (2003-2006). Catch data for 2007 are available for Chinese Taipei, the Peoples Republic of China, the Republic of Korea, Japan, the United States, and Vanuatu from the monthly reporting statistics.

Trends in the catches of bigeye tuna taken from the EPO during each year of the 1975-2007 period are shown in Figure 2.2. There has been substantial annual variation in the catches of bigeye by all fisheries operating in the EPO (Figure 2.2). Prior to 1996, the longline fleet (Fisheries 8-9 and 14-15) removed more bigeye (in weight) from the EPO than did the surface fleet (Fisheries 1-7 and 10-13) (Figure 2.2). Since 1996, however, the catches by the surface fleet have mostly been greater than those by the longline fleet (Figure 2.2). It should be noted that the assessment presented in this report uses data starting from 1 January, 1975, and substantial amounts of bigeye were already being removed from the EPO by that time.

2.2.1. Discards

For the purposes of stock assessment, it is assumed that bigeye tuna are discarded from the catches made by purse-seine vessels for one of two reasons: inefficiencies in the fishing process (*e.g.* when the catch from a set exceeds the remaining storage capacity of the fishing vessel) or because the fishermen sort the catch to select fish that are larger than a certain size. In either case, the amount of discarded bigeye is estimated with information collected by IATTC or national observers, applying methods described by Maunder and Watters (2003). Regardless of why bigeye are discarded, it is assumed that all discarded fish die.

Estimates of discards resulting from inefficiencies in the fishing process are added to the retained catches made by purse-seine vessels (Table 2.1). No observer data are available to estimate discards for surface fisheries that operated prior to 1993 (Fisheries 1 and 6), and it is assumed that there were no discards from these fisheries. For surface fisheries that have operated since 1993 (Fisheries 2-5 and 7), there are periods for which observer data are not sufficient to estimate the discards. For these periods, it is assumed that the discard rate (discards/retained catches) is equal to the discard rate for the same quarter of the previous year or, if not available, the closest year.

Discards that result from the process of sorting the catch are treated as separate fisheries (Fisheries 10-13), and the catches taken by these fisheries are assumed to be composed only of fish that are 2-4 quarters old (Maunder and Hoyle 2007). Watters and Maunder (2001) provide a rationale for treating such discards as separate fisheries. Estimates of the amounts of fish discarded during sorting are made only for fisheries that take bigeye associated with floating objects (Fisheries 2-5) because sorting is thought to be infrequent in the other purse-seine fisheries.

Time series of discards as proportions of the retained catches for the surface fisheries that catch bigeye tuna in association with floating objects are shown in Figure 2.3. For the largest floating-object fisheries (2, 3, and 5), the proportions of the catches discarded have been low for the last seven years relative to those observed during fishing on the strong cohorts produced in 1997. There is strong evidence that some of this is due to the weak year classes after 1997. However, there have been large recruitments since 1997 (Figure 4.5). It is possible that regulations prohibiting discarding of tuna have caused the proportion of discarded fish to decrease.

It is assumed that bigeye tuna are not discarded from longline fisheries (Fisheries 8-9 and 14-15).

2.3. Indices of abundance

Indices of abundance were derived from purse-seine and longline catch and effort data. Fishing effort data for the surface fisheries (Fisheries 1-7 and 10-13) have been updated and new data included for 2007. New or updated catch and effort data are available for the Japanese longline fisheries (2003-2006). Trends in the amount of fishing effort exerted by the 15 fisheries defined for the stock assessment of bigeye tuna in the EPO are shown in Figure 2.4.

The CPUE for the purse-seine fisheries was calculated as catch divided by number of days fished. The number of days fished by set type was calculated from the number of sets, using a multiple regression of total days fished against number of sets by set type (Maunder and Watters, 2001).

Estimates of standardized catch per unit effort (1975-2006) were obtained for the longline fisheries (Fisheries 8 and 9). A delta-lognormal general linear model, in which the explanatory variables were latitude, longitude, and hooks per basket, was used (Hoyle and Maunder 2006).

The CPUE time series for the different fisheries are presented in Figure 2.5. The indices of abundance that were considered appropriate for use in the assessment were those from Fisheries 2, 3, and 5 (purse-seine sets on floating objects) and 8 and 9 (longline fisheries). The fisheries excluded were considered inappropriate because the catch rates were extremely low. In addition, the first two years of the purse-seine fisheries were excluded because these fisheries were still expanding. Observations with few effort data were also excluded.

2.4. Size composition data

New length-frequency data for 2007 and updated data for previous years are available for the surface fisheries. New or updated length-frequency data are available for the Japanese longline fleet are available (2002-2004). Size composition data for the other longline fleets are not used in the assessment.

The fisheries of the EPO catch bigeye tuna of various sizes. The average size compositions of the catches from each fishery defined in Table 2.1 have been described in previous assessments. The fisheries that catch bigeye associated with floating objects typically catch small (<75 cm) and medium-sized (75 to 125 cm) bigeye (Figures 2.6a-i, Fisheries 1-5). Prior to 1993, the catch of small bigeye was roughly equal to that of medium-sized bigeye (Figure 2.6a , Fishery 1). Since 1993, however, small bigeye from fisheries that catch bigeye in association with floating objects have dominated the catches (Figures 2.6b-e, Fisheries 2-5). An exception is the 1999-2002 period, when a strong cohort moved through the fishery and large fish dominated the catch.

Prior to 1990, mostly medium-sized bigeye were captured in unassociated schools (Figure 2.6f, Fishery 6). Since 1990, more small and large (>125 cm long) bigeye have been captured in unassociated schools (Figure 2.6g, Fishery 7). The catches taken by the two longline fisheries (Fisheries 8 and 9) have distinctly different size compositions. In the area north of 15°N (Fishery 8), longliners catch mostly medium-sized fish, and the average size composition has two distinct peaks (these appear as bands at 80 cm and 120 cm in Figure 2.6h). In the area south of 15°N (Fishery 9), longliners catch substantial numbers of both medium-sized and large bigeye (Figure 2.6i). However, there appears to have been a transition from medium to large fish in about 1984.

The length-frequency data for the Chinese Taipei fleet include more smaller fish than those for the Japanese fleet. However, there is concern about the representativeness of the length-frequency samples from the Chinese Taipei fleet (Stocker 2005, Anonymous 2006). Maunder and Hoyle (2007) conducted a sensitivity analysis, using the Chinese Taipei fleet as a separate fishery.

3. ASSUMPTIONS AND PARAMETERS

3.1. Biological and demographic information

3.1.1. Growth

Schaefer and Fuller (2006) used both tag-recapture data and otolith daily increments to estimate growth curves for bigeye tuna in the EPO. The two data sources provided similar estimates, with an apparent bias in the tagging data, which is hypothesized to be due to shrinkage because the recaptured bigeye tuna were measured at unloading (after they had been stored frozen). The growth curve estimated by Schaefer and Fuller (2006) is substantially different from the growth curves used in previous assessments (Figure

3.1). In particular, it shows growth to be approximately linear, and produces larger fish for a given age. The asymptotic length of the von Bertalanffy growth curve estimated by Schaefer and Fuller (2006) is much greater than any length recorded. This is reasonable as long as no biological meaning is given to the asymptotic length parameter and that the model is used only as a representation of the ages of fish that they sampled. The maximum age of the bigeye tuna in their data set is around 4 years (16 quarters) and their von Bertalanffy growth curve is not considered appropriate for ages greater than this. Maunder and Hoyle (2006) fit a Richards growth curve, using a lognormal likelihood function with constant variance and the asymptotic length parameter set at about the length of the largest-sized bigeye in the data (186.5 cm). Maunder and Hoyle (2007) used the resulting growth curve as a prior for all ages in the stock assessment. This growth curve is also used to convert the other biological parameters to age from length and for the estimation of natural mortality.

Previous assessments (*e.g.* Harley and Maunder 2005), the EPO yellowfin tuna assessments (*e.g.* Maunder 2002), and tuna assessments in the western and central Pacific Ocean (Lehodey *et al.* 1999; Hampton and Fournier 2001a, 2001b) suggest that the growth of younger tuna does not follow a von Bertalanffy growth curve. However, this observation may be a consequence of length-specific selectivity for small fish.

The length at age used in the assessment model is based on the von Bertalanffy growth curve. The parameters of the growth curve were estimated by obtaining the best correspondence of length at age used by Maunder and Hoyle (2007).

Hampton and Maunder (2005) found that the results of the stock assessment are very sensitive to the assumed value for the asymptotic length parameter. Therefore, Maunder and Hoyle (2007) conducted sensitivity analyses to investigate the influence of the assumed value of that parameter. A lower value of 171.5 cm, which is around the value estimated by stock assessments for the western and central Pacific Ocean (Adam Langley, Secretariat of the Pacific Community, pers. com.), and an upper value of 201.5 cm were investigated. A sensitivity analysis of the bigeye assessment to these same two values was also conducted by Aires-da-Silva and Maunder (2007). A lesser value of the asymptotic length parameter produced greater biomasses and recruitments.

Another important component of growth used in age-structured statistical catch-at-length models is the variation in length at age. Age-length information contains information about variation of length at age, in addition to information about mean length at age. Variation in length at age was taken from the previous assessment. A sensitivity analysis that estimated mean length and variation of length at age by integrating age-length data from otolith readings (Schaefer and Fuller 2006) in the assessment model was conducted.

The following weight-length relationship, from Nakamura and Uchiyama (1966), was used to convert lengths to weights in the current stock assessment:

$$w = 3.661 \times 10^{-5} \cdot l^{2.90182}$$

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

3.1.2. Natural mortality

Age-specific vectors of natural mortality (M) are assumed for bigeye. This assessment uses a sex-specific model and therefore natural mortality schedules are provided for each sex (Figure 3.2). The previous stock assessment assumes constant natural mortality (M = 0.1) for fish 0-4 quarters old (Aires-da-Silva and Maunder 2007). New features have been implemented in SS2 which provide more flexibility in the treatment of natural mortality. As a result, a higher natural mortality (M = 0.25) is assumed for fish of both sexes 0 quarters old, decreasing to 0.1 at 5 quarters of age. As in the previous assessment, it is assumed that the natural mortality of females increases after they mature. These age-specific vectors of natural mortality are based on fitting to age-specific proportions of females, maturity at age, and natural mortality estimates of Hampton (2000).

The previous observation that different levels of natural mortality had a large influence on the absolute population size and the population size relative to that corresponding to the maximum sustainable yield (MSY) (Watters and Maunder 2001) is retained. Harley and Maunder (2005) performed a sensitivity analysis to assess the effect of increasing natural mortality for bigeye younger than 10 quarters.

3.1.3. Recruitment and reproduction

It is assumed that bigeye tuna can be recruited to the fishable population during every quarter of the year. Recruitment may occur continuously throughout the year, because individual fish can spawn almost every day if the water temperatures are in the appropriate range (Kume 1967; Schaefer *et al*. 2005).

SS2 allows a Beverton-Holt (1957) stock-recruitment relationship to be specified. The Beverton-Holt curve is parameterized so that the relationship between spawning biomass (biomass of mature females) and recruitment is determined by estimating the average recruitment produced by an unexploited population (virgin recruitment), a parameter called steepness. Steepness controls how quickly recruitment decreases when the spawning biomass is reduced. It is defined as the fraction of virgin recruitment that is produced if the spawning biomass is reduced to 20% of its unexploited level. Steepness can vary between 0.2 (in which case recruitment is a linear function of spawning biomass) and 1.0 (in which case recruitment is independent of spawning biomass). In practice, it is often difficult to estimate steepness because of a lack of contrast in spawning biomass and because there are other factors (*e.g.* environmental influences) that can cause recruitment to be extremely variable. For the current assessment, recruitment is assumed to be independent of stock size (steepness = 1). There is no evidence that recruitment is related to spawning stock size for bigeye in the EPO and, if steepness is estimated as a free parameter, it is estimated to be close to 1. We also present a sensitivity analysis with steepness = 0.75. In addition to the assumptions required for the stock-recruitment relationship, a constraint on quarterly recruitment deviates with a standard deviation of 0.6 is applied.

Reproductive inputs are based on the results of Schaefer *et al*. (2005) and data provided by Dr. N. Miyabe of the National Research Institute of Far Seas Fisheries (NRIFSF) of Japan. Information on age-at-length (Schaefer and Fuller 2006) was used to convert fecundity and proportion mature at length into ages (Figure 3.3, Table 3.1.

3.1.4. Movement

The current assessment does not consider movement explicitly. Rather, it is assumed that the population is randomly mixed at the beginning of each quarter of the year. The IATTC staff is studying the movement of bigeye within the EPO, using data recently collected from conventional and archival tags, and these studies indicate substantial levels of regional fidelity of bigeye within the EPO. The results of these studies may eventually provide information useful for stock assessment. A spatially-structured framework will be considered in future stock assessments.

3.1.5. Stock structure

Document SARM-9-08 provides an overview of current knowledge about the stock structure of bigeye in the EPO. The results of tagging studies indicate regional fidelity of the species in the region, and suggest a very low level of mixing between the eastern and the western Pacific (Schaefer and Fuller 2002; Schaefer and Fuller 2008). Accordingly, and for the purposes of the current stock assessment, it is assumed that there are two stocks, one in the EPO and the other in the western and central Pacific, and that there is no net exchange of fish between these regions. The IATTC staff currently conducts a Pacific-wide assessment of bigeye in collaboration with scientists of the Oceanic Fisheries Programme of the Secretariat of the Pacific Community, and of the NRIFSF. This work may help indicate how the assumption of a single stock in the EPO is likely to affect interpretation of the results obtained from the SS2 method. Recent analyses (Hampton *et al*. 2003) that estimate movement rates within the Pacific

Ocean provided biomass trends very similar to those estimated by Harley and Maunder (2004).

3.2. Environmental influences

Oceanographic conditions might influence the recruitment of bigeye tuna to fisheries in the EPO. In previous assessments (*e.g.* Watters and Maunder 2001), zonal-velocity anomalies (velocity anomalies in the east-west direction) at 240 m depth and in an area from 8°N to 15°S and 100° to 150°W were used as the candidate environmental variable for affecting recruitment. The zonal-velocity anomalies were estimated from the hindcast results of a general circulation model obtained at http://ingrid.ldeo.columbia.edu/. Maunder and Hoyle (2007) conducted a sensitivity analysis to investigate the relationship between recruitment and the El Niño index; this showed that there was a significant negative relationship, but it explained only a small proportion of the total variability in the recruitment.

In previous assessments (Watters and Maunder 2001, 2002; Maunder and Harley 2002) it was assumed that oceanographic conditions might influence the efficiency of the fisheries that catch bigeye associated with floating objects (Fisheries 1-5). In the assessment of Maunder and Harley (2002), an environmental influence on catchability was assumed for Fishery 3 only. It was found that including this effect did not greatly improve the results, and no environmental influences on catchability have been considered in this assessment.

4. STOCK ASSESSMENT

The SS2 method was first used to assess the status of bigeye tuna in the EPO by Aires-da-Silva and Maunder (2007). It consists of a size-based, age-structured, integrated (fitted to many different types of data) statistical stock assessment model.

The model is fitted to the observed data (indices of relative abundance and size compositions) by finding a set of population dynamics and fishing parameters that maximize a penalized likelihood, given the amount of catch taken by each fishery. Many aspects of the underlying assumptions of the model are described in Section 3. It also includes the following important assumptions:

1. Bigeye tuna are recruited to the discard fisheries (Fisheries 10-13) one quarter after hatching, and these discard fisheries catch only fish of the first few age classes.
2. As bigeye tuna age, they become more vulnerable to longlining in the area south of 15°N (Fisheries 9 and 14) and Fishery 7, and the oldest fish are the most vulnerable to these gears.
3. The data for fisheries that catch bigeye tuna from unassociated schools (Fisheries 6 and 7), the pre-1993 and coastal floating-object fisheries (Fisheries 1 and 4), and fisheries whose catch is composed of the discards from sorting (Fisheries 10-13) provide relatively little information about biomass levels, because they do not direct their effort at bigeye. For this reason, the CPUE time series for these fisheries were not used as indices of abundance.

The following parameters have been estimated in the current stock assessment of bigeye tuna from the EPO:

1. recruitment in every quarter from the first quarter of 1975 through the fourth quarter of 2007 (includes estimation of virgin recruitment and temporal recruitment anomalies);
2. catchability coefficients for the five CPUE time series that are used as indices of abundance;
3. selectivity curves for 9 of the 15 fisheries (Fisheries 10-13 have an assumed selectivity curve, and the selectivities of Fisheries 14 and 15 are the same as those of Fisheries 8 and 9, respectively);
4. initial population size and age structure.

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

1. sex- and age-specific natural mortality rates (Figure 3.2);
2. age-specific maturity curve (Table 3.1 and Figure 3.3);
3. selectivity curves for the discard fisheries (Fisheries 10-13);
4. the steepness of the stock-recruitment relationship;
5. mean length at age (Section 3.1.1., Figure 3.1);
6. parameters of a linear model relating the standard deviations in length at age to the mean lengths at age.

The estimates of management quantities and future projections were computed based on 3-year average harvest (exploitation) rates, by gear, for 2005-2007. The sensitivity of estimates of key management quantities to including the last year (2007) in the 3-year average harvest rate estimate was tested. For this purpose, a 2-year (2005-2006) average harvest rate was used in the calculations.

There is uncertainty in the results of the current stock assessment. This uncertainty arises because the observed data do not perfectly represent the population of bigeye tuna in the EPO. Also, the stock assessment model may not perfectly represent the dynamics of the bigeye population or of the fisheries that operate in the EPO. Uncertainty is expressed as approximate confidence intervals and coefficients of variation (CVs). The confidence intervals and CVs have been estimated under the assumption that the stock assessment model perfectly represents the dynamics of the system. Since it is unlikely that this assumption is satisfied, these values may underestimate the amount of uncertainty in the results of the current assessment.

4.1. Assessment results

Below we describe the important aspects of the base case assessment (1 below) and the three sensitivity analyses (2-4):

1. Base case assessment: steepness of the stock-recruitment relationship equals 1 (no relationship between stock and recruitment), CPUE time series for the floating-object Fisheries 2-5 and the longline Fisheries 8-9, time-invariant size selectivities for the different fisheries (a single time block).
2. Sensitivity to the steepness of the stock-recruitment relationship. The base case assessment included an assumption that recruitment was independent of stock size, and a Beverton-Holt (1957) stock-recruitment relationship with a steepness of 0.75 was used for the sensitivity analysis.
3. Sensitivity to the indices of abundance. The base case assessment included the CPUE time series for Fisheries 2, 3, and 5 (purse-seine sets on floating objects) and 8 and 9 (longline fisheries). A sensitivity analysis of the assessment results to the use of only the standardized CPUE for Fishery 9 was conducted. Standardized CPUE for Fishery 8 was not included, due to the seasonal nature of this fishery.
4. Sensitivity to assuming two time blocks for the size selectivities of the floating-object Fisheries 2-5. A requirement that purse-seine vessels retain all catches of tuna, originally introduced in IATTC Resolution C-00-08, has been in force since 2001. This could have resulted in changes in the selectivity of the retained catches of these fisheries, particularly for smaller fish, which might not have been observed in the size samples taken before the Resolution. Accordingly, two selectivity time blocks were considered: pre-Resolution (1975-2000) and post-Resolution (2001-present). The selectivity patterns of the discard Fisheries (10-13) remained unchanged in this analysis.

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

4.1.1. Fishing mortality

There have been important changes in the amount of fishing mortality of bigeye in the EPO. On average, the fishing mortality of fish less than about 15 quarters old has increased since 1993, and that on fish more than about 15 quarters old has increased slightly since then (Figure 4.1). The increase in average fishing mortality on younger fish can be attributed to the expansion of the fisheries that catch bigeye in association with floating objects. These fisheries (Fisheries 2-5) catch substantial amounts of bigeye (Figure 2.2), select fish that are generally less than about 100 cm in length (Figure 4.2), and have expended a relatively large amount of fishing effort since 1993 (Figure 2.4).

Temporal trends in the age-specific amounts of annual fishing mortality of bigeye are shown in Figure 4.3. These trends reflect the distribution of fishing effort among the various fisheries that catch bigeye (see Figure 2.4) and changes in catchability. The trend in annual fishing mortality rate by time shows that fishing mortality has increased greatly for young fish, and only slightly for older fish, since about 1993. An annual summary of the estimates of total fishing mortality is presented in Appendix D (Table D.1).

4.1.2. Recruitment

Previous assessments found that abundance of bigeye being recruited to the fisheries in the EPO appeared to be related to zonal-velocity anomalies at 240 m during the time that these fish are assumed to have hatched (Watters and Maunder 2002). The mechanism that is responsible for this relationship has not been identified, and correlations between recruitment and environmental indices are often spurious, so the relationship between zonal-velocity and bigeye recruitment should be viewed with skepticism. Nevertheless, this relationship tends to indicate that bigeye recruitment is increased by strong El Niño events and decreased by strong La Niña events. Analyses in which no environmental indices were included produced estimates of recruitment similar to those that used zonal velocity (Harley and Maunder 2004). This suggests that there is sufficient information in the length-frequency data to estimate most historical year-class strengths, but the index may be useful for reducing uncertainty in estimates of the strengths of the most recent cohorts, for which few size-composition samples are available. A previous sensitivity analysis to the effect of including the environmental index showed that the index was not statistically significant (Maunder and Hoyle 2006), or explained only a small proportion of the total variation in recruitment (Maunder and Hoyle 2007). Therefore, no environmental index was included in the analysis.

Over the range of estimated spawning biomasses shown in Figure 4.7, the abundance of bigeye recruits appears to be unrelated to the spawning biomass of adult females at the time of hatching (Figure 4.4). Previous assessments of bigeye in the EPO (*e.g.* Watters and Maunder 2001, 2002) also failed to show a relationship between adult biomass and recruitment over the estimated range of spawning biomasses. The base case estimate of steepness is fixed at 1, which produces a model with a weak assumption that recruitment is independent of stock size. The consequences of overestimating steepness, in terms of lost yield and potential for recruitment overfishing, are far worse than those of underestimating it (Harley *et al.* unpublished analysis). A sensitivity analysis is presented in Appendix B that assumes that recruitment is moderately related to stock size (steepness = 0.75).

The time series of estimated recruitment of bigeye is shown in Figure 4.5, and the total recruitment estimated to occur during each year is presented in Table 4.1. There are several important features in the time series of estimated recruitment of bigeye. First, estimates of recruitment before 1993 are very uncertain, as the techniques for catching small bigeye associated with floating-objects were not in use. There was a period of above-average recruitment in 1994-1998, followed by a period of below-average recruitment in 1999-2000. The recruitments have been above average since 2001, and were particularly large in 2005 and 2006. The recent recruitment estimates are 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 large recruitments in 1994-1998 coincided with the expansion of the fisheries that catch bigeye in association with floating objects.

4.1.3. Biomass

Trends in the biomass of 3+-quarter-old bigeye tuna in the EPO are shown in Figure 4.6, and estimates of the biomass at the beginning of each year are presented in Table 4.1. The biomass of 3+-quarter-old bigeye increased during 1983-1984, and reached its peak level of about 626,000 t in 1986, after which it decreased to an historic low of about 270,000 t at the beginning of 2007.

The trend in spawning biomass is also shown in Figure 4.7, and estimates of the spawning biomass at the beginning of each year are presented in Table 4.1. The spawning biomass has generally followed a trend similar to that for the biomass of 3+-quarter-old bigeye, but with a 1- to 2-year time lag. The biomasses of both 3+-quarter-old fish and spawners were estimated to have increased slightly in recent years.

There is uncertainty in the estimated biomasses of spawners. The average CV of the spawning biomass estimates is 0.15.

Given the amount of uncertainty in the estimates of both biomass and recruitment (Sections 4.1.2 and 4.1.3), it is difficult to determine whether trends in the biomass of bigeye have been influenced more by variation in fishing mortality or recruitment. Nevertheless, the assessment suggests two conclusions. First, it is apparent that fishing has reduced the total biomass of bigeye present in the EPO. This conclusion is drawn from the results of a simulation in which the biomass of bigeye tuna estimated to be present in the EPO if fishing had not occurred was projected, using the time series of estimated recruitment anomalies, and the estimated environmental effect, in the absence of fishing. The simulated biomass estimates are always greater than the biomass estimates from the base case assessment (Figure 4.8). Second, the biomass of bigeye can be substantially increased by strong recruitment events. Both peaks in the biomass of 3+-quarter-old bigeye (1986 and 2000; Figure 4.6) were preceded by peak levels of recruitment (1982-1983 and 1997-1998, respectively; Figure 4.5) as is the recent slight increase in biomass.

To estimate the impact that different fisheries have had on the depletion of the stock, we ran simulations in which each gear was excluded and the model was run forward as is done in the no-fishing simulation. The results of this analysis are also provided in Figure 4.8. It is clear that the longline fishery had the greatest impact on the stock prior to 1995, but with the decrease in effort by the longline fisheries, and the expansion of the floating-object fishery, at present the impact of the purse-seine fishery on the population is far greater than that of the longline fishery. The discarding of small bigeye has a small, but detectable, impact on the depletion of the stock. Overall the spawning biomass is estimated to be about 17% of that expected had no fishing occurred.

4.1.4. Average weights of fish in the catch

Trends in the average weights of bigeye captured by the fisheries that operate in the EPO are shown in Figure 4.9. The fisheries that catch bigeye in association with floating objects (Fisheries 1-5) have taken mostly small fish that, on average, weigh less than the critical weight, which indicates that these fisheries do not maximize the yield per recruit (see Maunder and Hoyle 2007). The average weight of bigeye taken by the longline fisheries (Fisheries 8 and 9) has been around the critical weight, which indicates that this fishery tends to maximize the yield per recruit (see Maunder and Hoyle 2007). The average weight for all fisheries combined declined substantially after 1993 as the amount of purse-seine effort on floating objects increased.

The average weight in both surface and longline fisheries declined around 1997-1998 as a strong cohort entered the fishery. The average weights then increased as the fish in that cohort increased in size. The average weight then declined as that cohort was removed from the population.

The average weights for the surface fishery predicted by the model differ from the "observed" mean weights, particularly before 1984. The "observed" average weights are estimated by scaling up the length-frequency samples to the total catch, which differs from the method used in the stock assessment model which uses the fixed selectivity curves and estimated harvest rates for each fishery to estimate the average weight.

4.2. Comparisons to external data sources

No comparisons to external data were made in this assessment.

4.3. Diagnostics

Diagnostics are discussed in two sections: residual and retrospective analysis.

4.3.1. Residual analysis

The model fits to the CPUE data from different fisheries are presented in Figure 4.10. As expected, the model fits the southern longline CPUE observations closely. The fits to the other CPUE data series are less satisfactory.

Pearson residual plots are presented for the model fits to the length composition data (Figures 4.11a to 4.11i). The solid and open circles represent observations that are less and greater than the model predictions, respectively. The area of the circles is proportional to the absolute value of the residuals. There are several notable characteristics of the residuals. The model overestimates the large and small fish for the post-1993 floating-object fisheries. In particular, it overestimates the large fish during 1999-2002, when a strong cohort moved through the fishery. Conversely, the model overestimates medium-sized fish for the southern longline fishery. This overestimation is centered around 80 cm prior to 1988 and then increases to 180 cm, indicating a change in selectivity. A sensitivity analysis was conducted in the previous assessment in which two time blocks were considered for the selectivity and catchability of the southern longline fishery. The residual pattern of the model fit to the size composition data for this fishery was improved. The model fitted the southern longline CPUE index of abundance very closely. However, the biomasses during the early part of the historical period were less than those estimated by the base case assessment.

The fit to the data, as measured by root mean square error, suggests that the model fits the CPUE index for Fishery 9 better (CV = 0.17) than those for other fisheries. The worst fits to the CPUE data are those for Fisheries 3 and 5 (CV = 0.79), followed by Fishery 2 (CV = 0.42). With respect to the length-frequency data, and except for Fisheries 6 and 7, the model fits the data better (as indicated by the estimated effective sample size) than is reflected by the assumed sample sizes in the likelihood functions. In the last assessment (Aires-da-Silva and Maunder 2007), a sensitivity analysis, using iterative reweighting, was conducted to investigate the weighting of the data sets. Specifically, the appropriate standard deviations and sample sizes for the likelihood functions were determined iteratively, based on the fit to the data. When iterative reweighting was applied, more weight was given to the length-frequency data, and the biomasses were estimated to be lower in the earlier and later segments of the historical period.

4.3.2. Retrospective analysis

Retrospective analysis is useful for determining how consistent a stock assessment method is from one year to the next. Inconsistencies can often highlight inadequacies in the stock assessment method. This approach is different from the comparison of recent assessments (Section 4.5), in which the model assumptions differ among these assessments, and differences would be expected. Retrospective analyses are usually carried out by repeatedly eliminating one year of data from the analysis while using the same method and assumptions. This allows the analyst to determine the change in estimated quantities as more data are included in the model. Estimates for the most recent years are often uncertain and biased. Retrospective analysis, and the assumption that the use of more data improves the estimates, can be used to determine if there are consistent biases in the estimates.

Retrospective analyses were conducted by removing one year (2007), two years (2007 and 2006), three years (2007, 2006, 2005) and four years (2007, 2006, 2005, 2004) of data (Figure 4.12). The retrospective analyses show an increase in biomass over 2004, 2005, 2006, and 2007 whereas the base case shows a nearly stable trend over the same period. This corroborates the results of previous retrospective analyses, which show that the recent estimates of biomass are subject to retrospective bias (Harley and Maunder 2004; Aires-da-Silva and Maunder 2007). Although the trends in the biomasses are the same, in general, the retrospective analysis also shows that the biomass estimates from the base case model are lower than those estimated when the last years of data are not incorporated in the model. Retrospective bias does not necessarily indicate the magnitude and direction of the bias in the current assessment, just that the model may be misspecified.

4.4. Sensitivity analyses

The results from the three sensitivity analyses are presented in the appendices: sensitivity to the stock–recruitment relationship (Appendix A), use of the southern longline CPUE data only (Appendix B), and using two time blocks for selectivity of the floating-object fisheries (Appendix C). Here we describe differences in model fit and model prediction, and defer our discussion of differences in stock status until Section 5. A comparison table of the likelihoods for the base case and sensitivity analyses is provided in Table 4.3.

The steepness of the Beverton-Holt (1957) stock-recruitment relationship was set equal to 0.75. The estimates of biomass (Figure A.1) are greater than those estimated in the base case assessment, but the trends are similar. The recruitment time series is similar to the base case (Figure A.2). The estimated stock-recruitment relationship is presented in Figure A.4.

When only the CPUE for the southern longline fishery was used, the estimated biomass was generally greater. However, the estimated biomass trends for the sensitivity analysis and the base case model are very similar (Figure B.1). The recruitment estimates are also very similar for both models (Figure B.2); however, they are slightly different for the most recent quarters in 2007, for which CPUE data for the southern longline fishery are not available. The model fit to the CPUE time series of Fishery 9 is shown in Figure B.4.

Two time blocks were considered for the size selectivities of floating-object Fisheries 2-5; specifically, the periods before (1975-2000) and after (2001-present) Resolution C-00-08, which prohibited discards of small tunas. Minor differences in the size-selectivity curves of these fisheries were obtained (Figure C.4), but the estimated biomasses and recruitment estimates were very similar to those obtained for the base case model.

Other sensitivity analyses, including investigation of growth estimation, environmental effects on recruitment and catchability, natural mortality, use of iterative reweighting, and use of two time blocks for selectivity and catchability for the southern longline fishery, were conducted by Watters and Maunder (2002), Harley and Maunder (2004, 2005), Maunder and Hoyle (2007) and Aires-da-Silva and Maunder (2007).

4.5. Comparison to previous assessments

The summary and the spawning biomasses (Figures 4.13 and 4.14, respectively) estimated by the current and the previous stock assessment model (Aires-da-Silva and Maunder 2007) are very similar in absolute terms. The starting biomasses, however, are slightly lower for the current stock assessment. There is a slightly greater absolute difference between the estimates of the spawning biomass ratios (SBRs) from the current and the previous assessments (Aires-da-Silva and Maunder 2007), particularly during the starting years of the model (1975-1980) (Figure 4.15). The trends in the SBRs, however, are very similar.

The recruitments estimated by the current assessment are slightly greater than the estimates from the previous assessment (Figure 4.16a). As expected, because of the increase in natural mortality, recruitments are higher in the base case when compared to the previous assessment. However, the relative recruitments are very similar (Figure 4.16b).

4.6. Summary of results from the assessment model

There have been important changes in the amount of fishing mortality caused by the fisheries that catch bigeye tuna in the EPO. On average, the fishing mortality on bigeye less than about 15 quarters old has increased substantially since 1993, and that on fish more than about 15 quarters old has increased slightly since then. The increase in fishing mortality on the younger fish was caused by the expansion of the fisheries that catch bigeye in association with floating objects.

Over the range of spawning biomasses estimated by the base case assessment, the abundance of bigeye recruits appears to be unrelated to the spawning potential of adult females at the time of hatching.

There are several important features in the estimated time series of bigeye recruitment. First, estimates of recruitment before 1993 are very uncertain, as the floating-object fisheries were not catching significant amounts of small bigeye. There was a period of above-average recruitment in 1995-1998, followed by a period of below-average recruitment in 1999-2000. The recruitments have been above average since 2001, and were particularly large in 2005 and 2006. The most recent recruitment is very uncertain, due to the fact that recently-recruited bigeye are represented in only a few length-frequency samples. The extended period of relatively large recruitments in 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 level of 625,649 t in 1986, after which it decreased to an historic low of 269,266 t at the beginning of 2007. Spawning biomass has generally followed a trend similar to that for the biomass of 3+-quarter-olds, but lagged by 1-2 years. There is uncertainty in the estimated biomasses of both 3+-quarter-old bigeye and spawners. Nevertheless, it is apparent that fishing has reduced the total biomass of bigeye in the EPO. The biomasses of both 3+-quarter-old fish and spawners were estimated to have increased in recent years (2005-2007).

The estimates of biomass are only moderately sensitive to the steepness of the stock-recruitment relationship. Specifically, the estimates of biomass are greater than those estimated in the base case assessment, but the trends are similar. The recruitment time series is similar to the base case.

When only the CPUE for the southern longline fishery is used, the estimates of biomass are greater than those estimated in the base case, but the trends are similar. The recruitment time series is very similar to the base case. The recruitment estimates, however, are slightly different in 2007, for which CPUE data for the southern longline fishery are not available.

When two time blocks were applied to the size selectivity of the floating-object fisheries, the estimates of biomass and recruitment were very similar to those obtained with the base case model.

5. STOCK STATUS

The status of the stock of bigeye tuna in the EPO is assessed by considering calculations based on the spawning biomass and the maximum sustainable yield (MSY). MSY is defined as the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions.

Precautionary reference points, as described in the FAO Code of Conduct for Responsible Fisheries and the United Nations Fish Stocks Agreement, are being widely developed as guides for fisheries management. Maintaining tuna stocks at levels that produce the MSY is the management objective specified by the IATTC Convention. The IATTC has not adopted any target or limit reference points for the stocks it manages, but some possible reference points are described in the following subsections.

5.1. Assessment of stock status based on spawning biomass

The spawning biomass ratio (the ratio of the spawning biomass at that time to that of the unfished stock; SBR), described by Watters and Maunder (2001), has been used to define reference points in many fisheries. It has a lower bound of zero. If it is near zero, the population has been severely depleted, and is probably overexploited. If the SBR is one, or slightly less than that, the fishery has probably not reduced the spawning stock. If the SBR is greater than one, it is possible that the stock has entered a regime of increased production.

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

Estimates of SBR for bigeye tuna in the EPO have been computed from the base case assessment. Estimates of the spawning biomass during the study period (1975-2007) are presented in Section 4.1.3. The SBR corresponding to the MSY (SBR_{MSY}) is estimated to be about 0.19.

At the beginning of January 2008, the spawning biomass of bigeye tuna in the EPO was near the historical low level (Figure 5.1). At that time the SBR was about 0.17, 10% less than the level corresponding to the MSY.

At the beginning of 1975, the SBR was about 0.26 (Figure 5.1), which is consistent with the fact that bigeye was being fished by longliners in the EPO for a long period prior to 1975 and that the spawning biomass is made up of older individuals that are vulnerable to longline gear. The SBR increased, particularly during 1984-1986, and by the beginning of 1987 was 0.47. This increase can be attributed to the above-average recruitment during 1982 and 1983 (Figure 4.5) and to the relatively small catches that were taken by the surface fisheries during that time (Figure 2.2, Fisheries 1 and 6). This peak in spawning biomass was soon followed by a peak in the longline catch (Figure 2.2, Fishery 9). After 1987 the SBR decreased to a level of about 0.20 by mid-1999. This depletion can be attributed mostly to a long period (1984-1993) during which recruitment was low. Also, it should be noted that the southern longline fishery took relatively large catches during 1985-1994 (Figure 2.2, Fishery 9). In 1999 the SBR began to increase, and reached about 0.33 in 2002. This increase can be attributed to the relatively high levels of recruitment that are estimated to have occurred during 1994-1998 (Figure 4.5). During the latter part of 2002 through 2003, the SBR decreased rapidly, due to the weak year classes in 1999 and 2000 and the large catches from surface fisheries and increased longline catches.

Over time, the SBR shows a trend similar to that of the previous assessment (Figure 4.15). However, the estimated SBR levels are lower than that estimated in the previous assessment (Aires-da-Silva and Maunder 2007), particularly in the early years of the study period (1975-1980).

5.2. Assessment of stock status based on MSY

Maintaining tuna stocks at levels that permit the MSY to be taken is the management objective specified by the IATTC Convention. Watters and Maunder (2001) describe how the MSY and its related quantities are calculated. These calculations have, however, been modified to include, where applicable, the Beverton-Holt (1957) stock-recruitment relationship (see Maunder and Watters (2003) for details). It is important to note that estimates of the MSY and its associated quantities are sensitive to the steepness of the stock-recruitment relationship (Section 5.4), and, for the base case assessment, steepness was fixed at 1 (an assumption that recruitment is independent of stock size); however, a sensitivity analysis (steepness = 0.75) is provided to investigate the effect of a stock-recruitment relationship.

The MSY-based estimates were computed with the parameter estimates from the base case assessment and estimated fishing mortality patterns averaged over 2005 and 2007. Therefore, while these MSY-based results are currently presented as point estimates, there are uncertainties in the results. While analyses to present uncertainty in the base case estimates were not undertaken as in a previous assessment (Maunder and Harley 2002), additional analyses were conducted to present the uncertainty in these quantities in relation to the periods assumed to represent catchability and fishing mortality.

At the beginning of January 2008, the spawning biomass of bigeye tuna in the EPO appears to have been about 10% less than S_{MSY}, and the recent catches are estimated to have been about 8% greater than the MSY (Table 5.1).

If fishing mortality is proportional to fishing effort, and the current patterns of age-specific selectivity (Figure 4.2) are maintained, F_{MSY} is about 82% of the current level of effort.

The MSY-based quantities are estimated by assuming that the stock is at equilibrium with fishing, but during 1995-1998 that was not the case. This has potentially important implications for the surface fisheries, as it suggests that the catch of bigeye by the surface fleet may be determined largely by the strength of recruiting cohorts. For example, the catches of bigeye taken by the surface fleet declined when the large cohorts recruited during 1995-1998 were no longer vulnerable to those fisheries.

Estimates of the MSY, and its associated quantities, are sensitive to the age-specific pattern of selectivity that is used in the calculations. The MSY-based quantities described previously were based on an average selectivity pattern for all fisheries combined (calculated from the current allocation of effort among fisheries). Different allocations of fishing effort among fisheries would change this combined selectivity pattern. To illustrate how the MSY might change if the effort is reallocated among the various fisheries that catch bigeye in the EPO, the previously-described calculations were repeated, using the age-specific selectivity pattern estimated for each group of fisheries (Table 5.2). If only the purse-seine fishery were operating the MSY would be about 30% less. If bigeye were caught only by the longline fishery the MSY would about 89% greater than that estimated for all gears combined. To achieve this MSY level longline effort would need to be increased by 320%.

The MSY-related quantities vary as the size composition of the catch varies. The evolution of four of these over the course of 1975-2007 is shown in Figure 5.2. Before the expansion of the floating-object fishery that began in 1993, MSY was greater than the current MSY and the fishing mortality was less than that corresponding to MSY (Figure 5.2).

When MSY is estimated using the average fishing mortality rates for 2005-2006, it is 416 t (0.5%) less than the base case.

Figure 5.3 shows the historical time series of exploitation rates and spawning biomass relative to the MSY reference points. Overall, the reference points have not been exceeded until recent years. The four most recent estimates indicate that the bigeye stock in the EPO is probably overexploited ($S < S_{MSY}$) and that overfishing is taking place ($F > F_{MSY}$); the confidence intervals on spawning biomass straddle the MSY level.

5.3. Sensitivity to alternative parameterizations and data

Yields and reference points are moderately sensitive to alternative model assumptions, input data, and the periods assumed for fishing mortality (Tables 5.1 and 5.2).

The sensitivity analysis that included a stock-recruitment model with a steepness of 0.75 estimated the SBR required to support the MSY to be at 0.30, compared to 0.19 for the base case assessment (Table

5.1). The sensitivity analysis for steepness estimates an F multiplier considerably less than that for the base case assessment (0.57). All analyses estimate the current SBR to be less than SBR_{MSY}.

The management quantities are only moderately sensitive to the recent periods for fishing mortality used in the calculations (Table 5.2).

5.4. Summary of stock status

At the beginning of January 2008, the spawning biomass of bigeye tuna in the EPO was near the historic low level (Figure 5.1). At that time the SBR was about 0.17, about 10% less than the level corresponding to the MSY.

Recent catches are estimated to have been about the MSY level (Table 5.1). 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 MSY is about 82% of the current (2005-2007) level of effort. The MSY 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 floating-object fishery that began in 1993, the MSY was greater than the current MSY and the fishing mortality was less than F_{MSY} (Figure 5.2).

All analyses indicate that, at the beginning of 2008, the spawning biomass was probably below S_{MSY} (Tables 5.1 and 5.2). The MSY and the 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 all scenarios considered, fishing mortality is well above F_{MSY}.

6. SIMULATED EFFECTS OF FUTURE FISHING OPERATIONS

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

A method based on the normal approximation to the likelihood profile has been applied (Maunder *et al.* 2006). Unfortunately, the appropriate methods are not often applicable to models as large and computationally intense as the bigeye stock assessment model. Therefore, we have used a normal approximation to the likelihood profile that allows for the inclusion of both parameter uncertainty and uncertainty about future recruitment. This method is implemented by extending the assessment model an additional five years with exploitation rates equal to the average for 2005-2007. No catch or length-frequency data are included for these years. The recruitments for the five years are estimated as in the assessment model, with a lognormal penalty with a standard deviation of 0.6.

6.1. Assumptions about fishing operations

6.1.1. Fishing effort

Future projection studies were carried out to investigate the influence of different levels of fishing effort (harvest rates) on the stock biomass and catch.

The analyses carried out were:

1. Quarterly harvest rates for each year in the future were set equal to the average harvest rates from 2005 to 2007, to simulate the reduced effort due to the conservation measures of IATTC Resolution C-04-09.
2. An additional analysis was carried out that estimates the population status if the resolution was not implemented. For 2004-2007, purse-seine catch in the third quarter was increased by 86%

and the catch in the southern longline fishery was increased by 39% in all quarters. For 2008-2012, the purse-seine harvest rate was increased by 13% for all quarters and the harvest rate in the southern longline fishery was increased by 39% in all quarters.

6.2. Simulation results

The simulations were used to predict future levels of the SBR, total biomass, the total catch taken by the primary surface fisheries that would presumably continue to operate in the EPO (Fisheries 2-5 and 7), and the total catch taken by the longline fleet (Fisheries 8-9 and 14-15). There is probably more uncertainty in the future levels of these outcome variables than is suggested by the results presented in Figures 6.1-6.4. The amount of uncertainty is probably underestimated, because the simulations were conducted under the assumption that the stock assessment model accurately describes the dynamics of the system and with no account taken of variation in catchability.

6.2.1. Current harvest rates

Projections were undertaken, assuming that harvest rates would remain at the average 2005-2007 levels (including the effort and catch restrictions in Resolutions C-04-09 and C-06-02).

SBR is estimated to have been increasing slightly in recent years (Figure 5.1). This increase is attributed to two spikes in recent recruitment. If recent levels of effort and catchability continue, the SBR is predicted to increase above the level that would support MSY during 2009-2010, and then to decline during 2011-2013 to a level slightly below to that which would support MSY (Figure 6.1a). The spawning biomass is estimated to increase slightly from 2005-2007, but it will probably decline in the future (Figure 6.2).

Purse-seine catches are predicted to decline during the projection period (Figure 6.3, left panels). Longline catches are predicted to increase moderately in 2008, but start declining by 2009 under current effort (Figure 6.3, right panels). The catches would decline slightly further if a stock-recruitment relationship was included, due to reductions in the levels of recruitment that contribute to purse-seine catches.

Predicted catches for both gears are based on the assumption that the selectivity of each fleet will remain the same and that catchability will not increase as abundance declines. If the catchability of bigeye increases at low abundance, catches will, in the short term, be greater than those predicted here.

6.2.2. No management restrictions

IATTC Resolutions C-04-09 and C-06-02 call for restrictions on purse-seine effort and longline catches during 2004-2007: a 6-week closure during the third *or* fourth quarter of the year for purse-seine fisheries, and longline catches not to exceed 2001 levels. To assess the utility of these management actions, we projected the population forward 5 years, assuming that these conservation measures are not implemented in the future. Projected catches would be less if the resolution had not been adopted (Figure 6.3, lower panels).

Comparison of the SBR predicted with and without the restrictions from the resolution show some difference (Figure 6.4). Without the restrictions, SBR would increase only slightly and then decline to lower levels.

The reductions in fishing mortality that could occur as result of the continuation of Resolution C-06-02 are insufficient to allow the population to be maintained above levels corresponding to the MSY in the long term, although an increase above the MSY level is expected for a few years, due to recent high recruitment.

6.2.3. Sensitivity analysis

The analysis that includes a stock-recruitment relationship indicates that the population is substantially below SBR_{MSY} and will remain at this level under current effort levels (Figure 6.1b).

6.3. Summary of the simulation results

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 SBR. Under current effort levels, the population is unlikely to remain at levels that support MSY unless fishing mortality levels are greatly reduced or recruitment is above average for several consecutive years.

The effects of Resolutions C-04-09 and C-06-02 are estimated to be insufficient to allow the stock to remain at levels that would support MSY.

These simulations are based on the assumption that selectivity and catchability patterns will not change in the future. Changes in targeting practices or increasing catchability of bigeye as abundance declines (*e.g.* density-dependent catchability) could result in differences from the outcomes predicted here.

7. FUTURE DIRECTIONS

7.1. Collection of new and updated information

The IATTC staff intends to continue its collection of catch, effort, and size-composition data from the fisheries that catch bigeye tuna in the EPO. Updated and new data will be incorporated into the next stock assessment.

The IATTC staff will continue to compile longline catch and effort data for fisheries operating in the EPO. In particular, it will attempt to obtain data for recently-developed and growing fisheries.

7.2. Refinements to the assessment model and methods

The IATTC staff will continue developing the Stock Synthesis II assessment for bigeye tuna in EPO. Much of the progress will depend on how the Stock Synthesis II software is modified in the future. The following changes would be desirable for future assessments:

1. Use a more flexible growth curve (*e.g.* the Richards growth curve) or input a vector of length-at-age so that the growth curve better represents that used in previous assessments using A-SCALA.
2. Make it easier to run projections with fixed harvest rates.
3. Re-evaluate the definitions of fisheries.
4. Determine appropriate weighting of the different data sets.
5. Include available tagging data in the assessment.

Collaboration with staff members of the Secretariat of the Pacific Community on the Pacific-wide bigeye model will continue.

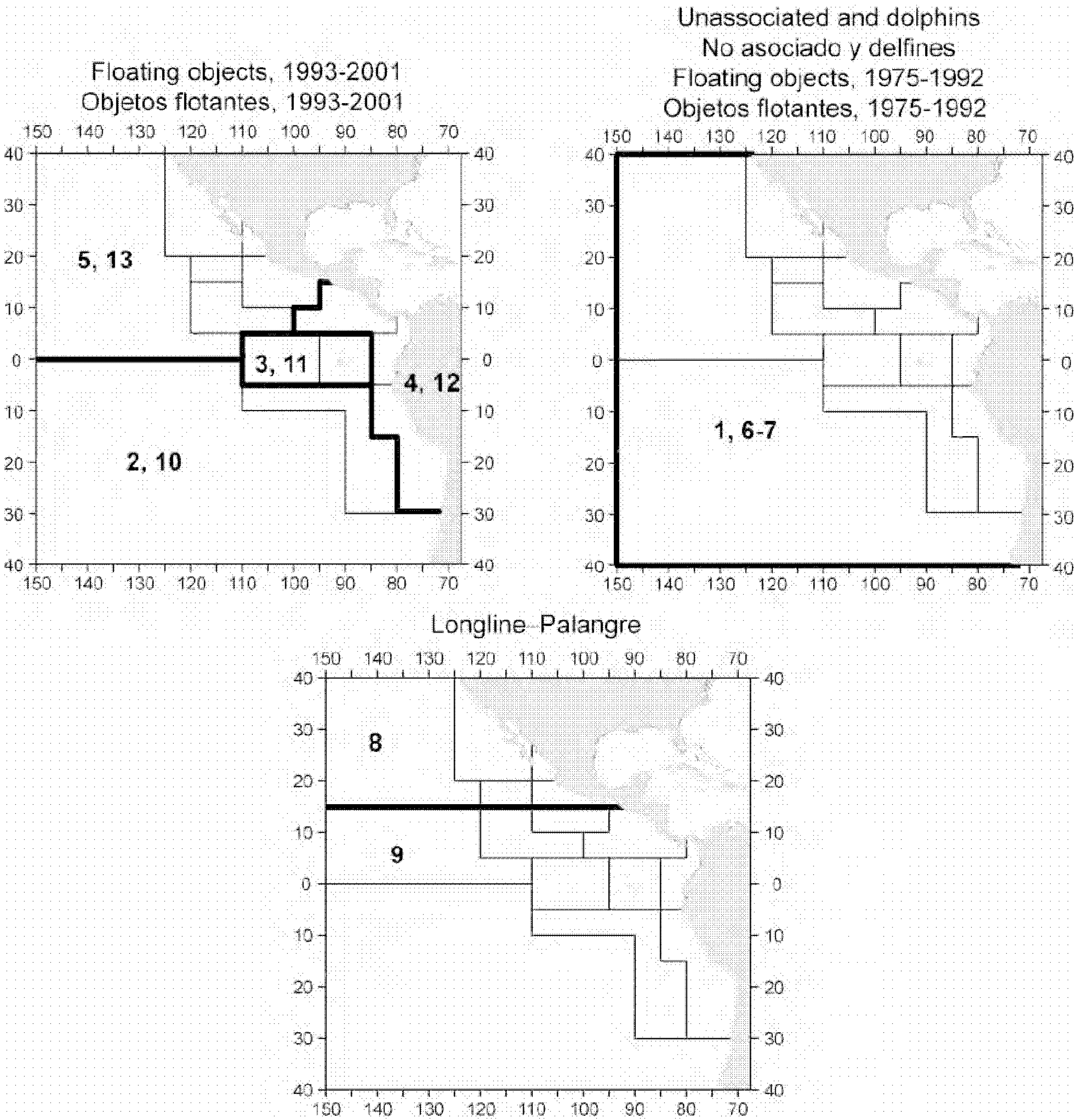

FIGURE 2.1. Spatial extents of the fisheries defined for the stock assessment of bigeye tuna in the EPO. The thin lines indicate the boundaries of 13 length-frequency sampling areas, the bold lines the boundaries of each fishery defined for the stock assessment, and the bold numbers the fisheries to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

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

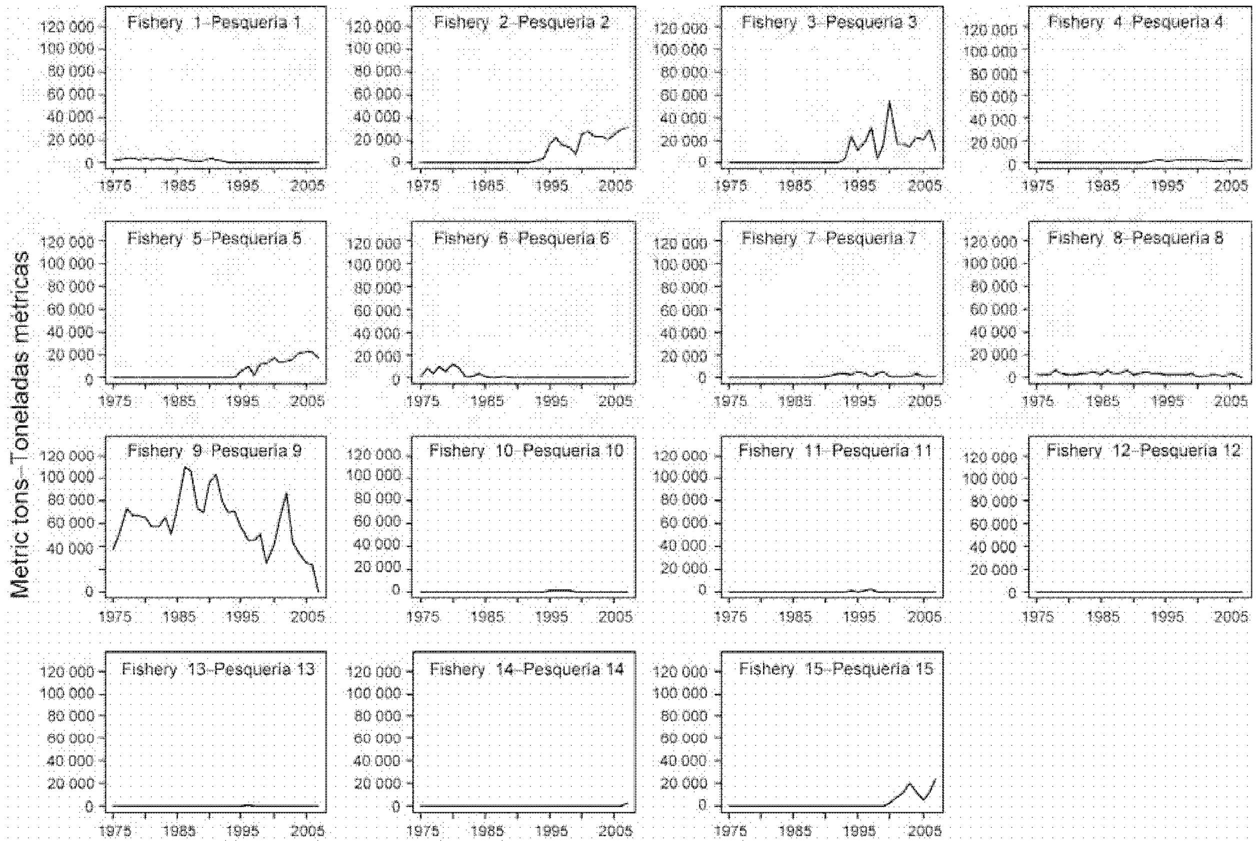

FIGURE 2.2. Annual catches of bigeye tuna taken by the fisheries defined for the stock assessment of that species in the EPO (Table 2.1). Although all the catches are displayed as weights, the stock assessment model uses catches in numbers of fish for Fisheries 8 and 9. Catches in weight for Fisheries 8 and 9 were estimated by multiplying the catches in numbers of fish by estimates of the average weights.

FIGURA 2.2. Capturas anuales de atún patudo realizadas por las pesquerías definidas para la evaluación de la población de esa especie en el OPO (Tabla 2.1). Aunque se presentan todas las capturas como pesos, el modelo de evaluación usa capturas en número de peces para las Pesquerías 8 y 9. Se estimaron las capturas en peso para las Pesquerías 8 y 9 multiplicando las capturas en número de peces por estimaciones del peso medio.

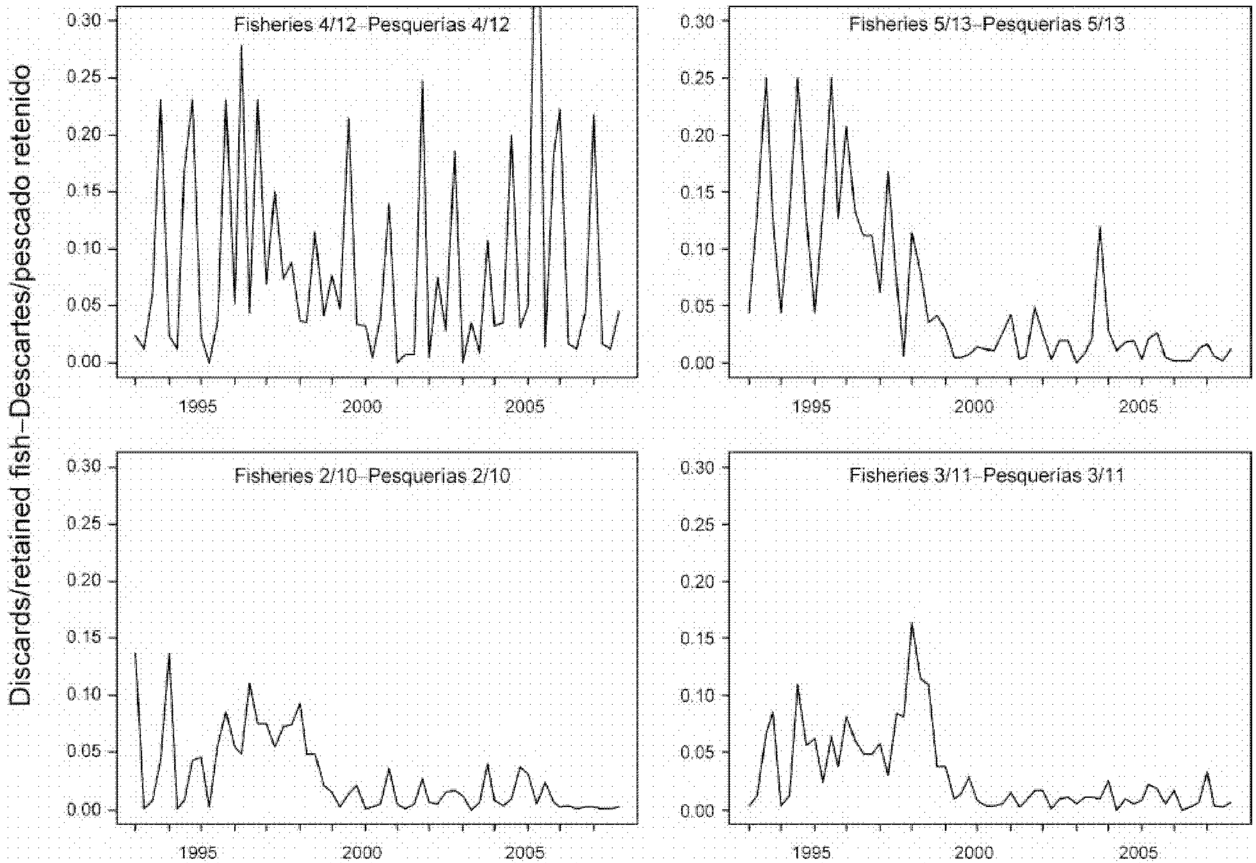

FIGURE 2.3. Weights of discarded bigeye tuna as proportions of the retained quarterly catches for the four floating-object fisheries. Fisheries 2, 3, 4, and 5 are the "real" fisheries, and Fisheries 10, 11, 12, and 13 are the corresponding discard fisheries.

FIGURA 2.3. Pesos de atún patudo descartado como proporción de las capturas trimestrales retenidas de las cuatro pesquerías sobre objetos flotantes. Las pesquerías 2, 3, 4, y 5 son las pesquerías "reales", y las Pesquerías 10, 11, 12, y 13 las pesquerías de descarte correspondientes.

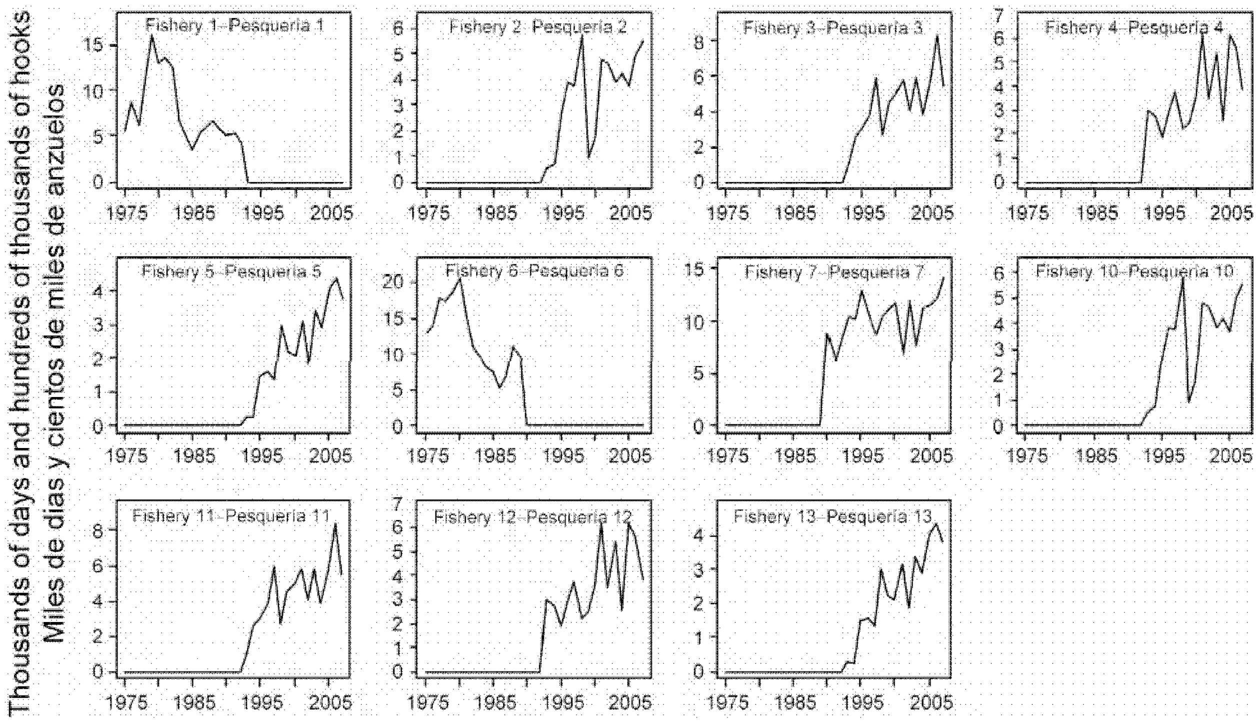

FIGURE 2.4. Annual fishing effort exerted by the fisheries defined for the stock assessment of bigeye tuna in the EPO (Table 2.1). The effort for Fisheries 1-7 and 10-13 is in days fished, and that for Fisheries 8-9, and 13-15 in standardized numbers of hooks. Note that the vertical scales of the panels are different.

FIGURA 2.4. Esfuerzo de pesca anual ejercido por las pesquerías definidas para la evaluación de la población de atún patudo en el OPO (Tabla 2.1). Se expresa el esfuerzo de las Pesquerías 1-7 y 10-13 en días de pesca, y el de las Pesquerías 8, 9, y 13-15 en número estandardizado de anzuelos. Nótese que las escalas verticales de los recuadros son diferentes.

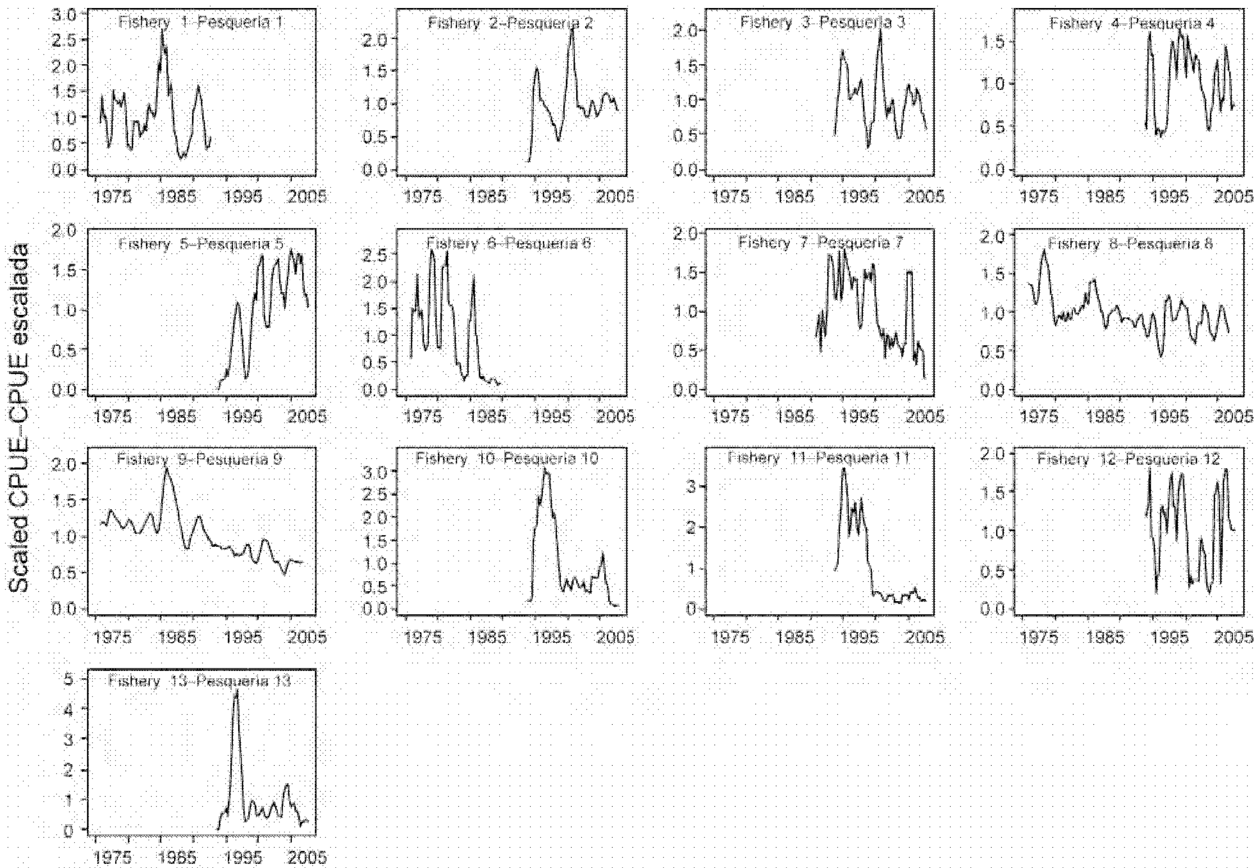

FIGURE 2.5. Four-quarterly running average CPUEs of the fisheries defined for the stock assessment of bigeye tuna in the EPO (Table 2.1). The CPUEs for Fisheries 1-7 and 10-13 are in kilograms per day fished, and those for Fisheries 8 and 9 in numbers of fish caught per standardized number of hooks. The data are adjusted so that the mean of each time series is equal to 1.0. Note that the vertical scales of the panels are different.

FIGURA 2.5. Promedio móvil de cuatro trimestres de las CPUE de las pesquerías definidas para la evaluación de la población de atún patudo en el OPO (Tabla 2.1). Se expresan las CPUE de las Pesquerías 1-7 y 10-13 en kilogramos por día de pesca, y las de las Pesquerías 8 y 9 en número de peces capturados por número estandarizado de anzuelos. Se ajustaron los datos para que el promedio de cada serie de tiempo equivalga a 1,0. Nótese que las escalas verticales de los recuadros son diferentes.

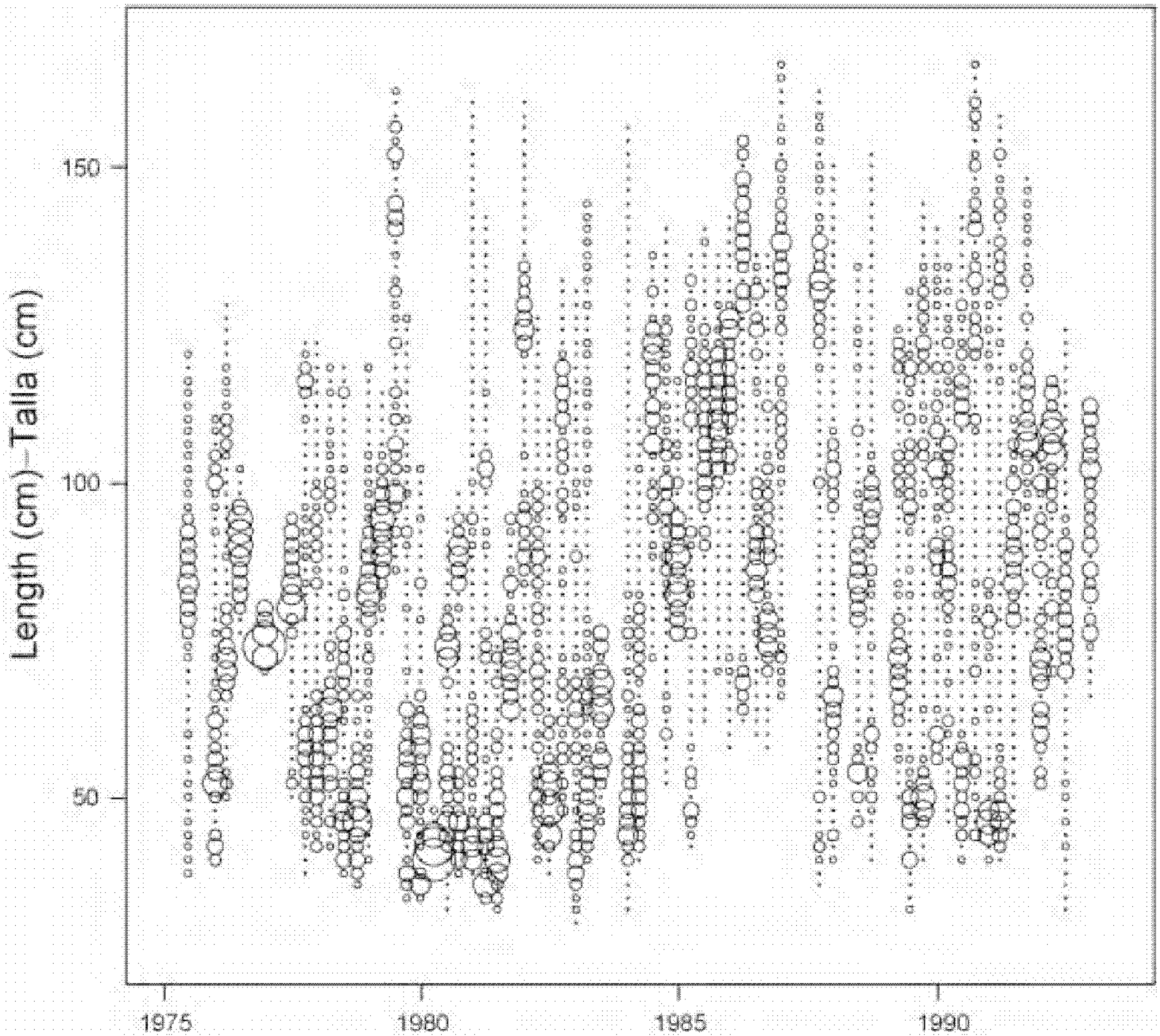

FIGURE 2.6a. Size compositions of the catches of bigeye tuna taken by Fishery 1, by quarter. The sizes of the circles are proportional to the catches.

FIGURA 2.6a. Composición por talla de las capturas de patudo de la Pesquería 1, por trimestre. El tamaño de los círculos es proporcional a la captura.

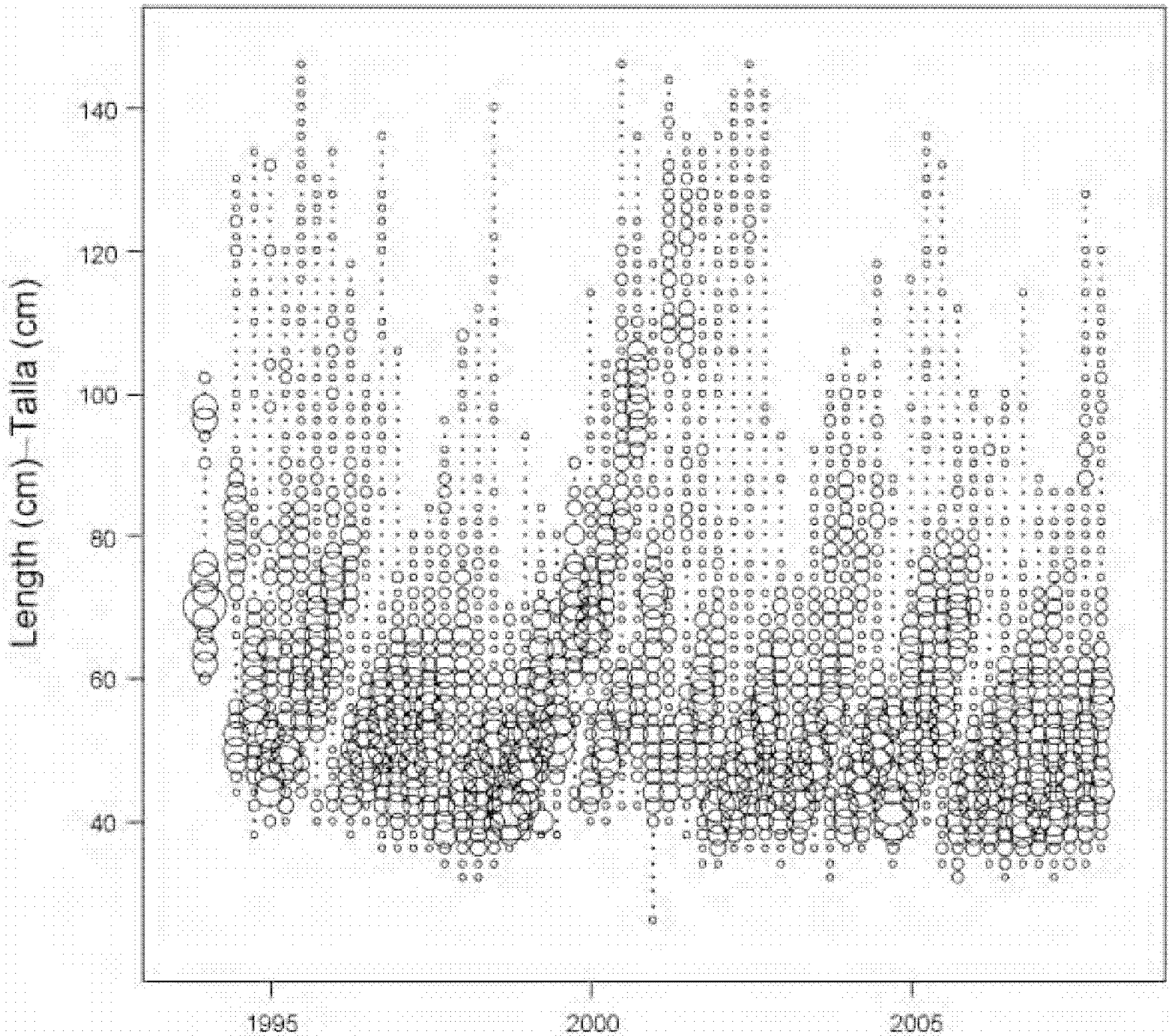

FIGURE 2.6b. Size compositions of the catches of bigeye tuna taken by Fishery 2, by quarter. The sizes of the circles are proportional to the catches.
FIGURA 2.6b. Composición por talla de las capturas de patudo de la Pesquería 2, por trimestre. El tamaño de los círculos es proporcional a la captura.

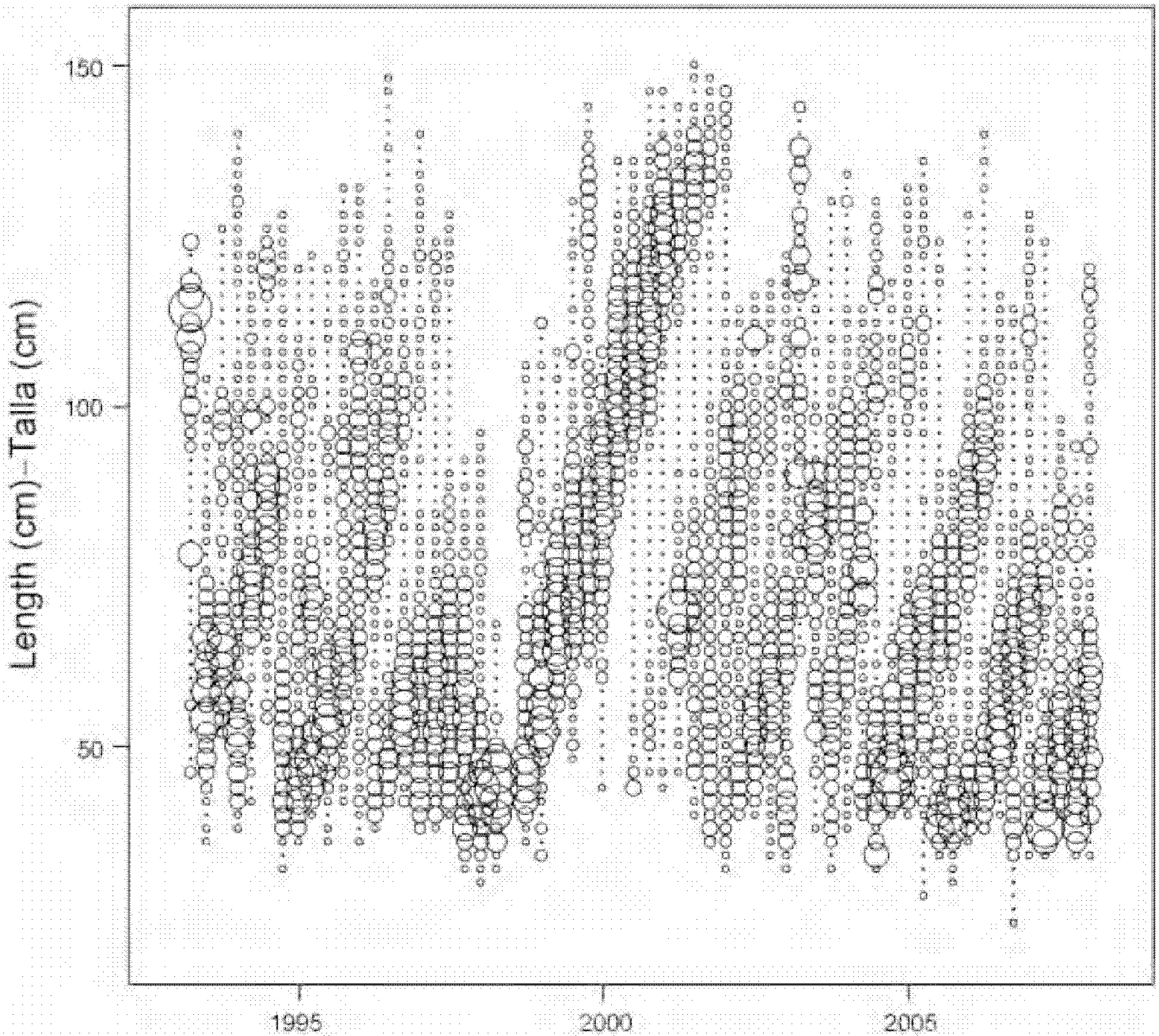

FIGURE 2.6c. Size compositions of the catches of bigeye tuna taken by Fishery 3, by quarter. The sizes of the circles are proportional to the catches.

FIGURA 2.6c. Composición por talla de las capturas de patudo de la Pesquería 3, por trimestre. El tamaño de los círculos es proporcional a la captura.

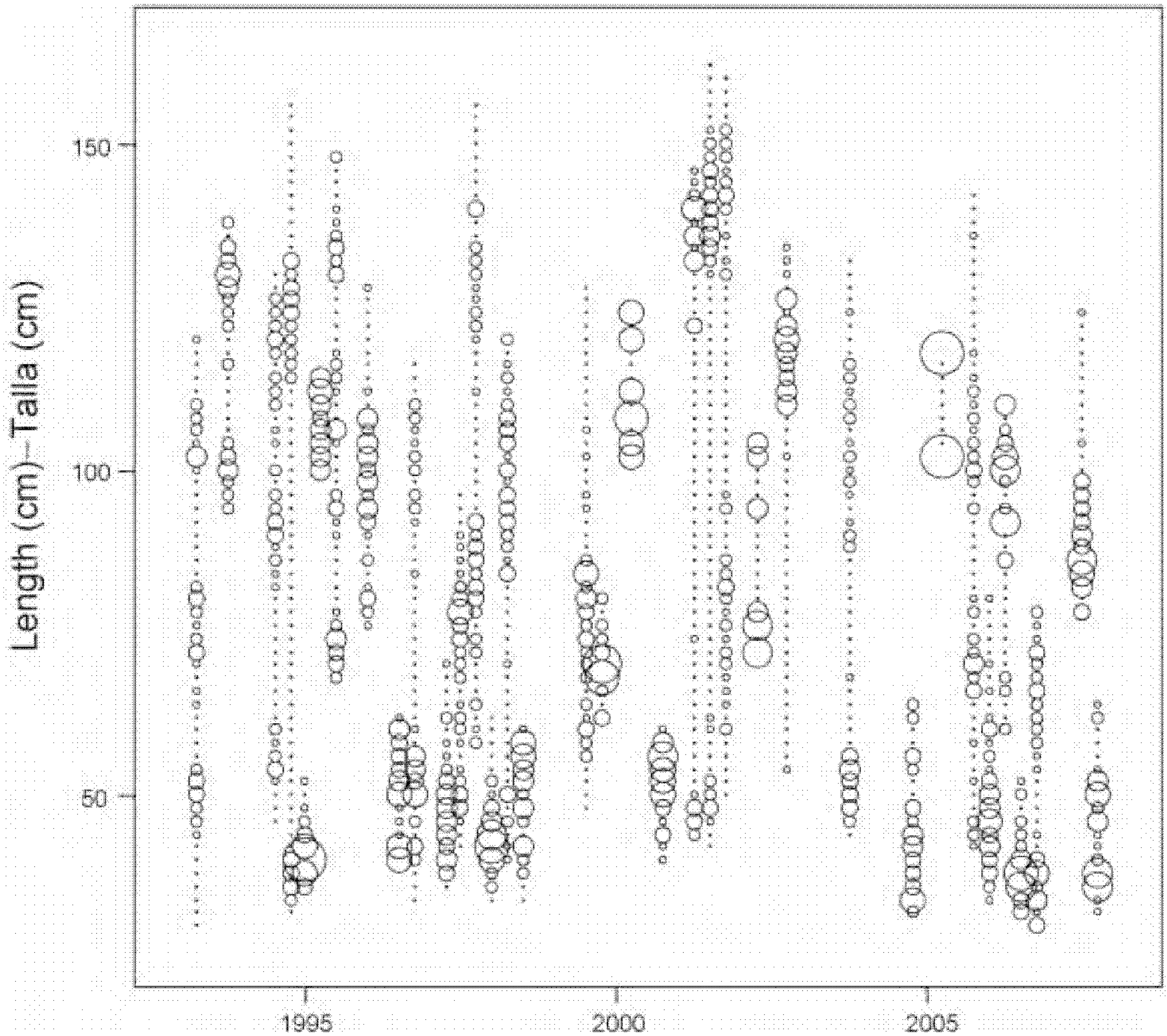

FIGURE 2.6d. Size compositions of the catches of bigeye tuna taken by Fishery 4, by quarter. The sizes of the circles are proportional to the catches.

FIGURA 2.6d. Composición por talla de las capturas de patudo de la Pesquería 4, por trimestre. El tamaño de los círculos es proporcional a la captura.

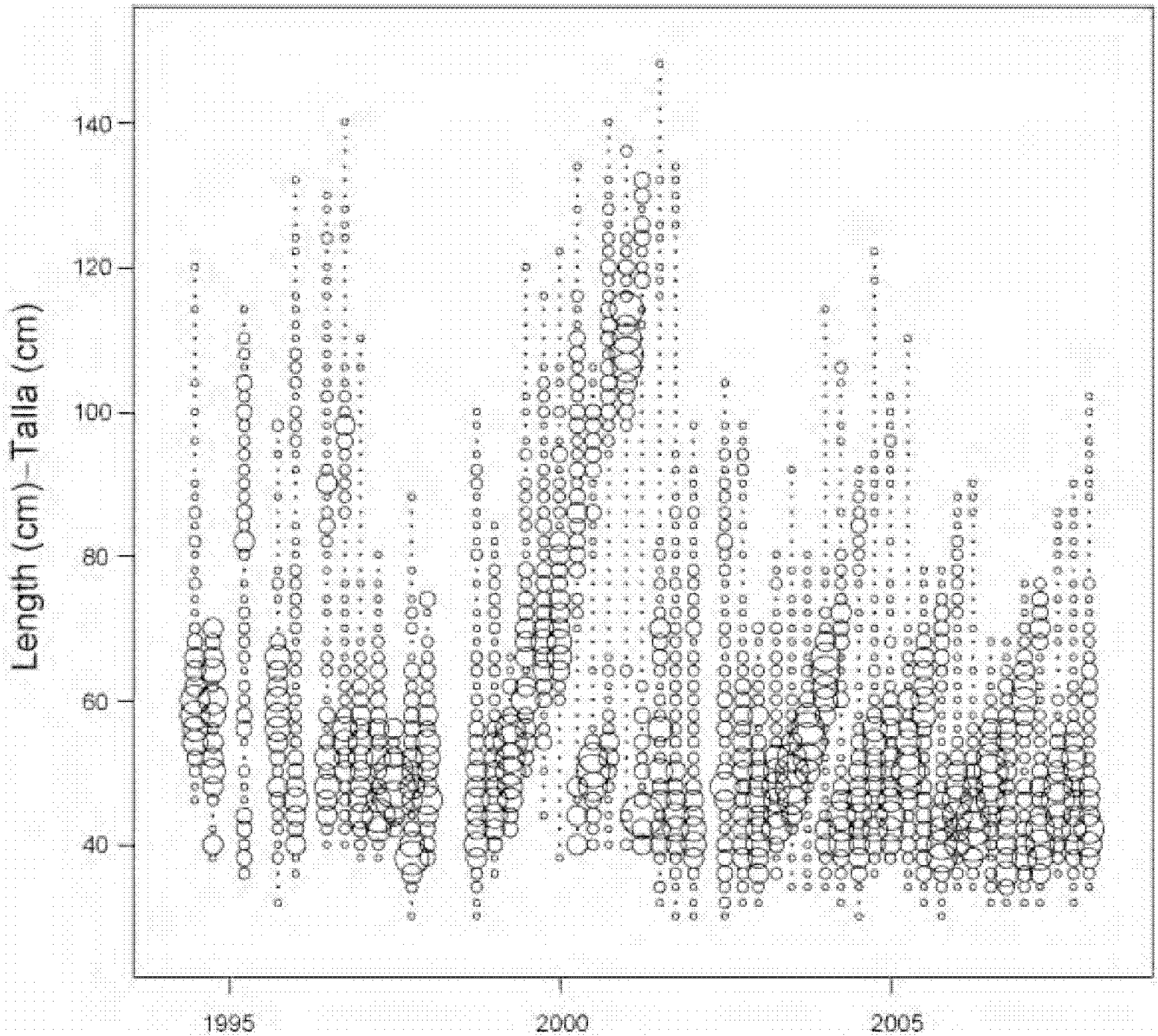

FIGURE 2.6e. Size compositions of the catches of bigeye tuna taken by Fishery 5, by quarter. The sizes of the circles are proportional to the catches.

FIGURA 2.6e. Composición por talla de las capturas de patudo de la Pesquería 5, por trimestre. El tamaño de los círculos es proporcional a la captura.

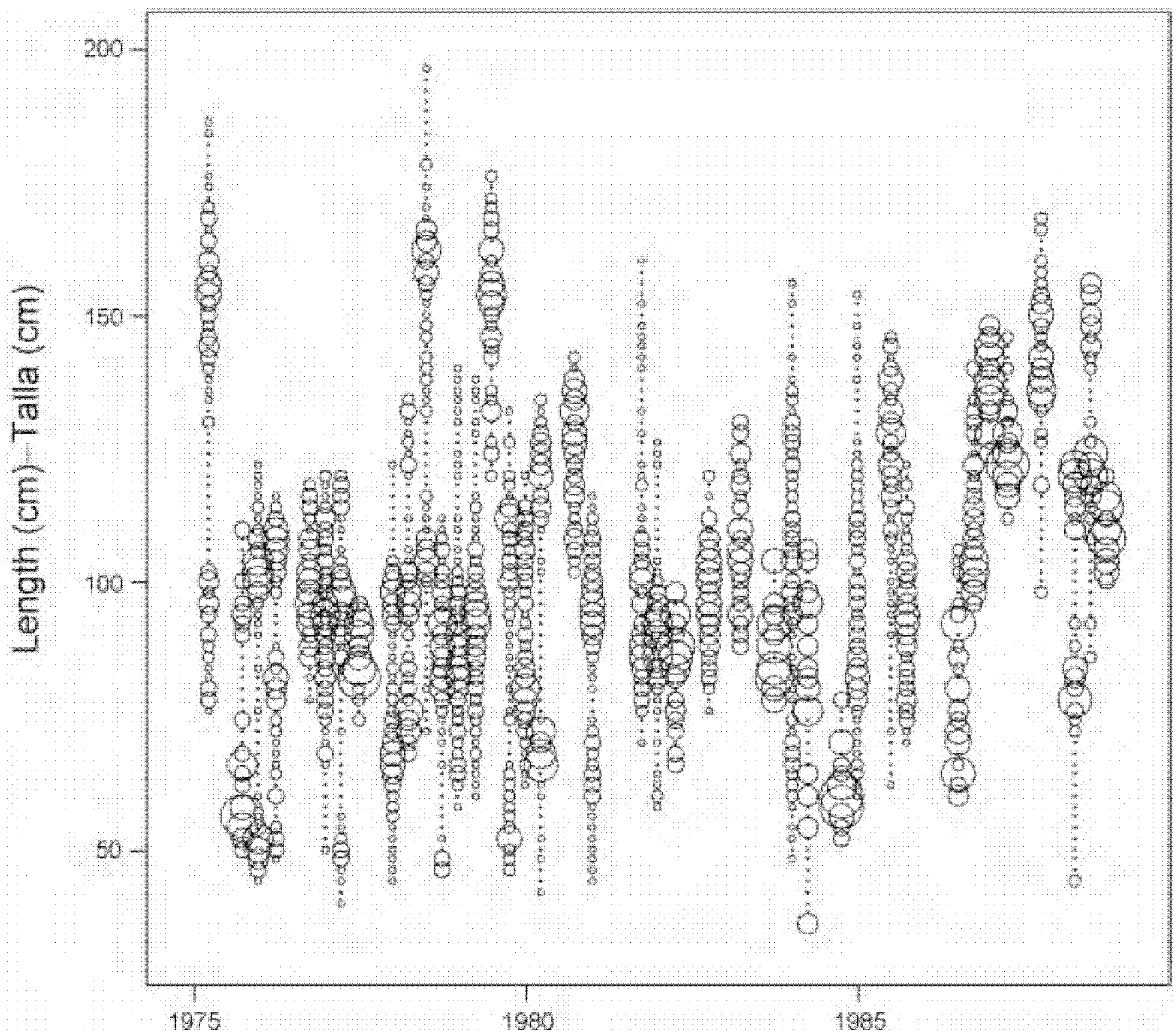

FIGURE 2.6f. Size compositions of the catches of bigeye tuna taken by Fishery 6, by quarter. The sizes of the circles are proportional to the catches.
FIGURA 2.6f. Composición por talla de las capturas de patudo de la Pesquería 6, por trimestre. El tamaño de los círculos es proporcional a la captura.

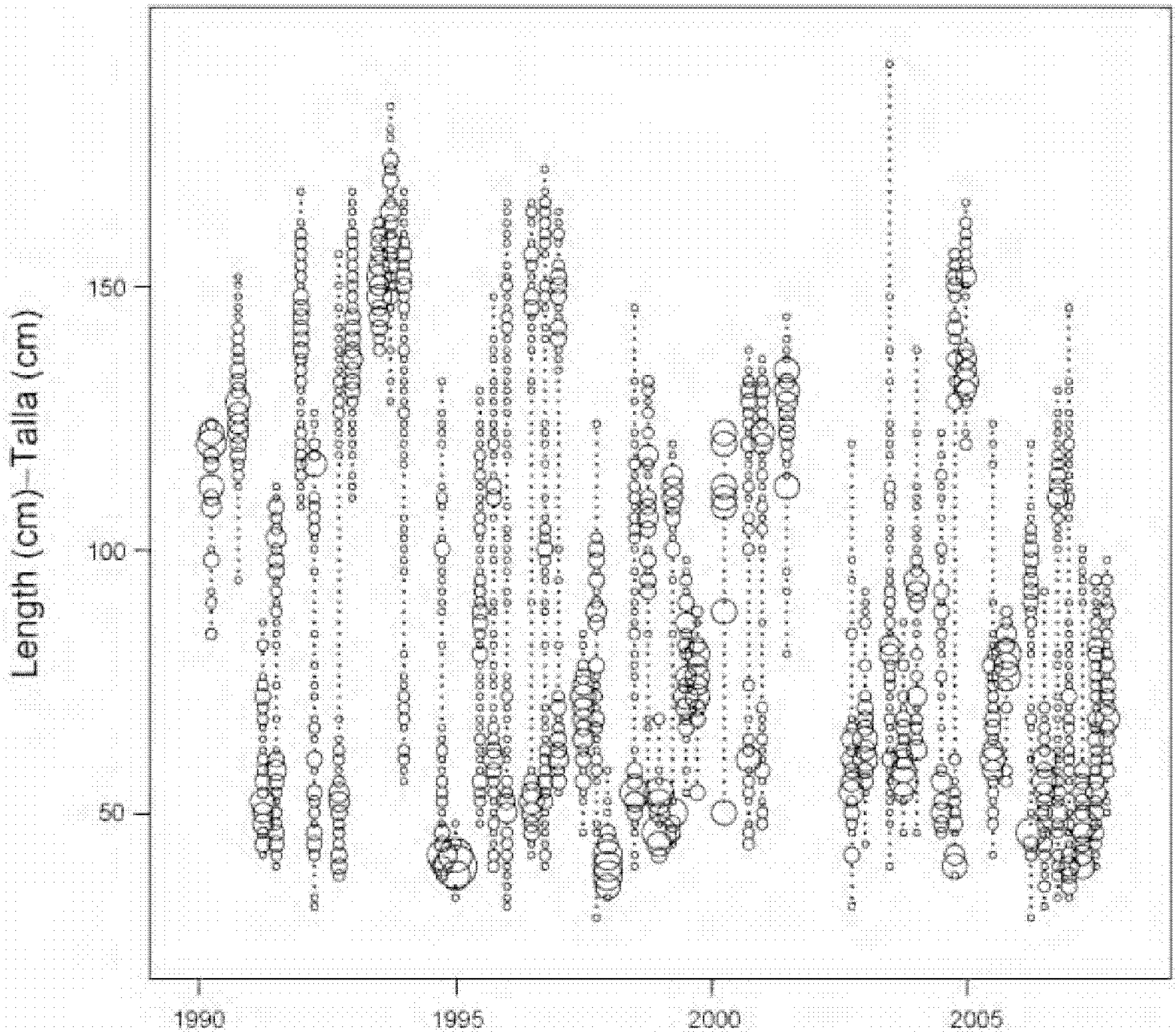

FIGURE 2.6g. Size compositions of the catches of bigeye tuna taken by Fishery 7, by quarter. The sizes of the circles are proportional to the catches.

FIGURA 2.6g. Composición por talla de las capturas de patudo de la Pesquería 7, por trimestre. El tamaño de los círculos es proporcional a la captura.

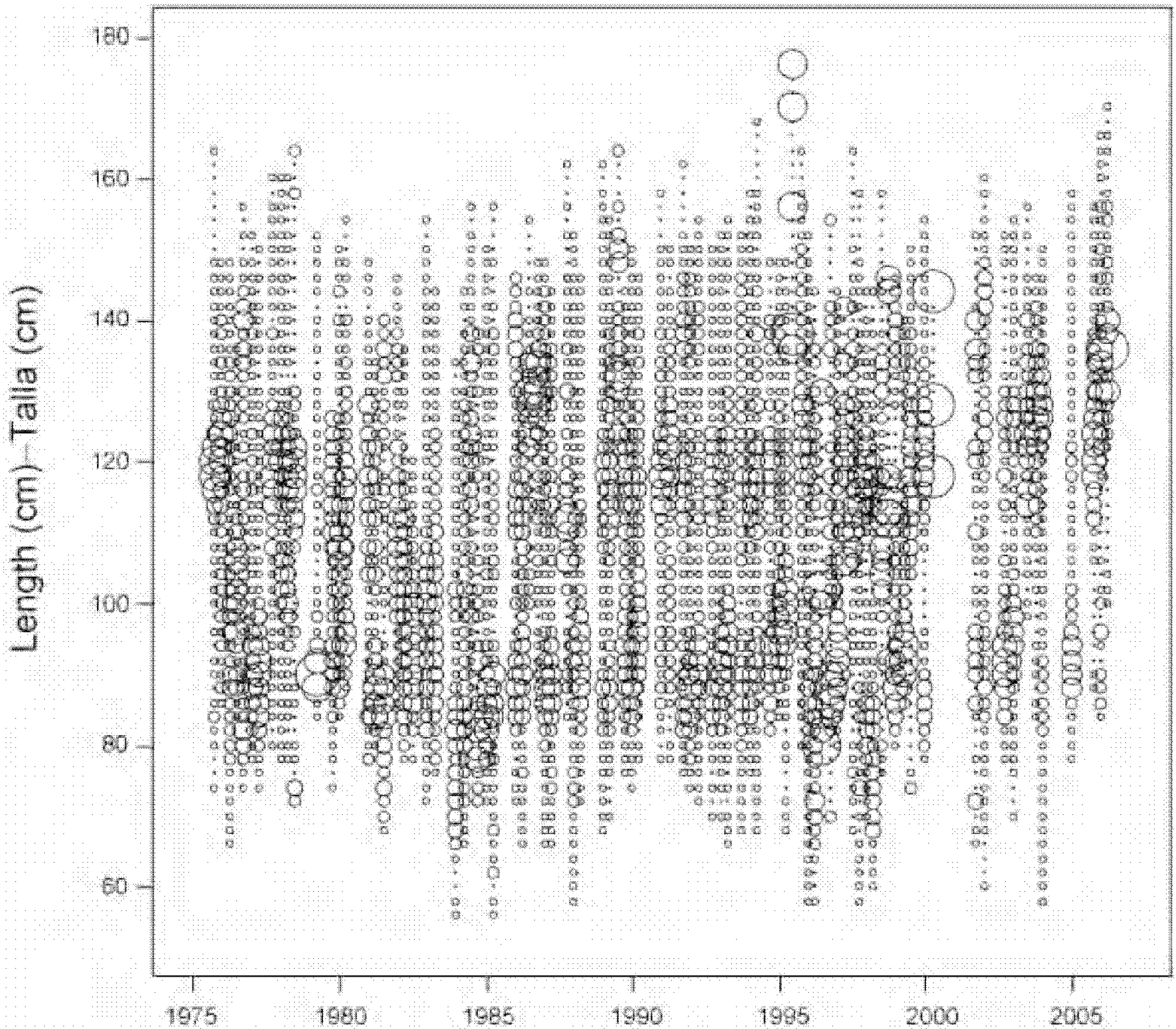

FIGURE 2.6h. Size compositions of the catches of bigeye tuna taken by Fishery 8, by quarter. The sizes of the circles are proportional to the catches.

FIGURA 2.6h. Composición por talla de las capturas de patudo de la Pesquería 8, por trimestre. El tamaño de los círculos es proporcional a la captura.

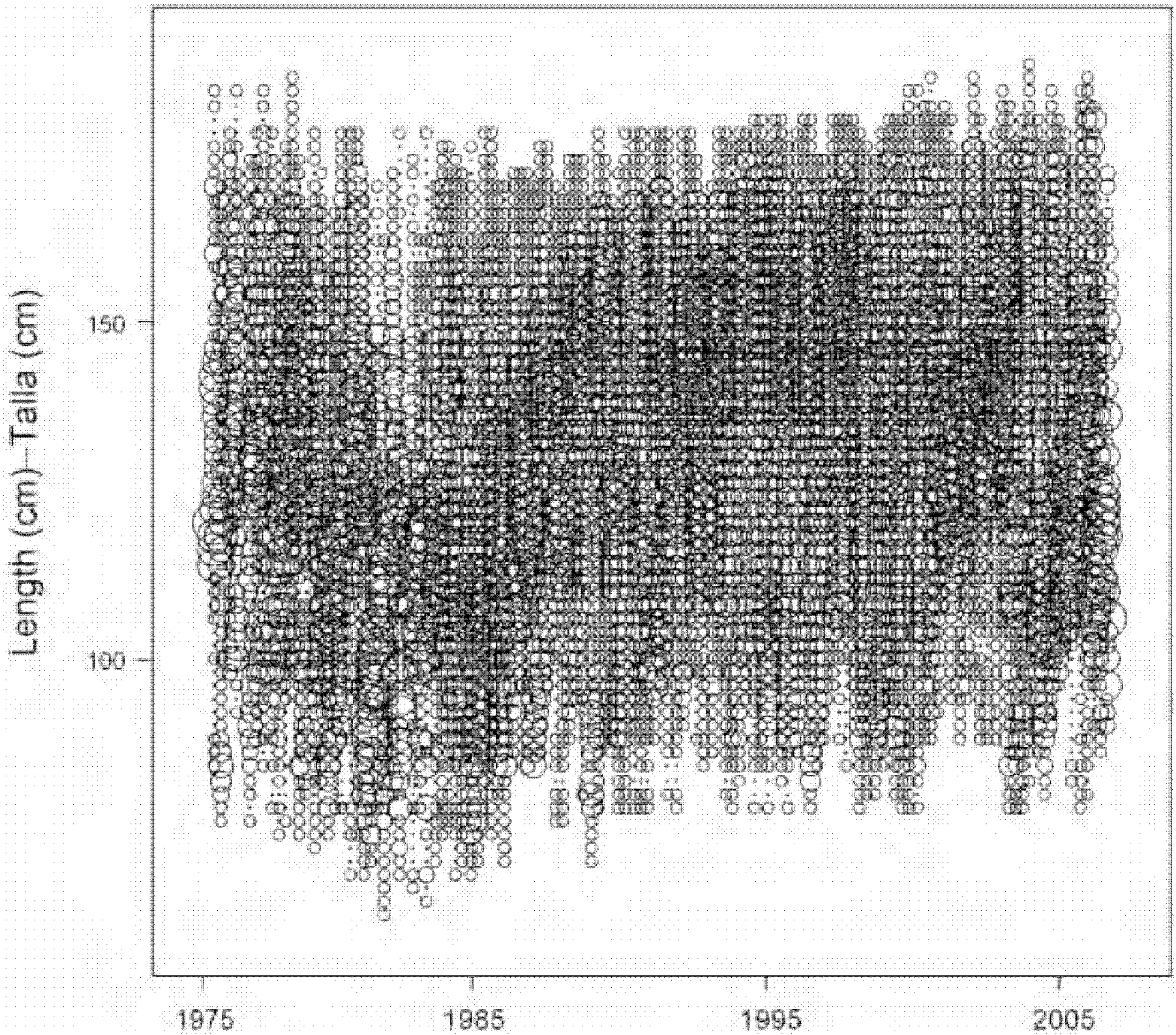

FIGURE 2.6i. Size compositions of the catches of bigeye tuna taken by Fishery 9, by quarter. The sizes of the circles are proportional to the catches.

FIGURA 2.6i. Composición por talla de las capturas de patudo de la Pesquería 9, por trimestre. El tamaño de los círculos es proporcional a la captura.

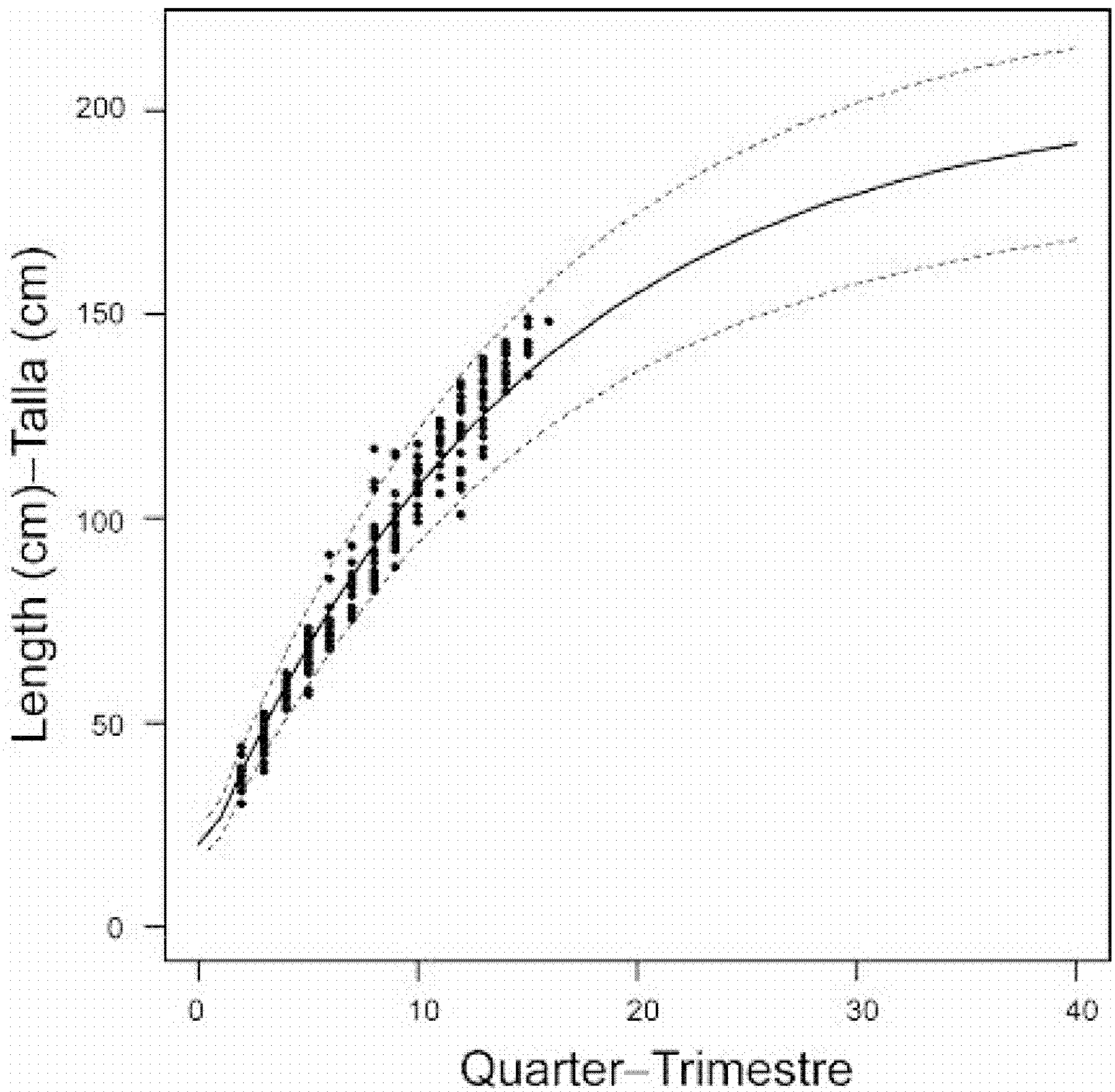

FIGURE 3.1. Estimated average lengths at age for bigeye tuna in the EPO. The dots represent the otolith age-length data from Schaefer and Fuller (2006). The dashed lines indicate the confidence intervals (±2 standard deviations) of the mean lengths at age.

FIGURA 3.1. Talla a edad media estimada del atún patudo en el OPO. Los puntos representan los datos de otolitos de talla a edad de Schaefer y Fuller (2006). Las líneas de trazos indican los intervalos de confianza (±2 desviaciones estándar) de la talla media a edad.

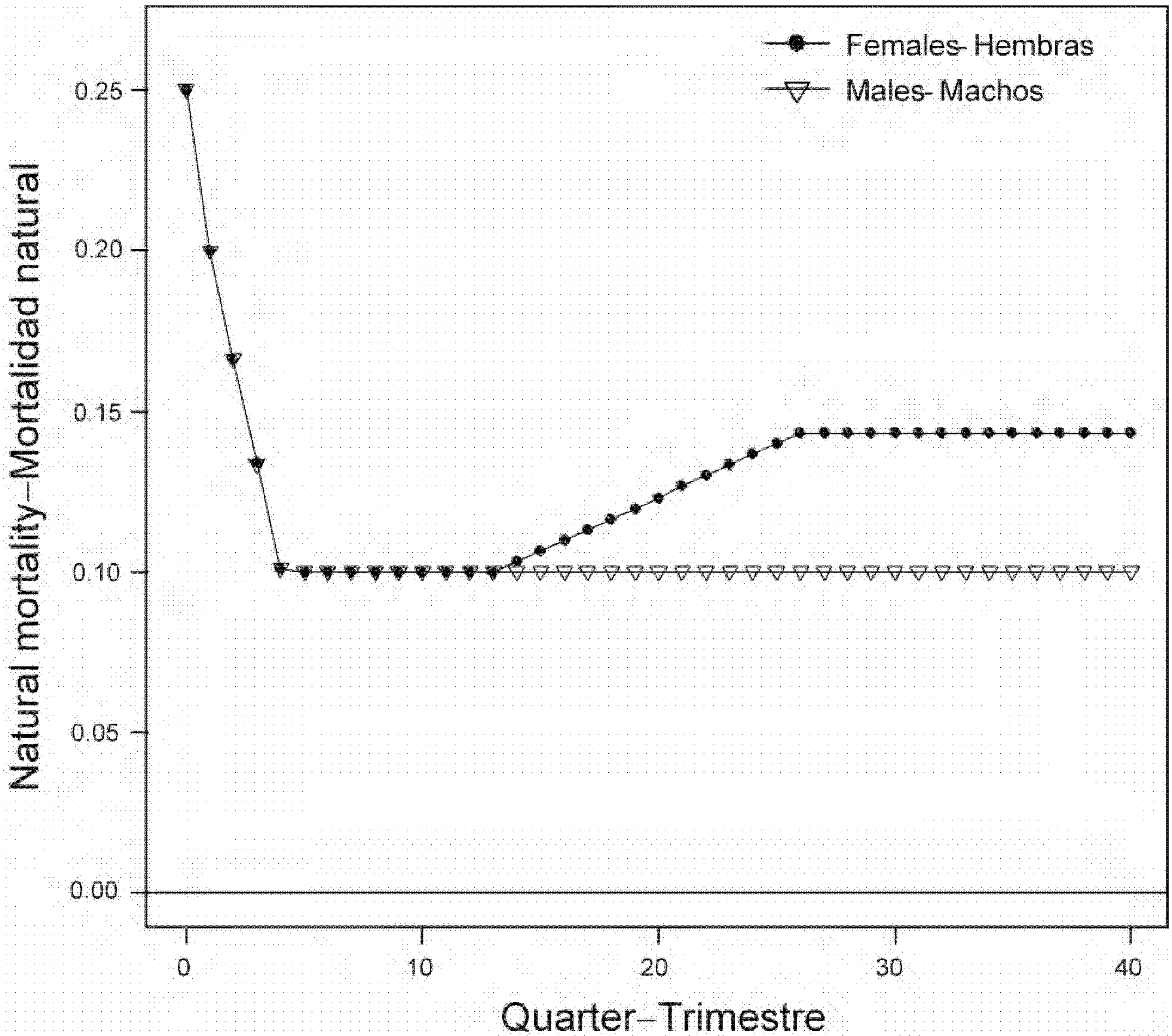

FIGURE 3.2. Quarterly natural mortality (*M*) rates used for the base case assessment of bigeye tuna in the EPO.
FIGURA 3.2. Tasas trimestrales de mortalidad natural (*M*) usadas en la evaluación del caso base del atún patudo en el OPO.

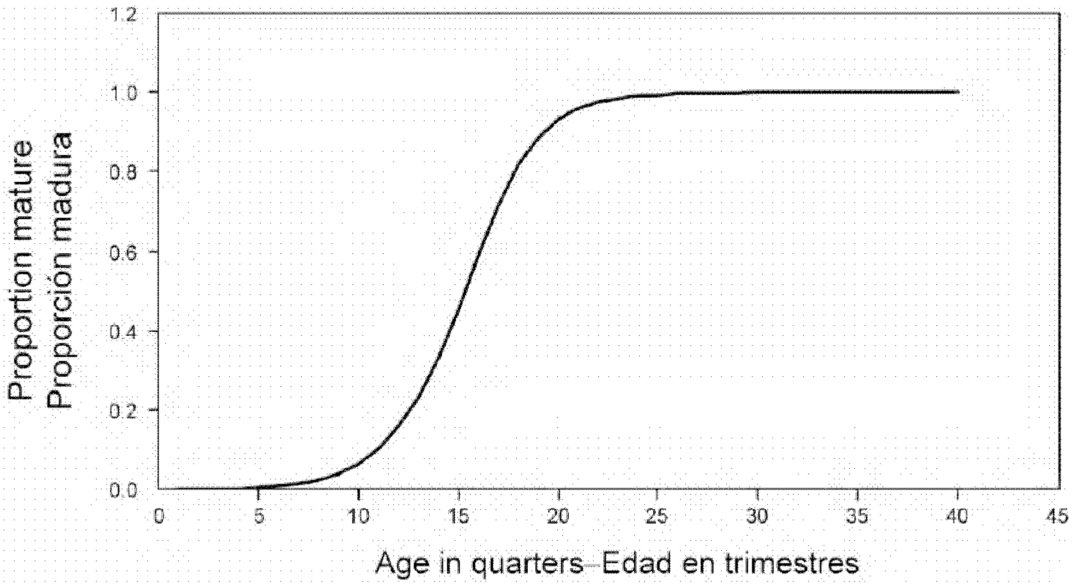

FIGURE 3.3. Age-specific index of fecundity of bigeye tuna as assumed in the base case model and in the estimation of natural mortality.
FIGURA 3.3. Índice de fecundidad por edad de atún patudo supuesto en el modelo del caso base y en la estimación de la mortalidad natural.

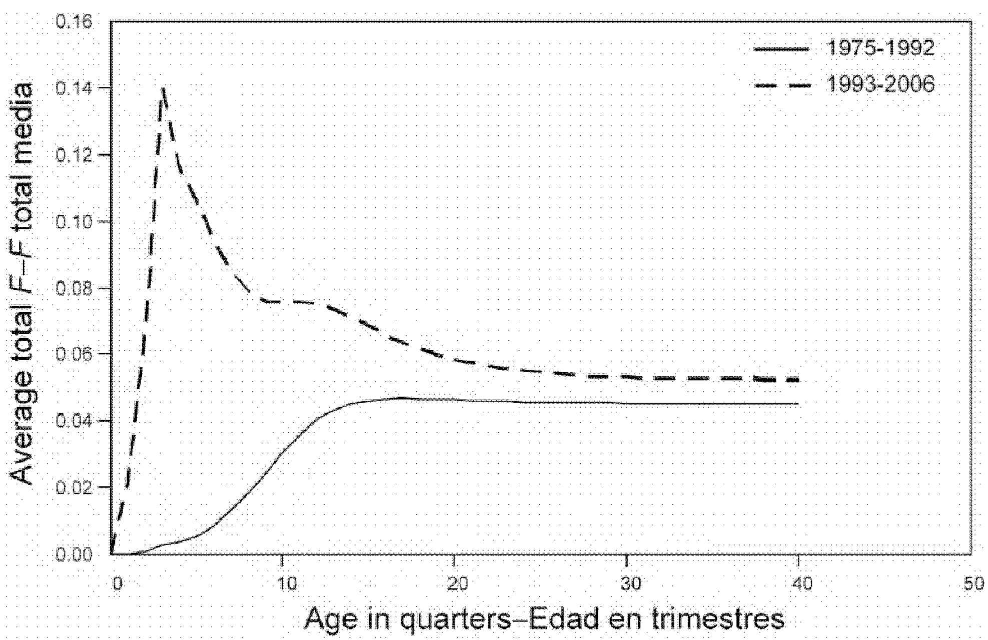

FIGURE 4.1. Average quarterly fishing mortality (approximated by exploitation rate) at age of bigeye tuna, by all gears, in the EPO. The curves for 1975-1992 and 1993-2007 display the averages for the periods prior to and since the expansion of the floating-object fisheries, respectively.
FIGURA 4.1. Mortalidad por pesca trimestral media (aproximada por la tasa de explotación) por edad de atún patudo en el OPO, por todas las artes. Las curvas de 1975-1992 y 1993-2007 muestran los promedios de los períodos antes y después de la expansión de las pesquerías sobre objetos flotantes, respectivamente.

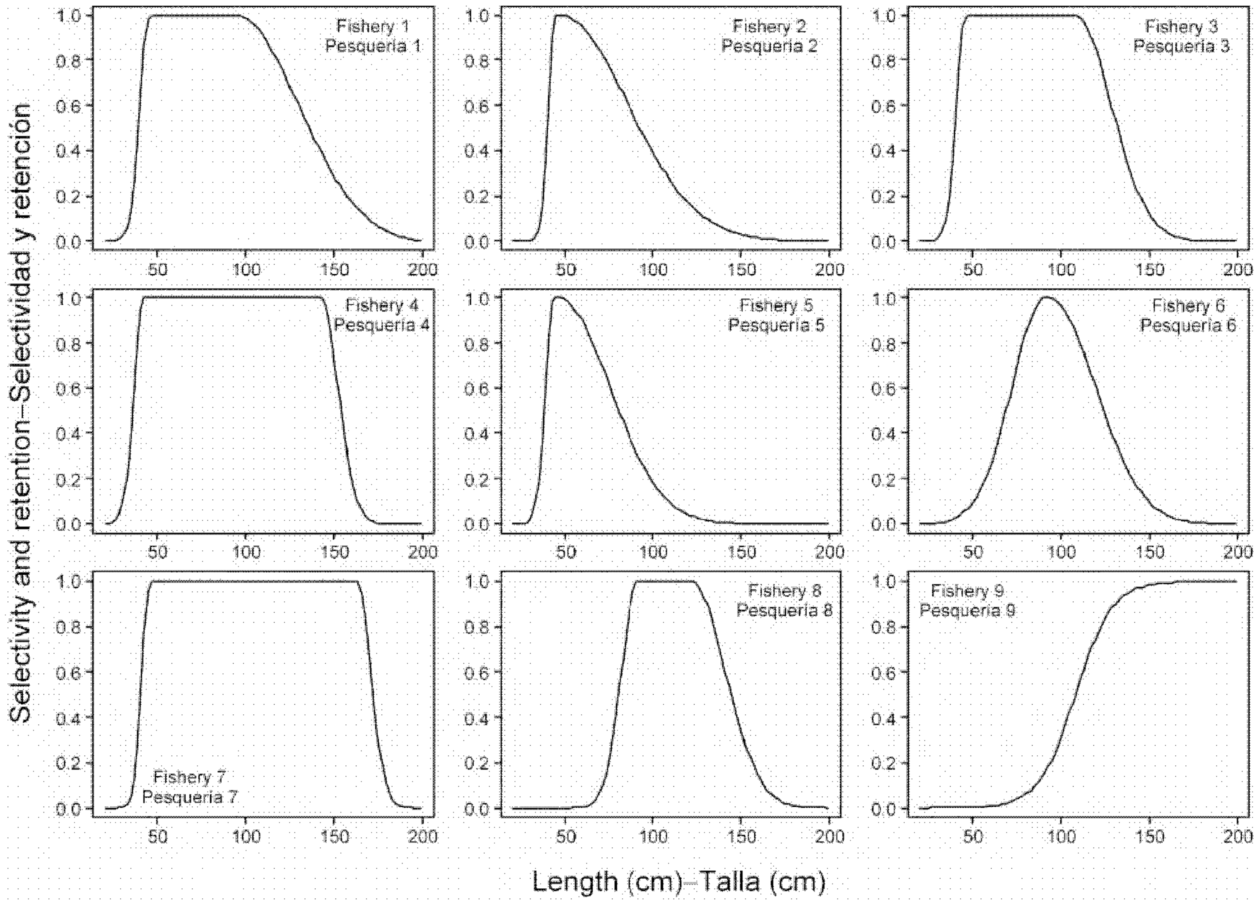

FIGURE 4.2. Size selectivity curves for Fisheries 1-9, estimated with SS2. Fish are assumed to be fully selected for the discard Fisheries 10-13. The selectivity curves for Fisheries 14 and 15 are the same as Fisheries 8 and 9, respectively.

FIGURA 4.2. Curvas de selectividad por talla correspondientes a las Pesquerías 1 a 9, estimadas con SS2. En el caso de las pesquerías de descarte (10-13), se supone que el pescado es plenamente seleccionado. Las curvas de selectividad de las Pesquerías 14 y 15 son iguales que las de las Pesquerías 8 y 9, respectivamente.

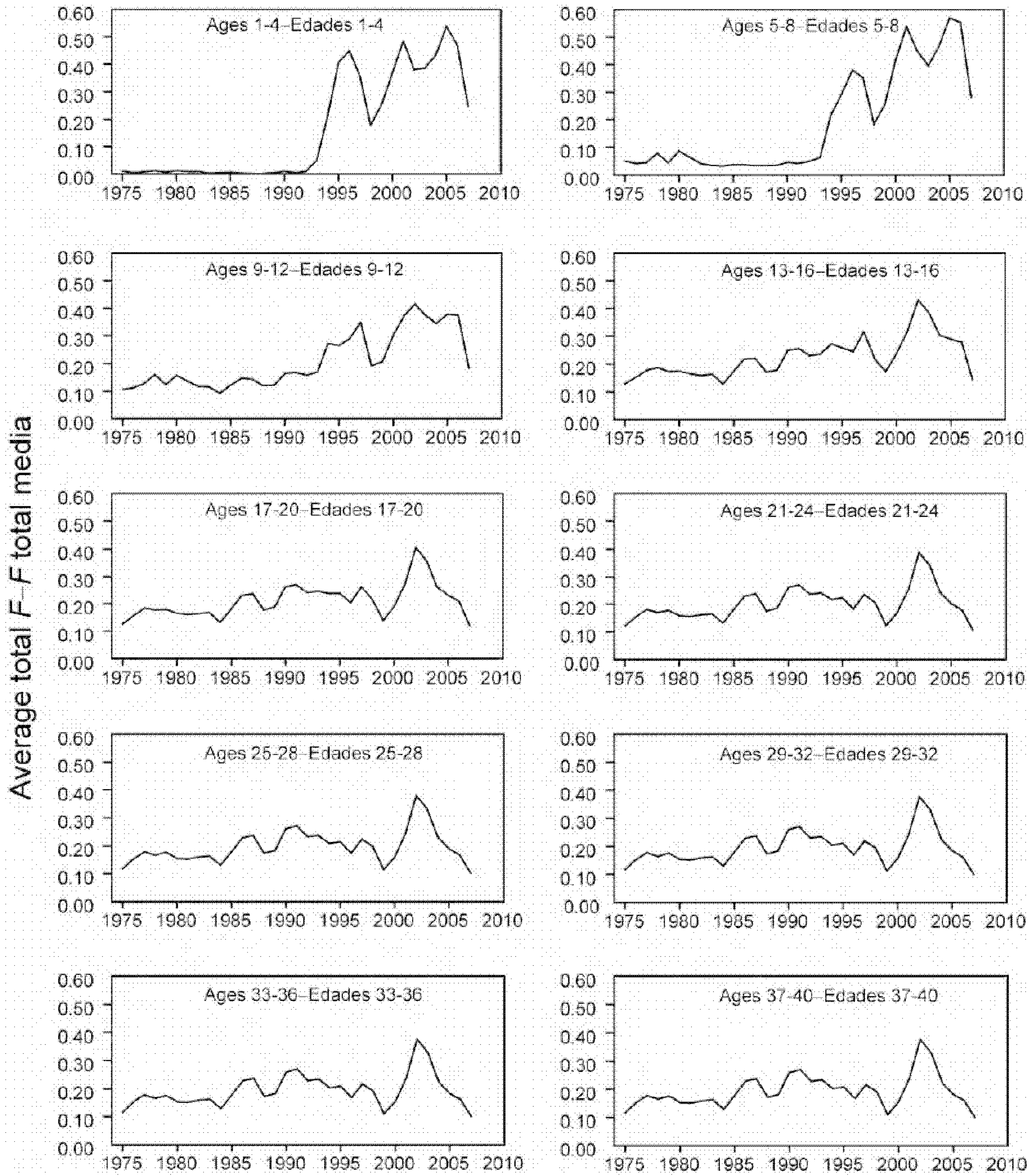

FIGURE 4.3. Average annual fishing mortality, by all gears, of bigeye tuna recruited to the fisheries of the EPO. Each panel illustrates an average of four annual fishing mortality vectors that affected the fish within the range of ages indicated in the title of each panel. For example, the trend illustrated in the upper-left panel is an average of the fishing mortalities that affected the fish that were 1-4 quarters old.

FIGURA 4.3. Mortalidad por pesca anual media, por todos los 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 los peces de entre 1-4 trimestres de edad.

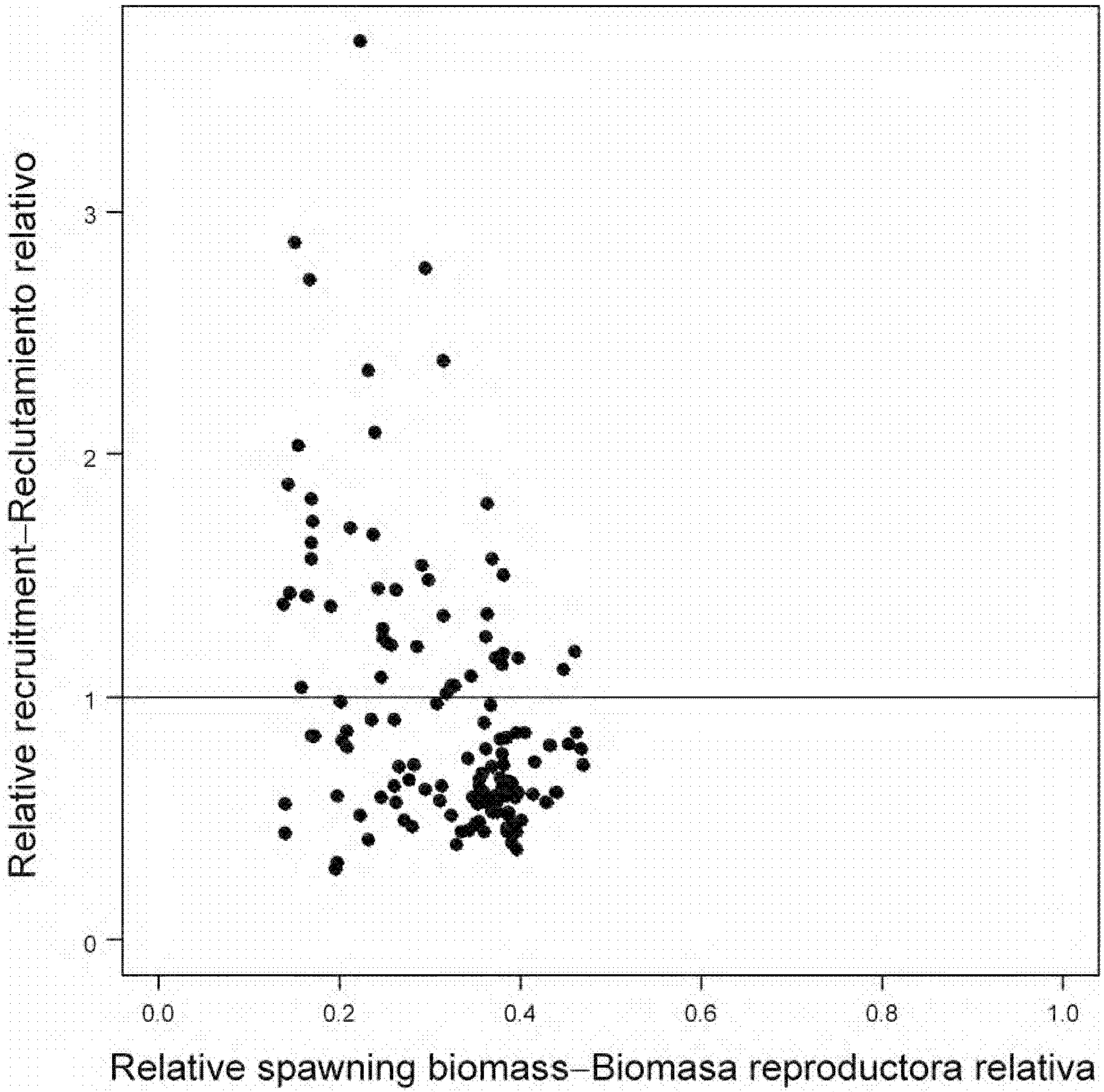

FIGURE 4.4. Estimated relationship between the recruitment of bigeye tuna and spawning biomass. The recruitment is scaled so that the estimate of virgin recruitment is equal to 1.0. Likewise, the spawning biomass is scaled so that the estimate of virgin spawning biomass is equal to 1.0. The horizontal line represents the assumed stock-recruitment relationship.

FIGURA 4.4. Relación estimada entre el reclutamiento y la biomasa reproductora de atún patudo. Se escala el reclutamiento para que la estimación de reclutamiento virgen equivalga a 1,0, y la biomasa reproductora para que la estimación de biomasa reproductora virgen equivalga a 1,0. La línea horizontal representa la relación población-reclutamiento supuesta.

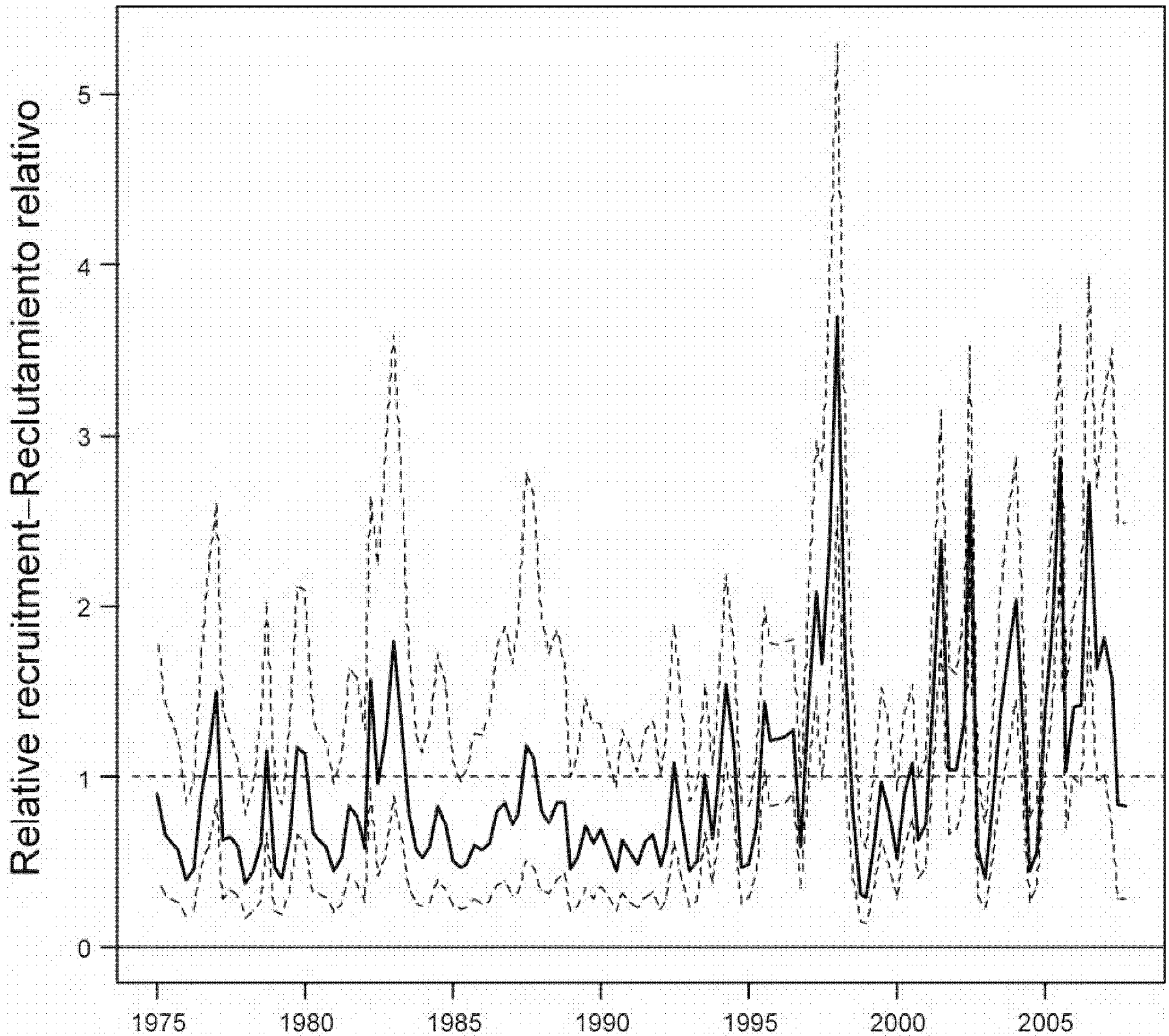

FIGURE 4.5. Estimated recruitment of bigeye tuna to the fisheries of the EPO. The estimates are scaled so that the estimate of virgin recruitment is equal to 1.0. The bold line illustrates the maximum likelihood estimates of recruitment, and the thin dashed lines the confidence intervals (±2 standard deviations) around those estimates. The dashed horizontal line represents the average recruitment for the period. The labels on the time axis are drawn at the beginning of each year, but, since the assessment model represents time on a quarterly basis, there are four estimates of recruitment for each year.

FIGURA 4.5. 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 gruesa ilustra las estimaciones de reclutamiento de verosimilitud máxima, y las líneas delgadas de trazos los intervalos de confianza (±2 desviaciones estándar) alrededor de esas estimaciones. La línea horizontal de trazos representa el reclutamiento promedio del período. Se dibujan las leyendas en el eje de tiempo al principio de cada año, pero, ya que el modelo de evaluación representa el tiempo por trimestres, hay cuatro estimaciones de reclutamiento para cada año.

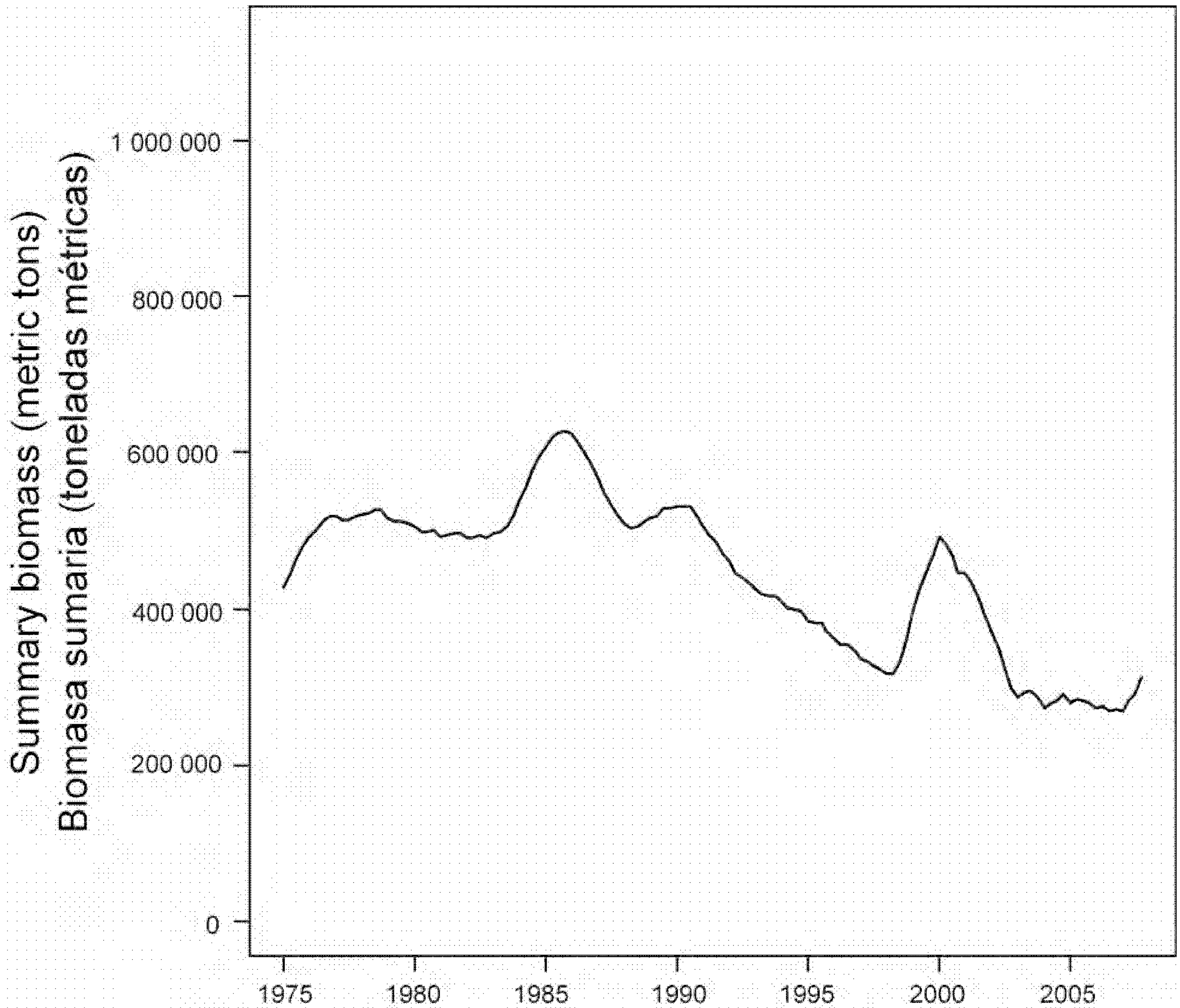

FIGURE 4.6. Maximum likelihood estimates of the biomass of bigeye tuna 3+ quarters old in the EPO (summary biomass). Since the assessment model represents time on a quarterly basis, there are four estimates of biomass for each year.

FIGURA 4.6. Estimaciones de verosimilitud máxima de la biomasa de atún patudo de 3+ trimestres de edad en el OPO (biomasa sumaria). Ya que el modelo de evaluación representa el tiempo por trimestre, hay cuatro estimaciones de biomasa para cada año.

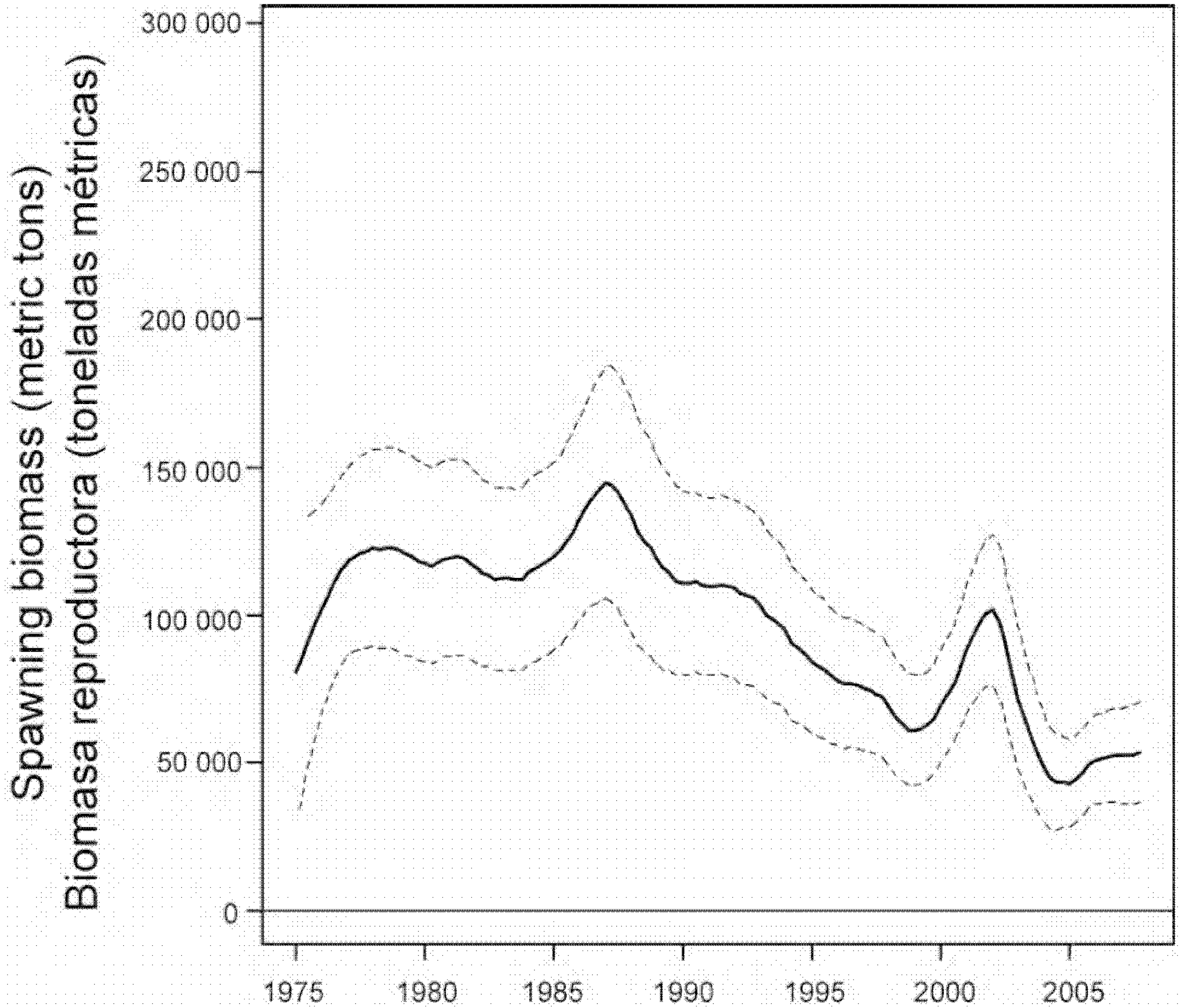

FIGURE 4.7. Maximum likelihood estimates of the spawning biomass (see Section 4.1.3) of bigeye tuna in the EPO. The bold line illustrates the maximum likelihood estimates of the biomasses, and the thin dashed lines the confidence intervals (±2 standard deviations) around those estimates. Since the assessment model represents time on a quarterly basis, there are four estimates of the index for each year.
FIGURA 4.7. Estimaciones de verosimilitud máxima del índice de biomasa reproductora (ver Sección 4.1.3) de atún patudo en el OPO. La línea gruesa ilustra las estimaciones de verosimilitud máxima de la biomasa, y las líneas delgadas de trazos los intervalos de confianza (±2 desviaciones estándar) alrededor de estas estimaciones. Ya que el modelo de evaluación representa el tiempo por trimestre, hay cuatro estimaciones del índice para cada año.

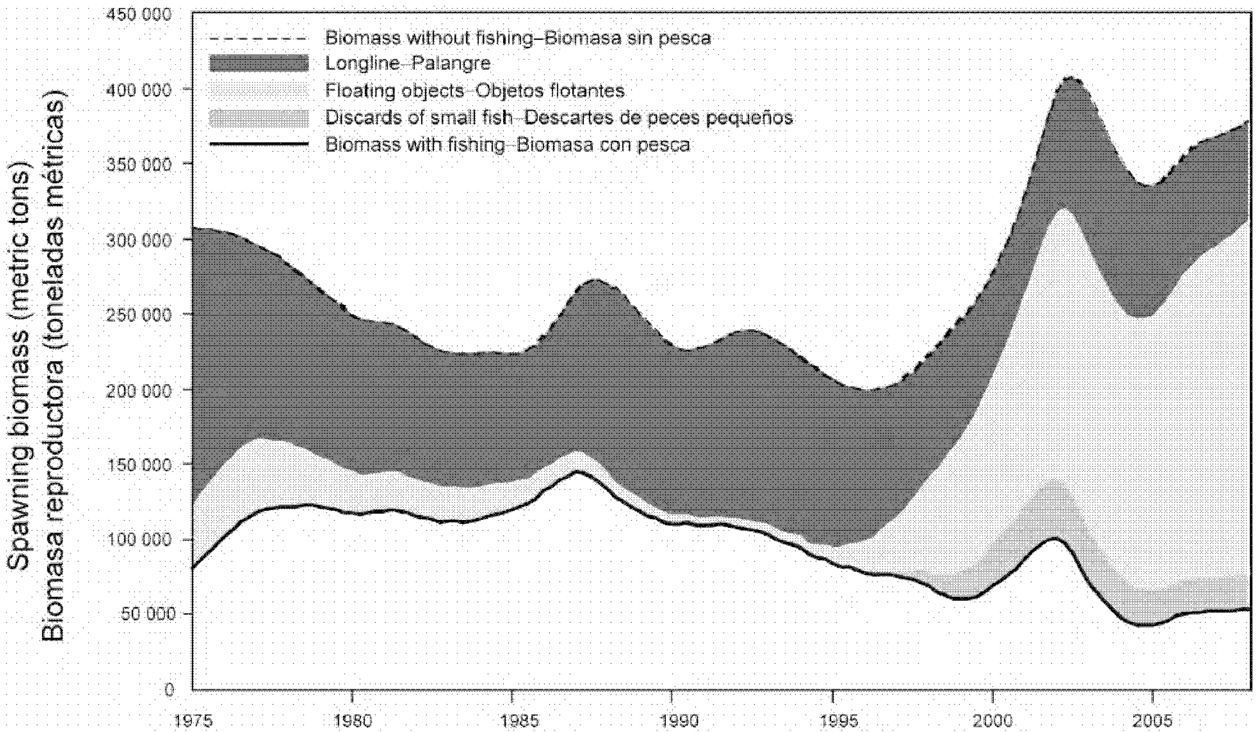

FIGURE 4.8. Trajectory of the spawning biomass of a simulated population of bigeye tuna that was not exploited (top line) and that predicted by the stock assessment model (bottom line). The shaded areas between the two lines show the portions of the impact attributed to each fishing method.

FIGURA 4.8. Trayectoria de la biomasa reproductora de una población simulada de atún patudo no explotada (línea superior) y la que predice el modelo de evaluación (línea inferior). Las áreas sombreadas entre las dos líneas señalan la porción del efecto atribuida a cada método de pesca.

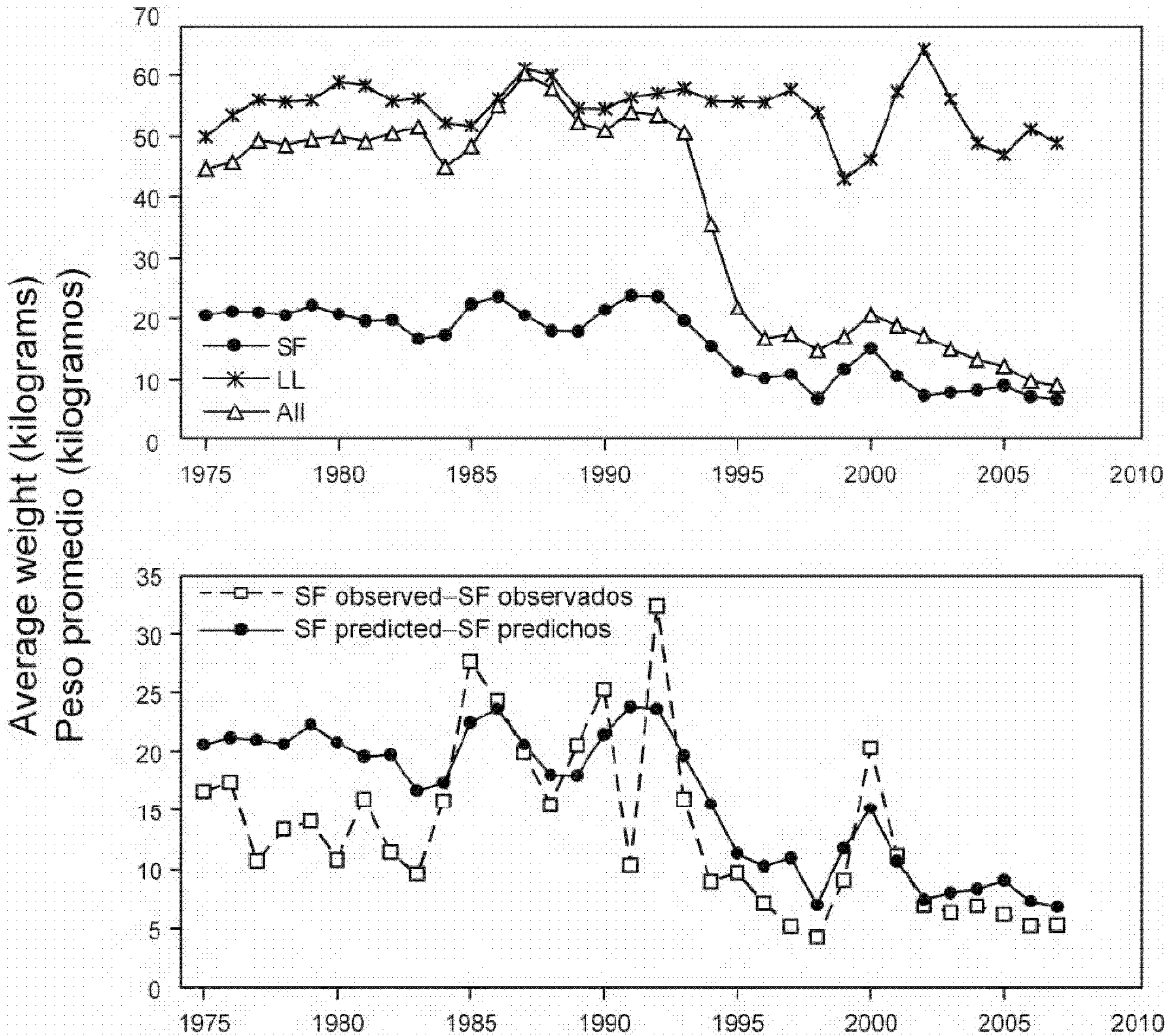

FIGURE 4.9. Average weights of bigeye tuna caught in the EPO, 1975-2007, by the surface fisheries (SF, Fisheries 1-7), longline fisheries (LL, Fisheries 8-9 and 14-15), and all fisheries combined (All). Upper panel: predicted average weights; lower panel: predicted and observed average weights for the surface fisheries.

FIGURA 4.9. Peso medio estimado de atún patudo capturado en el OPO, 1975-2007,por las pesquerías de superficie (SF, Pesquerías 1-7), de palangre (LL, Pesquerías 8, 9 y 14-15), y todas las pesquerías combinadas (All). Recuadro superior: pesos medios predichos; recuadro inferior: pesos medios predichos y observados de las pesquerías de superficie.

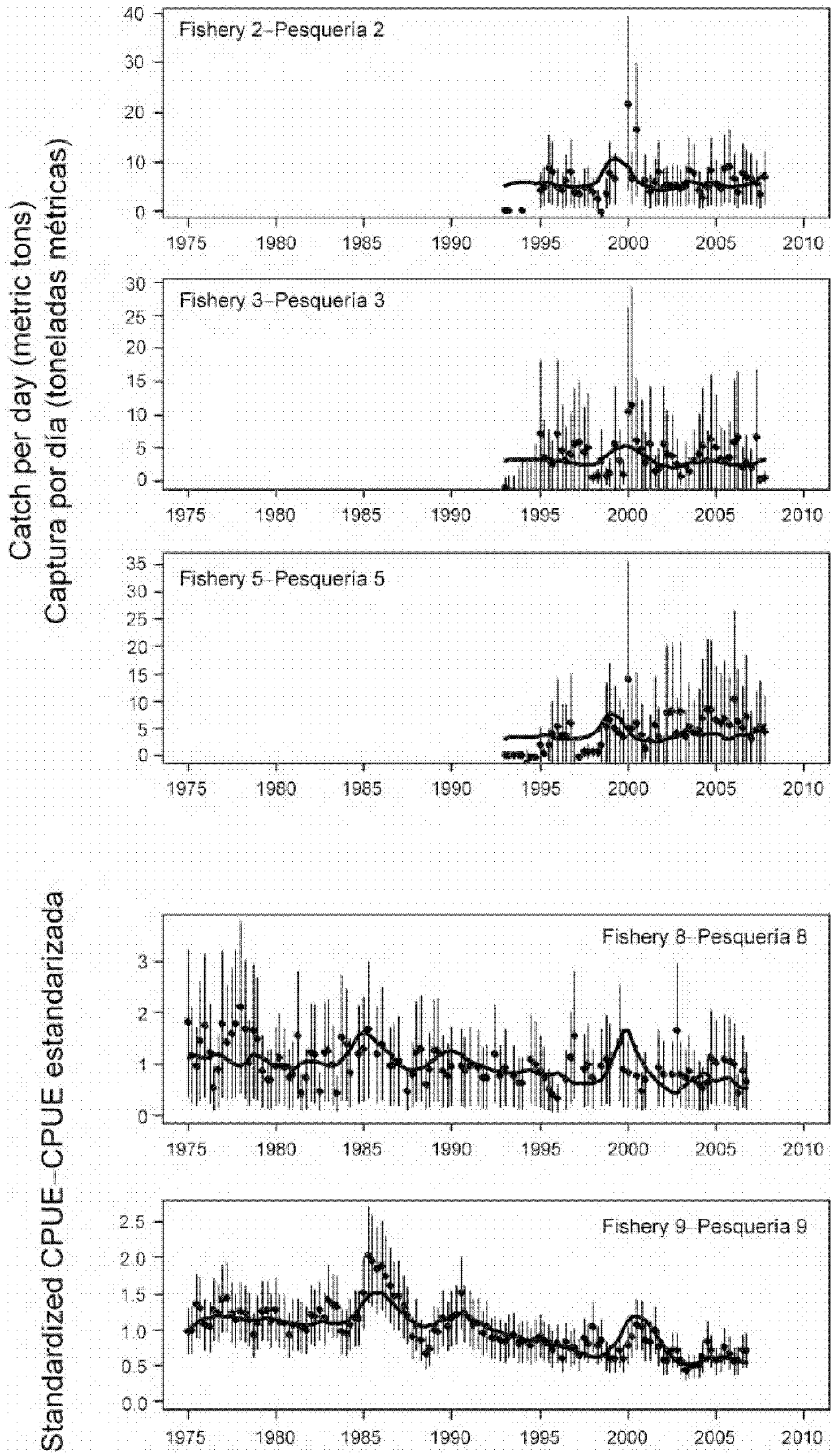

FIGURE 4.10. Model fit to the CPUE data from different fisheries.
FIGURA 4.10. Ajuste del modelo a los datos de CPUE de varias pesquerías.

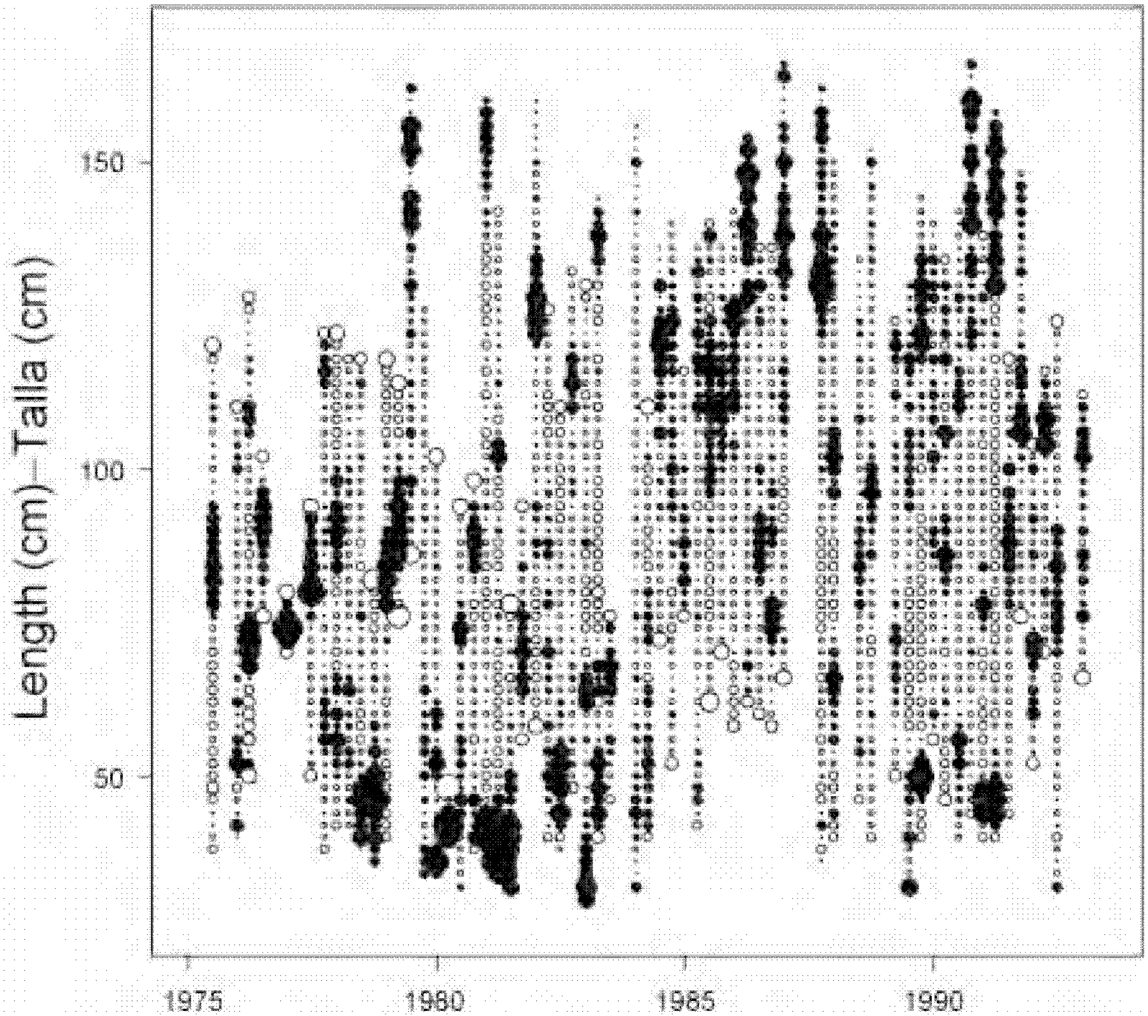

FIGURE 4.11a. Pearson residual plots for the model fits to the length composition data for Fishery 1. The open and solid circles represent observations that are higher and lower, respectively, than the model predictions. The sizes of the circles are proportional to the absolute values of the residuals.

FIGURA 4.11a. Gráficas de residuales de Pearson para los ajustes del modelo a los datos de composición por talla de la Pesquería 1. Los círculos abiertos y sólidos representan observaciones mayores y menores, respectivamente, que las predicciones del modelo. El tamaño de los círculos es proporcional al valor absoluto de los residuales.

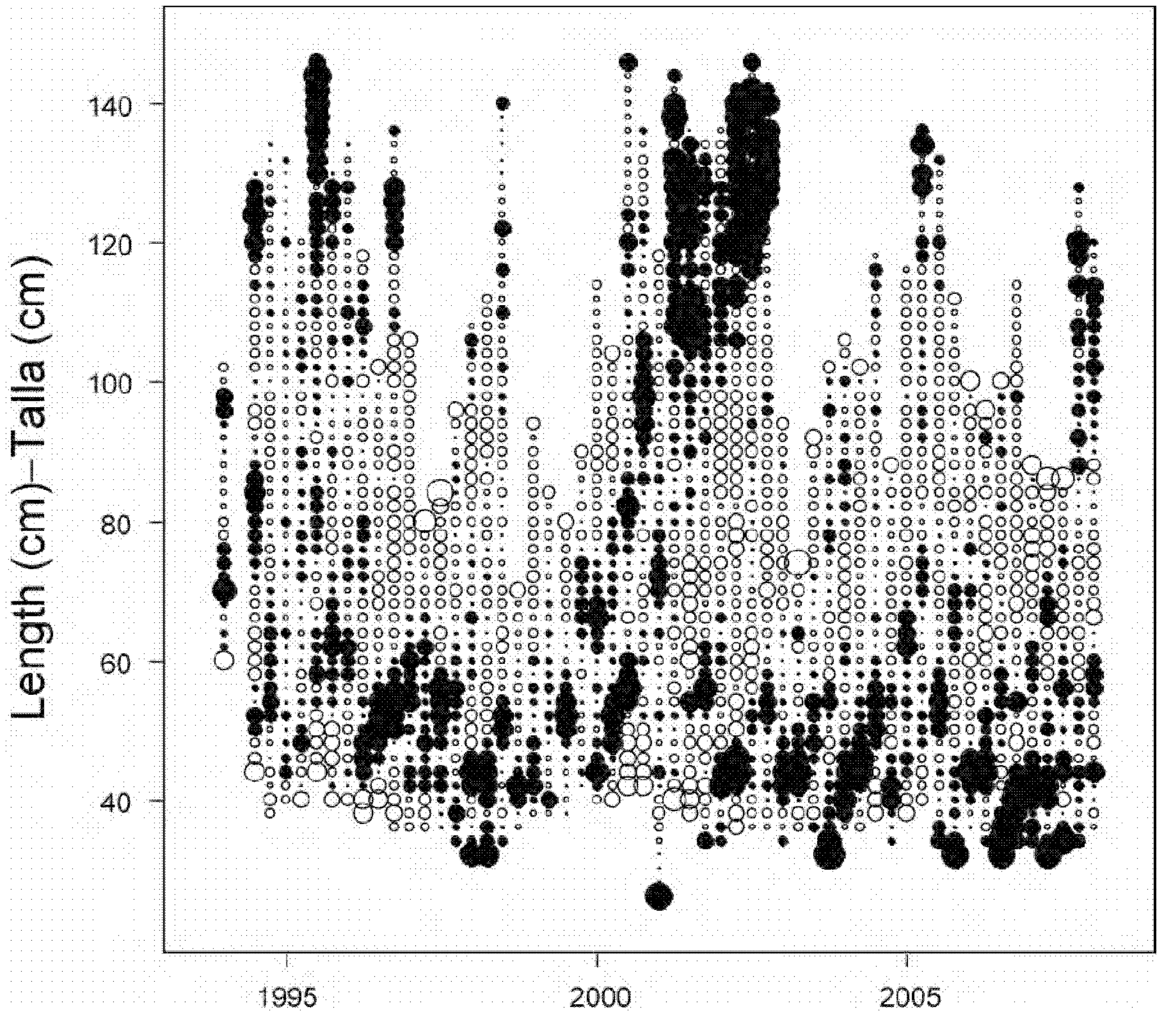

FIGURE 4.11b. Pearson residual plots for the model fits to the length composition data for Fishery 2. The open and solid circles represent observations that are higher and lower, respectively, than the model predictions. The sizes of the circles are proportional to the absolute values of the residuals.

FIGURA 4.11b. Gráficas de residuales de Pearson para los ajustes del modelo a los datos de composición por talla de la Pesquería 2. Los círculos abiertos y sólidos representan observaciones mayores y menores, respectivamente, que las predicciones del modelo. El tamaño de los círculos es proporcional al valor absoluto de los residuales.

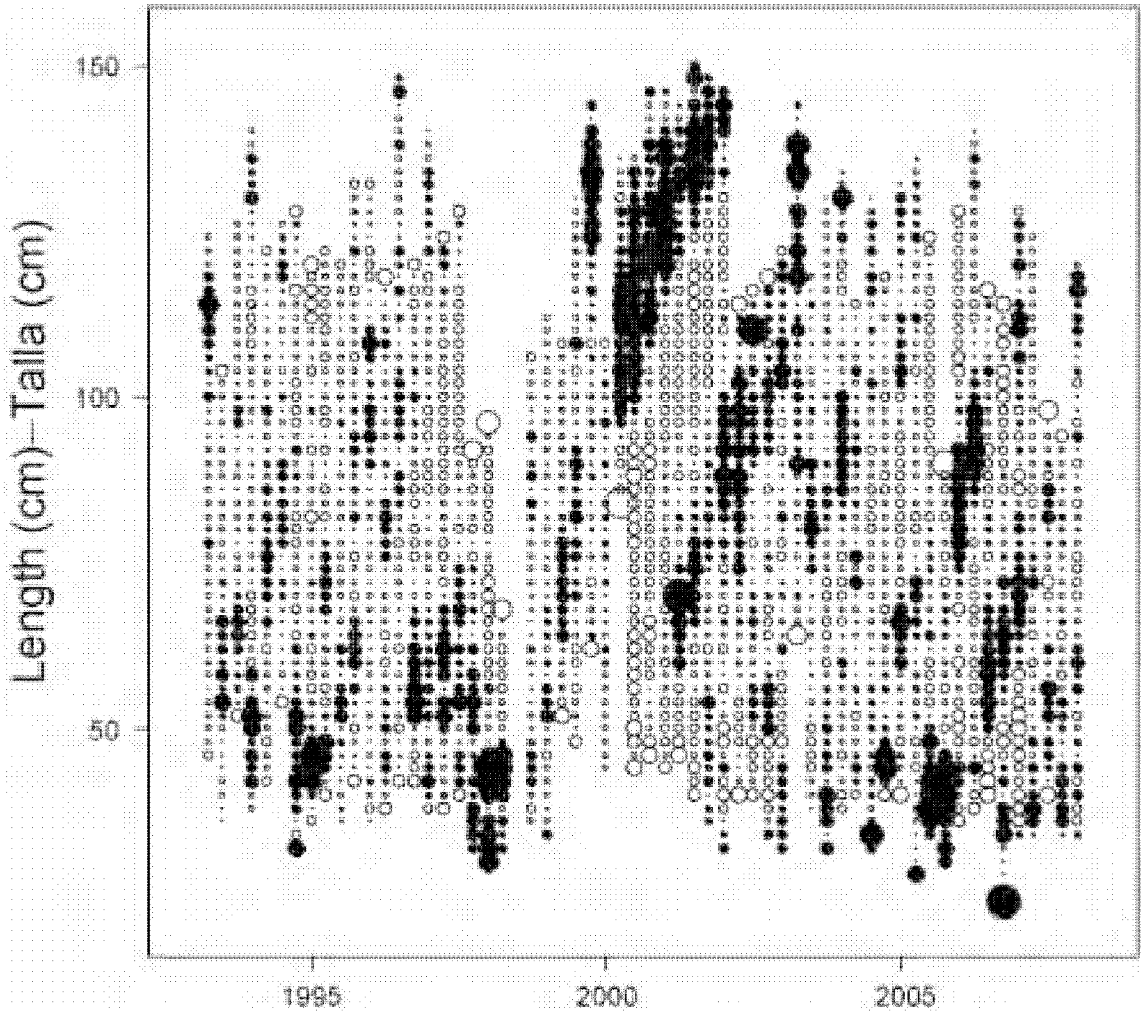

FIGURE 4.11c. Pearson residual plots for the model fits to the length composition data for Fishery 3. The open and solid circles represent observations that are higher and lower, respectively, than the model predictions. The sizes of the circles are proportional to the absolute values of the residuals.

FIGURA 4.11c. Gráficas de residuales de Pearson para los ajustes del modelo a los datos de composición por talla de la Pesquería 3. Los círculos abiertos y sólidos representan observaciones mayores y menores, respectivamente, que las predicciones del modelo. El tamaño de los círculos es proporcional al valor absoluto de los residuales.

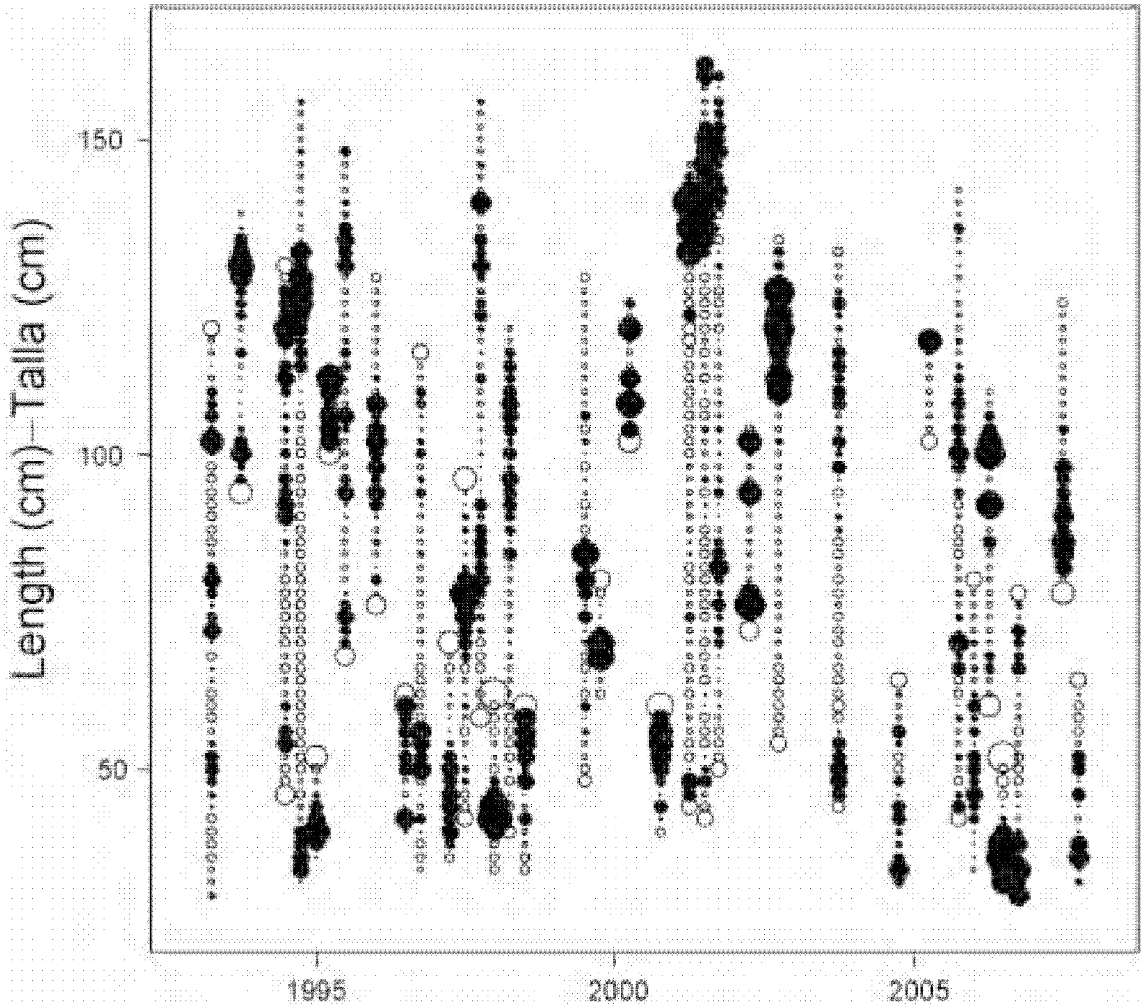

FIGURE 4.11d Pearson residual plots for the model fits to the length composition data for Fishery 4. The open and solid circles represent observations that are higher and lower, respectively, than the model predictions. The sizes of the circles are proportional to the absolute values of the residuals.
FIGURA 4.11d. Gráficas de residuales de Pearson para los ajustes del modelo a los datos de composición por talla de la Pesquería 4. Los círculos abiertos y sólidos representan observaciones mayores y menores, respectivamente, que las predicciones del modelo. El tamaño de los círculos es proporcional al valor absoluto de los residuales.

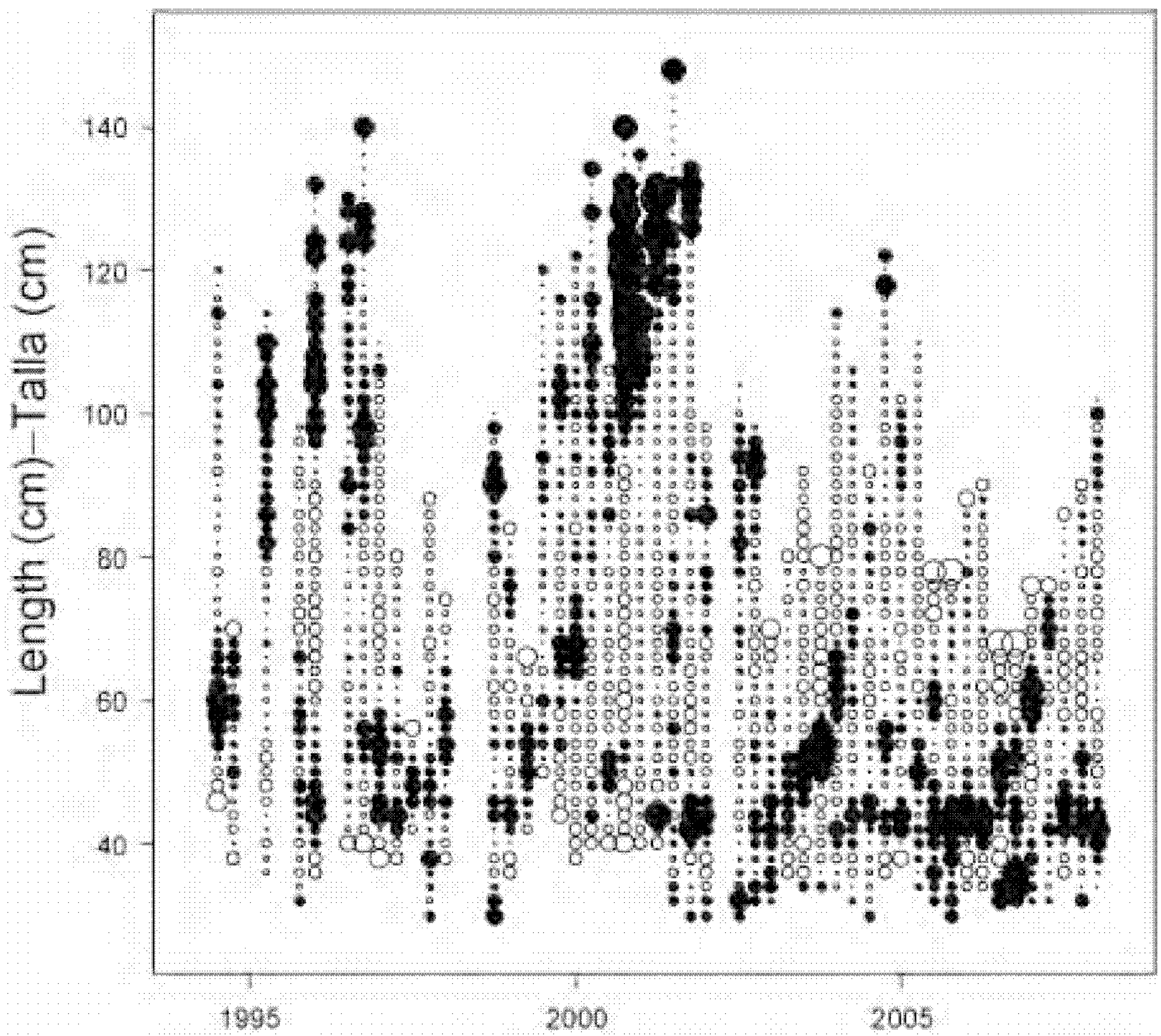

FIGURE 4.11e. Pearson residual plots for the model fits to the length composition data for Fishery 5. The open and solid circles represent observations that are higher and lower, respectively, than the model predictions. The sizes of the circles are proportional to the absolute values of the residuals.

FIGURA 4.11e. Gráficas de residuales de Pearson para los ajustes del modelo a los datos de composición por talla de la Pesquería 5. Los círculos abiertos y sólidos representan observaciones mayores y menores, respectivamente, que las predicciones del modelo. El tamaño de los círculos es proporcional al valor absoluto de los residuales.

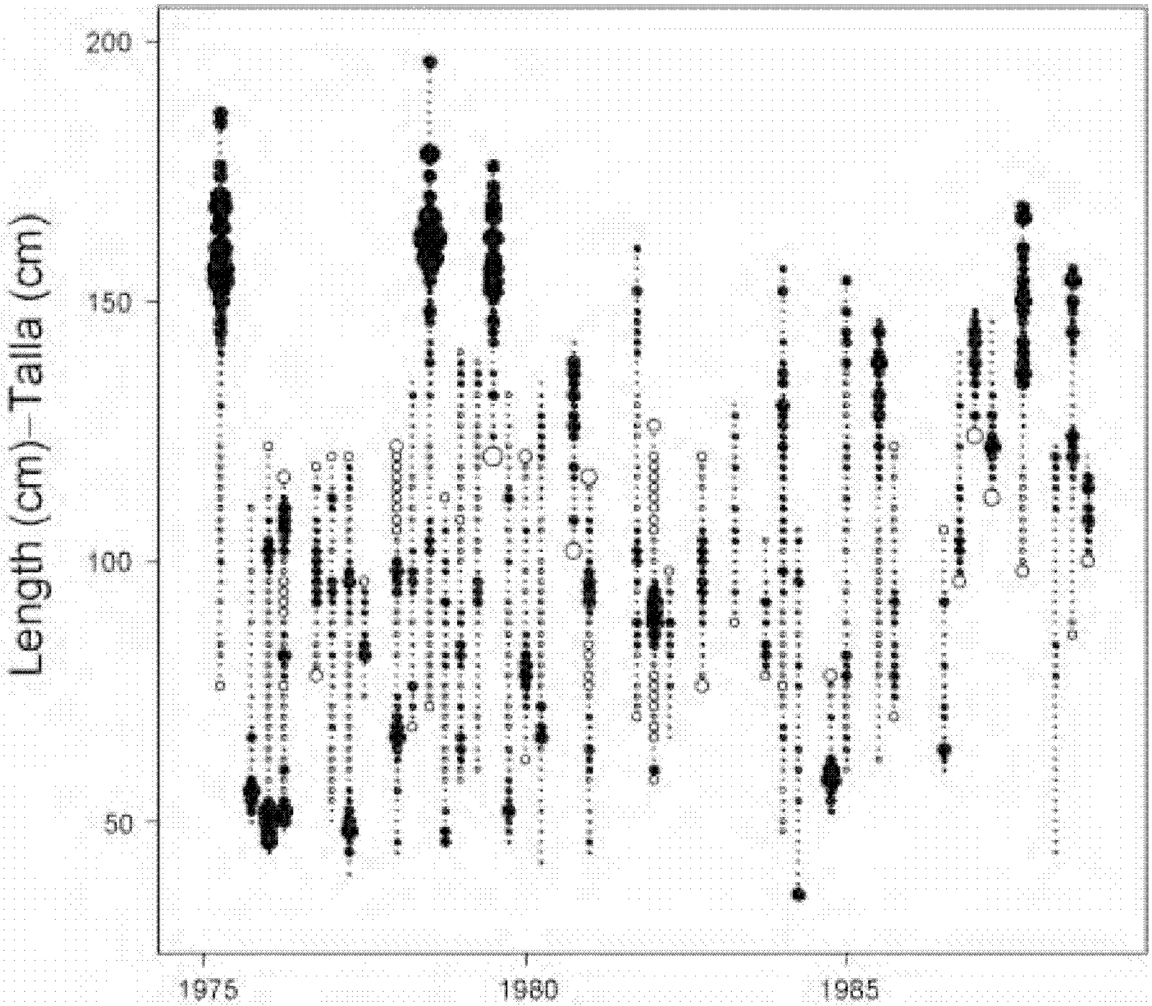

FIGURE 4.11f. Pearson residual plots for the model fits to the length composition data for Fishery 6. The open and solid circles represent observations that are higher and lower, respectively, than the model predictions. The sizes of the circles are proportional to the absolute values of the residuals.

FIGURA 4.11f. Gráficas de residuales de Pearson para los ajustes del modelo a los datos de composición por talla de la Pesquería 6. Los círculos abiertos y sólidos representan observaciones mayores y menores, respectivamente, que las predicciones del modelo. El tamaño de los círculos es proporcional al valor absoluto de los residuales.

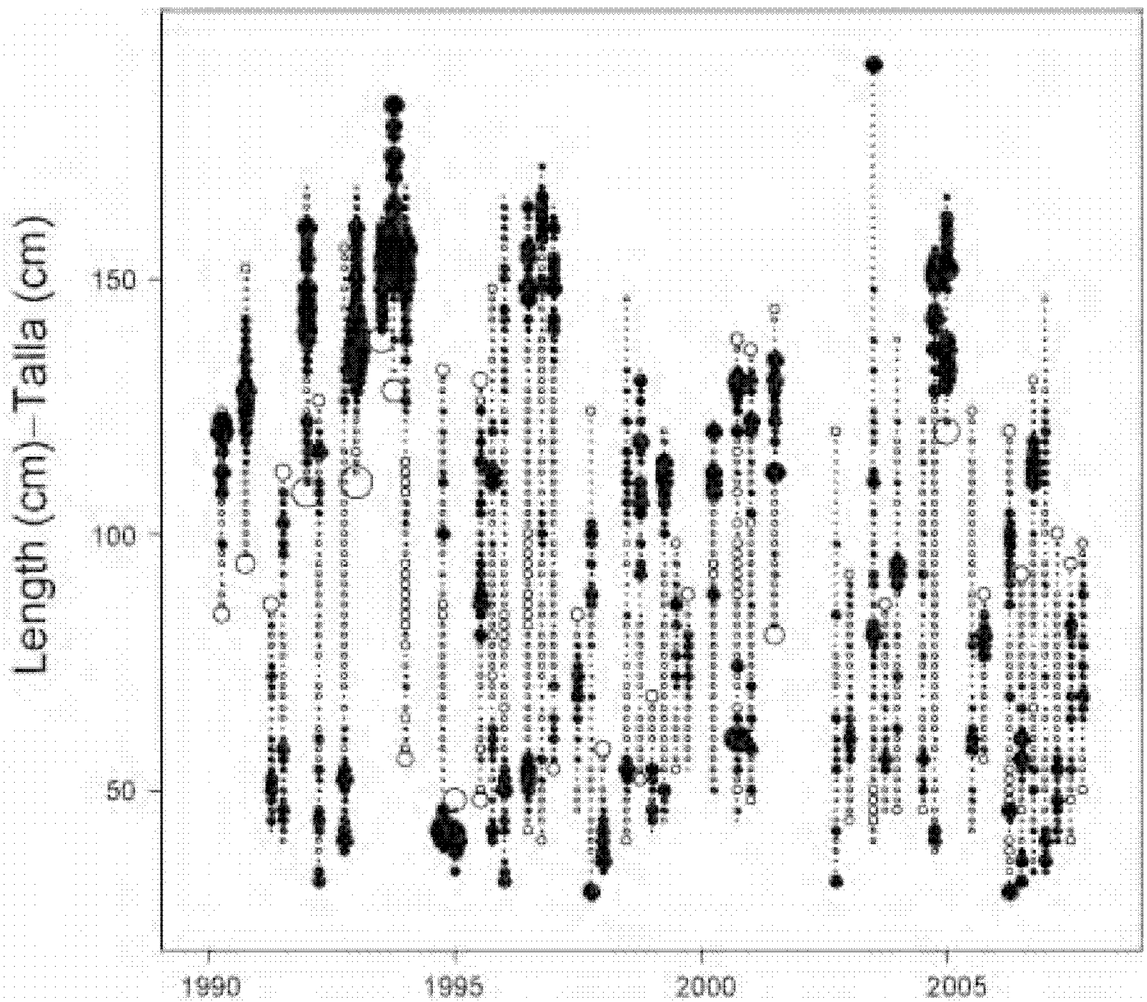

FIGURE 4.11g. Pearson residual plots for the model fits to the length composition data for Fishery 7. The open and solid circles represent observations that are higher and lower, respectively, than the model predictions. The sizes of the circles are proportional to the absolute values of the residuals.

FIGURA 4.11g. Gráficas de residuales de Pearson para los ajustes del modelo a los datos de composición por talla de la Pesquería 7. Los círculos abiertos y sólidos representan observaciones mayores y menores, respectivamente, que las predicciones del modelo. El tamaño de los círculos es proporcional al valor absoluto de los residuales.

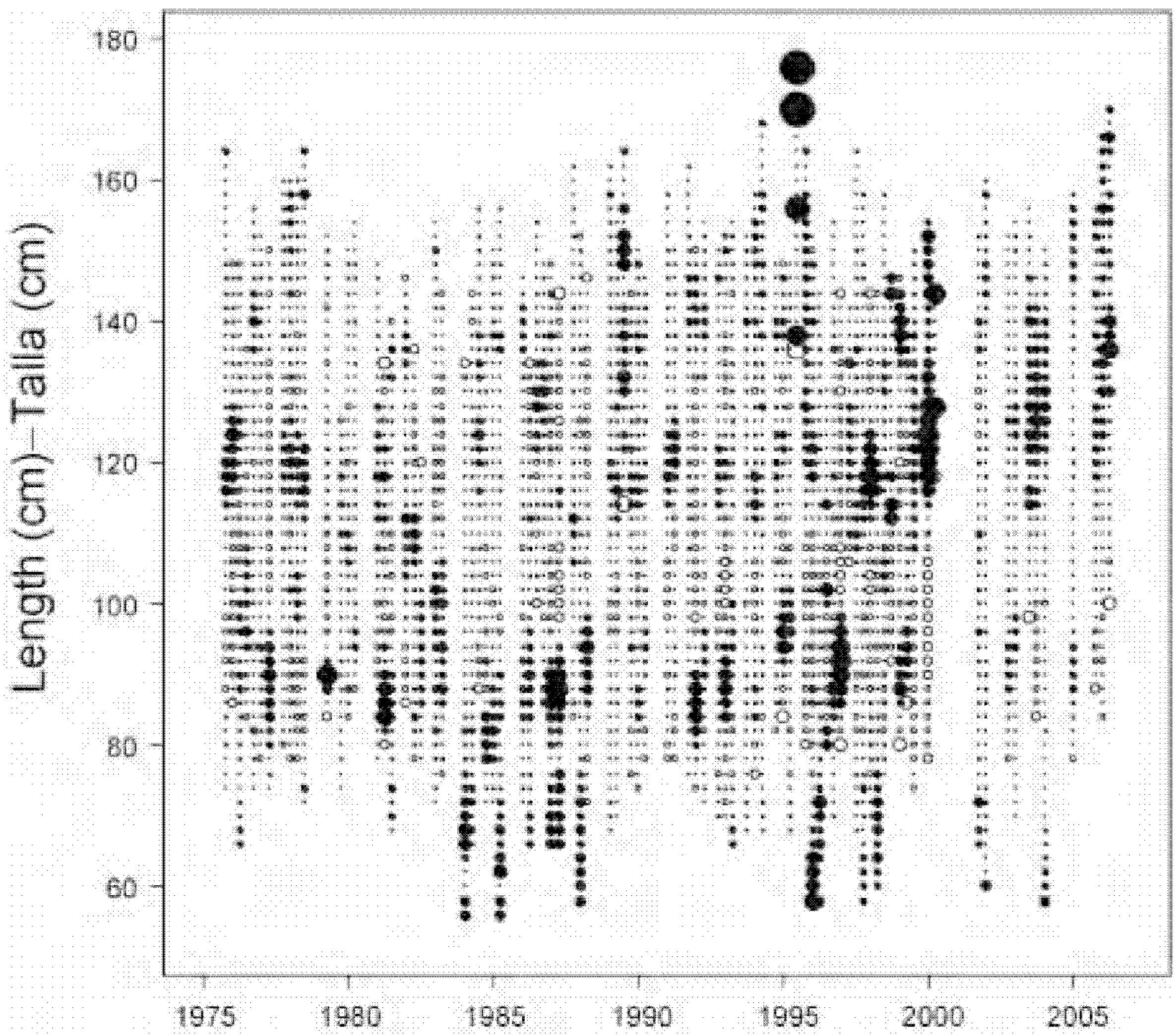

FIGURE 4.11h. Pearson residual plots for the model fits to the length composition data for Fishery 8. The open and solid circles represent observations that are higher and lower, respectively, than the model predictions. The sizes of the circles are proportional to the absolute values of the residuals.
FIGURA 4.11h. Gráficas de residuales de Pearson para los ajustes del modelo a los datos de composición por talla de la Pesquería 8. Los círculos abiertos y sólidos representan observaciones mayores y menores, respectivamente, que las predicciones del modelo. El tamaño de los círculos es proporcional al valor absoluto de los residuales.

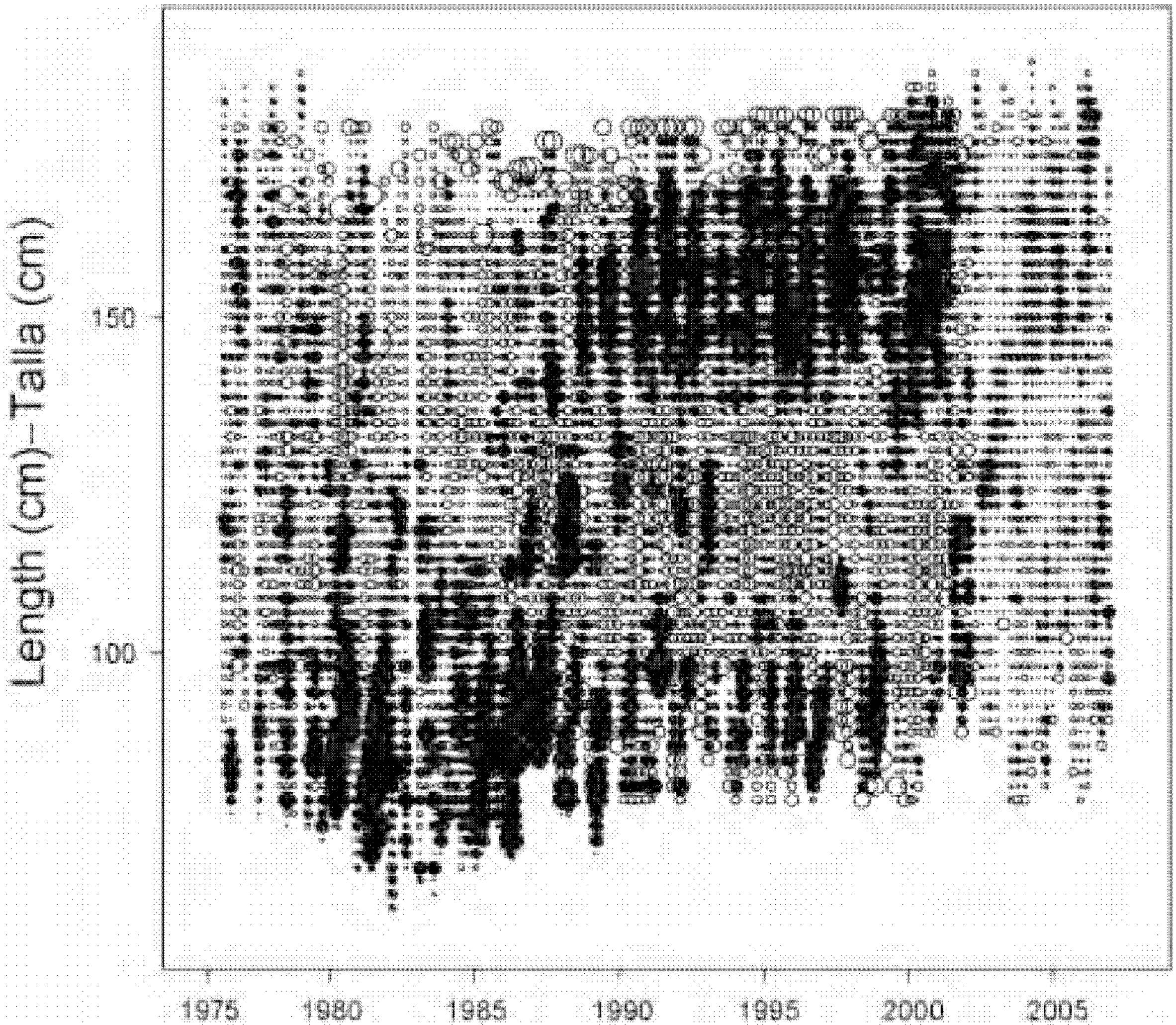

FIGURE 4.11i. Pearson residual plots for the model fits to the length composition data for Fishery 9. The open and solid circles represent observations that are higher and lower, respectively, than the model predictions. The sizes of the circles are proportional to the absolute values of the residuals.

FIGURA 4.11i. Gráficas de residuales de Pearson para los ajustes del modelo a los datos de composición por talla de la Pesquería 9. Los círculos abiertos y sólidos representan observaciones mayores y menores, respectivamente, que las predicciones del modelo. El tamaño de los círculos es proporcional al valor absoluto de los residuales.

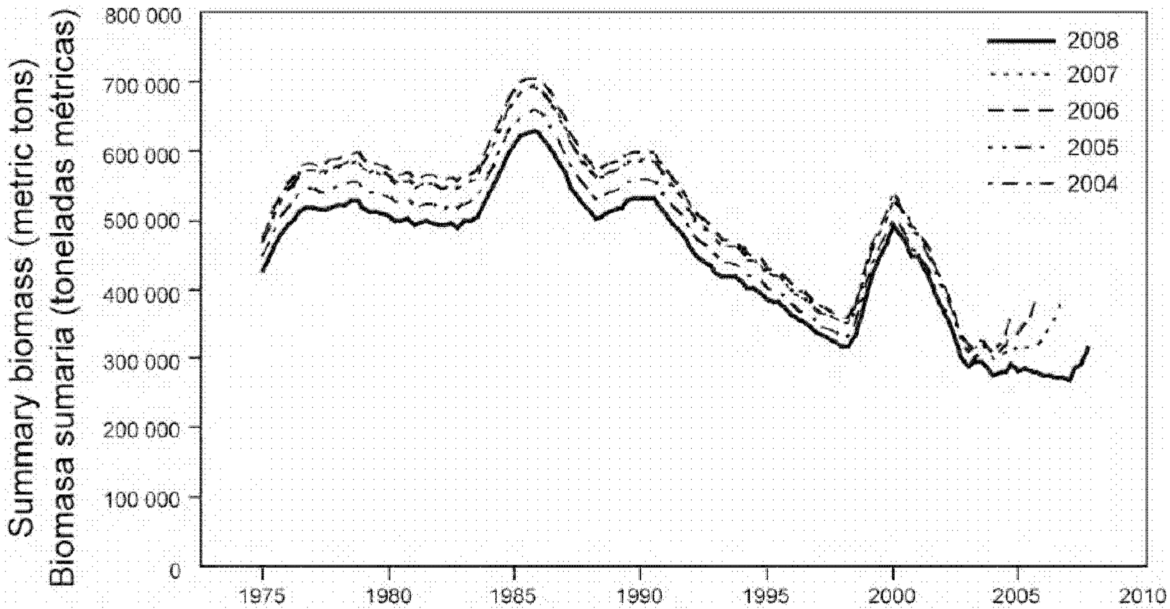

FIGURE 4.12. Retrospective comparisons of estimates of the summary biomass (fish of age 3 quarters and older) of bigeye tuna in the EPO. The estimates from the base case model are compared with the estimates obtained when the most recent year (2007), two years (2007 and 2006), three years (2007, 2006 and 2005) or four years (2007, 2006, 2005 and 2004) of data were excluded.
FIGURA 4.12. Comparaciones retrospectivas de las estimaciones de la biomasa sumaria (peces de 3 trimestres y más de edad) de atún patudo. Se comparan las estimaciones del modelo del caso base con aquéllas obtenidas cuando se excluyeron los datos del año más reciente (2007), a de los dos años (2007 y 2006), tres años (2007, 2006, y 2005), o cuatro años (2007, 2006, 2005 y 2004) más recientes.

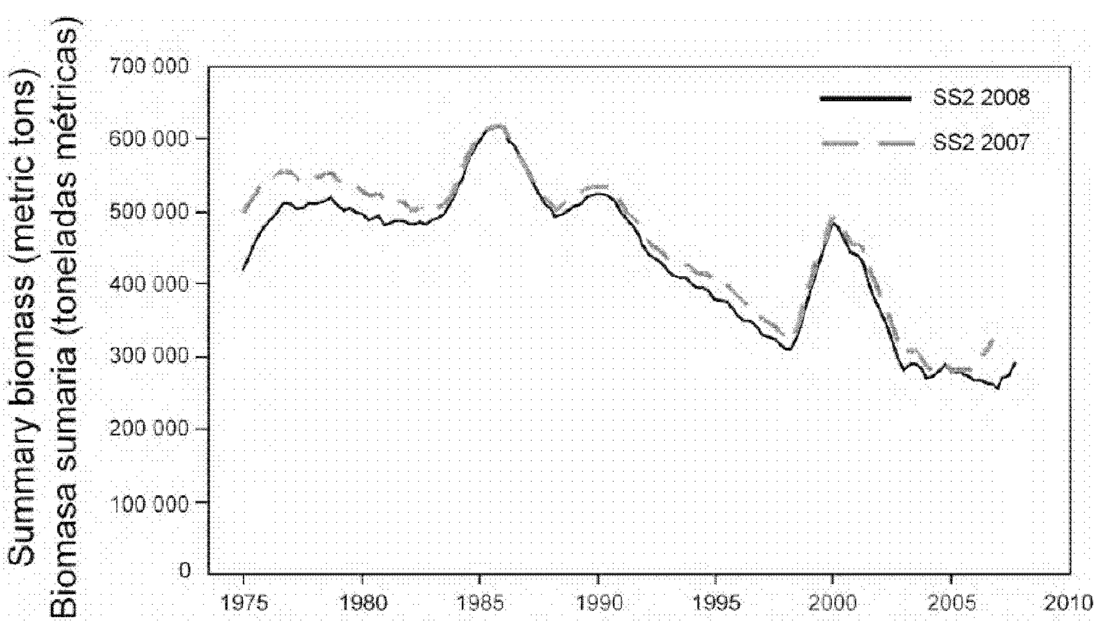

FIGURE 4.13. Comparison of estimates of the summary biomass (fish of age 3 quarters and older) of bigeye tuna from the most recent assessment (2007) and the current assessment, both using SS2.
FIGURA 4.13. Comparación de las estimaciones de la biomasa sumaria (peces de 3 trimestres y más de edad) de atún patudo de la evaluación más reciente (2007) y la evaluación actual, ambas con SS2.

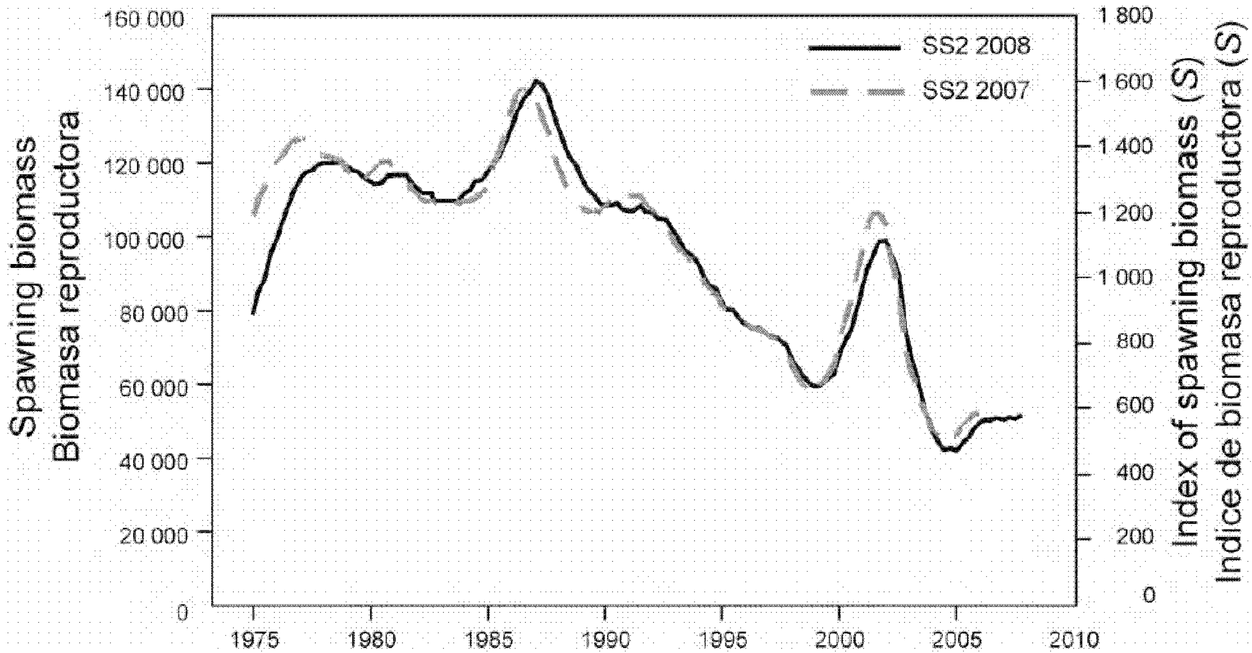

FIGURE 4.14. Comparison of estimates of the index of spawning biomass for bigeye tuna in the EPO from the most recent assessment (2007) and the current assessment (SS2), both using SS2.

FIGURA 4.14. Comparación del índice de biomasa reproductora estimada del atún patudo en el OPO de la evaluación más reciente (2007) y la evaluación actual, ambas con SS2.

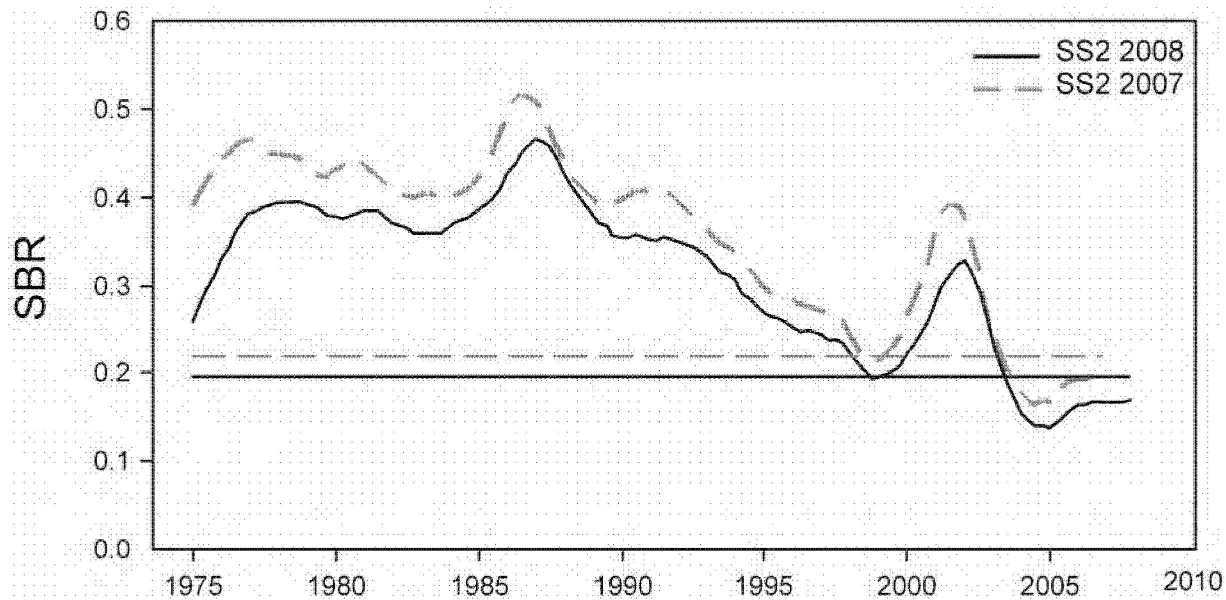

FIGURE 4.15. Comparison of estimated spawning biomass ratios (SBRs) for bigeye tuna in the EPO from the most recent assessment (2007) and the current assessment, both using SS2. The horizontal line (at about 0.22) indicates the SBR at MSY.

FIGURA 4.15. Comparación del cociente de biomasa reproductora (SBR) del atún patudo en el OPO de la evaluación más reciente (2007) y la evaluación actual, ambas con SS2. La línea horizontal (en aproximadamente 0,22) indica el SBR en RMS.

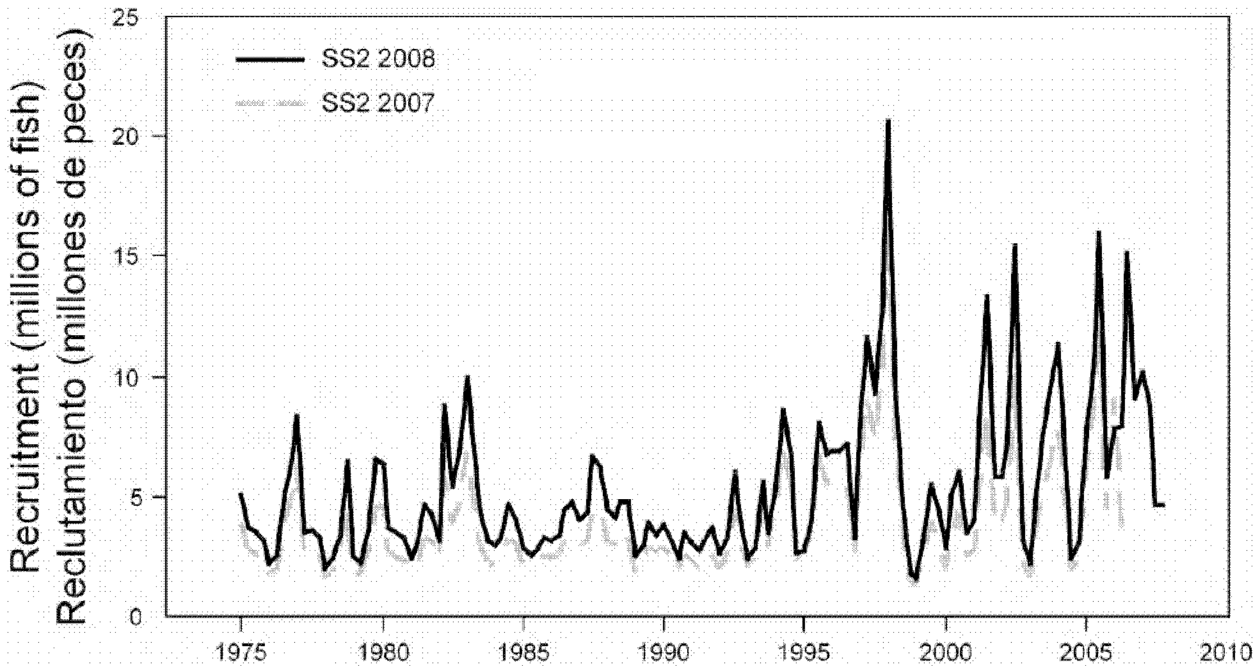

FIGURE 4.16a. Comparison of estimated recruitment of bigeye tuna in the EPO from the most recent assessment (2007) and the current assessment (SS2), both using SS2.
FIGURA 4.16. Comparación del reclutamiento estimado del atún patudo en el OPO de la evaluación más reciente (2007) y la evaluación actual (SS2), ambas con SS2.

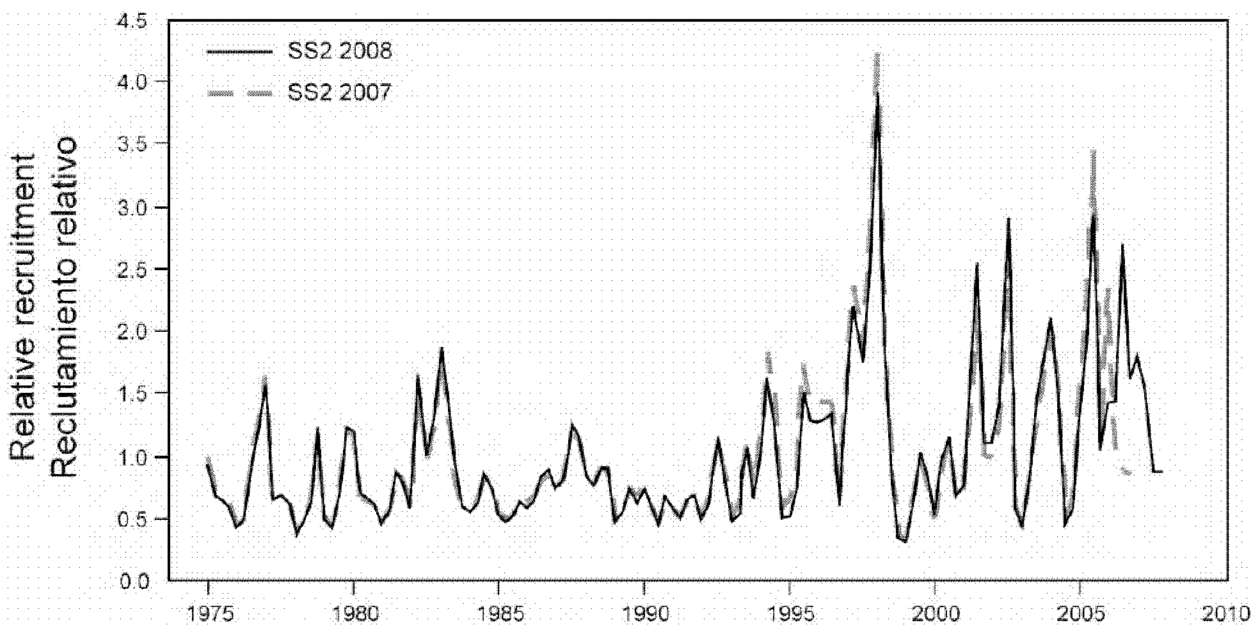

FIGURE 4.16b. Comparison of estimated relative recruitment of bigeye tuna in the EPO from the most recent assessment (2007) and the current assessment (SS2), both using SS2.
FIGURA 4.16b. Comparación del reclutamiento relativo estimado del atún patudo en el OPO de la evaluación más reciente (2007) y la evaluación actual (SS2), ambas con SS2.

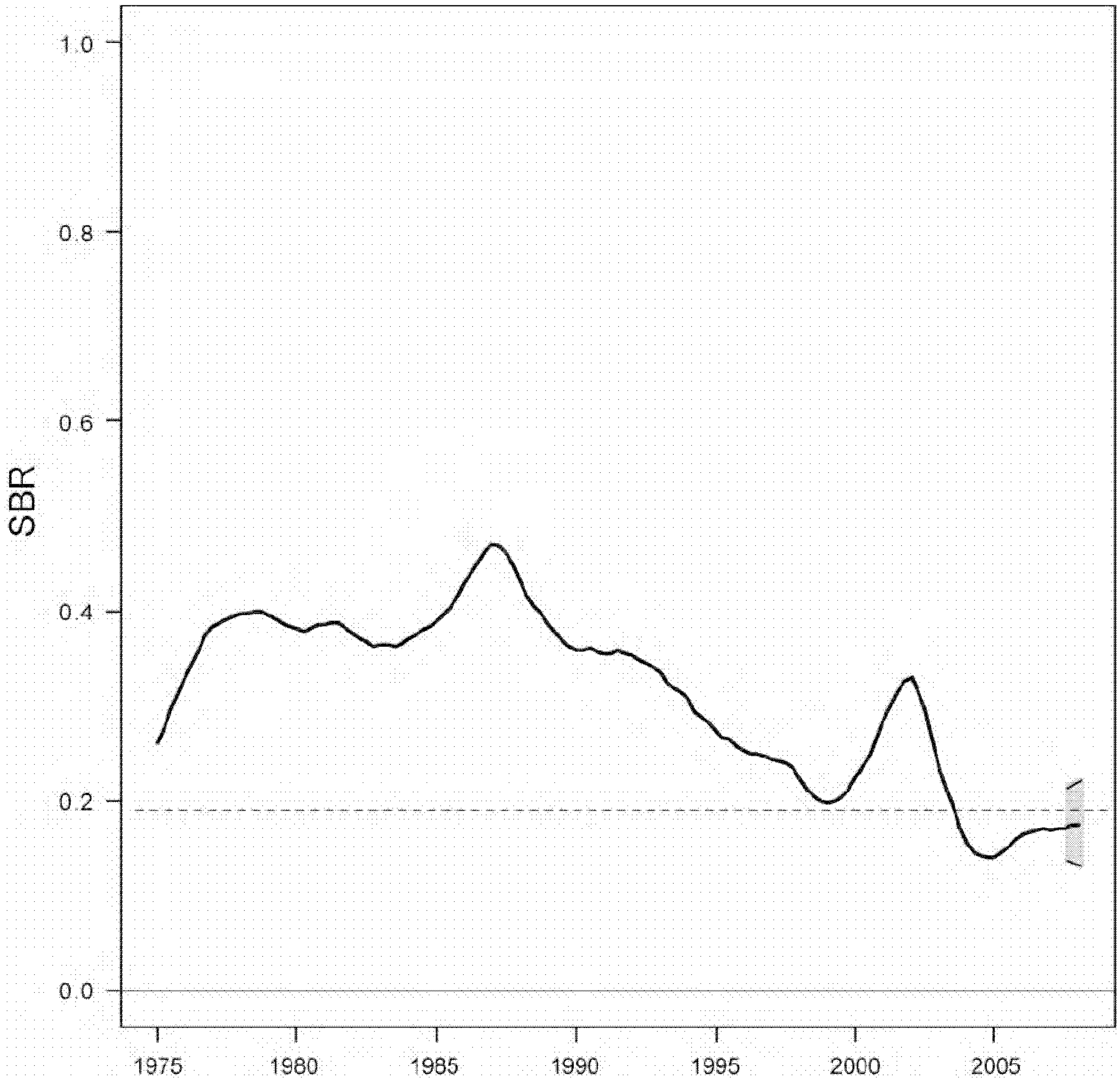

FIGURE 5.1. Estimated spawning biomass ratios (SBRs) for bigeye tuna in the EPO. The dashed horizontal line (at about 0.19) identifies the SBR at MSY. The curve illustrates the maximum likelihood estimates, and the shaded area at the end of the time series represents the confidence intervals (±2 standard deviations) around those estimates.

FIGURA 5.1. Cocientes de biomasa reproductora (SBR) estimados para el atún patudo en el OPO. La línea de trazos horizontal (en aproximadamente 0.22) identifica el SBR en RMS. La curva ilustra las estimaciones de verosimilitud máxima, y el área sombreada al fin de la serie de tiempo representan los intervalos de confianza (±2 desviaciones estándar) alrededor de esas estimaciones.

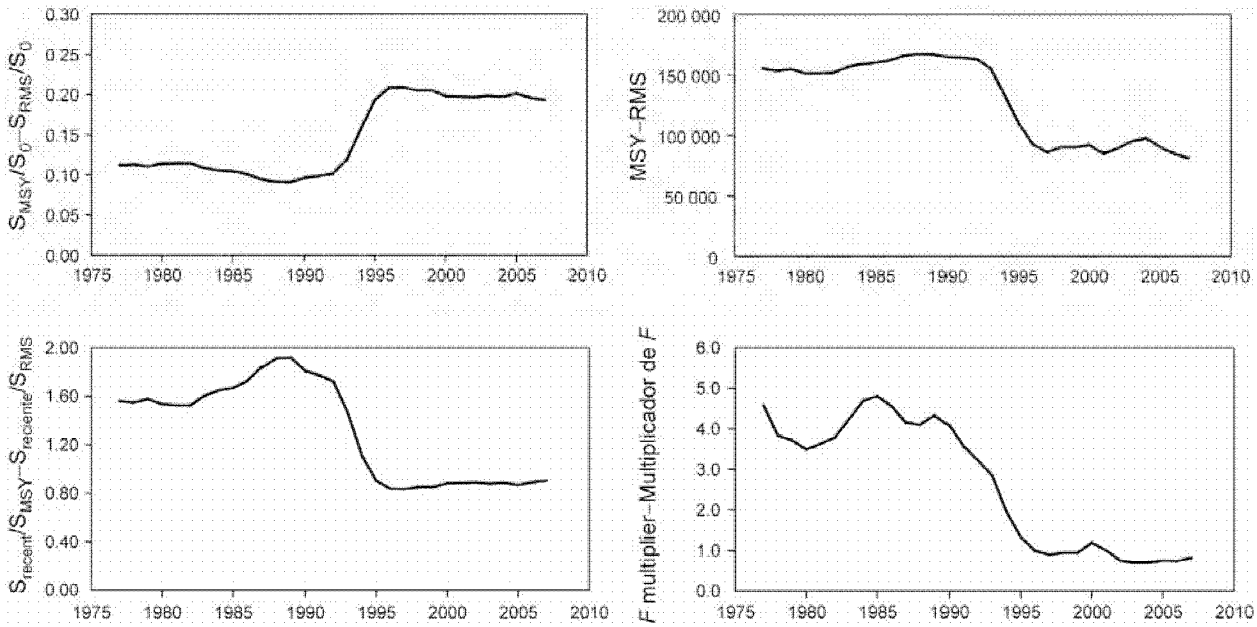

FIGURE 5.2. Estimates of MSY-related quantities calculated using the average age-specific fishing mortality for each year. (S_{recent} is the spawning biomass at the beginning of 2007.)

FIGURA 5.2. Estimaciones de cantidades relacionadas con el RMS calculadas usando la mortalidad por pesca por edad para cada año. ($S_{reciente}$ es la biomasa reproductora al principio de 2007.)

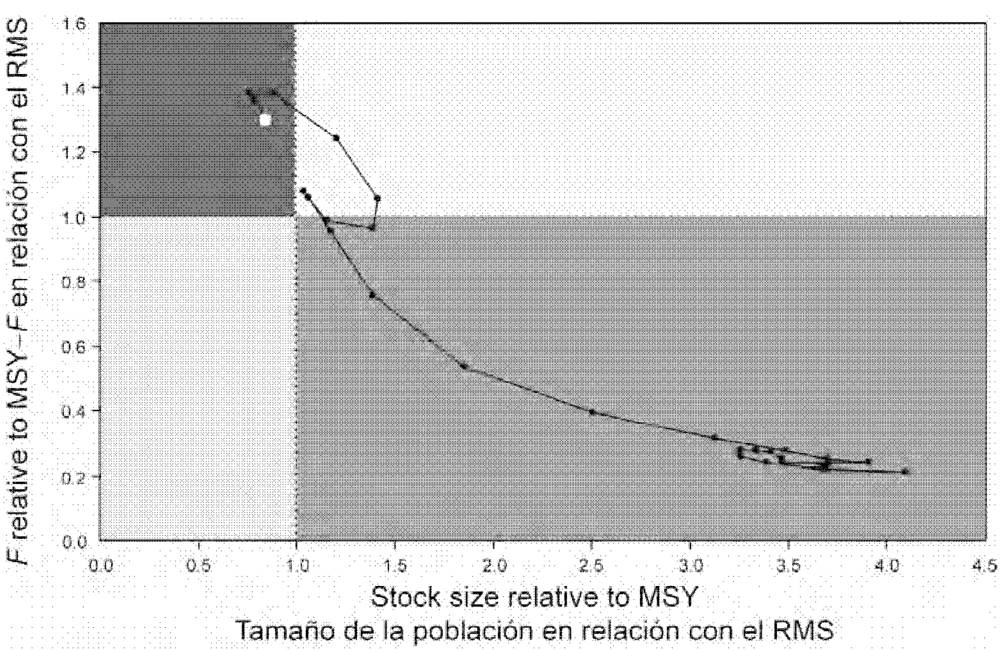

FIGURE 5.3. Phase plot of the time series of estimates of stock size and fishing mortality relative to their MSY reference points. Each dot is based on the average exploitation rate over three years; the large dot indicates the most recent estimate.

FIGURA 5.3. Gráfica de fase de la serie de tiempo de las estimaciones del tamaño de la población y la mortalidad por pesca en relación con sus puntos de referencia de RMS. Cada punto representa un promedio móvil de tres años. Cada punto se basa en la tasa de explotación media de tres años; el punto grande indica la estimación más reciente.

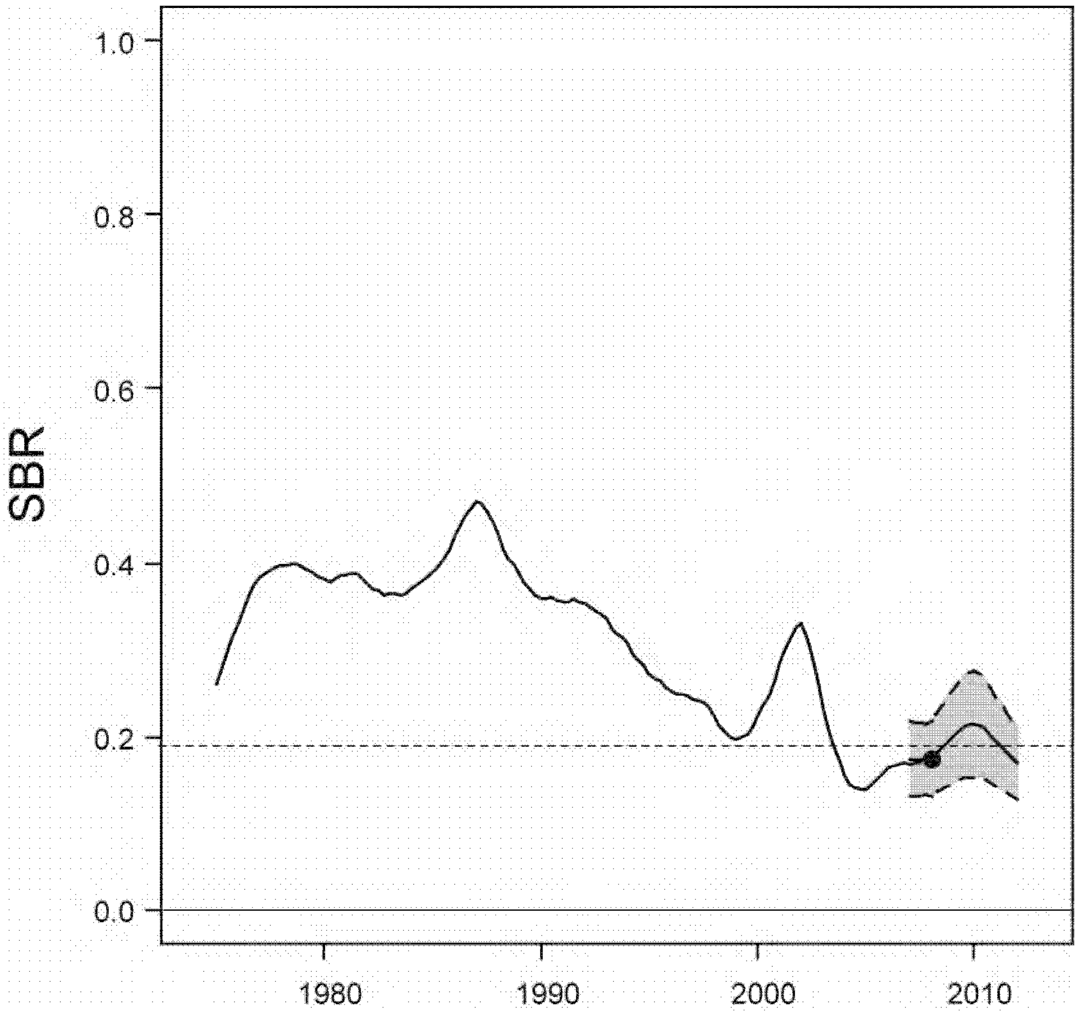

FIGURE 6.1a. Spawning biomass ratios (SBRs) of bigeye tuna in the EPO. The dashed horizontal line (at about 0.19) identifies the SBR at MSY. The solid curve illustrates the maximum likelihood estimates, and the estimates after 2007 (the large dot) indicate the SBR predicted to occur if fishing mortality rates continue at the average of that observed during 2005-2007. The dashed lines are the 95-percent confidence intervals around these estimates.

FIGURA 6.1a. Cocientes de biomasa reproductora (SBR) del atún patudo en el OPO. La línea de trazos horizontal (en aproximadamente 0.19) identifica el SBR en RMS. La curva sólida ilustra las estimaciones de verosimilitud máxima, y las estimaciones a partir de 2007 (el punto grande) señalan el SBR predicho si las tasas de mortalidad por pesca continúa en el promedio observado durante 2004-2007. Las líneas de trazos representan los intervalos de confianza de 95% alrededor de esas estimaciones.

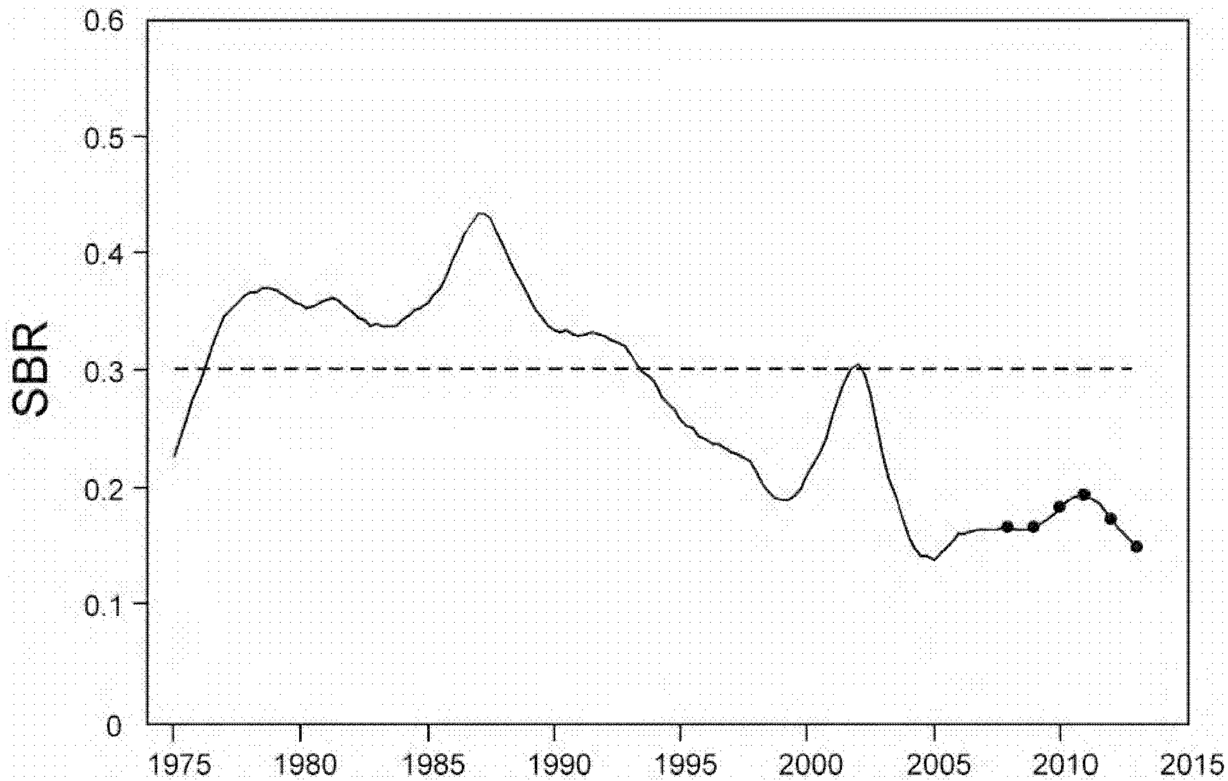

FIGURE 6.1b. Spawning biomass ratios (SBRs) of bigeye tuna in the EPO from the stock-recruitment sensitivity analysis. The dashed horizontal line (at about 0.31) identifies the SBR at MSY.
FIGURA 6.1b. Cocientes de biomasa reproductora (SBR) para el atún patudo en el OPO del análisis de sensibilidad de población-reclutamiento. La línea de trazos horizontal (en aproximadamente 0,31) identifica el SBR en RMS.

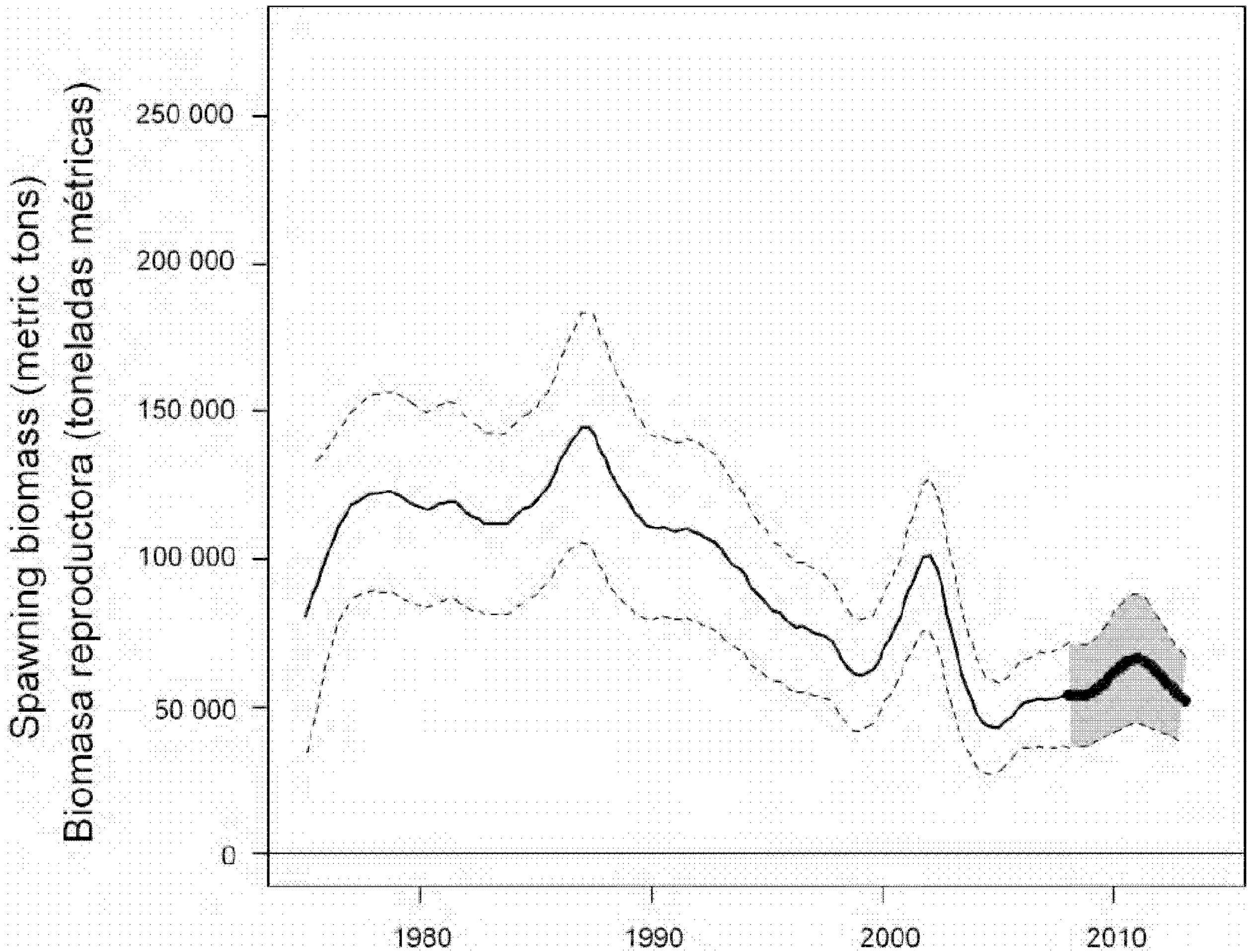

FIGURE 6.2. Spawning biomass of bigeye tuna, including projections for 2008-2012 based on average fishing mortality rates during 2005-2007. These calculations include parameter estimation uncertainty and uncertainty about future recruitment. The areas between the dashed curves indicate the 95-percent confidence intervals, and the shaded area represents the projection period.

FIGURE 6.2. Biomasa reproductora de atún patudo, incluyendo proyecciones para 2008-2012 basadas en las tasas de mortalidad por pesca media durante 2004-2007. Los cálculos incluyen incertidumbre en la estimación de los parámetros y sobre el reclutamiento futuro. Las zonas entre las curvas de trazos señalan los intervalos de confianza de 95%, y el área sombreada representa el período de la proyección.

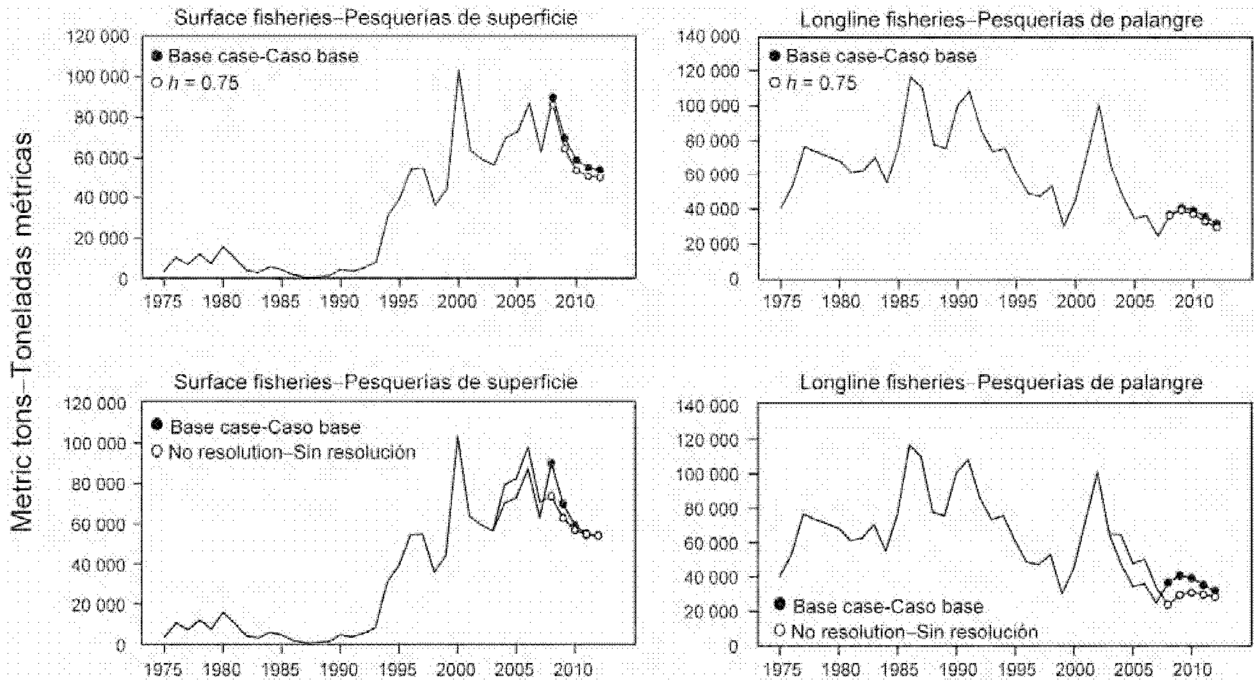

FIGURE 6.3. Predicted quarterly catches of bigeye tuna for the purse-seine and pole-and-line (left panels) and longline (right panels) fisheries, based on fishing mortality rates during 2005-2007. Predicted catches are compared between the base case and the analysis in which a stock-recruitment relationship was used (upper panels), and the analysis assuming that IATTC Resolution C-04-09 was not implemented (lower panels).

FIGURA 6.3. Capturas trimestrales predichas de atún patudo en las pesquerías de cerco y caña (recuadros izquierdos) y palangreras (recuadros derechos), basadas en las tasas de mortalidad por pesca durante 2004-2007. Se comparan las capturas predichas entre el caso base y el análisis en el que se usó una relación población-reclutamiento (recuadros superiores), y el análisis que supuso que la Resolución C-04-09 de la CIAT no fue aplicada (recuadros inferiores).

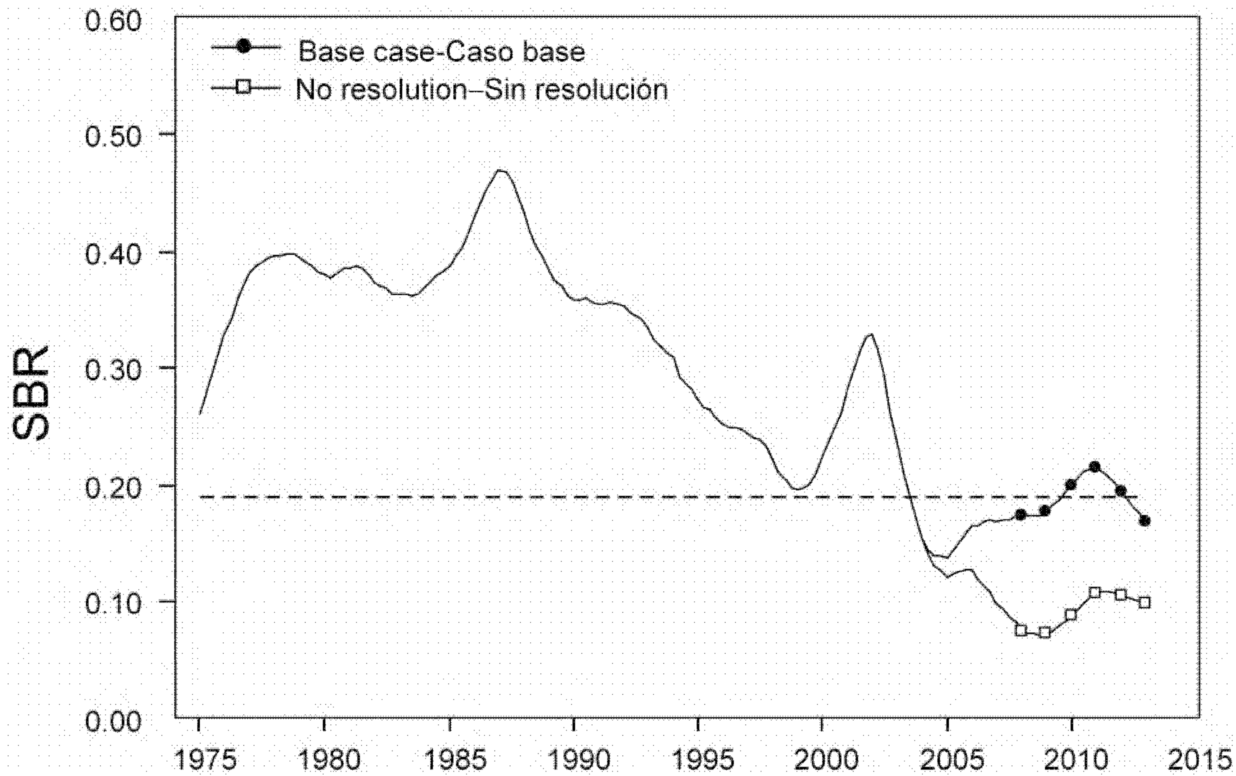

FIGURE 6.4. Predicted spawning biomass ratio (SBR) from the base case model and without restriction from IATTC Resolution C-04-09.

FIGURA 6.4. Cociente de biomasa reproductora (SBR) predicho del modelo de caso base y sin la restricción de la Resolución C-04-09 de la CIAT.

TABLE 2.1. Fishery definitions used for the stock assessment of bigeye tuna in the EPO. PS = purse-seine; LP = pole and line; LL = longline; OBJ = sets on floating objects; NOA = sets on unassociated fish; DEL = sets on dolphins. The sampling areas are shown in Figure 2.1, and descriptions of the discards are provided in Section 2.2.2.

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

Fishery	**Gear**	**Set type**	**Years**	**Sampling areas**	**Catch data**
Pesquería	**Arte**	**Tipo de lance**	**Años**	**Zonas de muestreo**	**Datos de captura**
1	PS	OBJ	1975-1992	1-13	retained catch only–captura retenida solamente
2	PS	OBJ	1993-2007	11-12	retained catch + discards from inefficiencies in fishing process–captura retenida + descartes de ineficacias en el proceso de pesca
3	PS	OBJ	1993-2007	7, 9	
4	PS	OBJ	1993-2007	5-6, 13	
5	PS	OBJ	1993-2007	1-4, 8, 10	
6	PS LP	NOA DEL	1980-1989	1-13	retained catch only–captura retenida solamente
7	PS LP	NOA DEL	1990-2007	1-13	retained catch + discards from inefficiencies in fishing process–captura retenida + descartes de ineficacias en el proceso de pesca
8	LL		1975-2007	N of–de 15°N	retained catch only (in numbers)–captura retenida solamente (en número)
9	LL		1975-2007	S of–de 15°N	retained catch only (in numbers) –captura retenida solamente (en número)
10	PS	OBJ	1993-2007	11-12	discards of small fish from size-sorting the catch by Fishery 2–descartes de peces pequeños de clasificación por tamaño en la Pesquería 2
11	PS	OBJ	1993-2007	7, 9	discards of small fish from size-sorting the catch by Fishery 3–descartes de peces pequeños de clasificación por tamaño en la Pesquería 3
12	PS	OBJ	1993-2007	5-6, 13	discards of small fish from size-sorting the catch by Fishery 4–descartes de peces pequeños de clasificación por tamaño en la Pesquería 4
13	PS	OBJ	1993-2007	1-4, 8, 10	discards of small fish from size-sorting the catch by Fishery 5–descartes de peces pequeños de clasificación por tamaño en la Pesquería 5
14	LL		1975-2007	N of–de 15°N	retained catch only (in weight) –captura retenida solamente (en peso)
15	LL		1975-2007	S of–de 15°N	retained catch only (in weight) –captura retenida solamente (en peso)

TABLE 3.1. Age-specific fecundity indices used to define the spawning biomass.
TABLA 3.1. Indices de fecundidad por edad usados para definir la biomasa reproductora.

Age (quarters)	Proportion mature	Age (quarters)	Proportion mature
Edad (trimestres)	**Proporción madura**	**Edad (trimestres)**	**Proporción madura**
1	0.00	21	0.96
2	0.00	22	0.98
3	0.00	23	0.98
4	0.00	24	0.99
5	0.00	25	0.99
6	0.01	26	1.00
7	0.01	27	1.00
8	0.02	28	1.00
9	0.04	29	1.00
10	0.06	30	1.00
11	0.10	31	1.00
12	0.16	32	1.00
13	0.23	33	1.00
14	0.33	34	1.00
15	0.45	35	1.00
16	0.59	36	1.00
17	0.71	37	1.00
18	0.82	38	1.00
19	0.89	39	1.00
20	0.93	40	1.00

TABLE 4.1. Estimated total annual recruitment (thousands of fish), summary biomass (fish of age 3 quarters and older), spawning biomass (metric tons), and spawning biomass ratio (SBR) of bigeye tuna in the EPO.

TABLA 4.1. Reclutamiento anual total estimado (miles de peces), biomasa sumaria (peces de 3 trimestres de edad o más), biomasa reproductora (toneladas métricas), y cociente de biomasa reproductora (SBR) de atún patudo en el OPO.

	Total recruitment	Summary biomass	Spawning biomass	SBR
	Reclutamiento total	**Biomasa sumaria**	**Biomasa reproductora**	**SBR**
1975	15,338	427,658	80,521	0.26
1976	16,163	493,735	101,649	0.33
1977	18,740	517,906	118,106	0.38
1978	14,362	520,505	122,406	0.40
1979	15,025	516,832	121,751	0.40
1980	16,852	504,587	117,604	0.38
1981	14,318	492,050	118,996	0.39
1982	24,314	490,930	115,565	0.38
1983	25,029	497,205	112,265	0.36
1984	14,825	538,212	113,814	0.37
1985	11,486	607,408	119,768	0.39
1986	15,734	625,649	132,436	0.43
1987	21,241	566,617	144,627	0.47
1988	18,052	510,389	133,724	0.43
1989	12,819	515,483	119,009	0.39
1990	12,987	532,348	110,604	0.36
1991	12,899	508,176	109,307	0.35
1992	16,114	459,742	108,763	0.35
1993	14,524	425,610	103,356	0.34
1994	23,386	410,968	95,086	0.31
1995	21,536	383,839	84,041	0.27
1996	24,167	362,174	78,039	0.25
1997	42,093	336,192	75,197	0.24
1998	36,458	316,600	68,973	0.22
1999	14,792	392,346	60,771	0.20
2000	17,451	491,649	69,165	0.22
2001	31,451	446,712	87,335	0.28
2002	31,842	369,524	101,459	0.33
2003	24,346	287,106	71,941	0.23
2004	24,944	274,856	48,030	0.16
2005	39,998	281,335	42,747	0.14
2006	40,093	274,956	50,988	0.17
2007	28,242	269,266	52,205	0.17
2008		330,719	53,831	0.17

TABLE 4.2. Estimates of the average sizes of bigeye tuna. The ages are quarters after hatching.
TABLA 4.2. Estimaciones del tamaño medio del atún patudo. La edad es en trimestres desde la cría.

Age (quarters)	Average length (cm)	Average weight (kg)	Age (quarters)	Average length (cm)	Average weight (kg)
Edad (trimestres)	**Talla media (cm)**	**Peso medio (kg)**	**Edad (trimestres)**	**Talla media (cm)**	**Peso medio (kg)**
1	26.61	0.51	21	158.52	89.67
2	38.25	1.46	22	161.52	94.69
3	49.12	3.01	23	164.33	99.54
4	59.29	5.18	24	166.96	104.22
5	68.79	7.97	25	169.41	108.71
6	77.67	11.33	26	171.70	113.00
7	85.97	15.21	27	173.84	117.09
8	93.72	19.54	28	175.85	120.96
9	100.97	24.25	29	177.72	124.61
10	107.74	29.27	30	179.47	128.03
11	114.07	34.53	31	181.10	131.22
12	119.99	39.99	32	182.63	134.17
13	125.51	45.57	33	184.06	136.89
14	130.68	51.22	34	185.39	139.40
15	135.51	56.90	35	186.64	141.69
16	140.02	62.57	36	187.80	143.78
17	144.24	68.19	37	188.89	145.68
18	148.18	73.74	38	189.91	147.41
19	151.86	79.18	39	190.86	148.97
20	155.30	84.49	40	191.75	150.40

TABLE 4.3. Likelihood components obtained for the base case and sensitivity analyses. OBJ: fishery on floating objects.

TABLA 4.3. Componentes de verosimilitud obtenidos para la análisis del caso base y de sensibilidad. OBJ: pesquería sobre objetos flotantes.

Data		**Base case**	**h = 0.75**	**CPUE Fishery 9**	**Time blocks (OBJ)**
Datos		**Caso base**	**h = 0.75**	**CPUE Pesquería 9**	**Bloques de tiempo (OBJ)**
CPUE					
Fishery Pesquería	2	-17.83	-17.32	103.47	-18.1856
	3	13.78	13.77	112.26	13.614
	5	12.93	13.42	105.79	14.2527
	8	-44.92	-44.80	237.11	-45.4316
	9	-165.95	-166.86	-151.11	-166.918
Size composition Composición por talla					
Fishery Pesquería	1	171.03	170.85	170.87	171.044
	2	260.51	261.00	250.31	259.993
	3	298.24	298.19	289.48	297.602
	4	67.87	67.74	66.92	67.2198
	5	169.72	170.17	164.04	161.977
	6	144.66	144.91	144.17	144.66
	7	133.18	131.97	131.24	133.677
	8	126.10	125.89	126.21	125.937
	9	313.39	317.37	316.47	312.761
Age at length Edad a talla		-	-	-	-
Recruitment Reclutamiento		-21.93	-17.53	-19.52	-22.0554
Total		**1460.77**	**1468.78**	**2047.71**	**1450.1469**

TABLE 5.1. Estimates of the MSY and its associated quantities for bigeye tuna for the base case assessment and sensitivity analyses. All analyses are based on average fishing mortality during 2005-2007. B_{recent} and B_{MSY} are defined as the biomass of fish 3+ quarters old at the beginning of 2006 and at MSY, respectively, and S_{recent} and S_{MSY} are defined as indices of spawning biomass (therefore, they are not in metric tons). C_{recent} is the estimated total catch in 2006. OBJ: fishery on floating objects.

TABLA 5.1. Estimaciones del RMS y sus cantidades asociadas de atún patudo para la evaluación del caso base y los análisis de sensibilidad. Todos los análisis se basan en la mortalidad por pesca promedio de 2005-2007. Se definen B_{recent} y B_{RMS} como la biomasa de peces de 3+ trimestres de edad al principio de 2006 y en RMS, respectivamente, y S_{recent} y S_{RMS} como los índices de la biomasa reproductora (por lo tanto, no se expresan en toneladas métricas). C_{recent} es la captura total estimada en 2006. OBJ: pesquería sobre objetos flotantes.

	Base case	**h = 0.75**	**CPUE Fishery 9**	**Time blocks (OBJ)**
	Caso base	**h = 0.75**	**CPUE Pesquería 9**	**Bloques de tiempo (OBJ)**
MSY—RMS	81,350	78,150	85,005	79,654
B_{MSY}—B_{RMS}	287,912	500,357	303,515	287,613
S_{MSY}—S_{RMS}	59,626	118,154	63,318	59,963
B_{MSY}/B_0—B_{RMS}/B_0	0.26	0.34	0.25	0.26
S_{MSY}/S_0—S_{RMS}/B_0	0.19	0.30	0.19	0.20
C_{recent}/MSY—C_{recent}/RMS	1.08	1.12	1.03	1.18
B_{recent}/B_{MSY}—B_{recent}/B_{RMS}	1.15	0.74	1.23	1.12
S_{recent}/S_{MSY}—S_{recent}/S_{RMS}	0.90	0.56	0.90	0.89
F multiplier—Multiplicador de F	0.82	0.57	0.85	0.81

TABLE 5.2. Estimates of the MSY and its associated quantities for bigeye tuna, obtained by assuming that there is no stock-recruitment relationship (base case), that each fishery maintains its current pattern of age-specific selectivity (Figure 4.5), and that each fishery is the only fishery operating in the EPO. The estimates of the MSY and B_{MSY} are in metric tons. The *F* multiplier indicates how many times effort would have to be effectively increased to achieve the MSY in relation to the average fishing mortality from 2005-2007. A sensitivity of the management quantities estimates to using the average fishing mortality rates for the period 2005-2006, is also presented. "only" means that only that gear is used and the fishing mortality for the other gears is set to zero.
TABLA 5.2. Estimaciones del RMS y sus cantidades asociadas de atún patudo, obtenidas suponiendo que no existe una relación población-reclutamiento (caso base), que cada pesquería mantiene su patrón actual de selectividad por edad (Figura 4.5), y que cada pesquería es la única que opera en el OPO. Se expresan las estimaciones del RMS y B_{RMS} en toneladas métricas. El multiplicador de *F* indica cuántas veces el esfuerzo necesitaría ser incrementado efectivamente para obtener el RMS en relación con la mortalidad por pesca promedio durante 2003-2004, 2005-2006 y 2004-2006. "solamente" significa que se usa solamente ese arte, y se fija la mortalidad por pesca de las otras artes en cero.

	Base case	**Purse-seine only**	**Longline only**	**2005-2006**
	Caso base	**Cerco solamente**	**Palangre solamente**	**2005-2006**
MSY—RMS	81,350	57,503	168,419	80,934
B_{MSY}—B_{RMS}	287,912	223,293	300,043	287,750
S_{MSY}—S_{RMS}	59,626	50,080	26,604	59,685
B_{MSY}/B_0—B_{RMS}/B_0	0.26	0.20	0.27	0.26
S_{MSY}/S_0—S_{RMS}/B_0	0.19	0.16	0.09	0.19
C_{recent}/MSY—C_{recent}/RMS	1.08	1.53	0.52	1.08
B_{recent}/B_{MSY}—B_{recent}/B_{RMS}	1.15	1.48	1.10	1.15
S_{recent}/S_{MSY}—S_{recent}/S_{RMS}	0.90	1.07	2.02	0.90
F multiplier—Multiplicador de *F*	0.82	1.24	5.56	0.74

APPENDIX A: SENSITIVITY ANALYSIS FOR STEEPNESS
ANEXO A: ANÁLISIS DE SENSIBILIDAD A LA INCLINACIÓN

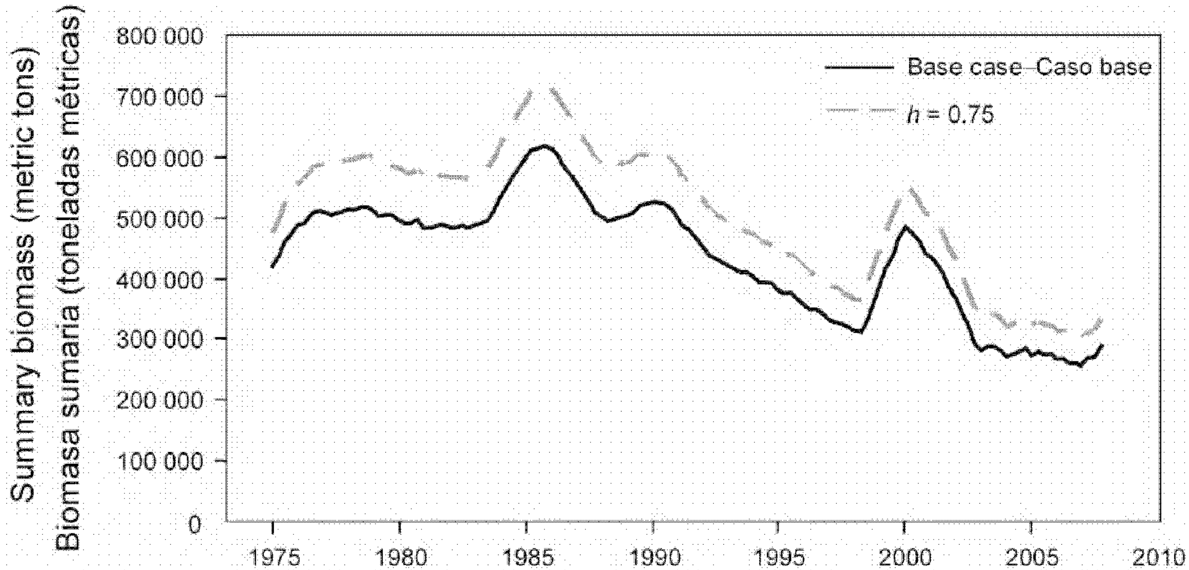

FIGURE A.1. Comparison of estimates of biomass of bigeye tuna from the analysis without a stock-recruitment relationship (base case) and with a stock-recruitment relationship (steepness = 0.75).
FIGURA A.1. Comparación de las estimaciones de la biomasa de atún patudo del análisis sin una relación población-reclutamiento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

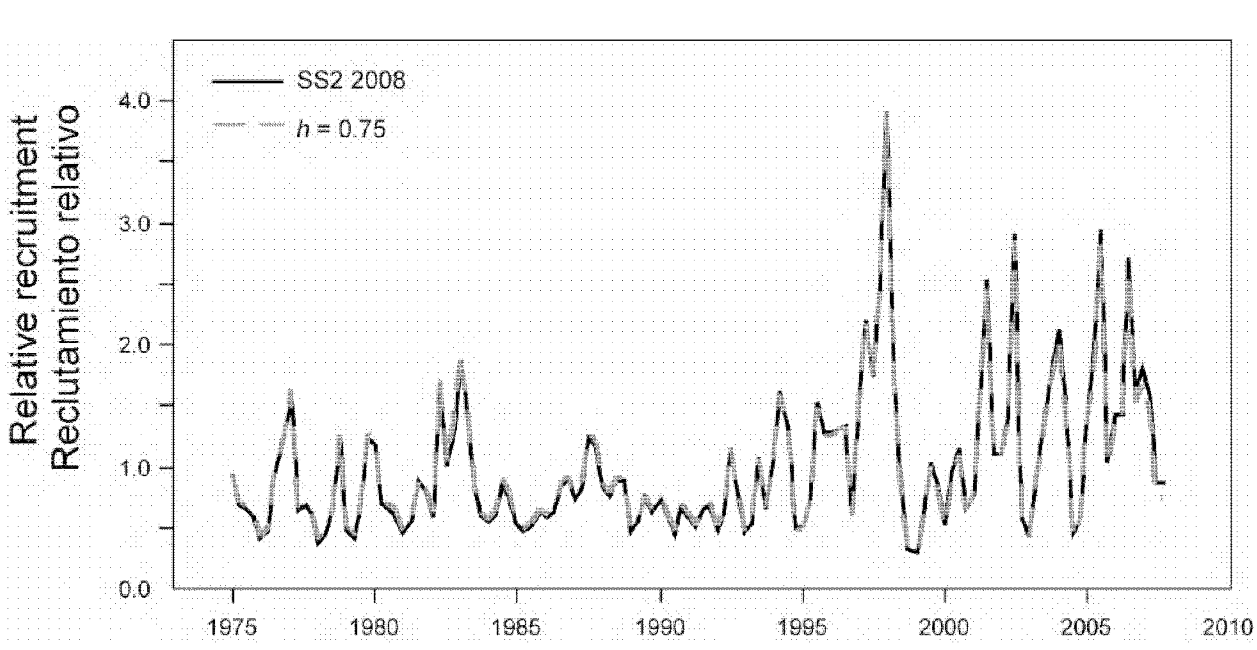

FIGURE A.2. Comparison of estimates of relative recruitment for bigeye tuna from the analysis without a stock-recruitment relationship (base case) and with a stock-recruitment relationship (steepness = 0.75).
FIGURA A.2. Comparación de las estimaciones de reclutamiento relativo de atún patudo del análisis sin una relación población-reclutamiento (caso base) y con dicha relación (inclinación = 0.75).

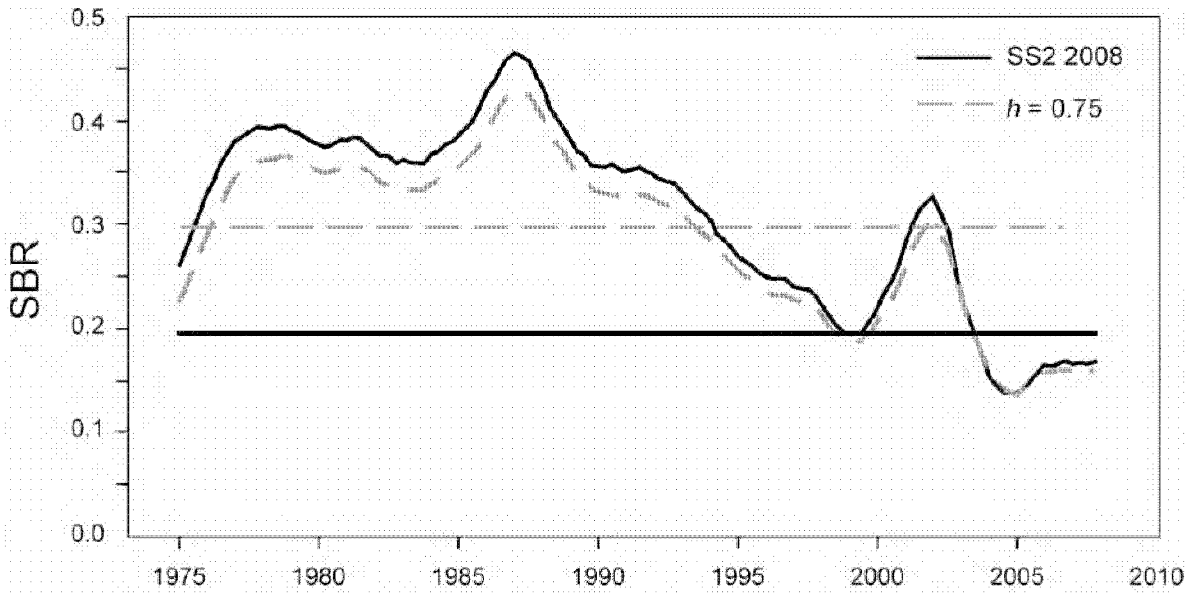

FIGURE A.3. Comparison of estimates of the spawning biomass ratio (SBR) of bigeye tuna from the analysis without a stock-recruitment relationship (base case) and with a stock-recruitment relationship (steepness = 0.75). The horizontal lines represent the SBRs associated with MSY under the two scenarios.

FIGURA A.3. Comparación de las estimaciones del cociente de biomasa reproductora (SBR) de atún patudo del análisis sin una relación población-reclutamiento (caso base) y con dicha relación (inclinación = 0.75). Las líneas horizontales representan los SBR asociados con el RMS en los dos escenarios.

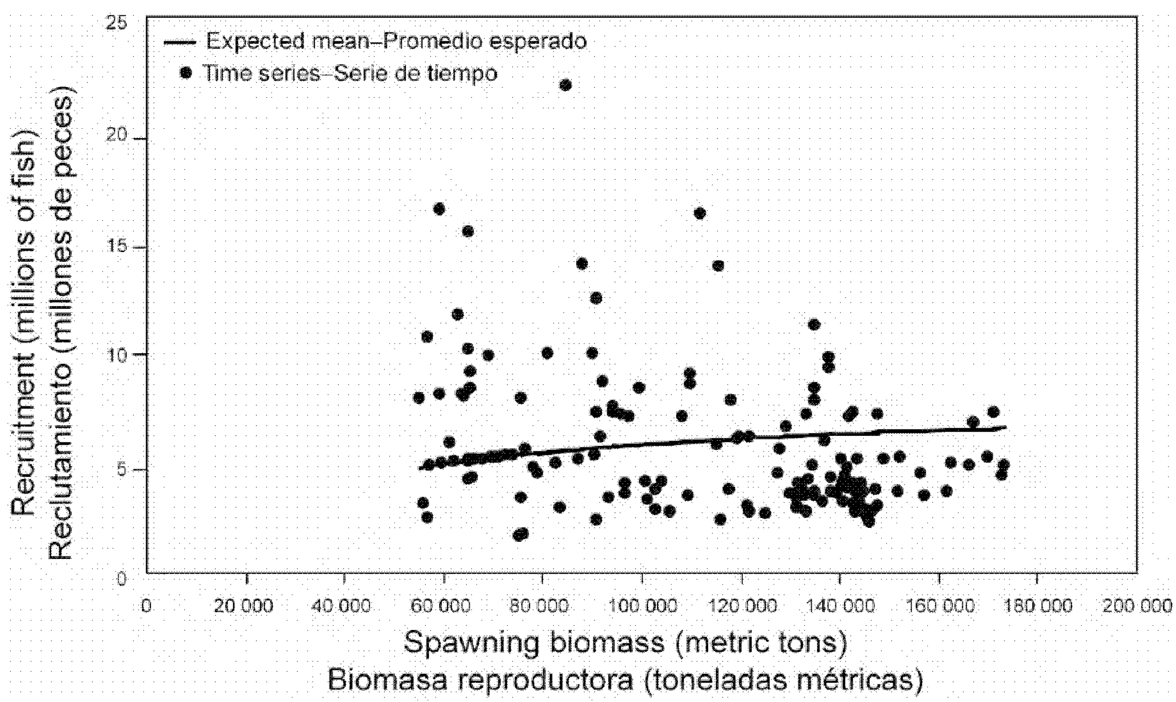

FIGURE A.4. Recruitment of bigeye tuna plotted against spawning biomass when the analysis has a stock-recruitment relationship (steepness = 0.75).

FIGURA A.4. Reclutamiento de atún patudo graficado contra biomasa reproductora cuando el análisis incluye una relación población-reclutamiento (inclinación = 0.75).

APPENDIX B: SENSITIVITY ANALYSIS USING CPUE DATA FOR SOUTHERN LONGLINE FISHERY ONLY
ANEXO B: ANÁLISIS DE SENSIBILIDAD USANDO DATOS DE CPUE DE LA PESQUERÍA DE PALANGRE DEL SUR SOLAMENTE

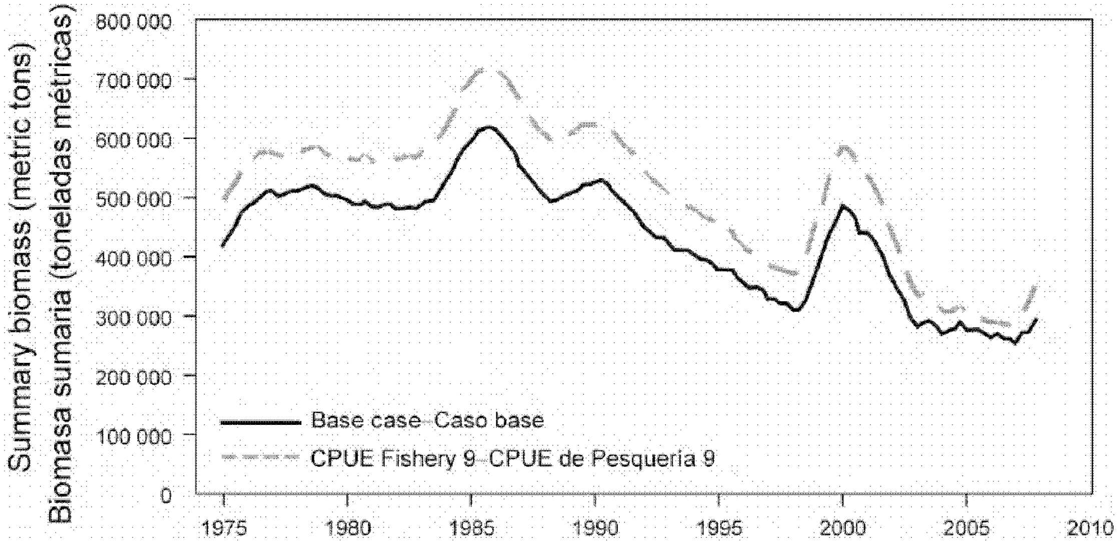

FIGURE B.1. Comparison of estimates of biomass of bigeye tuna from the base case analysis with a model in which only the CPUE data for the southern longline fishery (Fishery 9) were used.
FIGURA B.1. Comparación de las estimaciones de biomasa de atún patudo del análisis del caso base con un modelo en el cual se usaron los datos de CPUE de la pesquería de palangre del sur (Pesquería 9) solamente.

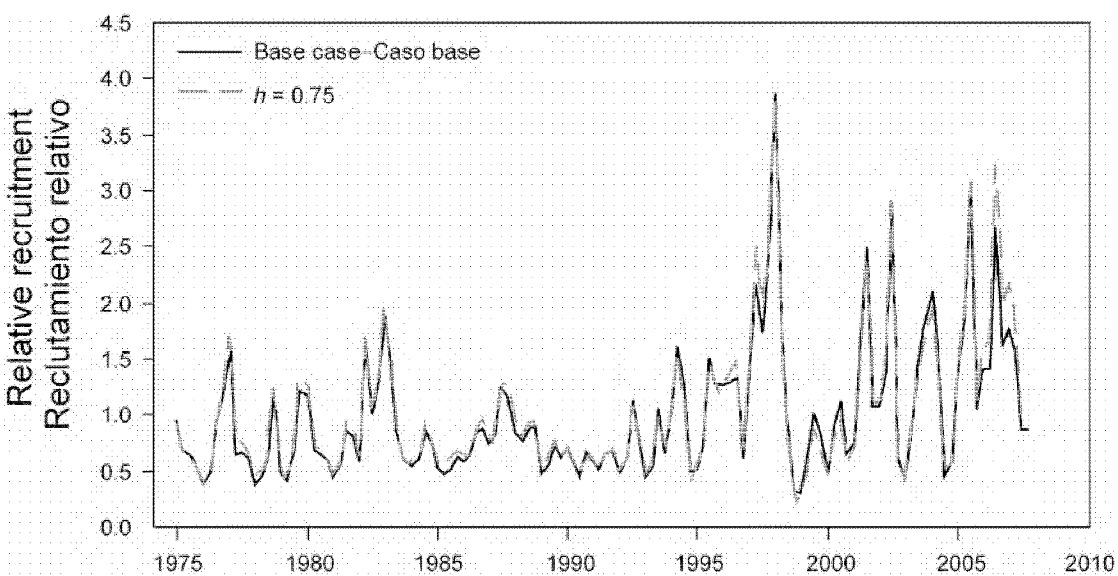

FIGURE B.2. Comparison of estimates of recruitment for bigeye tuna from the base case analysis with a model in which only the CPUE data for the southern longline fishery (Fishery 9) were used.
FIGURA B.2. Comparación de las estimaciones de reclutamiento de atún patudo del análisis del caso base con un modelo en el cual se usaron los datos de CPUE de la pesquería de palangre del sur (Pesquería 9) solamente.

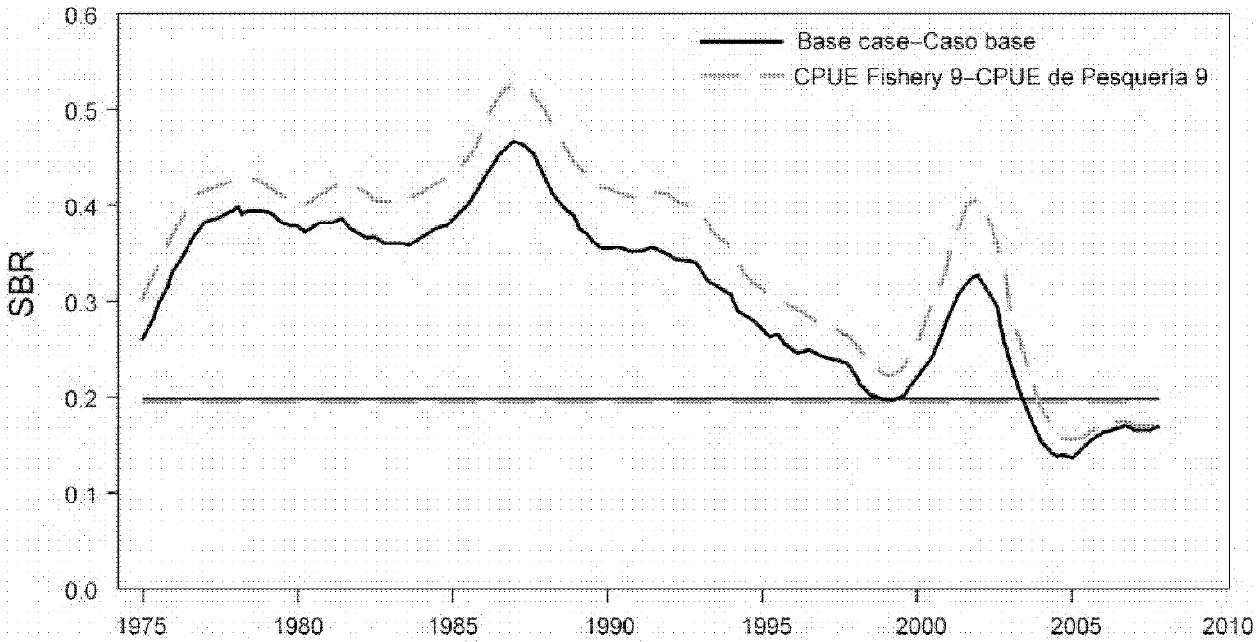

FIGURE B.3. Comparison of estimates of the spawning biomass ratio (SBR) of bigeye tuna from the base case analysis with a model in which only the CPUE data for the southern longline fishery (Fishery 9) were used. The horizontal lines represent the SBRs associated with MSY under the two scenarios.

FIGURA B.3. Comparación de las estimaciones del cociente de biomasa reproductora (SBR) de atún patudo del análisis del caso base con un modelo en el cual se usaron los datos de CPUE de la pesquería de palangre del sur (Pesquería 9) solamente. Las líneas horizontales representan los SBR asociados con el RMS en los dos escenarios.

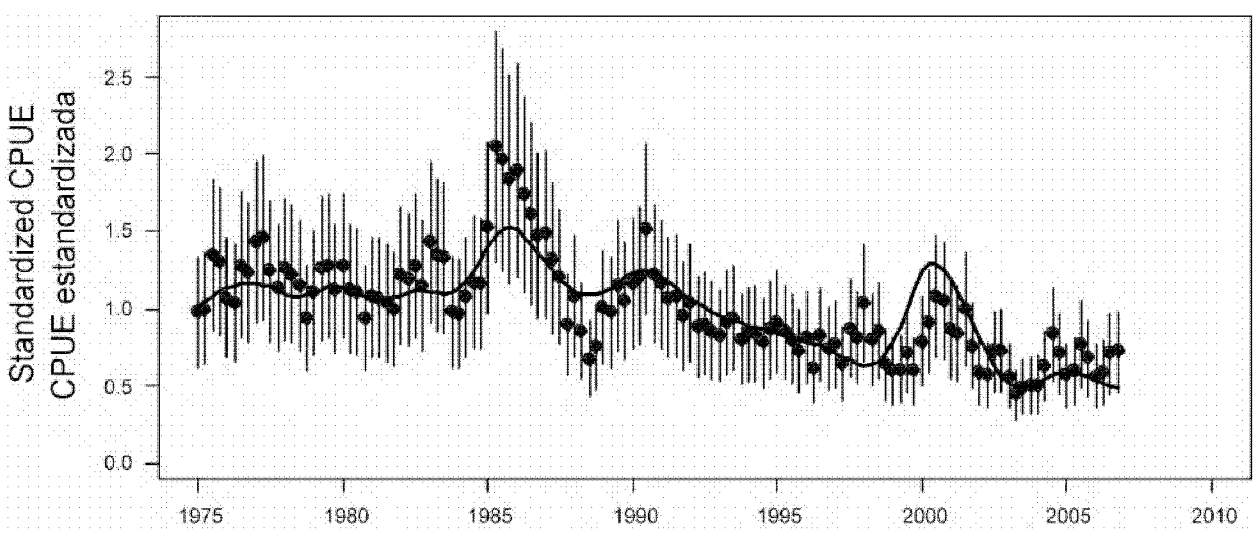

FIGURE B.4. Model fit to the CPUE data for the southern longline fishery (Fishery 9). The vertical lines are the approximate 95% confidence intervals.

FIGURA B.4. Ajuste del modelo a los datos de CPUE de la pesquería de palangre del sur (Pesquería 9). Las líneas verticales representan los intervalos de confianza aproximados de 95%

APPENDIX C: SENSITIVITY ANALYSIS TO ASSUMING TWO TIME BLOCKS FOR THE SELECTIVITIES OF THE FLOATING-OBJECT FISHERIES
ANEXO C: ANÁLISIS DE SENSIBILIDAD AL SUPUESTO DE DOS BLOQUES DE TIEMPO PARA LA SELECTIVIDAD DE LAS PESQUERÍAS SOBRE OBJETOS FLOTANTES

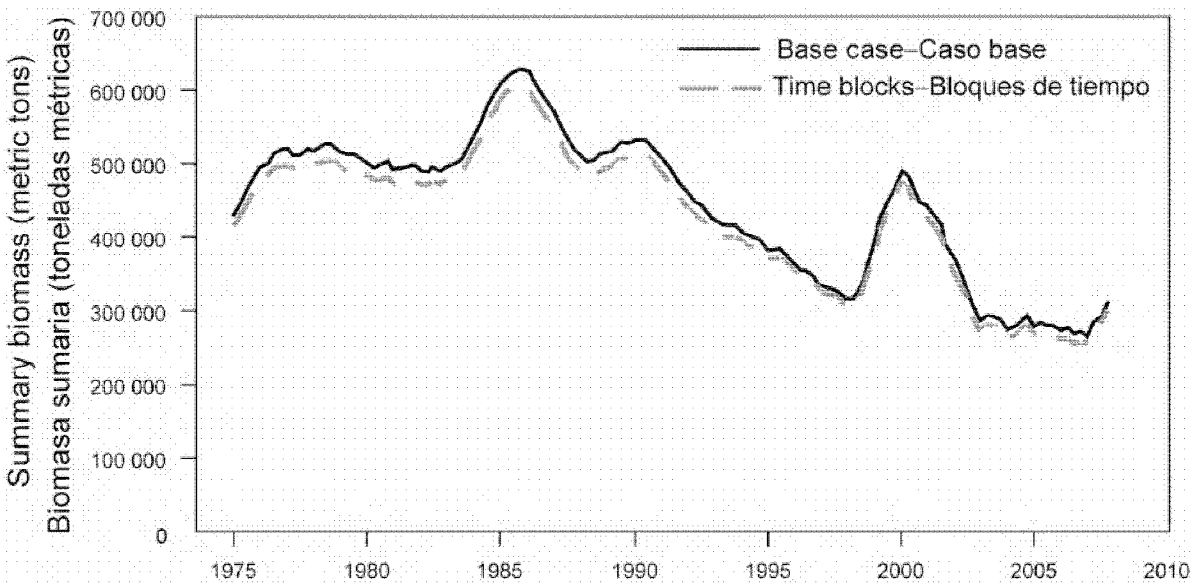

FIGURE C.1. Comparison of estimates of biomass of bigeye tuna from the base case analysis with a model in which two time blocks for the floating-object fisheries were used.
FIGURA C.1. Comparación de estimaciones de la biomasa de patudo del análisis de caso base con un modelo en el cual se usaron dos bloques de tiempo para las pesquerías sobre objetos flotantes.

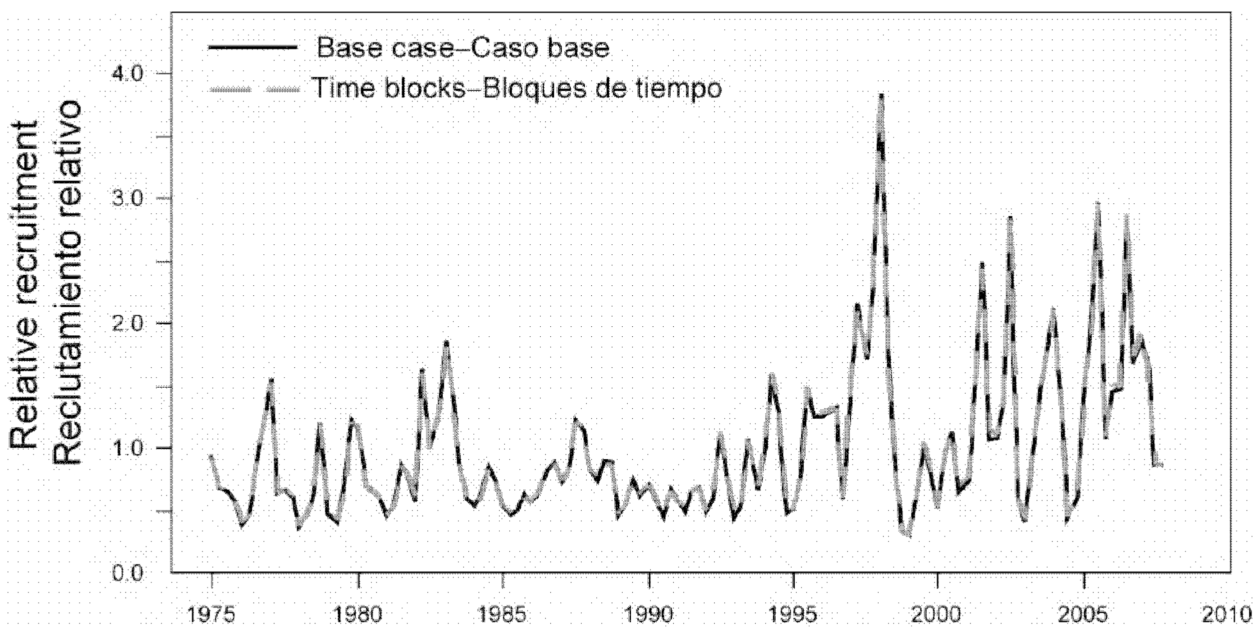

FIGURE C.2. Comparison of estimates of recruitment for bigeye tuna from the base case analysis with a model in which two time blocks for the floating-object fisheries were used.
FIGURA C.2. Comparación de estimaciones del reclutamiento de patudo del análisis de caso base con un modelo en el cual se usaron dos bloques de tiempo para las pesquerías sobre objetos flotantes.

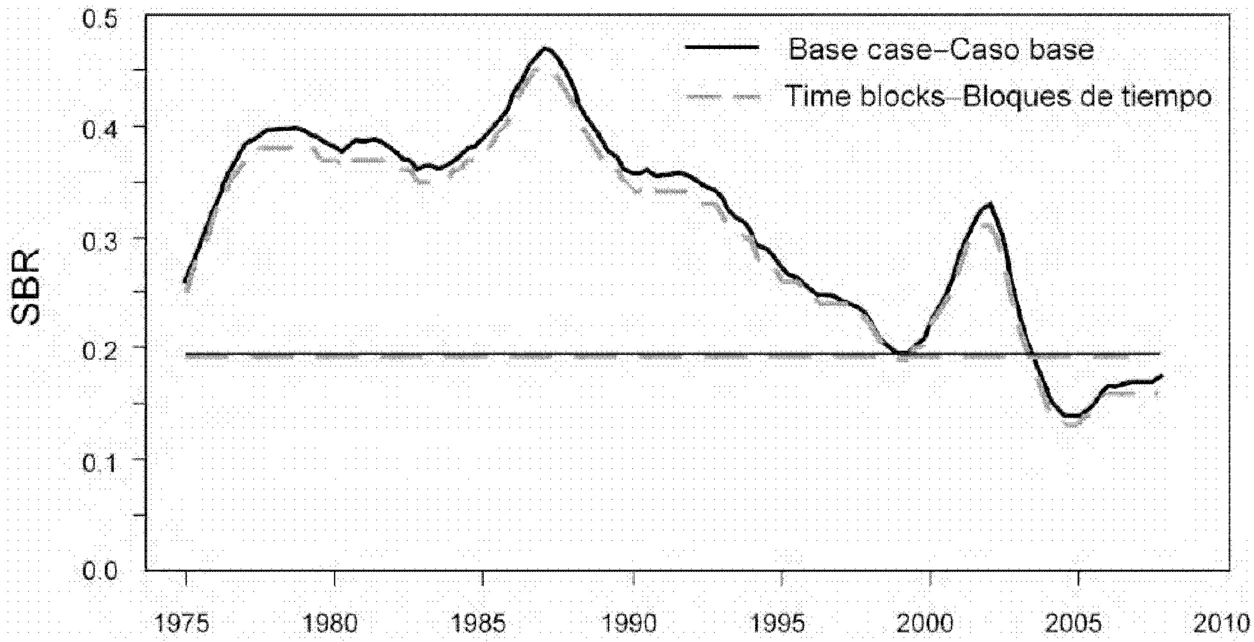

FIGURE C.3. Comparison of estimates of the spawning biomass ratio (SBR) of bigeye tuna from the base case analysis with a model in which two time blocks for the floating-object fisheries were used. The horizontal lines represent the SBRs associated with MSY under the two scenarios.
FIGURA C.3. Comparación de estimaciones del cociente de biomasa reproductora (SBR) de patudo del análisis de caso base con un modelo en el cual se usaron dos bloques de tiempo para las pesquerías sobre objetos flotantes. Las líneas horizontales representan los SBR asociados con el RMS para los dos escenarios.

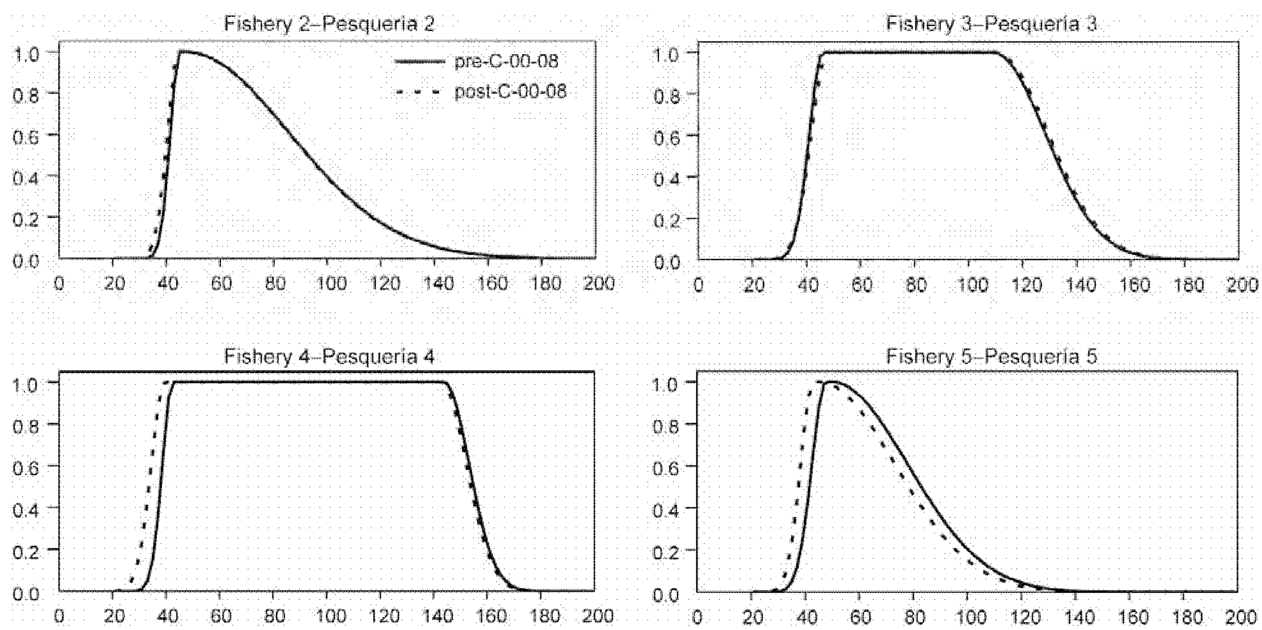

FIGURE C.4. Size selectivity curves for the floating object fisheries (Fisheries 2-5) for two periods: 1) pre-Resolution C-00-08 (1975-2000), and post-Resolution C-00-08 (2001-present).
FIGURA C.4. Curvas de selectividad de tamaño de las pesquerías sobre objetos flotantes (Pesquerías 2-5) durante dos períodos: 1) antes de la Resolución C-00-08 (1975-2000), y después de la misma (2001-presente).

APPENDIX D: ADDITIONAL RESULTS FROM THE BASE CASE ASSESSMENT

This appendix contains additional results from the base case assessment of bigeye tuna in the EPO. These results are total fishing mortality rates. This appendix was prepared in response to requests received during the second meeting of the Scientific Working Group.

ANEXO D: RESULTADOS ADICIONALES DE LA EVALUACIÓN DEL CASO BASE

Este anexo contiene resultados adicionales de la evaluación de caso base del atún patudo en el OPO. Estos resultados son tasas de mortalidad por pesca total. Fue preparado en respuesta a solicitudes expresadas durante la segunda reunión del Grupo de Trabajo Científico.

TABLE D.1. Average annual fishing mortality rates for bigeye tuna in the EPO for the base case assessment.
TABLA D.1. Tasas medias de mortalidad anual por pesca de atún patudo en el OPO para la evaluación del caso base.

Year	Age (quarters - Edad (trimestres)									
	1-4	5-8	9-12	13-16	17-20	21-24	25-28	29-32	33-36	37-40
1975	0.01	0.03	0.08	0.12	0.12	0.12	0.11	0.11	0.11	0.11
1976	0.01	0.05	0.11	0.14	0.14	0.14	0.13	0.13	0.13	0.13
1977	0.01	0.05	0.13	0.18	0.19	0.18	0.18	0.18	0.18	0.18
1978	0.01	0.07	0.15	0.18	0.18	0.17	0.17	0.17	0.17	0.17
1979	0.01	0.05	0.13	0.17	0.17	0.17	0.17	0.17	0.17	0.17
1980	0.01	0.08	0.16	0.18	0.18	0.17	0.17	0.17	0.17	0.17
1981	0.01	0.06	0.13	0.16	0.16	0.16	0.15	0.15	0.15	0.15
1982	0.01	0.04	0.11	0.16	0.16	0.16	0.15	0.15	0.15	0.15
1983	0.01	0.04	0.12	0.17	0.18	0.17	0.17	0.17	0.17	0.17
1984	0.01	0.04	0.10	0.13	0.13	0.13	0.13	0.13	0.13	0.13
1985	0.01	0.03	0.11	0.15	0.16	0.16	0.16	0.16	0.16	0.16
1986	0.00	0.04	0.14	0.21	0.23	0.22	0.22	0.22	0.22	0.22
1987	0.00	0.03	0.15	0.22	0.24	0.24	0.24	0.24	0.24	0.24
1988	0.00	0.03	0.12	0.18	0.19	0.19	0.19	0.19	0.19	0.19
1989	0.00	0.03	0.12	0.18	0.19	0.18	0.18	0.18	0.18	0.18
1990	0.01	0.04	0.15	0.23	0.24	0.24	0.24	0.24	0.24	0.24
1991	0.01	0.05	0.17	0.26	0.27	0.27	0.27	0.27	0.27	0.27
1992	0.01	0.05	0.16	0.23	0.24	0.24	0.23	0.23	0.23	0.23
1993	0.05	0.06	0.16	0.22	0.23	0.22	0.22	0.22	0.22	0.21
1994	0.17	0.18	0.27	0.29	0.26	0.25	0.24	0.24	0.24	0.24
1995	0.34	0.26	0.25	0.25	0.24	0.22	0.21	0.21	0.21	0.21
1996	0.47	0.39	0.29	0.25	0.21	0.19	0.18	0.18	0.18	0.18
1997	0.38	0.36	0.35	0.29	0.23	0.20	0.19	0.19	0.19	0.18
1998	0.21	0.21	0.23	0.26	0.26	0.25	0.24	0.24	0.24	0.24
1999	0.17	0.17	0.16	0.16	0.14	0.12	0.12	0.11	0.11	0.11
2000	0.41	0.45	0.32	0.23	0.17	0.15	0.14	0.14	0.13	0.13
2001	0.46	0.50	0.34	0.28	0.24	0.22	0.22	0.21	0.21	0.21
2002	0.42	0.51	0.45	0.44	0.41	0.38	0.38	0.37	0.37	0.37
2003	0.38	0.39	0.37	0.39	0.36	0.35	0.34	0.34	0.34	0.34
2004	0.41	0.45	0.35	0.33	0.30	0.28	0.27	0.26	0.26	0.26
2005	0.51	0.52	0.34	0.26	0.20	0.18	0.17	0.16	0.16	0.16
2006	0.50	0.59	0.41	0.32	0.24	0.21	0.20	0.19	0.19	0.19
2007	0.33	0.39	0.25	0.20	0.16	0.14	0.13	0.13	0.13	0.13

CONDICIÓN DEL ATÚN PATUDO EN EL OCÉANO PACÍFICO ORIENTAL EN 2007 Y PERSPECTIVAS PARA EL FUTURO

by

Alexandre Aires-da-Silva y Mark N. Maunder

ÍNDICE

1. RESUMEN

Este documento presenta la evaluación actual de la población de atún patudo (*Thunnus obesus*) en el Océano Pacífico oriental (OPO). Al igual que en la última evaluación, la presente evaluación fue efectuada con el modelo Población Synthesis II (SS2; Methot 2005). La evaluación aquí reportada se basa en el supuesto que hay una sola población de patudo en el OPO, y que no hay intercambio de atún patudo en el Pacífico entero entre el OPO y el Océano Pacífico occidental y central.

La evaluación de poblaciones requiere una cantidad sustancial de información. Se analizaron datos de capturas retenidas, descartes, captura por unidad de esfuerzo (CPUE), usados como índices de abundancia, y composición por tamaño de las capturas de varias pesquerías distintas. Se hicieron también varios supuestos sobre procesos tales como crecimiento, reclutamiento, desplazamiento, mortalidad natural, y mortalidad por pesca. Se actualizaron los datos de captura, CPUE y frecuencia de talla de las pesquerías de superficie para incluir datos nuevos de 2007 y datos revisados de 2003-2006.

En el caso de las pesquerías de palangre, la captura ha sido actualizada para incluir datos nuevos de 2007. Se dispone de dos años adicionales de datos de CPUE nuevos (2005-2006) para las pesquerías de palangre. Se dispone de datos de frecuencia de talla actualizados (2002-2004) y nuevos (2004-2006) de la pesquería de palangre japonesa.

El modelo de evaluación del caso base supone que no existe una relación entre la población y el reclutamiento (es decir, la inclinación de la relación población-reclutamiento es igual a 1), e incluye la serie de tiempo de CPUE de las pesquerías sobre objetos flotantes y de palangre. Se supone un solo bloque de tiempo para las selectividades por tamaño de las distintas pesquerías. Se usan calendarios de mortalidad natural (*M*) actualizados para ambos sexos.

Se realizaron análisis para evaluar la sensibilidad a: (1) una relación población-reclutamiento; (2) el uso de las datos de CPUE de la pesquería de palangre del sur solamente; 3) el uso de dos bloques de tiempo para la selectividad por tamaño de las pesquerías sobre objetos flotantes, separados por la aplicación en 2001 de la Resolución C-00-08 de la CIAT, que prohíbe los descartes de atunes en el OPO.

Han ocurrido cambios importantes en la cantidad de mortalidad por pesca causada por las pesquerías que capturan atún patudo en el OPO. En promedio, desde 1993 la mortalidad por pesca de patudo de menos de unos 15 trimestres de edad ha aumentado sustancialmente, y la de los de más de unos 15 trimestres de edad ha aumentado ligeramente desde entonces. El aumento de la mortalidad por pesca de los peces más

jóvenes fue causado por la expansión de las pesquerías que capturan atún en asociación con objetos flotantes.

Dentro del rango de biomasas reproductoras estimadas por la evaluación del caso base, la abundancia de los reclutas de patudo no parece estar relacionada con el potencial reproductor de las hembras adultas en el momento de cría.

La serie de tiempo de estimaciones de reclutamiento de patudo tiene varias características importantes. En primer lugar, las estimaciones del reclutamiento antes de 1993 son muy inciertas, ya que las pesquerías sobre objetos flotantes no capturaban cantidades importantes de patudo pequeño. Hubo un período de reclutamiento alto en 1995-1998, seguido por un período de reclutamiento bajo en 1999-2000. Los reclutamientos desde 2000 han sido superiores al promedio, y fue particularmente grande en 2005. El reclutamiento más reciente es muy incierto, debido a que el patudo recién reclutado está representado en solamente unas pocas muestras de frecuencia de talla. El período extendido de reclutamientos relativamente grandes 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 nivel pico de unas 626 mil toneladas (t) en 1986, tras lo cual disminuyó a un mínimo histórico de 270 mil toneladas al principio de 2007. La biomasa reproductora ha seguido generalmente una tendencia similar a de la biomasa de peces de edad 3+ trimestres, pero con un retraso de 1 a 2 años. Hay incertidumbre en la biomasa estimada de los patudos de edad 3+ trimestres y de los reproductores. No obstante, es aparente que la pesca ha reducido la biomasa total de patudo en el OPO. Se estima que la biomasa tanto de los peces de 3+ trimestres de edad como de los reproductores ha aumentado ligeramente en los últimos años.

Las estimaciones de reclutamiento y biomasa son tan sólo moderadamente sensibles a la inclinación de la relación población-reclutamiento. Concretamente, las estimaciones de la biomasa son mayores que en la evaluación del caso base, pero las tendencias son similares. .

Cuando se usa solamente la CPUE de la pesquería palangrera del sur, las estimaciones de la biomasa son mayores que en el caso base, pero las tendencias son similares. La serie de tiempo del reclutamiento es muy similar a aquélla de la evaluación del caso base, pero las estimaciones del reclutamiento son ligeramente diferentes en 2007, para cual año no se dispone de datos de CPUE de la pesquería de palangre del sur.

Cuando se aplicaron dos bloques de tiempo a la selectividad por tamaño de la pesquería sobre objetos flotantes, las biomasas estimadas y las estimaciones del reclutamiento fueron muy similares a aquéllas obtenidas para la evaluación del caso base.

Al principio de enero de 2008, la biomasa reproductora de atún patudo en el OPO estaba cerca del nivel bajo histórico. En ese momento el cociente de biomasa reproductora (*spawning biomass ratio*, o SBR: el cociente de la biomasa reproductora actual a aquélla de la población no explotada) era aproximadamente 0,17, un 10% menos que el nivel correspondiente al rendimiento máximo sostenible promedio (RMS).

Se estima que las capturas recientes han estado alrededor del nivel de RMS. Si la mortalidad por pesca (F) es proporcional al esfuerzo de pesca, y se mantienen los patrones actuales de selectividad por edad, el nivel de esfuerzo de pesca correspondiente al RMS es aproximadamente el 82% de nivel de esfuerzo actual (2005-2007). El RMS de patudo en el OPO podría ser incrementado al máximo si el patrón de selectividad por edad fuese similar a aquél de la pesquería palangrera que opera al sur de 15°N, porque captura peces más grandes de un peso cercano al crítico. Antes de la expansión de la pesquería sobre objetos flotantes que comenzó en 1993, el RMS fue mayor que el RMS actual, y la mortalidad por pesca fue inferior a F_{RMS}.

Todos los cuatro escenarios considerados sugieren que, al principio de 2008, la biomasa reproductora (S) estuvo por debajo de (S_{RMS}). El RMS y el multiplicador de F son sensibles a la forma de parametrizar el modelo de evaluación, los datos que se incluyen en la evaluación, y los períodos que se supone representan mortalidad por pesca media, pero bajo todos los escenarios considerados, la mortalidad por pesca está muy por encima de F_{RMS}.

Se predice que los picos recientes en el reclutamiento resultarán en niveles incrementados de SBR y capturas palangreras en los próximos pocos años, pero se espera que los altos niveles de mortalidad por pesca reduzcan subsiguientemente el SBR. Con los niveles actuales de esfuerzo, es poco probable que la población siga en niveles que soportan el RMS a menos que se reduzcan mucho los niveles de mortalidad por pesca o el reclutamiento sea mayor al promedio durante varios años consecutivos.

Se estima que los efectos de las Resoluciones C-04-09 y C-06-02, adoptadas en 2004 y 2006, respectivamente, son insuficientes para permitir a la población permanecer en niveles que soportarían el RMS.

Estas simulaciones se basan en el supuesto que los patrones de selectividad y capturabilidad no cambiarán en el futuro. Cambios en las prácticas con respecto a los objetivos de la pesca, o una mayor capturabilidad de patudo a medida que disminuye la abundancia (por ejemplo, capturabilidad dependiente de la densidad) podrían resultar en diferencias de los resultados aquí predichos.

2. DATOS

Se usaron datos de captura, esfuerzo, y composición por tamaño de enero de 1975 a diciembre de 2007 para llevar a cabo la evaluación de la población de atún patudo (*Thunnus obesus*) en el Océano Pacífico oriental (OPO). Los datos de 2007, de carácter preliminar, incluyen registros incorporados en la base de datos de la CIAT hasta mediados de marzo de 2008. Se resumen y analizan los datos por trimestre.

2.1. Definiciones de las pesquerías

Se definen 15 pesquerías para la evaluación de la población de patudo. Se definen sobre la base de tipo de arte (red de cerco, caña, y palangre), tipo de lance cerquero (sobre objetos flotantes, cardúmenes no asociados, y delfines), período de tiempo, zona de la CIAT de muestreo de frecuencia de tallas o latitud, y unidad de captura palangrera (número capturado o captura en peso).

En la Tabla 2.1 se definen las pesquerías de patudo, y en la Figura 2.1 se ilustran la extensión espacial de cada pesquería y los límites de las zonas de muestreo de frecuencia de tallas.

En general, se definen las pesquerías de tal forma que, con el tiempo, ocurren pocos cambios en la composición por tamaño media de la captura. Se estratifican además las definiciones de las pesquerías cerqueras sobre objetos flotantes para distinguir de forma gruesa entre lances realizados principalmente sobre objetos flotantes naturales (que también incluyen desperdicios y otros objetos artificiales) (Pesquería 1), sobre dispositivos agregadores de peces (plantados) (Pesquerías 2-3, 5, 10-11, y 13), y sobre una mezcla de los dos (Pesquerías 4 y 12). Se supone que es apropiado agrupar los datos de capturas de los barcos cañeros, y de los buques cerqueros que pescan sobre delfines y cardúmenes no asociados (Pesquerías 6 y 7). Los dos primeros métodos capturan relativamente poco patudo, y en los datos de las Pesquerías 6 y 7 predomina información sobre capturas de cardúmenes de patudo no asociados. En vista de este último, en este informe se denominarán las Pesquerías 6 y 7 pesquerías que capturan patudo en cardúmenes no asociados.

En las evaluaciones previas, se supusieron dos pesquerías de palangre con datos de captura en número (Pesquerías 8 y 9). No obstante, los datos de captura reportados por las pesquerías de palangre son una mezcla de captura en número y registros de peso. Ya que SS2 tiene la flexibilidad de incluir los datos de captura en número o en peso, se definieron dos pesquerías de palangre adicionales que reportan la captura en peso (Pesquerías 14 y 15).

2.2. Captura

Para realizar la evaluación de la población de atún patudo, se estratifican los datos de captura y esfuerzo en la base de datos de la CIAT conforme a las definiciones de pesquerías en la Sección 2.1 y la Tabla 2.1. Las tres definiciones relacionadas con los datos de captura usados en informes anteriores (descargas, descartes, y captura) son descritas por Maunder y Watters (2001). La terminología en el presente informe es consistente con aquélla usada en otros informes de la CIAT. Las capturas realizadas en un año dado son asignadas a ese año, aun si no son descargadas hasta el año siguiente. Las capturas son asignadas a dos categorías, capturas retenidas y descartes. En este documento, se usa el término "captura" para reflejar o captura total (descartes más captura retenida) o captura retenida; el contexto determina la definición apropiada.

Se usan tres tipos de datos de captura para evaluar la población de patudo. Las extracciones por las Pesquerías 1 y 8-9 son simplemente captura retenida (Tabla 2.1). Las extracciones por las Pesquerías 2-5 y 7 son captura retenida, más algunos descartes que resultan de ineficacias en el proceso de pesca (Sección 2.2.3) (Tabla 2.1). Las extracciones por las Pesquerías 10-13 son descartes que resultan solamente de la clasificación de la captura de las Pesquerías 2-5 (Sección 2.2.1).

Se incorporaron en la presente evaluación datos actualizados y nuevos de captura de las pesquerías de superficie (Pesquerías 1-7 y 10-13). Se usó el método de composición por especies (Tomlinson 2002) para estimar las capturas de las pesquerías de superficie. Se calcularon factores de escala medios para 2000-2007 dividiendo la captura total de todos los años y trimestres de las estimaciones de composición por especie par la captura total de todos los años y trimestres de las estimaciones estándar, y se aplicaron a las estimaciones de enlatadora y descargas de 1975-1999. En el caso de las Pesquerías 1, 6, y 7, usamos el promedio de las Pesquerías 2-5, para las Pesquerías 2 y 3 usamos el promedio de las Pesquerías 2 y 3, y para las Pesquerías 4 y 5 el promedio de las Pesquerías 4 y 5. Harley y Maunder (2005) presentan un análisis de sensibilidad en el que se comparan los resultados de la evaluación de la población basada en las estimaciones de composición por especie de las descargas de la pesquería de cerco con los resultados de la evaluación de la población basada en las estimaciones de descarga de las enlatadoras. Watters y Maunder (2001) presentan una breve descripción del método usado para estimar el esfuerzo de pesca de superficie.

Se dispone de datos de captura actualizados o nuevos de las pesquerías palangreras (Pesquerías 8-9 y 14-15) de Japón (2003-2006) y Taipei Chino (2004-2006). Se dispone de datos de captura de 2007 para China, Corea, Estados Unidos, Japón y Vanuatu de las estadísticas de los informes mensuales.

En la Figura 2.2 se ilustran las tendencias en la captura de patudo del OPO durante cada año del período de 1975-2007. Hubo una variación anual sustancial en las capturas de patudo de todas las pesquerías que operan en el OPO (Figura 2.2). Antes de 1996, aproximadamente, la flota palangrera (Pesquerías 8-9 y 14-15) extrajo más patudo (en peso) del OPO que la flota de superficie (Pesquerías 1-7 y 10-13) (Figura 2.2), pero desde 1996 las capturas de la flota de superficie han sido generalmente mayores que las de la flota palangrera (Figura 2.2). Cabe destacar que la evaluación presentada en este informe usa datos correspondientes al período desde el 1 de enero de 1975, y que antes de esa fecha se estaba ya pescando cantidades sustanciales de patudo en el OPO.

2.2.1. Descartes

Para los propósitos de la evaluación de poblaciones, se supone que los buques cerqueros descartan patudo de sus capturas por uno de dos motivos: ineficacias en el proceso de pesca (por ejemplo, si la captura de un lance no cabe en las bodegas disponibles del buque), o porque los pescadores seleccionan solamente el pescado de más de un cierto tamaño. En cualquier caso, se estima la cantidad de patudo descartado con información reunida por observadores de la CIAT o nacionales, aplicando métodos descritos por Maunder y Watters (2003). Sin considerar el motivo por el descarte, se supone que muere todo el pescado descartado.

Las estimaciones de descartes que resultan de ineficacias en el proceso de pesca son sumadas a las capturas retenidas de los buques cerqueros (Tabla 2.1). No se dispone de datos de observadores para estimar los descartes en las pesquerías de superficie que operaban antes de 1993 (Pesquerías 1 y 6), y se supone que dichas pesquerías no tenían descartes. Para las pesquerías de superficie que operan desde 1993 (Pesquerías 2-5 y 7), hay períodos para los cuales los datos de los observadores son inadecuados para estimar los descartes. Para estos períodos se supone que la tasa de descarte (descartes/capturas retenidas) es igual a la tasa de descarte del mismo trimestre en el año anterior o, si no se dispone de ésta, la del año más cercano.

Se tratan los descartes que resultan del proceso de clasificar la captura como pesquerías separadas (Pesquerías 10-13), y se supone que las capturas de estas pesquerías consisten solamente de peces de 2-4 trimestres de edad (Maunder y Hoyle, 2007). Watters y Maunder (2001) presentan una justificación por tratar estos descartes como pesquerías separadas. Se calculan estimaciones de la cantidad de pescado descartado durante la clasificación solamente para las pesquerías que capturan patudo asociado con objetos flotantes (Pesquerías 2-5) porque se cree que este tipo de clasificación es infrecuente en las demás pesquerías cerqueras.

En la Figura 2.3 se presenta una serie de tiempo de descartes como proporción de las capturas retenidas de las pesquerías de superficie que capturan patudo en asociación con objetos flotantes. En el caso de las pesquerías más importantes sobre objetos flotantes (2, 3 y 5), la proporción de la captura descartada ha sido baja durante los siete últimos años con respecto a la que se observa en la pesca sobre las cohortes fuertes producidas en 1997. Hay evidencias fuertes de que esto se debe en parte a las clases anuales débiles a partir de 1997, pero desde 1997 han ocurrido reclutamientos grandes (Figura 4.5). Es posible que los reglamentos que prohíben los descartes de atún hayan causado una reducción de la proporción de pescado descartado.

Se supone que no se descarta patudo en las pesquerías palangreras (Pesquerías 8-9 y 14-15).

2.3. Índices de abundancia

Los índices de abundancia fueron derivados de datos de captura y esfuerzo de cerco y de palangre. Se actualizaron los datos de esfuerzo de pesca de las pesquerías de superficie (Pesquerías 1-7 y 10-13) y se incluyeron datos nuevos de 2007. Se dispone de datos nuevos o actualizados de captura y esfuerzo de las pesquerías palangreras japonesas (2203-2006). En la Figura 2.4 se ilustran las tendencias en la cantidad de esfuerzo de pesca ejercido por las 15 pesquerías definidas para la evaluación de la población de atún patudo en el OPO.

La CPUE de las pesquerías de cerco fue calculada como captura dividida por el número de días de pesca. El número de días de pesca por tipo de lance fue calculado a partir del número de lances, usando una regresión múltiple del total de días de pesca contra número de lances por tipo (Maunder y Watters, 2001).

Se obtuvieron estimaciones de la captura por unidad de esfuerzo estandarizada (1975-2006) para las pesquerías de palangre (Pesquerías 8 y 9). Se usó un modelo lineal general delta logarítmico normal, en el cual las variables explicativas fueron latitud, longitud, y anzuelos por canasta (Hoyle y Maunder, 2006).

En la Figura 2.5 se ilustra la serie de tiempo de la CPUE de las distintas pesquerías. Los índices de abundancia considerados apropiados para uso en la evaluación fueron aquéllos de las Pesquerías 2, 3, y 5 (lances cerqueros sobre objetos flotantes) y 8 y 9 (pesquerías de palangre). Se consideraron inapropiadas las pesquerías excluidas porque las tasas de captura fueron extremadamente bajas. Además, se excluyeron los dos primeros años de las pesquerías de cerco porque estaban todavía expandiendo. Se excluyeron también observaciones con pocos datos de esfuerzo.

2.4. Datos de composición por tamaño

Se dispone de datos de frecuencia de talla nuevos de 2007 y actualizados de años previos para las pesquerías de superficie. Se dispone de datos de frecuencia de talla nuevos o actualizados de la flota palangrera japonesa (2002-2004). No se usan en la evaluación datos de composición por tamaño de las otras flotas palangreras.

Las pesquerías del OPO capturan patudo de varios tamaños. En evaluaciones previas se describió la composición por tamaño media de las capturas de cada pesquería definida en la Tabla 2.1. Las pesquerías que capturan patudo asociado con objetos flotantes captura típicamente patudo pequeño- (< 75 cm) y mediano (75 a 125 cm) (Figuras 2.6a-i, Pesquerías 1-5). Antes de 1993, la captura de patudo pequeño fue aproximadamente igual a la de patudo mediano (Figura 2.6a, Pesquería 1), pero desde 1993 predomina el patudo pequeño de las pesquerías que capturan patudo en asociación con objetos flotantes (Figuras 2.6b-e, Pesquerías 2-5). Una excepción es el período de 1999-2002, cuando una cohorte fuerte pasó por la pesquería y predominaron peces grandes en la captura.

Antes de 1990, los lances sobre atunes no asociados capturaban principalmente patudo mediano (Figura 2.6f, Pesquería 6), pero desde entonces han capturado más patudo pequeño y grande (de más de 125 cm) (Figura 2.6g, Pesquería 7). Las capturas de las dos pesquerías palangreras (Pesquerías 8 y 9) son de composición por tamaño marcadamente diferentes. En la zona al norte de 15ºN (Pesquería 8), los palangreros capturan principalmente pescado mediano, y la composición por tamaño media muestra dos picos notorios (las bandas en 80 cm y 120 cm en la Figura 2.6h); en la zona al sur de 15ºN (Pesquería 9), capturan cantidades sustanciales de patudos medianos y grandes, pero la composición de tamaños tiene una sola moda (Figura 2.6i), pero parece haber ocurrido una transición de peces medianos a grandes en aproximadamente 1984.

Los datos de frecuencia de talla de la flota de Taipei Chino incluyen más peces pequeños que aquéllos de la flota japonesa, pero existen preocupaciones acerca de la representatividad de las muestras de frecuencia de talla de la flota de Taipei Chino (Stocker 2005, Anónimo 2006). Maunder y Hoyle (2007) realizaron un análisis de sensibilidad usando la flota de Taipei Chino como pesquería separada.

3. SUPUESTOS Y PARÁMETROS

3.1. Información biológica y demográfica

3.1.1. Crecimiento

Schaefer y Fuller (2006) usaron datos de marcado y recaptura y de los incrementos diarios en los otolitos para estimar curvas de crecimiento para el atún patudo en el OPO. Ambas fuentes de datos brindaron estimaciones similares, con un sesgo aparente en los datos de marcado, el cual se cree ser debido a que se encoja el pescado, ya que los atunes recapturados fueron medidos durante la descarga (después que fueron almacenados congelados). La curva de crecimiento estimada por Schaefer y Fuller (2006) es sustancialmente diferente de las curvas de crecimiento usadas en las evaluaciones previas del atún patudo en el OPO (Figura 3.1): en particular, indica que el crecimiento es aproximadamente lineal, y resulta en peces más grandes a una edad dada. La talla asintótica de la curva de crecimiento de von Bertalanffy estimada por Schaefer y Fuller (2006) es mucho mayor que cualquier talla observada. Esto es razonable, siempre que no se asigne ningún significado biológico al parámetro de talla asintótica y que se use el modelo solamente como representación de las edades de los peces que muestrearon. La edad máxima de los patudos en su conjunto de datos es aproximadamente 4 años (16 trimestres), y no se considera que su curva de crecimiento de von Bertalanffy sea apropiada para peces de edades mayores. Maunder y Hoyle (2006) ajustaron una curva de crecimiento de Richards, usando una función de verosimilitud logarítmica normal con varianza constante y el parámetro de talla asintótica fijado en aproximadamente la talla del patudo de mayor tamaño en los datos (186,5 cm). Maunder y Hoyle (2007) usaron la curva de crecimiento resultante como distribución previa para todas las edades en la evaluación de la población. Se usa esta curva de crecimiento también para convertir los otros parámetros biológicos de edad a talla y para la estimación de la mortalidad natural.

Las evaluaciones previas (por ejemplo, Harley y Maunder 2005), las evaluaciones del atún aleta amarilla del OPO (por ejemplo, Maunder 2002), y las evaluaciones de los atunes en el Océano Pacífico occidental y central (Lehodey *et al.* 1999; Hampton y Fournier 2001a, 2001b;) sugieren que el crecimiento de los atunes más jóvenes no sigue una curva de crecimiento de von Bertalanffy. Sin embargo, es posible que esta observación sea consecuencia de una selectividad por talla de peces pequeños.

La talla a edad usada en el modelo de evaluación se basa en la curva de crecimiento de von Bertalanffy. Se estimaron los parámetros de la curva de crecimiento obteniendo la mejor correspondencia de talla a edad usada por Maunder y Hoyle (2007).

Hampton y Maunder (2005) descubrieron que los resultados de la evaluación de la población son muy sensibles al valor supuesto del parámetro de talla asintótica. Por lo tanto, Maunder y Hoyle (2007) realizaron análisis de sensibilidad para investigar la influencia del valor supuesto de ese parámetro. Se investigaron un valor mínimo de 171,5, cercano al valor estimado por las evaluaciones de las poblaciones del Océano Pacífico occidental y central (Adam Langley, Secretaría de la Comunidad del Pacífico, com. pers.), y un valor máximo de 201,5. Aires-da-Silva y Maunder (2007) también realizaron un análisis de sensibilidad de la evaluación del patudo a esos mismos dos valores. Un valor más bajo del parámetro de talla asintótica produjo biomasas y reclutamientos mayores.

Otro componente importante del crecimiento usado en los modelos estadísticos por edad de la captura por talla es la variación en la talla a edad. La información sobre la talla a edad contiene información sobre la variación de la talla a edad además de información sobre la talla a edad promedio. La variación en la talla a edad fue tomada de la evaluación previa. Se realizó un análisis de sensibilidad que estimó la talla media y la variación en la talla a edad mediante la integración de datos de edad-talla de lecturas de otolitos (Schaefer y Fuller, 2006) en el modelo de evaluación.

Se usó la siguiente relación peso-talla, de Nakamura y Uchiyama (1966), para convertir tallas a pesos en la presente evaluación de la población:

$$w = 3.661 \times 10^{-5} \cdot l^{2.90182}$$

donde w = peso en kilogramos y l = talla en centímetros.

3.1.2. Mortalidad natural

Se suponen los vectores de mortalidad natural (M) por edad para el patudo. La presente evaluación usa un modelo específico por sexo, y por lo tanto incluye un calendario de mortalidad natural para cada sexo (Figura 3.2). La evaluación previa de la población supone una mortalidad natural constante (M = 0,1) para los peces de 0-4 trimestres de edad (Aires-da-Silva y Maunder 2007). Han sido implementados en SS2 nuevos elementos que brindan mayor flexibilidad en el tratamiento de la mortalidad natural. Como resultado, se supone una estimación mayor de la mortalidad natural (M = 0,25) para los peces de ambos sexos de 0 trimestres de edad, disminuyendo a 0,1 a los 5 trimestres de edad. Al igual que en la evaluación previa, se supone que la mortalidad natural de las hembras aumento después de alcanzar la madurez. Estos vectores por edad de la mortalidad natural se basan en un ajuste de las proporciones de hembras por edad, la madurez por edad, y las estimaciones de mortalidad natural de Hampton (2000).

3.1.3. Reclutamiento y reproducción

Se supone que el patudo puede ser reclutado a la población pescable durante cada trimestre del año. Es posible que el reclutamiento sea continuo durante todo el año, porque peces individuales pueden desovar casi cada día si la temperatura del agua es adecuada (Kume 1967; Schaefer *et al.* 2005).

SS2 permite especificar una relación población-reclutamiento de Beverton-Holt (1957). Se parametriza la curva de Beverton-Holt para que la relación entre la biomasa reproductora (la biomasa de hembras maduras) y el reclutamiento sea determinada mediante la estimación del reclutamiento medio producido por una población no explotada (reclutamiento virgen), un parámetro denominado inclinación. La inclinación controla la velocidad con la cual disminuye el reclutamiento cuando se reduce la biomasa reproductora. Se define como la fracción del reclutamiento virgen que se produce si se reduce la biomasa reproductora al 20% de su nivel no explotado. La inclinación puede variar entre 0,2 (en cual caso el reclutamiento es una función lineal de la biomasa reproductora) y 1,0 (en cual caso el reclutamiento es independiente de la biomasa reproductora). En la práctica es a menudo difícil estimar la inclinación debido a una falta de contraste en la biomasa reproductora y porque hay otros factores (por ejemplo, influencias ambientales) que pueden causar que el reclutamiento sea altamente variable. Para la presente evaluación, se supone que el reclutamiento es independiente del tamaño de la población (inclinación = 1). No existen evidencias de que el reclutamiento esté relacionado con el tamaño de la población reproductora en el caso del patudo en el OPO y, si se estima la inclinación como parámetro libre, es cercana a 1. Se presenta también un análisis de sensibilidad con inclinación = 0,75. Además de los supuestos requeridos para la relación población-reclutamiento, se aplica un limitación de los desvíos del reclutamiento con una desviación estándar de 0,6.

Los insumos de reproducción se basan en los resultados de Schaefer *et al*. (2005) y en datos provistos por el Dr. N. Miyabe, del Instituto Nacional de Investigación de Pesquerías de Ultramar (NRIFSF) de Japón. Se usó información sobre la edad a talla (Schaefer y Fuller 2006) para convertir en edad la fecundidad y la proporción madura por talla (Figura 3.3, Tabla 3.1).

3.1.4. Desplazamientos

La presente evaluación no considera los desplazamientos explícitamente, sino que se supone que la población esté mezclada al azar al principio de cada trimestre del año. El personal de la CIAT está estudiando los desplazamientos del patudo dentro del OPO usando datos recién obtenidos de marcas convencionales y archivadoras, y estos estudios indican niveles sustanciales de fidelidad regional del patudo en el OPO. Es posible que los resultados de estos estudios produzcan información útil para la evaluación de la población. Se considerará un marco con estructura espacial en las evaluaciones futuras de las poblaciones.

3.1.5. Estructura de la población

En el Documento SARM-9-08 se resumen los conocimientos actuales de la estructura de la población del patudo en el OPO. Los resultados de los estudios de marcado indican una fidelidad regional de la especie en la región, y sugieren un grado muy bajo de mezcla entre el Pacífico oriental y occidental (Schaefer y Fuller 2002; Schaefer y Fuller 2008). Por consiguiente, y para los propósitos de la presente evaluación, se supone que hay dos, una en el OPO y la otra en el Pacífico occidental y central, y que no ocurre un intercambio de peces neto entre estas dos regiones. El personal de la CIAT está realizando una evaluación del patudo del Pacífico entero en colaboración con científicos del Programa de Pesquerías Oceánicas de la Secretaría de la Comunidad del Pacífico (SPC) y del NRIFSF. Es posible que esta labor ayude a señalar cómo el supuesto de una sola población en el OPO podría afectar la interpretación de los resultados obtenidos del método SS2. Análisis recientes (Hampton *et al*. 2003) que estiman tasas de desplazamiento dentro del Océano Pacífico, produjeron tendencias de la biomasa muy similares a aquéllas estimadas por Harley y Maunder (2004).

3.2. Influencias ambientales

Las condiciones oceanográficas podrían afectar el reclutamiento de atún patudo a las pesquerías en el OPO. En evaluaciones previas (Watters y Maunder 2001, por ejemplo), se usaron anomalías de la velocidad zonal (anomalías de la velocidad en dirección este-oeste) a 240 m de profundidad en una zona desde 8°N hasta 15°S entre 100°-150°O como candidato de variable ambiental para afectar el reclutamiento. Se estimaron las anomalías de velocidad zonal a partir de los resultados de un modelo general de circulación obtenidos en http://ingrid.ldeo.columbia.edu. Maunder y Hoyle (2007) realizaron un análisis de sensibilidad para investigar la relación entre el reclutamiento y el índice de El Niño; demostró que existía una relación negativa significativa, pero que explicaba solamente una pequeña proporción de la variabilidad total del reclutamiento.

En evaluaciones previas (Watters y Maunder 2001 y 2002; Maunder y Harley 2002), se supuso que las condiciones oceanográficas afectan la eficacia de las cinco pesquerías que capturan patudo asociado con objetos flotantes (Pesquerías 1-5). En la evaluación de Maunder y Harley (2002) se supuso una influencia ambiental sobre capturabilidad para la Pesquería 3 solamente. Se descubrió que incluir este efecto no mejoró mucho los resultados, y no se consideraron influencias ambientales sobre la capturabilidad en la presente evaluación.

4. EVALUACIÓN DE LA POBLACIÓN

Aires-da-Silva y Maunder (2007) fueron los primeros en usar el método SS2 para evaluar la condición del atún patudo en el OPO. Consiste en un modelo de evaluación de poblaciones estadístico integrado (ajustado a muchos tipos de datos diferentes) basado en tamaño y con estructura por edad. El modelo es ajustado a los datos observados (índices de abundancia relativa y composiciones de tamaño) con un conjunto de parámetros de dinámica de población y de pesca que maximizan una verosimilitud penalizada, dada la cantidad de captura tomada por cada pesquería. Muchos aspectos de los supuestos subyacentes del modelo son descritos en la Sección 3. Incluye también los siguientes supuestos importantes:

1. El patudo es reclutado a las pesquerías de descarte (Pesquerías 10-13) 1 trimestre después de la cría, y dichas pesquerías capturan solamente peces de las primeras pocas clases de edad.
2. A medida que envejece el patudo, se vuelve más vulnerable a los palangres en la zona al sur de 15°N (Pesquerías 9 y 14) y la Pesquería 7, y los peces de mayor edad son los más vulnerables a estas artes.
3. Los datos de las pesquerías que capturan patudo en cardúmenes no asociados (Pesquerías 6 y 7), las pesquerías antes de 1993 y costera sobre objetos flotantes (Pesquería 1 y 4), y las pesquerías cuya captura consiste de descartes de clasificación (Pesquerías 10-13) brindan relativamente poca información sobre niveles de biomasa, porque no dirigen su esfuerzo hacia el patudo. Por este motivo, las series de tiempo de CPUE de estas pesquerías no fueron usadas cama índices de abundancia.

Se estimaron los parámetros siguientes en la presente evaluación de la población de patudo del OPO:

1. Reclutamiento en cada trimestre desde el primer trimestre de 1975 hasta el cuarto trimestre de 2007 (incluye estimación del reclutamiento virgen y anomalías temporales del reclutamiento);
2. Coeficientes de capturabilidad de las cinco series de tiempo de CPUE usadas como índices de abundancia;
3. Curvas de selectividad para 9 de las 15 pesquerías (las Pesquerías 10-13 tienen curvas de selectividad supuestas, y las selectividades de las Pesquerías 14 y 15 son iguales que las de las Pesquerías 8 y 9, respectivamente);
4. Tamaño inicial y estructura por edad de la población.

Se supone que se conocen los parámetros siguientes para la presente evaluación de la población de patudo en el OPO:

1. tasas de mortalidad natural por sexo y edad (Figura 3.2);
2. curva de madurez por edad (Tabla 3.1 y Figura 3.3);
3. curvas de selectividad para las pesquerías de descarte (Pesquerías 10-13);
4. la inclinación de la relación población-reclutamiento;
5. talla media por edad (Sección 3.1.1, Figura 3.1);
6. parámetros de un modelo lineal que relaciona las desviaciones estándar en la talla a edad con la talla a edad promedio.

Se calcularon las estimaciones de las cantidades de ordenación y las proyecciones a futuro con base en las tasas medias de explotación trienales, por arte, de 2005-2007. Se probó la sensibilidad de las estimaciones de cantidades de ordenación clave a la inclusión del último año (2007) en la estimación de la tasa de explotación trienal media. Para este fin, se usó una tasa de explotación media bienal (2005-2006) en los cálculos.

Hay incertidumbre en los resultados de la presente evaluación de la población. Esta incertidumbre resulta de que los datos observados no representan perfectamente la población de patudo en el OPO. Además, es posible que el modelo de evaluación de la población no represente perfectamente la dinámica de la población de patudo ni de las pesquerías que operan en el OPO. Se expresa la incertidumbre en la forma de intervalos de confianza aproximados y coeficientes de variación (CV). Se estimaron los intervalos de confianza y CV bajo el supuesto que el modelo de evaluación de la población representa perfectamente la dinámica del sistema. Ya que es poco probable que se satisfaga este supuesto, es posible que estos valores subestimen el grado de incertidumbre en los resultados de la presente evaluación.

4.1. Resultados de la evaluación

A continuación describimos los aspectos importantes de la evaluación del caso base (1) y los siete análisis de sensibilidad (2-4):

1. Evaluación del caso base: inclinación de la relación población-reclutamiento = 1 (no hay relación entre población y reclutamiento), series de tiempo de CPUE para las Pesquerías 2-5 sobre objetos flotantes y las Pesquerías 8-9 de palangre, selectividad de tamaño de las distintas pesquerías que no varían con el tiempo (un solo bloque de tiempo);
2. Sensibilidad a la inclinación de la relación población-reclutamiento. La evaluación del caso base incluye un supuesto que el reclutamiento es independiente del tamaño de la población y se usó una relación población-reclutamiento de Beverton-Holt (1957) con una inclinación de 0,75 para el análisis de sensibilidad.
3. Sensibilidad a los índices de abundancia. La evaluación del caso base incluyó la serie de tiempo de CPUE de las Pesquerías 2, 3, y 5 (lances cerqueros sobre objetos flotantes) y 8 y 9 (pesquerías de palangre). Se realizó un análisis de sensibilidad de los resultados de la evaluación al uso de solamente la CPUE estandarizada de la Pesquería 9. No se incluyó la CPUE estandarizada de la Pesquería 8, debido al carácter estacional de esta pesquería.
4. Sensibilidad al supuesto de dos bloques de tiempo para las selectividades de tamaño de las Pesquerías 2-5 sobre objetos flotantes. Un requisito que los buques de cerco retengan todo el atún capturado, introducido originalmente en la Resolución C-00-08 de la CIAT, está en vigor desde 2001. Esto podría haber resultado en cambios en la selectividad de las capturas retenidas de estas pesquerías, particularmente de peces pequeños, que podrían no haber sido observados en las muestras de tamaño tomadas antes de la Resolución. Por lo tanto, se consideraron dos bloques de tiempo de selectividad: antes de la Resolución (1975-2000) y después de la Resolución (2001-presente). Los patrones de selectividad de las Pesquerías de descarte (10-13) permanecieron sin cambiar en este análisis.

Es probable que los resultados presentados en las secciones siguientes cambien en evaluaciones futuras porque (1) datos futuros podrían proporcionar evidencias contrarias a estos resultados, y (2) es posible que cambien los supuestos y constreñimientos usados en el modelo de evaluación. Cambios futuros afectarán más probablemente las estimaciones absolutas de la biomasa, del reclutamiento, y de la mortalidad por pesca.

4.1.1. Mortalidad por pesca

Han ocurrido cambios importantes en la cantidad de mortalidad por pesca de patudo en el OPO. En promedio, la mortalidad por pesca de peces de menos de unos 15 trimestres de edad ha aumentado desde 1993, y la de peces de más de unos 15 trimestres ha aumentado ligeramente (Figura 4.1). El aumento en la mortalidad por pesca media de peces jóvenes puede ser atribuido a la expansión de las pesquerías que capturan patudo en asociación con objetos flotantes. Estas pesquerías (Pesquerías 2-5) capturan cantidades sustanciales de patudo (Figura 2.2), seleccionan peces que generalmente miden menos de 100 cm de talla (Figura 4.2), y han ejercido una cantidad de esfuerzo de pesca relativamente grande desde 1993 (Figura 2.4).

En la Figura 4.3 se ilustran las tendencias temporales en la cantidad de mortalidad por pesca anual por edad de atún patudo. Estas tendencias reflejan la distribución del esfuerzo de pesca entre las varias pesquerías que capturan patudo (Figura 2.4) y cambios en la capturabilidad. La tendencia temporal en la tasa de mortalidad por pesca anual demuestra que la mortalidad por pesca ha aumentado mucho para los peces pequeños y tan sólo ligeramente para los mayores desde aproximadamente 1993. En el Anexo D (Tabla D.1) se presenta un resumen anual de las estimaciones de la mortalidad por pesca total.

4.1.2. Reclutamiento

Las evaluaciones previas descubrieron que la abundancia del patudo reclutado a las pesquerías en el OPO parecía estar relacionada con anomalías de la velocidad zonal a 240 m durante el período en el que se supone que se criaron los peces (Watters y Maunder 2002). El mecanismo responsable de esta relación no ha sido identificado, y las correlaciones entre el reclutamiento y los índices ambientales son a menudo espurias; se debería considerar la relación entre la velocidad zonal y el reclutamiento de patudo con escepticismo. No obstante, esta relación suele señalar que el reclutamiento de patudo es incrementado por eventos fuertes de El Niño y reducido por eventos fuertes de La Niña. Los análisis que no incluyeron índices ambientales y que usaron velocidad zonal produjeron estimaciones de reclutamiento similares (Harley y Maunder 2004). Esto sugiere que hay suficiente información en los datos de frecuencia de talla para estimar la fuerza de la mayoría de las clases anuales históricas, pero el índice podría ser útil para reducir la incertidumbre en las estimaciones de la fuerza de las cohortes más recientes, para las cuales se dispone de pocas muestras de composición por tamaño. Un análisis previo de sensibilidad al efecto de incluir el índice ambiental demostró que el índice no fue estadísticamente significativo (Maunder y Hoyle 2006), o explicó solamente una pequeña proporción de la variación total del reclutamiento (Maunder y Hoyle 2007). Por lo tanto, no fue incluido ningún índice ambiental en el análisis.

Dentro del rango de biomasas reproductoras estimadas ilustradas en la Figura 4.7, la abundancia de reclutas de patudo no parece estar relacionada con la biomasa reproductora de hembras adultas en el momento de cría (Watters y Maunder 2002, Figura 4.4). Evaluaciones previas del patudo en el OPO (por ejemplo, Watters y Maunder 2001, 2002) tampoco señalaron una relación entre biomasa adulta y reclutamiento sobre el rango estimado de biomasas reproductoras. La estimación de inclinación del caso base está fijada en 1, lo cual arroja un modelo con un supuesto débil que el reclutamiento es independiente del tamaño de la población. Las consecuencias de sobreestimar la inclinación, en términos de rendimiento perdido y el potencial de sobrepesca de reclutamiento (Harley *et al.*, análisis inédito), son mucho peores que las consecuencias de subestimarla. En el Anexo B se presenta un análisis de sensibilidad que supone que el reclutamiento está moderadamente relacionado con el tamaño de la población (inclinación = 0,75).

En la Figura 4.5 se ilustra la serie de tiempo del reclutamiento estimado de patudo, y en la Tabla 4.1 el reclutamiento total que se estima ocurre durante cada año. La serie de tiempo del reclutamiento estimado de patudo tiene varias características importantes. En primer lugar, las estimaciones del reclutamiento antes de 1993 son muy inciertas, ya que las técnicas para capturar patudos pequeños asociados con objetos flotantes no estaban en uso. Hubo un período de reclutamiento alto en 1994-1998, seguido por un período de reclutamiento bajo en 1999-2000. Los reclutamientos desde 2001 han sido superiores al promedio, y fue particularmente grande en 2005 y 2006. Las estimaciones del reclutamiento reciente son muy inciertas, debido a que el patudo recién reclutado está representado en solamente unos pocos conjuntos de datos de frecuencia de talla. El período extendido de reclutamientos relativamente grandes durante 1994-1998 coincidió con la expansión de las pesquerías que capturan patudo en asociación con objetos flotantes.

4.1.3. Biomasa

En la Figura 4.6 se ilustran las tendencias en la biomasa de patudo de edad 3+ trimestres en el OPO, y en la Tabla 4.1 estimaciones de la biomasa al principio de cada año. La biomasa de patudo de 3+ trimestres de edad aumentó durante 1983-1984, y alcanzó su nivel máximo de unas 626.000 toneladas en 1986, tras lo cual disminuyó a un nivel mínimo histórico de unas 270.000 toneladas al principio de 2007.

En la Figura 4.7 se ilustra la tendencia estimada en la biomasa reproductora, y en la Tabla 4.1 las estimaciones de la biomasa reproductora al principio de cada año. Generalmente, la biomasa reproductora ha seguido una tendencia similar a la de la biomasa de patudos de 3+ trimestres, pero con un retraso de uno ó dos años. Se estimó que la biomasa de los peces de 3+ trimestres de edad y de los reproductores aumentaron ligeramente en los últimos años.

Existe incertidumbre en las biomasas estimadas de los reproductores. El CV medio de las estimaciones de la biomasa reproductora es 0,15.

Dado el grado de incertidumbre en las estimaciones de la biomasa y del reclutamiento (Secciones 4.1.2 y 4.1.3), es difícil determinar si las tendencias en la biomasa de patudo son más afectadas por variación en la mortalidad por pesca o el reclutamiento. No obstante, la evaluación sugiere dos conclusiones. En primer lugar, es aparente que la pesca ha reducido la biomasa total de patudo presente en el OPO. Se formó esta conclusión sobre la base de los resultados de una simulación en la cual se proyectó la biomasa de patudo que se estima estaría presente en el OPO si no hubiese tenido lugar la pesca, usando la serie de tiempo de anomalías estimadas del reclutamiento y el efecto ambiental estimado sin pesca. Las estimaciones de biomasa simuladas son siempre mayores que las estimaciones de biomasa del modelo de evaluación del caso base (Figura 4.8). En segundo lugar, la biomasa de patudo puede ser incrementada sustancialmente por reclutamientos fuertes. Ambos picos en la biomasa de patudos de 3+ trimestres de edad (1986 y 2000; Figura 4.6) fueron precedidos por niveles pico de reclutamiento (1982-1983, y 1997-1998, respectivamente; Figura 4.5), al igual que el ligero incremento reciente de la biomasa.

A fin de estimar el impacto de las distintas pesquerías sobre la reducción de la población, realizamos simulaciones en las que se excluyó cada arte y se extendió el modelo a futuro, igual que en la simulación sin pesca. En la Figura 4.8 se presentan también los resultados de este análisis. Queda claro que la pesquería palangrera ejerció el mayor impacto sobre la población antes de 1995, pero con la reducción del esfuerzo de las pesquerías palangreras, y la expansión de la pesca sobre objetos flotantes, actualmente el impacto de la pesquería de cerco sobre la población es mucho mayor que aquél de la pesquería palangrera. Los descartes de patudo pequeño tienen un impacto pequeño, pero detectable, sobre la reducción de la población. En general, se estima que la biomasa reproductora es aproximadamente el 17% de lo que se esperaría si no hubiera ocurrido pesca.

4.1.4. Peso promedio de los peces en la captura

En la Figura 4.9 se ilustran las tendencias en el peso medio de patudo capturado por las pesquerías que faenan en el OPO. Las pesquerías que capturan patudo en asociación con objetos flotantes (Pesquerías 1-5) capturan principalmente peces pequeños de, en promedio, menos del peso crítico, indicando que estas pesquerías no maximizan el rendimiento por recluta (ver Maunder y Hoyle 2007). El peso medio del patudo capturado por las pesquerías palangreras (Pesquerías 8 y 9) ha estado alrededor del peso crítico, indicando que esta pesquería suele maximizar el rendimiento por recluta (ver Maunder y Hoyle 2007). El peso medio de todas las pesquerías combinadas disminuyó sustancialmente a partir de 1993 a medida que aumentó el esfuerzo cerquero sobre objetos flotantes.

El peso medio en las pesquerías tanto de superficie como de palangre disminuyó alrededor de 1997-1998 al ingresar a la pesquería una cohorte fuerte. Los pesos medios aumentaron entonces a medida que crecieron los peces en esa cohorte, y luego disminuyeron a medida que esos peces fueron eliminados de la población.

Los pesos medios de las pesquerías de superficie predichos por el modelo difieren que los pesos medios "observados", particularmente antes de 1984. Se estiman los pesos medios "observados" mediante la ampliación de las muestras de frecuencia de talla a la captura total, método diferente a aquél usado en el modelo de evaluación de la población, que usa las curvas de selectividad fijas y las tasas de explotación estimadas de cada pesquería para estimar el peso medio.

4.2. Comparaciones con fuentes externas de datos

No se realizaron comparaciones con datos externos en la presente evaluación.

4.3. Diagnósticos

Se comentan los diagnósticos en dos secciones, análisis de residuales y retrospectivos.

4.3.1. Análisis de residuales

En la Figura 4.10 se ilustran los ajustes del modelo a los datos de CPUE de distintas pesquerías. Tal como se espera, el modelo se ajusta estrechamente a las observaciones de CPUE de la pesquería palangrera del sur. Los ajustes a las otras series de datos de CPUE son menos satisfactorios.

Se presentan gráficas de residuales de Pearson para los ajustes del modelo a los datos de composición por talla (Figuras 4.11a-i). Los círculos sólidos y abiertos representan observaciones inferiores y superiores, respectivamente, a las predicciones del modelo. El tamaño de los círculos es proporcional al valor absoluto de los residuales. Los residuales presentan varias características notables. El modelo sobreestima los peces grandes y pequeños para las pesquerías sobre objetos flotantes posteriores a 1993. En particular, sobreestima los peces grandes durante 1999-2002, cuando una cohorte fuerte pasó por la pesquería. A la inversa, el modelo sobreestima los peces medianos para la pesquería palangrera del sur. Esta sobreestimación se centra en los 80 cm antes de 1988, y luego sube a 180 cm, indicando un cambio en la selectividad. Se realizó un análisis de sensibilidad en la evaluación previa en el que se consideraron dos bloques de tiempo para la selectividad y capturabilidad de la pesquería de palangre del sur. El patrón de residuales del ajuste del modelo a los datos de composición por tamaño de esta pesquería mejoró. El modelo se ajustó al índice de abundancia de la CPUE de la pesquería de palangre del sur muy estrechamente. No obstante, las biomasas durante la parte temprana del período histórico fueron menores que aquéllas estimadas por la evaluación del caso base.

El ajuste a los datos medido por el error cuadrático medio sugiere que el modelo se ajusta al índice de CPUE de la Pesquería 9 mejor (CV = 0.17) mejor que aquéllos de otras pesquerías. Los peores ajustes a los datos de CPUE son aquéllos de las Pesquerías 3 y 5 (CV = 0.79), seguidos por la Pesquería 2 (CV = 0,42). Con respecto a los datos de frecuencia de talla, y con la excepción de las Pesquerías 6 y 7el modelo se ajusta a los datos mejor (tal como indica el tamaño de muestra efectivo estimado) que lo que se refleja en los CV supuestos en las funciones de verosimilitud. En la última evaluación (Aires-da-Silva y Maunder 2007), se realizó un análisis de sensibilidad para investigar la ponderación de los conjuntos de datos. Concretamente, las desviaciones estándar y tamaños de muestra apropiados para las funciones de verosimilitud fueron determinados iterativamente, con base en el ajuste a los datos. Cuando se aplicó una reponderación iterativa, se asignó más peso a los datos de frecuencia de talla, y se estimó que las biomasas fueron más bajas en los segmentos más temprano y más tardío del período histórico.

4.3.2. Análisis retrospectivo

Los análisis retrospectivos son útiles para determinar la consistencia de un método de evaluación de poblaciones de un año al siguiente. Inconsistencias pueden a menudo señalar insuficiencias en el método de evaluación. Este enfoque es diferente de la comparación de evaluaciones recientes (Sección 4.6) en la que los supuestos del modelo difieren entre estas evaluaciones, y diferencias serían de esperar. Los análisis retrospectivos generalmente implican la eliminación repetida de un año de datos del análisis pero sin cambiar el método ni los supuestos. Esto permite al analista determinar el cambio en las cantidades estimadas a medida que se incluyen más datos en el modelo. Las estimaciones de los años más recientes son a menudo inciertas y sesgadas. El análisis retrospectivo y el supuesto que el uso de más datos mejora las estimaciones pueden ser usados para determinar si hay sesgos consistentes en las estimaciones.

Se realizaron análisis retrospectivos mediante la eliminación de un año (2007), dos años (2007 y 2006), tres años (2007, 2006, 2005), y cuatro años (2007, 2006, 2005, 2004) de datos (Figura 4.12). Estos análisis señalaron un incremento de la biomasa en 2004, 2005, 2006, y 2007, mientras que el caso base indicó una tendencia casi estable durante el mismo período. Esto corrobora los resultados de análisis retrospectivos previos, que indican que las estimaciones recientes de biomasa son sujetas a sesgos retrospectivos (Harley y Maunder, 2004; Aires-da-Silva y Maunder 2007). Aunque las tendencias en las biomasas son iguales, en general, el análisis retrospectivo también señala que las estimaciones de la biomasa del modelo de caso base son menores que aquéllas estimadas cuando no se incorporan en el modelo los últimos años de datos. El sesgo retrospectivo no necesariamente indica la magnitud y dirección del sesgo en la evaluación actual, sino solamente que el modelo podría estar incorrectamente especificado..

4.4. Análisis de sensibilidad

Se presentan los resultados de los tres análisis de sensibilidad en los anexos: sensibilidad a la relación población-reclutamiento (Anexo A), uso de los datos de CPUE de la pesquería palangrera de sur solamente (Anexo B), y el uso de dos bloques de tiempo para la selectividad de las pesquerías sobre objetos flotantes (Anexo C). Aquí se describen las diferencias en al ajuste del modelo y las predicciones del modelo, y se aplaza la discusión de las diferencias en la condición de las poblaciones hasta la Sección 5. En la Tabla 4.3 se compara la verosimilitud del caso base y de los análisis de sensibilidad.

La inclinación de la relación población-reclutamiento de Beverton-Holt (1957) fue fijada igual a 0,75. Las estimaciones de biomasa (Figura A.1) son mayores que aquéllas estimadas en la evaluación del caso base, pero las tendencias son similares. La serie de tiempo de reclutamiento es similar al caso base (Figura A.2). En la Figura A.4 se presenta la relación población-reclutamiento estimada.

Cuando se usó solamente la CPUE de la pesquería palangrera de sur, la biomasa estimada fue generalmente mayor, pero las tendencias de la misma en el análisis de sensibilidad y el modelo del caso base son muy similares (Figura B.1). Las estimaciones de reclutamiento son asimismo muy similares en ambos modelos (Figura B.2), pero son ligeramente diferentes en los trimestres más recientes en 2007, para los cuales no se dispone de los datos de CPUE de la pesquería de palangre del sur. En la Figura B.4 se ilustra el ajuste del modelo a la serie de tiempo de CPUE de la Pesquería 9.

Fueron considerados dos bloques de tiempo para la selectividad por tamaño de las Pesquerías 2-5 sobre objetos flotantes; concretamente, los períodos antes (1975-2000) y después (2001-presente) de la Resolución C-00-08, que prohibió los descartes de atunes pequeños. Se obtuvieron pequeñas diferencias en las curvas de selectividad de tamaños de estas pesquerías (Figura C.4), pero las biomasas estimadas y las estimaciones del reclutamiento fueron muy similares a aquéllas obtenidas en el modelo del caso base.

Otros análisis de sensibilidad, incluyendo la investigación de la estimación del crecimiento, los efectos ambientales sobre el reclutamiento y la capturabilidad, la mortalidad natural, el uso de una reponderación iterativa, y el uso de dos bloques de tiempo para la selectividad y capturabilidad de la pesquería de palangre del sur, fueron realizadas por Watters y Maunder (2002), Harley y Maunder (2004, 2005), y Maunder y Hoyle (2007), y Aires-da-Silva y Maunder (2007).

4.5. Comparación con evaluaciones previas

Las biomasas sumaria y reproductora (Figuras 4.13 y 4.14, respectivamente) estimadas por las evaluaciones actual y previa del modelo de población (Aires-da-Silva y Maunder 2007) son muy similares en términos absolutos. Las biomasas iniciales, empero, son ligeramente menores en la evaluación actual de la población. La diferencia absoluta entre las estimaciones de los cocientes de la biomasa reproductora (SBR) de las evaluaciones actual y previa (Aires-da-Silva y Maunder 2007) es ligeramente mayor, particularmente durante los años iniciales del modelo (1975-1980). No obstante, las tendencias de los SBR son muy similares.

Los reclutamientos estimados por la evaluación actual son ligeramente mayores que las estimaciones de la evaluación previa (Figura 4.16a). Tal como se esperaba, debido al incremento de la mortalidad natural, los reclutamientos son mayores en el caso base comparados con la evaluación previa. No obstante, los reclutamientos relativos son muy similares (Figura 4.16b).

4.6. Resumen de los resultados del modelo de evaluación

Han ocurrido cambios importantes en la cantidad de mortalidad por pesca causada por las pesquerías que capturan atún patudo en el OPO. En promedio, la mortalidad por pesca de patudo de menos de unos 15 trimestres de edad ha aumentado sustancialmente desde 1993, y la de peces de más de unos 15 trimestres ha aumentado ligeramente desde entonces. El aumento en la mortalidad por pesca sobre los peces más jóvenes fue causado por la expansión de las pesquerías que capturan patudo en asociación con objetos flotantes.

Por todo el rango de biomasas reproductoras estimadas por la evaluación de caso base, la abundancia de los reclutas de patudo no parece estar relacionada con el potencial reproductor de hembras adultas en el momento de cría.

La serie de tiempo de estimaciones de reclutamiento de patudo tiene varias características importantes. En primer lugar, las estimaciones del reclutamiento antes de 1993 son muy inciertas, ya que las pesquerías sobre objetos flotantes no estaban capturando cantidades importantes de patudo pequeño. Hubo un período de reclutamiento alto en 1995-1998, seguido por un período de reclutamiento bajo en 1999-2000. Los reclutamientos desde 2001 han sido superiores al promedio, y fueron particularmente grandes en 2005 y 2006. El reclutamiento más reciente es muy incierto, debido a que el patudo recién reclutado está representado en solamente unas pocas muestras de frecuencia de talla. El período extendido de reclutamientos relativamente grandes durante 1995-1998 coincidió con la expansión de las pesquerías que capturan patudo en asociación con objetos flotantes.

La biomasa de patudos de 3+ trimestres de edad aumentó durante 1983-1984, y alcanzó su nivel pico de 625,649 toneladas en 1986, tras lo cual disminuyó a una mínima histórica de 269,266 toneladas al principio de 2007. En general, la biomasa reproductora ha seguido una tendencia similar a de la biomasa de peces de 3+ trimestres, pero con un retraso de 1-2 años. Hay incertidumbre en las biomasas estimadas de tanto los patudos de 3+ trimestres como de reproductores. No obstante, es aparente que la pesca ha reducido la biomasa total de patudo en el OPO. Se estimó que la biomasa de tanto los peces de 3+ trimestres de edad como los reproductores ha aumentado en los últimos años (2005-2007).

Las estimaciones de biomasa son tan sólo moderadamente sensibles a la inclinación de la relación población-reclutamiento. Concretamente, las estimaciones de la biomasa son mayores que aquéllas estimadas en la evaluación del caso base, pero las tendencias son similares. La serie de tiempo del reclutamiento es similar a aquélla del caso base.

Cuando se usa solamente la CPUE de la pesquería palangrera de sur, las estimaciones de la biomasa mayores que aquéllas estimadas en la evaluación del caso base, pero las tendencias son similares. La serie de tiempo del reclutamiento es muy similar a aquélla del caso base. No obstante, las estimaciones del reclutamiento son ligeramente diferentes en 2007, año para el cual no se dispone de datos de CPUE de la pesquería de palangre del sur.

Cuando se aplicaron dos bloques de tiempo a la selectividad de tamaño de las pesquerías sobre objetos flotantes, las estimaciones de biomasa y reclutamiento fueron muy similares a aquéllas obtenidas con el modelo de caso base.

5. CONDICIÓN DE LA POBLACIÓN

Se evalúa la condición de la población de patudo en el OPO mediante la consideración de cálculos basados en la biomasa reproductora y el rendimiento máximo sostenible (RMS). Se define el RMS como la mayor captura o rendimiento promedio a largo plazo que puede ser tomada de una población o de un complejo de poblaciones bajo las condiciones ecológicas y ambientales prevalecientes.

Se están desarrollando ampliamente como lineamientos para la ordenación de pesquerías puntos de referencia precautorios del tipo contemplado en el Código de Conducta de FAO para la Pesca Responsable y el Acuerdo de Naciones Unidas sobre Poblaciones de Peces. Mantener las poblaciones de atunes en niveles que produzcan el RMS es el objetivo de ordenación especificado en la Convención de la CIAT. La CIAT no ha adoptado puntos de referencia objetivo ni límite para las poblaciones de los que responde, pero en las cinco subsecciones siguientes se describen unos puntos de referencia posibles.

5.1. Evaluación de la condición de la población basada en biomasa reproductora

El cociente de biomasa reproductora (*spawning biomass ratio*, o SBR: el cociente de la biomasa reproductora actual a aquélla de la población no explotada), descrito por Watters y Maunder (2001), ha sido usado para definir puntos de referencia en muchas pesquerías. Tiene un límite inferior de cero. Si el SBR es cercano a cero, la población ha sido gravemente reducida y está probablemente sobreexplotada. Si el SBR es uno, o un poco menos que uno, la pesquería probablemente no ha reducido la población reproductora. Si el SBR es más que uno, es posible que la población haya emprendido un régimen de producción incrementada.

Varios estudios (Clark 1991, Francis 1993, Thompson 1993, Mace 1994, entre otros) sugieren que ciertas poblaciones de peces son capaces de producir el RMS cuando el SBR está entre 0,3 y 0,5, y que otras no son capaces de producir el RMS si la biomasa reproductora durante un período de explotación es menos de aproximadamente 0,2. Desgraciadamente, los tipos de dinámica poblacional que caracterizan las poblaciones de atunes no han sido considerados en estos estudios, y sus conclusiones son sensibles a supuestos sobre la relación entre biomasa adulta y reclutamiento, mortalidad natural, y tasas de crecimiento. A falta de estudios de simulación diseñados específicamente para determinar puntos de referencia apropiados para atunes basados en SBR, se pueden comparar estimaciones de SBR_t con una estimación de SBR correspondiente al RMS ($SBR_{RMS} = S_{RMS}/S_{F=0}$).

Se computaron estimaciones de SBR_t para el patudo en el OPO a partir de la evaluación del caso base. En la Sección 4.1.3 se presentan estimaciones de la biomasa reproductora durante el período del estudio (1975-2007). Se estimó el SBR correspondiente al RMS (SBR_{RMS}) en un 0,19.

Al principio de enero de 2008, la biomasa reproductora de patudo en el OPO estuvo cerca del nivel bajo histórico (Figura 5.1). En ese momento el SBR era aproximadamente 0,17, 10% menos que el nivel correspondiente al RMS.

Al principio de 1975, el SBR era aproximadamente 0,26 (Figura 5.1a). Esto es consistente con el hecho que el patudo en el OPO fue pescado con palangre durante un largo período antes de 1975 y que la biomasa reproductora consiste de individuos de mayor edad que son vulnerables a los palangres. El SBR aumentó, particularmente durante 1984-1986 y, al principio de 1987 fue 0,47. Este aumento puede ser atribuido al reclutamiento superior al promedio durante 1982 y 1983 (Figura 4.5) y a las capturas relativamente pequeñas de las pesquerías de superficie durante ese período (Figura 2.2, Pesquerías 1 y 6). Este pico en la biomasa reproductora fue seguido inmediatamente por un pico en la captura palangrera (Figura 2.2, Pesquería 9). Después de 1987, el SBR disminuyó a un nivel de aproximadamente 0,20 a mediados de 1999. Esta reducción puede ser atribuida principalmente a un largo período (1984-1993) durante el cual el reclutamiento fue bajo. Nótese también que la pesquería palangrera del sur tuvo capturas relativamente grandes durante 1985-1994 (Figura 2.2, Pesquería 9). En 1999, el SBR comenzó a aumentar, y alcanzó aproximadamente 0,33 en 2002. Este aumento puede ser atribuido a los niveles de reclutamiento relativamente altos que se estima ocurrieron durante 1994-1998 (Figura 4.5). A partir de fines de 2002 y durante 2003, el SBR disminuyó rápidamente, debido a las clases anuales débiles en 1999 y 2000, las capturas grandes de las pesquerías de superficie, y las capturas palangreras incrementadas.

El SBR muestra una tendencia con el tiempo similar a la evaluación previa (Figura 4.15). No obstante, los niveles de SBR estimados son más bajos que aquéllos estimados en la evaluación previa (Aires-da-Silva y Maunder 2007), particularmente en los primeros años del período del estudio (1975-1980).

5.2. Evaluación de la condición de la población con base en RMS

Mantener las poblaciones de atunes en niveles que permitan capturar el RMS es el objetivo especificado por la Convención de la CIAT. Watters y Maunder (2001) describen cómo se calculan el RMS y sus cantidades relacionadas, pero se modificaron estos cálculos para incluir, en casos apropiados, la relación población-reclutamiento de Beverton-Holt (1957) (ver Maunder y Watters (2003) para mayor detalle). Es importante notar que las estimaciones del RMS y sus cantidades asociadas son sensibles a la inclinación de la relación población-reclutamiento (Sección 5.4), y, para la evaluación del caso base, se fijó la inclinación en 1 (un supuesto que el reclutamiento es independiente del tamaño de la población); sin embargo, se realizó un análisis de sensibilidad (inclinación = 0,75) para investigar el efecto de una relación población-reclutamiento.

Se calcularon las estimaciones basadas en RMS con los parámetros estimados de la evaluación del caso base y patrones estimados de mortalidad por pesca promediados para 2005 y 2007. Por tanto, aunque se presentan estos resultados basados en RMS como estimaciones de punto, estos resultados contienen incertidumbres. Mientras que no se emprendieron análisis para presentar la incertidumbre en las estimaciones del caso base, como en una evaluación previa (Maunder y Harley 2002), se realizaron análisis adicionales para presentar la incertidumbre en esas cantidades en relación con los períodos que se supone representan capturabilidad y mortalidad por pesca.

Al principio de enero de 2008, la biomasa reproductora de patudo en el OPO parece haber sido un 10% menos que S_{RMS}, y se estima que las capturas recientes han sido un 8% mayores que el S_{RMS} (Tabla 5.1).

Si la mortalidad por pesca es proporcional al esfuerzo de pesca, y se mantienen los patrones actuales de selectividad por edad (Figura 4.2), el F_{RMS} es aproximadamente el 77% del nivel actual de esfuerzo.

Se estiman las cantidades basadas en el RMS suponiendo que la población está en equilibrio con la pesca, pero durante 1995-1998 no fue así. Esto tiene implicaciones potencialmente importantes para las pesquerías de superficie, ya que sugiere que la captura de patudo por la flota de superficie podría ser determinada principalmente por la fuerza de las cohortes reclutadas. Por ejemplo, las capturas de patudo por dicha flota disminuyeron cuando las cohortes grandes reclutadas durante 1995-1998 ya no eran vulnerables a esas pesquerías.

Las estimaciones del RMS, y sus cantidades asociadas, son sensibles al patrón de selectividad por edad que se usa en los cálculos. Las cantidades basadas en RMS descritas anteriormente se basaron en un patrón de selectividad promedio para todas las pesquerías combinadas (calculado a partir de la distribución actual de esfuerzo entre pesquerías). Distribuciones diferentes del esfuerzo de pesca entre pesquerías cambiarían este patrón de selectividad combinado. A fin de ilustrar cómo cambiaría el RMS si se distribuyera el esfuerzo de otra forma entre las distintas pesquerías (aparte de las pesquerías de descarte) que capturan patudo en el OPO, se repitieron los mismos cálculos usando el patrón de selectividad por edad estimado para cada grupo de pesquerías (Tabla 5.2). Si estuviese operando solamente la pesquería de cerco, el RMS sería aproximadamente 30% menos. Si el patudo fuese capturado por la pesquería palangrera solamente, el RMS sería aproximadamente 89% mayor que lo que se estima para todas las artes combinadas. Para lograr este nivel de RMS, el esfuerzo palangrero necesitaría ser incrementado un 320%.

Las cantidades relacionadas con el RMS varían con la composición por talla de la captura. En la Figura 5.2 se ilustra la evolución de cuatro de éstas durante 1975-2007. Antes de la expansión de la pesquería sobre objetos flotantes que comenzó en 1993, el RMS era mayor que el RMS actual, y la mortalidad por pesca era menor que aquélla correspondiente al RMS (Figura 5.2).

Cuando se estima el RMS usando las tasas medias de mortalidad por pesca de 2005-2006, es 416 t (0,5%) menos que el caso base.

La Figura 5.3 ilustra la serie de tiempo histórica de las tasas de explotación y la biomasa reproductora con respecto a los puntos de referencia de RMS. En general, los puntos de referencia no fueron rebasados hasta los años recientes. Las cuatro estimaciones más recientes indican que la población de patudo en el OPO se encuentra probablemente sobreexplotada ($S < S_{RMS}$) y que la pesca actual es excesiva ($F > F_{RMS}$); los intervalos de confianza de la biomasa reproductora abarcan el nivel de RMS.

5.3. Sensibilidad a parametrizaciones y datos alternativos

Los rendimientos y puntos de referencia son moderadamente sensibles a supuestos alternativos en el modelo, datos de insumo, y los períodos supuestos para la mortalidad por pesca (Tablas 5.1 y 5.2).

El análisis de sensibilidad que incluía un modelo población-reclutamiento con una inclinación de 0,75 estimó que el SBR requerido para sostener el RMS es 0,30, comparado con 0,19 para la evaluación del caso base (Tabla 5.1). El análisis de sensibilidad a inclinación estima un multiplicador de F considerablemente menor que la evaluación del caso base (0,57). Todos los análisis estiman que el SBR actual es menor que el SBR_{RMS}.

Las cantidades de ordenación son tan sólo moderadamente sensibles a los períodos recientes de mortalidad por pesca usados en los cálculos (Tabla 5.2).

5.4. Resumen de la condición de la población

Al principio de enero de 2008, la biomasa reproductora de atún patudo en el OPO estaba cerca del nivel bajo histórico (Figura 5.1). En ese momento el SBR era aproximadamente 0,17, un 10% menor que el nivel correspondiente al RMS (SBR_{RMS}).

Se estima que las capturas recientes han estado alrededor del nivel de RMS (Tabla 5.1). 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 RMS es aproximadamente el 82% de nivel de esfuerzo actual (2005-2007). El RMS de patudo en el OPO podría ser incrementado al máximo si el patrón de selectividad por edad fuese similar a aquél de la pesquería palangrera que opera al sur de 15°N, porque captura individuos de mayor tamaño, cercanos al peso crítico. Antes de la expansión de la pesquería sobre objetos flotantes que comenzó en 1993, el RMS era mayor que el RMS actual, y la mortalidad por pesca era menor que F_{RMS} (Figura 5.2).

Todos los análisis señalan que, al principio de 2008, la biomasa reproductora estuvo probablemente por debajo de S_{RMS} (Tablas 5.1 y 5.2). El RMS y el multiplicador de F son sensibles a la forma de parametrizar el modelo de evaluación, los datos que se incluyen en la evaluación, y los períodos que se supone representan mortalidad por pesca media, pero bajo todos los escenarios considerados, la mortalidad por pesca está muy por encima de F_{RMS}.

6. EFECTOS SIMULADOS DE OPERACIONES DE PESCA FUTURAS

Se realizó un estudio de simulación para lograr una mejor comprensión de cómo, en el futuro, cambios hipotéticos en la cantidad de esfuerzo de pesca ejercido por la flota de superficie podrían simultáneamente afectar a la población de patudo en el OPO y las capturas de patudo por las distintas pesquerías. Se construyeron varios escenarios hipotéticos para definir cómo las distintas pesquerías que capturan patudo en el OPO operarían en el futuro, y también para definir la dinámica futura de la población de patudo. En las Secciones 6.1 y 6.2 se describen los supuestos en los que se basan estos escenarios.

Se aplicó un método basado en la aproximación normal al perfil de verosimilitud (Maunder *et al.* 2006). Desgraciadamente, los métodos apropiados no son a menudo aplicables a modelos tan grandes e intensivos en términos de computación como el modelo de evaluación de la población de patudo. Por lo tanto, usamos una aproximación normal al perfil de verosimilitud, que permite la inclusión de la incertidumbre en los parámetros y la incertidumbre acerca del reclutamiento futuro. Este método es aplicado mediante la extensión del modelo de evaluación durante cinco años adicionales con tasas de explotación iguales medial promedio de 2005-2007. No se incluyen datos de captura ni de frecuencia de talla para estos años, y se estiman los reclutamientos de los cinco años de la misma forma que en el modelo de evaluación, con una pena logarítmica normal con una desviación estándar de 0.6.

6.1. Supuestos sobre las operaciones de pesca

6.1.1. Esfuerzo de pesca

Se realizaron estudios de proyección a futuro a fin de investigar el efecto de distintos niveles de esfuerzo de pesca (tasas de explotación) sobre la biomasa de la población y la captura.

Los análisis realizados fueron:

1. Las tasas de captura trimestrales de cada año en el futuro fueron fijadas iguales a la tasa de captura media de 2005 a 2007, para simular el esfuerzo reducido que resulta de las medidas de conservación de la Resolución C-04-09;
2. Se realizó un análisis adicional que estima la condición de la población status si la resolución no hubiera sido aplicada. Para 2004-2007, el esfuerzo cerquero en el tercer trimestre fue incrementado un 86%, y la captura en la pesquería palangrera del sur un 39% en todos los trimestres. Para 2008-2012, se incrementó la tasa de explotación cerquera un 13% en todos los trimestres y la tasa de explotación de la pesquería palangrera de sur un 39% en todos los trimestres.

6.2. Resultados de la simulación

Se usaron las simulaciones para pronosticar los niveles futuros del SBR, la biomasa total, la captura total de las pesquerías de superficie primarias que presuntamente seguirían operando en el OPO (Pesquerías 2-5 y 7), y la captura total de la flota palangrera (Pesquerías 8-9 y 14-15). Hay probablemente más incertidumbre en los niveles futuros de estas variables producidas por el modelo de lo que sugieren los resultados presentados en las Figuras 6.1-6.4. La cantidad de incertidumbre es probablemente subestimada, porque las simulaciones fueron realizadas bajo el supuesto que el modelo de evaluación de la población describe correctamente la dinámica del sistema y sin tomar en cuenta la variación en la capturabilidad.

6.2.1. Niveles actuales de captura

Se realizaron proyecciones, suponiendo que las tasas de explotación seguirían al nivel medio de 2004 y 2005 (incluyendo las restricciones de esfuerzo y captura de las Resoluciones C-04-09 y C-06-02).

Se estima que el SBR ha aumentado ligeramente en los últimos años (Figura 5.1). Se atribuye el aumento a dos picos en el reclutamiento reciente. Si continúan los niveles recientes de esfuerzo y capturabilidad, se predice que el SBR aumentará por encima del nivel que soportaría el RMS durante 2009-2010, y que luego disminuirá durante 2011-2013 a un nivel ligeramente menor que aquél que soportaría el RMS (Figura 6.1a). Se estima que la biomasa reproductora aumentará ligeramente con respecto a 2005-2007, pero que probablemente disminuirá en el futuro (Figura 6.2).

Se predice que las capturas cerqueras disminuirán durante el período de la proyección (Figura 6.3, recuadros izquierdos). Se predice que las capturas palangreras aumentarán moderadamente en 2008, pero que comenzarán a disminuir antes de 2009 con el esfuerzo actual (Figura 6.3, recuadros derechos). Las capturas disminuirían ligeramente más si se incluyera una relación población-reclutamiento, debido a reducciones en los niveles de reclutamiento que contribuyen a las capturas cerqueras.

Las capturas predichas para ambas artes se basan en el supuesto que la selectividad de cada flota seguirá igual, y que la capturabilidad no aumentará a medida que disminuya la abundancia. Si la capturabilidad del patudo aumenta con abundancia baja, las capturas serán, a corto plazo, mayores que las que se predicen en el presente análisis.

6.2.2. Sin restricciones de ordenación

Las Resoluciones C-04-09 y C-06-02 contemplan restricciones sobre el esfuerzo cerquero y las capturas palangreras durante 2004-2007: una veda de seis semanas durante el tercer o cuarto trimestre en el caso de las pesquerías de cerco, y una limitación de las capturas palangreras al nivel de 2001. A fin de evaluar la utilidad de estas medidas, proyectamos la población 5 años al futuro, suponiendo que no se apliquen estas medidas de conservación en el futuro. Las capturas proyectadas hubieran sido menores de no haber sido adoptada la resolución (Figura 6.3, recuadros inferiores)

Una comparación del SBR predicho sin y con las restricciones de la resolución señala cierta diferencia (Figura 6.4). Sin las restricciones, el SBR aumentaría tan sólo ligeramente y luego disminuiría a niveles más bajos.

Las reducciones de la mortalidad por pesca que podrían resultar de la continuación de la Resolución C-06-02 son insuficientes para permitir a la población mantener niveles por encima de aquéllos correspondientes al RMS a largo plazo, aunque se espera un incremento por encima del nivel de RMS durante unos años, debido al alto reclutamiento reciente.

6.2.3. Análisis de sensibilidad

El análisis que incluye una relación población-reclutamiento indica que la población está sustancialmente por debajo de SBR_{RMS}, y que seguirá en este nivel con los niveles actuales de esfuerzo (Figura 6.1b).

6.3. Resumen de los resultados de la simulación

Se predice que los picos recientes en el reclutamiento resultarán en niveles de SBR y capturas palangreras incrementados en los próximos años, pero se espera que altos niveles de mortalidad por pesca reduzcan subsecuentemente el SBR. Con los niveles de esfuerzo actuales, es poco probable que la población permanezca en niveles que soportarían el RMS, a menos que se reduzcan mucho los niveles de mortalidad por pesca o que el reclutamiento sea mayor al promedio durante varios años consecutivos.

Se estima que los efectos de la Resolución C-04-09 serán insuficientes para permitir a la población permanecer en niveles que soportarían el RMS.

Estas simulaciones se basan en el supuesto que los patrones de selectividad y capturabilidad no cambiarán en el futuro. Cambios en el objetivo de la pesca o una mayor capturabilidad de patudo con una disminución de la abundancia (por ejemplo, una capturabilidad dependiente de la densidad) podrían causar resultados diferentes de los que aquí se predicen.

7. DIRECCIONES FUTURAS

7.1. Colección de información nueva y actualizada

El personal de la CIAT piensa continuar la colección de datos de captura, esfuerzo, y composición por tamaño de las pesquerías que capturan atún patudo en el OPO. En la próxima evaluación de la población se incorporarán datos actualizados y nuevos.

El personal de la CIAT continuará la compilación de datos de captura y esfuerzo palangreros de las pesquerías que operan en el OPO. En particular, se procurará obtener datos para pesquerías recientemente desarrolladas y crecientes.

7.2. Refinamientos del modelo y métodos de evaluación

El personal de la CIAT seguirá desarrollando la evaluación del atún patudo del OPO con *Stock Synthesis II*. En gran parte, los avances dependerán de cómo se modifique el software de *Stock Synthesis II* en el futuro. Los cambios siguientes serían deseables para evaluaciones futuras:

1. Usar una curva de crecimiento más flexible (por ejemplo, la de Richards) o incluir un vector de

talla a edad para que la curva de crecimiento represente mejor aquélla usada en las evaluaciones previas que usaron A-SCALA.

2. Facilitar la ejecución de proyecciones con tasas de explotación fijas.
3. Evaluar de nuevo las definiciones de las pesquerías.
4. Determinar ponderaciones apropiadas de los distintos conjuntos de datos.
5. Incluir los datos de marcado disponibles en la evaluación.

Continuará la colaboración con el personal de la Secretaría de la Comunidad del Pacífico en el modelo del patudo del Pacífico entero.

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January 5, 2009

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Subject: Western and Central Pacific Fisheries Commission Fifth Annual Meeting Report

Dear Don,

This letter provides you with an early report of the results of the Western and Central Pacific Fisheries Commission (WCPFC) Fifth Regular Session, held in Busan, South Korea, December 8-12, 2008, which I attended along with highly migratory species (HMS) Staff Officer Kit Dahl. Our attendance at regional fishery management organization (RFMO) meetings has become important, because decisions taken by the WCPFC, and the parallel RFMO in the eastern Pacific, the Inter-American Tropical Tuna Commission (IATTC), affect both the species and fisheries managed under the Pacific Fishery Management Council (Pacific Council) HMS fishery management plan (FMP). Furthermore, U.S. implementing legislation for accession to the treaty provides an active role for the Council in shaping positions taken by the U.S. delegation. Although it is unfortunate that the President did not appoint a Pacific Council member as a Commissioner, as per our interpretation of the implementing legislation, our attendance goes some way towards advancing Council positions within the U.S. delegation.

The Commission considered seven Conservation and Management Measures (CMMs) at this meeting; the following six CMMs were adopted:

- Bigeye and Yellowfin Tuna in the Western Pacific Ocean
- Sea Turtles
- Prohibit the Use of Large Scale Driftnets on the High Seas in the Convention Area
- Swordfish in the Southwest Pacific (Revision of CMM-2006-03)
- Sharks in the Western and Central Pacific Ocean (Revision of CMM-2006-05)
- Cooperating Nonmembers (Amendments to CMM 2004-02)

In addition, the Commission adopted a Resolution on Aspirations of Small Islands Developing States. The proposed CMM for North Pacific bluefin tuna considered by the Northern Committee (and discussed at the Council's November meeting) was not brought forward to the plenary because Korea did not lift their reservation. This was disappointing, as was the fairly cursory discussion of Northern Committee recommendations and future activities.

The Commission also elected a new Chair, Ambassador Satya N. Nandan of Fiji, succeeding the current Chair, Mr. Glenn Hurry of Australia. Ambassador Nandan has a distinguished career working in international institutions and played an important role in negotiations over the United Nations Convention on the Law of the Sea.

The CMM for bigeye and yellowfin tuna undoubtedly received the most attention during the meeting. A detailed 36 point Chairman's Proposal was circulated three weeks in advance of the meeting to highlight concern and initiate focused diligence on this CMM. Bigeye and yellowfin tuna are incidentally caught in purse seine fisheries targeting skipjack tuna in the Western and Central Pacific Ocean. They are also the target of longline fisheries, including the fishery based in Hawaii and the single vessel fishery based on the U.S. west coast. You will recall that the Pacific Council adopted an amendment to our HMS FMP in 2006 to address bigeye tuna overfishing in the eastern Pacific. Since that time, the condition of the stock in both the eastern and western Pacific has worsened. The latest WCPFC stock assessment finds that the 2003-2006 average fishing mortality rate for the western Pacific stock is about one and a half times the rate that would produce maximum sustainable yield (MSY). As a result, the WCPFC Science Committee recommended that fishing mortality on bigeye tuna be cut by 30 percent. There are also emerging conservation concerns for yellowfin tuna, which are caught together with bigeye tuna in purse seine and longline fisheries; measures sufficient to end overfishing on bigeye tuna are likely to also to address the threat of yellowfin tuna overfishing (there is a 47 percent chance that the Western Central Pacific Ocean yellowfin fishing mortality rate exceeds F_{MSY}). The attached "Kobe graphs" illustrate the multiple year conservation concern for bigeye tuna and the elevated risk of yellowfin tuna overfishing.

The CMM for bigeye and yellowfin tuna includes measures for both purse seine and longline fisheries during the 2009-2011 period. Purse seine measures include:

- Implementation of a vessel day scheme (VDS) by the Parties to the Nauru Agreement (PNA) members (Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Palau, Papua New Guinea, Solomon Islands, and Tuvalu), which limits total days fished in the Exclusive Economic Zone (EEZ) of PNA members to no greater than 2004 levels. (Most purse seine fishing occurs in the waters and adjacent high seas around these island nations.)
- A 3-month prohibition on using Fishing Aggregating Devices (FADs), which tend to attract juvenile bigeye and yellowfin tuna, when fishing in EEZs.

- Beginning in 2010 a closure of "high seas pockets" (high seas areas completely enclosed by EEZs).
- The development of a vessel day scheme for all high seas waters, which would complement the VDS PNA members have agreed to. The high seas VDS would come into effect in 2010.

For the longline fisheries, the measure identifies a 10 percent cut in catch from either the average catch 2001-2004 or 2004 catch, whichever is greater, in each year 2009-2011, resulting in a 30 percent cut by the end of the period. There are various exemptions and exceptions in the agreement. For example, nations whose longline fisheries catch less than 2,000 mt in 2004 may increase catch to that level. Furthermore, small island developing states undertaking "responsible development" of their domestic fisheries are exempted from this 2,000 mt limit. An exemption for longline fisheries delivering exclusively fresh fish was also agreed to, which would apply to the Hawaii fishery.

Other important aspects of the CMM included an alternative for Japan and the question of applicability to Philippine and Indonesian fisheries. An alternative to the purse seine FAD closure was carved out for nations that can demonstrate that they have an effective system for tracking bigeye tuna landings from the entire nation's purse seine vessels; instead they would be subject to a 10 percent catch reduction in 2009 relative to 2001-2004 catches. This exemption was put forward by Japan with the expectation that it would be the only nation qualifying. Perhaps most significant, it is unclear whether anything in the measure would apply to fisheries in the Philippines and Indonesia. Because the waters around these nations are the center of bigeye and yellowfin spawning, their fisheries tend to catch a disproportionate amount of juvenile fish, substantially contributing to current overfishing.

Overall, it does not appear the collective CMM will achieve the recommended 30 percent reduction in 2009, and it is unlikely to do so over the 3-year 2009-2011 period, based on preliminary assessment estimates. However, it does represent an important step forward, with concessions made across countries and sectors in order to reach agreement. In fact, it may be unprecedented in magnitude for international RFMOs in achieving conservation of a key HMS species.

The CMM on sea turtles is also of interest because of our history with longline fisheries. For longline fisheries, the CMM requires vessels operating in the Convention Area, beginning in 2010, to use large circle hooks, or whole finfish bait, or use any other measure or mitigation plan that the Commission finds is capable of reducing the sea turtle interaction rate. This measure was advanced by the U.S., and reflects research and experience in U.S. fisheries demonstrating the efficacy of circle hooks and fish bait. Implementation of this measure could reduce sea turtle takes in foreign fisheries, facilitating the recovery of sea turtle stocks in the Pacific. Since the Council is currently considering measures to reopen a west coast shallow-set longline fishery targeting swordfish, adoption of this measure is relevant to our activities.

Also it is important to mention the measures for sharks and high seas driftnets, both proposed by the United States. The shark measure updates CMM 2006-05 by strengthening requirements for reporting to the WCPFC on implementation of National Plans of Action and shark catch statistics. It also specifies a process for better specifying the weight ratio of shark fins to shark carcasses required aboard a vessel (to discourage retention of fins only). The high seas driftnet resolution supplements the current United Nations moratorium on large-scale driftnets by prohibiting them under the WCPFC and facilitating enforcement of the prohibition.

With regard to representing the Pacific Council during the course of the week, we participated in the U.S. delegation activities and hopefully made a positive contribution. We focused on issues related to the Northern Committee, especially albacore tuna, and the bigeye and yellowfin tuna CMM. We attempted to promote the Pacific Council perspective on conservation and management for each issue at hand. The head of the delegation, Ms. Jane Luxton, and the Commissioner from the State Department, Mr. Bill Gibbons-Fly, accepted our views and materials with interest and good grace.

At the onset of the week, I developed a scorecard intended to indicate how effective the package of bigeye tuna conservation measures would be in reducing fishing mortality by the amount needed to end overfishing, both in 2009 and over the full 3 years to which the CMM applies. Kit worked with U.S. Delegation Scientists to insert and update impact estimates of each CMM element (see attached mid-week and post-meeting scorecards). I believe this helped delegation members to keep in perspective the efficacy of the measures as they were being debated.

I think we will be able to more effectively participate in the U.S. delegation once the Pacific HMS Memorandum of Understanding (MOU) between the Council and the Departments of State and Commerce is finalized. Consultations before this meeting were confined to a single conference call of U.S. delegation participants barely 2 weeks before the beginning of the meeting. Through the MOU, we hope to have more substantive consultations in preparation for the WCPFC plenary meeting and subsidiary committee meetings (Scientific Committee, Northern Committee, and Technical Compliance Committee). As appropriate, the MOU may also help to formalize processes whereby Council input is given and received. As an ancillary benefit of attending the meeting, we were able to coordinate another negotiation session between all parties towards finalizing the MOU, scheduled for January 13, 2009.

It was awkward that the Commissioner selected between the Pacific and Western Pacific Councils, Mr. Peter Young, who sits on the Western Pacific Fisheries Management Council, did not attend the meeting, nor did he participate in the advance briefing and planning conference call mentioned above; we heard of no explanation given for his absence. Given that the President chose not to appoint a Commissioner from the Pacific Council, the expectations were for Mr. Young to bear the responsibility for representing the concerns of both Councils. In that regard we may have been shortchanged by his absence, ameliorated by the leadership of Ms. Luxton and Mr. Gibbons-Fly in allowing the Pacific Council perspective to be advanced in the daily U.S. Delegation meetings. In any event, our attendance at the meeting and participation in delegation meetings offered some compensation for Mr. Young's absence. However, the Commissioner seat provides a more formal and higher profile vantage point from which to articulate Council positions. For future WCPFC meetings, we hope that the incoming Presidential administration would give serious weight to our letter of record asking for reconsideration of a Pacific Council Commissioner appointment.

On the other hand, the collective U.S. Delegation worked diligently and effectively to achieve the successes accomplished at the meeting. Without listing all the individuals that warrant recognition, I would note a contingent of NMFS employees that were at the heart of the delegation who deserve a lot of credit for their advance preparations and key activity during the course of the week. Also, Ms. Luxton's organizational and communication skills as the head of delegation and Mr. Gibbons-Fly's experience and perseverance as the lead negotiator were vital to the favorable result.

I will give a full report on the results of the WCPFC Fifth Regular Session at our March Council meeting.

Sincerely,

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

Attachments
KRD:ckm

cc: Council Members
Ms. Jane Luxton, NOAA GC, Commissioner and Head of Delegation
Mr. Bill Gibbons-Fly, Department of State, Commissioner
Mr. Paul Krampe, Commissioner
Mr. Rick Gaffney, Commissioner
Mr. Peter Young, Commissioner
Ms. Kitty Simonds, WPFMC Executive Director
Mr. Sean Martin, WPFMC Chairman
Mr. Manuel Duenas, WPFMC Vice-Chairman
Dr. Rebecca Lent, NOAA Fisheries Director of International Affairs
Mr. Bill Robinson, Regional Administrator, NMFS Pacific Islands
Mr. Charles Karnella, NMFS PIRO International Fisheries Administrator
Mr. Ray Clarke, NMFS PIRO International Fisheries Program
Dr. Keith Bigelow, NMFS Fish Biology and Stock Assessment Division
Ms. Amanda Hallberg, Senate Commerce, Science, and Technology staff

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Prelminary U.S. Delegation Worksheet: initial estimates subject to further analysis

Bigeye Tuna Conservation Management Measure Summary Analysis

("Scorecard")

Objective: For the period 2009-2011, reduce the total population fishing mortality rate of at least 30% from the 2001-2004 average.

Individual CMM and Fishing Mortality Rate Reduction (FMR) Estimates

CMM No. (DP22 Rev3)	CMM Reference Summary	FMR Reduction Estimate 2009	2010	2011	Comment
					Estimates are in absolute percentage points of FMR
1 thru 7	General rules and provisions	0%	0%	0%	
Purse Seine Fisheries					
8 & 9	Objective & implementation provisions	0%	0%	0%	
10	Limit Vessel Days inPNA EEZ areas to 2004 level, 2009	0%	0%	0%	
10 (bis)	60 day FAD closure in EEZs and High Seas, 2009	-3.3%	0%	0%	
11	10% reduction in effort in High Seas area, 2009	0%	0%	0%	CMM 11 is an optional alternative to the High Seas portion of #10
12a	2010-11: Reduce to 2004 effort level in PNA EEZ areas	0%	0%	0%	
12b	2010-11: Implement PNA3	0%			
13	2010-11: Non-PNA area CCM compatable reductions	0%	-5%	-5%	Specified to be at -30% rate in EEZ areas, no specific CMMs
14	2010-11: 3 month High Seas FAD closure	0%			
15	2010-11: Close High Seas pockets	0%	-3.6%	-3.6%	
16	FAD Management Plans and marking requirements	0%	0%	0%	
17	Secretariat FAD report	0%	0%	0%	
18 & 19	Juvenile tuna research	0%	0%	0%	
20	Full catch retention	0%	0%	0%	
21	Observer requirement provision	0%	0%	0%	
22	Developing skipjack fisheries exemption	0%	0%	0%	
Longline Fisheries					
23	Phased reduction concept (see CMM no. 25 for est.)	0%	0%	0%	
24	Small fisheries exemption (< 2000 mt)	0%	0%	0%	Allows for increase in fishing mortality rate, but assume no increase
25a	10% catch reduction in 2009 (quota)	-4%	0%	0%	
25b	Additional 10% catch reduction in 2010 (quota)	0%	-7.9%	0%	
25c	Additional 10% catch reduction in 2011 (quota)	0%	0%	-11.8%	
26	2000 mt floor	0%	0%	0%	
27	YFT effrot transfer protection provision	0%	0%	0%	
28	Zone-based limits review and report	0%	0%	0%	
29	"Other" tuna fisheries provisions	0.5%	0.5%	0.5%	Allows for increase in fishing mortality rate
31 thru 36	Reports, controls, and administrative matters	0%	0%	0%	
	Total Fishing Mortality Rate Reduction	-6.8%	-16.0%	-19.9%	Estimates yet to be adjusted for "limitation avoidance" behavior and stock size declines 2009 - 2011.
	Objective	-30%	-30%	-30%	
	Difference from Objective	Far short	~half	~one third short	

Preliminary US Delegation Worksheet: initial estimates subject to further analysis

Bigeye Tuna Conservation Management Measure Summary Analysis

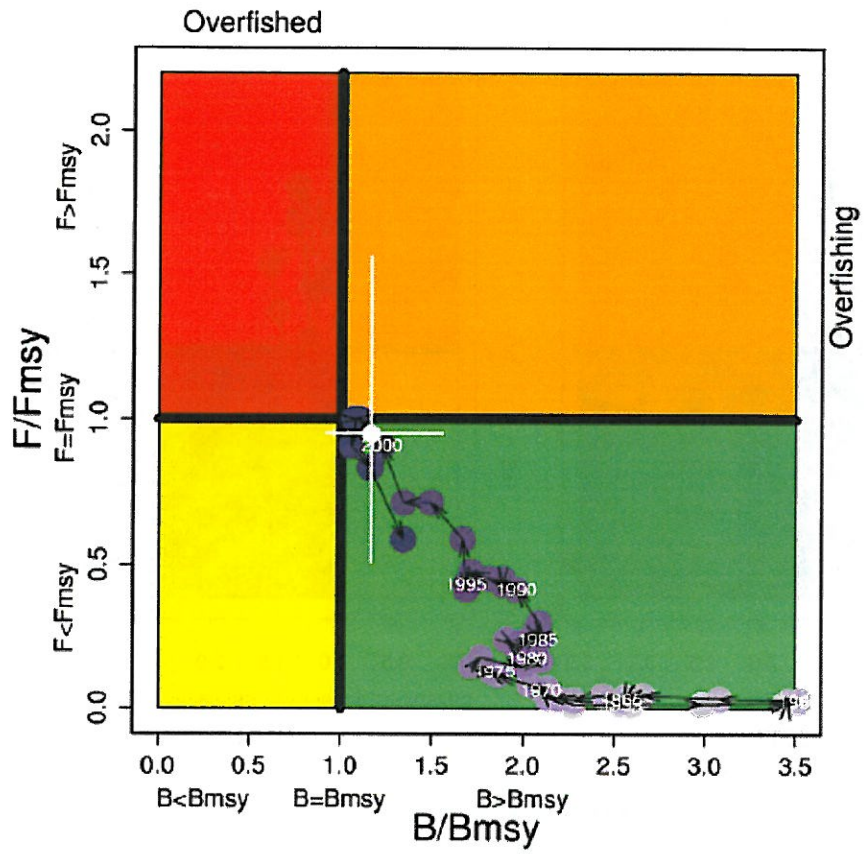
(The WCPFC5 BET "*Scorecard*")

Post-Meeting Version 1

Metric: adult equivalent Fishing Mortality Rate (FMR) percentage points of the total bigeye tuna population in WCPFC waters
Of the 40 plus elements in CMM 2008-DP001 Rev 5, only those with direct estimatable effects on 2009 - 2011 FMR are shown on this Scorecard

CMM Element No.	CMM Element Reference Summary	Estimate of FMR Reduction over 2002-04 Base Period 2009	2010	2011	2001-04 FMR for indicated fishery strata	Comments/Assumptions
	Purse Seine Fishery					
11	60 day FAD closure in PNA area EEZs, 2009	-2.7%	n/a	n/a		
12 (bis)	non-PNA CCM compatable measures. 2009	-1.7%	n/a	n/a		Estimated at comparable relative reductions to CMM 11
13	60 day FAD closure in High Seas areas, 2009	-0.5%	n/a	n/a		Assuming all countries, including Japan
14	10% catch limit in High Seas areas, 2009 (as alt. to # 13)	*				* Use of this alternative (Japan) incorporated into estimate for CMM
15a	2010-11: Reduce to 2004 effort level in PNA EEZ areas	n/a	0%	0%		
15b	2010-11: 90 day FAD closure in PNA EEZ areas	n/a	-4.7%	-4.7%		
17	2010-11: Non-PNA area CCM comp. reductions in EEZs	n/a	-2.6%	-2.6%		Assumed to be at a specified 30% reduction in FMR
18	2010-11: 90 day FAD closure in High Seas areas	n/a	-0.8%	-0.8%		
21	2010-11: Close High Seas pockets	n/a	-3.2%	-3.2%		
22	Developing skipjack fisheries exemption	0%	0%	0%		
	Longline Fisheries					
31	Small fisheries exemption (< 2000 mt)	+0.50%	+1.0%	+1.5%		
32	10% progressive catch reduction beginning in 2009	-3.6%	-7.6%	-11.6%		
32 (bis)	Exemption for fresh fish deliveries < 5000mt, 2010-11	n/a	+0.25%	+0.25%		
32 (quatro)	China exemption to 2004 levels, 2010-11	+0.54%	+0.54%	+0.54%		
	Other Commercial Tuna Fisheries					
29	"Other" commercial tuna fisheries provisions	+ % tbd	+ % tbd	+ % tbd		Outside the 20° lats; Phillipine & Indonesia other gear types
	Total Fishing Mortality Rate Reduction	-7.6%	-17.1%	-20.6%		Rounded to nearest 0.1%, not including tbd values
	Objective	-30%	-30%	-30%		

Yellowfin Tuna – Kobe Plot



This "Kobe Plot" graphic provides a visual explanation of fishery and fish stock health via color illustration as well as data display.

The green quadrant represents a safe fishery where stock size (B for biomass) is above the MSY level (B/Bmsy > 1.0) and fishing pressure (F) is less than the MSY level of intensity (F/Fmsy < 1.0).

The yellow quadrant represents are area of concern for the fishery, as the stock size is less than the MSY level (B/Bmsy < 1.0), even though the fishing pressure is less than the MSY level of intensity.

The orange quadrant represents an elevated level of concern for the fishery, a condition whereby overfishing is occurring (according to the definition used in the Pacific Council), even though the stock size is healthy: the fishing pressure is above the MSY level (F/Fmsy > 1.0), but the stock size is healthy (B/Bmsy. 1.0).

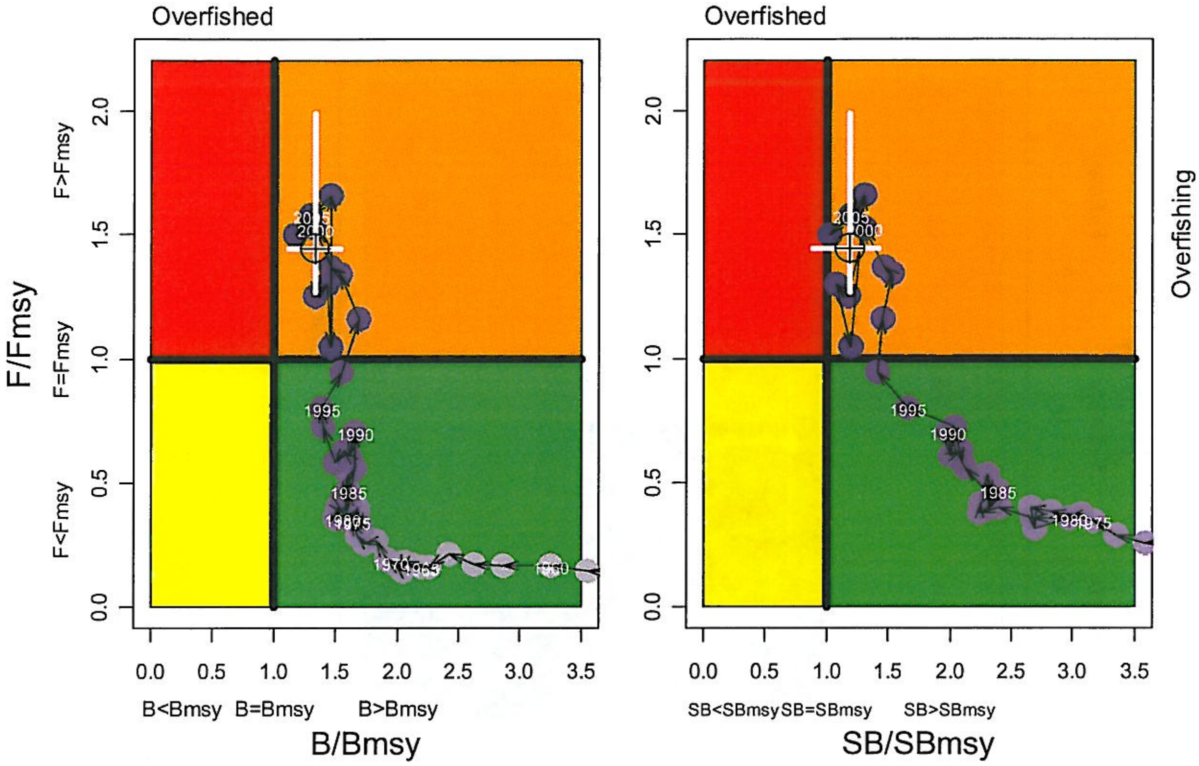
The red quadrant represents an unhealthy fishery where the stock is overfished (according to some definitions*) and overfishing is also occurring: The stock size is less than the MSY level (B/Bmsy < 1.0) and the fishing pressure is greater than the MSY level (F/Fmsy > 1.0).

* In the Pacific Council, a stock is in a depleted (aka overfished) essentially when it falls below a level half that of the MSY level, or B/Bmsy of 0.5

The fishing year is shown via purple circle, with some years labeled.

The white cross hair display represents the confidence interval around the 2002-2005 estimates.

Bigeye Tuna – Kobe Plots



This "Kobe Plot" graphic provides a visual explanation of fishery and fish stock health via color illustration as well as data display.

The green quadrant represents a safe fishery where stock size (B for biomass, SB for spawning biomass) is above the MSY level (B/Bmsy > 1.0) and fishing pressure (F) is less than the MSY level of intensity (F/Fmsy < 1.0).

The yellow quadrant represents are area of concern for the fishery, as the stock size is less than the MSY level (B/Bmsy < 1.0), even though the fishing pressure is less than the MSY level of intensity.

The orange quadrant represents an elevated level of concern for the fishery, a condition whereby overfishing is occurring (according to the definition used in the Pacific Council), even though the stock size is healthy: the fishing pressure is above the MSY level (F/Fmsy > 1.0), but the stock size is healthy (B/Bmsy. 1.0).

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* In the Pacific Council, a stock is in a depleted (aka overfished) when it fall below a level half that of the MSY level, or B/Bmsy of 0.5

The fishing year is shown via purple circle, with some years labeled.

The white cross hair display represents the confidence interval around the 2002-2005 estimates.

FIFTH REGULAR SESSION
Busan, Republic of Korea
8-12 December 2008

CONSERVATION AND MANAGEMENT MEASURE FOR BIGEYE AND YELLOWFIN TUNA IN THE WESTERN AND CENTRAL PACIFIC OCEAN

Conservation and Management Measure 2008-01

The Western and Central Pacific Fisheries Commission (WCPFC):

Recalling that since 1999, in the Multilateral High Level Conferences, the Preparatory Conferences, and in the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (the Commission), a number of resolutions and Conservation and Management Measures (CMMs) were developed to mitigate the overfishing of bigeye and yellowfin tuna and to limit the growth of fishing capacity in the Western and Central Pacific Ocean and that these measures have been unsuccessful in either restricting the apparent growth of fishing capacity or in reducing the fishing mortality of bigeye or juvenile yellowfin tuna;

Recalling that the objective of the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (the Convention) is to ensure through effective management, the long-term conservation and sustainable use of the highly migratory fish stocks of the Western and Central Pacific Ocean in accordance with the 1982 Convention and the Agreement;

Further recalling the final statement of the Chairman of the Multilateral High Level Conferences in 2000 that: "It is important to clarify, however, that the Convention applies to the waters of the Pacific Ocean. In particular, the western side of the Convention Area is not intended to include waters of South-East Asia which are not part of the Pacific Ocean, nor is it intended to include waters of the South China Sea as this would involve States which are not participants in the Conference" (Report of the Seventh and Final Session, 30th August- 5 September 2000, p.29).

Recognising that the Scientific Committee has determined that there is a high probability that the bigeye stock is subject to overfishing, and that and yellowfin stocks are currently being fished at capacity, reductions in fishing mortality are required in order to reduce the risks that these stocks will become overfished;

Conscious that the Commission, at its regular sessions in December 2005 and 2006 adopted CMMs for bigeye and yellowfin tuna and agreed to review annually those measures;

Aware that the Commission committed itself, in 2006 and 2007, to adopt a measure at its next session to reduce juvenile bigeye and yellowfin tuna mortalities from fishing effort on Fish Aggregating Devices (FADs)[1];

Noting that Article 30(1) of the Convention requires the Commission to give full recognition to the special requirements of developing States that are Parties to the Convention, in particular small island developing States and territories and possessions, in relation to the conservation and management of highly migratory fish stocks in the Convention Area and development of fisheries on such stocks;

Noting further that Article 30(2)(c) of the Convention requires the Commission to ensure that conservation and management measures adopted by it do not result in transferring, directly or indirectly, a disproportionate burden of conservation action onto developing States Parties, and territories and possessions;

Taking note of Article 8(1) of the Convention requiring compatibility of conservation and management measures established for the high seas and those adopted for areas under national jurisdiction;

Recalling Article 8 (4) of the Convention which requires the Commission to pay special attention to the high seas in the Convention Area that are surrounded by exclusive economic zones (EEZs);

Noting the Parties to the Nauru Agreement (PNA) have agreed to implement the Third Arrangement of the Nauru Agreement of May 2008 (Attachment A);

Also noting that the Pacific Islands Forum Fisheries Agency (FFA) Members will be adopting a system of zone-based longline limits to replace the current system of flag-based bigeye catch limits within their EEZs.

Noting further paragraph 19 of CMM 2005-01 which states that: "Any future reduction in catch levels shall take into account increases in the levels of such catches by each CCM in recent years."

Adopts, in accordance with Article 10 of the Convention, the following Measure to be implemented over a three-year period with respect to bigeye tuna and yellowfin tuna, in particular.

OBJECTIVES

1. The objectives of this Measure are to:

   - Ensure through the implementation of compatible measures for the high seas and EEZs that bigeye and yellowfin tuna stocks are maintained at levels capable of producing their maximum sustainable yield; as qualified by relevant environmental and economic factors including the special requirements of developing States in the Convention area as expressed by Article 5 of the Convention.

[1] For the purposes of these measures, the term Fish Aggregation Device (FAD) means any man-made device, or natural floating object, whether anchored or not, that is capable of aggregating fish.

- Achieve, through the implementation of a package of measures, over a three-year period commencing in 2009, a minimum of 30% reduction in bigeye tuna fishing mortality from the annual average during the period 2001-2004 or 2004;

- Ensure that there is no increase in fishing mortality for yellowfin tuna beyond the annual average during the period 2001-2004 average or 2004; and

- Adopt a package of measures that shall be reviewed annually and adjusted as necessary by the Commission taking account of the scientific advice available at the time as well as the implementation of the measures. In addition, this review shall include any adjustments required by Commission decisions regarding management objectives and reference points.

GENERAL RULES OF APPLICATION

2. For the purposes of these measures, vessels operated under charter, lease or other similar mechanisms by developing islands States and participating territories, as an integral part of their domestic fleet, shall be considered to be vessels of the host island State or territory. Such charter, lease or other similar mechanism shall be conducted in a manner so as not to charter known illegal, unreported and unregulated (IUU) vessels. The Commission shall consider the implementation of a Charter Arrangements Scheme at its 6th Session in 2009.

3. In giving effect to CMM 2004-02, the Commission shall advise non-Parties to the Convention wishing to acquire Co-operating Non member (CNM) status that there is a high probability that overfishing is currently taking place in respect of bigeye and yellowfin and tuna in the Convention Area. Therefore, where necessary, the limits that apply to CNMs, particularly on the high seas, will be determined by the Commission in accordance with CMM 2004-02 or its revision.

4. The Commission will not delay the adoption of precautionary measures while research to reduce the fishing mortality on juvenile bigeye and yellowfin tuna is being undertaken by CCMs.

5. The Commission encourages CCMs to ensure that the effectiveness of these measures is not undermined by a transfer of effort into archipelagic waters and territorial seas.

6. Unless otherwise stated, nothing in this measure shall prejudice the legitimate rights and obligations of those small island developing State Members and participating territories in the Convention Area seeking to develop their own domestic fisheries.

7. In the determination of levels of effort for the purpose of implementing this Measure current levels of fishing effort shall include, as applicable, fishing rights organized under existing regional of bilateral fisheries partnership arrangements or agreements previously registered with the Commission by December 2006 in accordance with CMM2005-01, provided that the number of licences authorized under such arrangements does not increase and noting that the registration of bilateral agreements or arrangements does not provide a basis for establishing effort levels on the high seas.

PURSE SEINE FISHERY

8. The purse seine fishery provisions of this Measure herein apply to the Convention Area bounded by 20ºN and 20ºS with the objective of achieving over a 3-year period commencing

from the date this measure comes into effect in 2009, a 30% reduction in fishing mortality on bigeye tuna in the purse seine fishery in that area and a reduction in the risk of overfishing yellowfin tuna.

9. CCMs shall ensure that the effectiveness of these measures for the purse seine fishery are not undermined by a transfer of effort in days fished into areas within the Convention Area south of 20ºS. In order to not undermine the effectiveness of these measures, CCMs shall not transfer fishing effort in days fished in the purse seine fishery to areas within the Convention Area north of 20ºN.

10. CCMs shall take necessary measures to ensure that the level of purse seine fishing effort in days fished[2] by their vessels in areas of the high seas does not exceed 2004 levels or the average of 2001-2004. In accordance with paragraph 6 this Measure, this paragraph shall not apply to small developing state members and participating territories.

Measures for 2009

<u>EEZ and High Seas</u>

11. For the members of the FFA who belong to the PNA, this measure will be implemented through their domestic processes and legislation, including the Vessel Day (VDS) Scheme which limits total days fished in the EEZs of PNA members to no greater than 2004 levels (Attachment C). The purse seine fishery in EEZs in the area bounded by 20ºN and 20ºS shall be closed to fishing on FADs between 0000 hours on 1 August and 2400 hours on 30 September. During this period all purse seine vessels required to carry an observer from the Regional Observer Program on board, and without such an observer on board, will cease fishing and return directly to port. During this period, a vessel may only engage in fishing operations if the vessel carries on board an observer from the Regional Observer Program to monitor that at no time does the vessel deploy or service any FAD or associated electronic devices or fish on schools in association with FADs.

12. Other non-PNA CCMs shall implement compatible measures to reduce purse seine fishing mortality on bigeye tuna in their EEZs.

13. The purse seine fishery on the high seas in the area bounded by 20ºN and 20ºS shall be closed to fishing on FADs between 0000 hours on 1 August and 2400 hours on 30 September. During this period all purse seine vessels without an observer from the Regional Observer Program on board will cease fishing and return directly to port. During this period, a vessel may only engage in fishing operations if the vessel carries on board an observer from the Regional Observer Program to monitor that at no time does the vessel deploy or service any FAD or associated electronic devices or fish on schools in association with FADs.

14. Vessels seeking an observer from the Regional Observer Program for the period of the closures identified in paragraphs 12 and 13 above shall notify the Regional Observer Program Coordinator 21 days in advance. If the lack of an available observer from the Regional Observer Program would prevent a vessel from being able to fish during the period in question, the flag State may place an observer from its national program on the vessel to monitor compliance with

[2] In the case of small developing fleets, of four vessels or less, that legitimately entered the fishery after 2000 but before 2004, the baseline level of effort shall be a year in the period 2001-2004 in which its full vessel complement was active in the fishery.

these measures with approval from the Regional Observer Program Coordinator and, in respect to fishing in EEZs, the approval of the relevant national authority.

High Seas Alternative to Paragraph 13 (Catch Limits)

15. As an alternative to the high seas FAD closure established pursuant to paragraph 13, Members may adopt measures to reduce their catch by weight of bigeye tuna in the purse seine fishery in the area between 20°N and 20°S by a minimum of 10 percent relative to 2001-2004 average levels through a Member-specific catch limit to achieve this goal. This alternative shall only be available to Members identified by the Commission in advance as having demonstrated a functioning capacity to implement such measures in an effective and transparent manner, including through: an established and functioning port monitoring program that allows monitoring of bigeye landings for each trip by each vessel; a commitment to carry on board observers from the Regional Observer Program, including upon return to port so that the observer can view the port monitoring program for each trip; a commitment to provide data for each trip by each vessel to the Commission within 30 days from the completion of the trip; having provided operational catch and effort data at least for the period 2001 to 2004 to substantiate the base level catch and effort; other such conditions as the Commission may determine. Any such program will be open to audit by the Commission to review the effectiveness of the program.

16. Once identified by the Commission as having met the requirements outlined above, the Members in question shall submit the full details of their intended measures and their port monitoring program to the Commission by 31 January 2009. The Commission will review these submissions and take them into account when assessing the effectiveness of the measures.

Measures for 2010-2011

EEZs

Waters under the jurisdiction of PNA members

17. For the members of the FFA who are members of the PNA, this measure will be implemented through their domestic processes and legislation, including:

a. the VDS which limits total days fished in the EEZs of PNA members to no greater than 2004 levels (Attachment C); and
b. the Third Arrangement Implementing the Nauru Agreement of May 2008 which comprises a 3 month FAD closure period in the EEZs of the PNA member countries from 0000 hours on 1 July each year until 2400 hours on 30 September each year; full catch retention and other conditions for the purse seine fleet in national waters.

Waters under the jurisdiction of non-PNA members

18. Other non-PNA CCMs shall implement compatible measures to reduce purse seine fishing mortality on bigeye tuna in their EEZs.

High Seas

19. The purse seine fishery on the high seas in the area bounded by 20ºN and 20ºS shall be closed to fishing on FADs between 0000 hours on 1 July and 2400 hours on 30 September. During this period all purse seine vessels without an observer from the Regional Observer Program on board will cease fishing and return directly to port. During this period, a vessel may

only engage in fishing operations if the vessel carries on board an observer from the Regional Observer Program to monitor that at no time does the vessel deploy or service any FAD or associated electronic devices or fish on schools in association with FADs.

20. Alternative measures may be set to reduce bigeye catch by a further 20% as a result of the review by the Commission of the 2009 alternative measure.

21. The Commission shall consider the development of a high seas vessel day scheme (HS VDS) to be compatible with the PNA VDS to provide a common currency for managing purse seine effort. Based on the advice and recommendations of the SC and TCC, the Commission shall consider such a scheme at its annual session in 2009 with a view to adoption at its annual session in 2010 with a view to ensuring that reductions in fishing effort on the high seas and in adjacent EEZs are compatible.

22. The high seas pockets indicated in Attachment D will be closed effective from 1 January 2010 unless the Commission decides otherwise at its 6^{th} annual meeting in December 2009. At this meeting the Commission will also consider the closure of all high seas pockets in the Convention Area between 20 north and 20 south.

FAD Management Plans

23. By 1 July 2009, CCMs fishing on the high seas shall submit to the Commission Management Plans for the use of FADs by their vessels on the high seas. These Plans shall include strategies to limit the capture of small bigeye and yellowfin tuna associated with fishing on FADs, including implementation of the FAD closure pursuant to paragraphs. 13 and 18 above. The Plans shall at a minimum meet the Suggested Guidelines for Preparation for FAD Management Plans for each CCM (Attachment E).

24. The Commission Secretariat will prepare a report on additional FAD management options for consideration by the Scientific Committee, the Technical & Compliance Committee and the Commission in 2009 including:

a. Marking and identification of FADs;
b. Electronic monitoring of FADs
c. Registration and reporting of position information from FAD-associated buoys; and
d. Limits to the number of FADs deployed or number of FAD sets made.

Juvenile Tuna Catch Mitigation Research

25. The Commission will work with CCMs, regional tuna commissions and industry to develop and implement a 3 year program to explore methods to reduce catches of juvenile bigeye and yellowfin tuna caught in association with FADs.

26. CCMs, working independently or collaboratively with industry, and reporting through the Scientific Committee and the Technical and Compliance Committee at each regular session, shall explore and evaluate mitigation measures for juvenile bigeye and yellowfin taken around FADs and present the results annually to the Commission.

Catch Retention

27. In order to create a disincentive to the capture of small fish and to encourage the

development of technologies and fishing strategies designed to avoid the capture of small bigeye and yellowfin tuna, CCMs shall require their purse seine vessels fishing in EEZs and on the high seas within the area bounded by 20ºN and 20ºS from 1 January 2010, subject to the Commission implementing the program in Paragraph 28 for 100 percent coverage on purse seine vessels by the observers from the Regional Observer Program, to retain on board and then land or transship at port all bigeye, skipjack and yellowfin tuna. The provisions of this paragraph, shall not prevent the PNA from implementing the catch retention requirement in their EEZs in accordance with the Third Implementing Agreement. The only exceptions shall be:

a) when, in the final set of a trip, there is insufficient well space to accommodate all fish caught in that set noting that excess fish taken in the last set may be transferred to and retained on board another purse seine vessel provided this is not prohibited under applicable national law; or
b) when the fish are unfit for human consumption for reasons other than size; or
c) when serious malfunction of equipment occurs.

Monitoring

28. Purse seine vessels fishing within the area bounded by 20^0N and 20^0S exclusively on the high seas, on the high seas and in waters under the jurisdiction of one or more coastal States, or vessels fishing in waters under the jurisdiction of two or more coastal States, shall carry effective 1 January 2010, an observer from the Commission's Regional Observer Programme.

29. In 2009 vessels fishing in the area described above will carry observers compliant with licensing arrangements and on the high seas will have a minimum of 20% observer coverage drawn from the Regional Observer Program. The level of coverage achieved will be monitored and reported through TCC. The Secretariat, in conjunction with the Inter-American Tropical Tuna Commission (IATTC), will develop a cross-endorsement arrangement in order to allow vessels operating within IATTC and Commission areas on the same fishing trip to use the same observer.

Other Considerations for Purse Seine Measures

30. Developing skipjack purse seine fisheries, between 20ºN and 20ºS that can provide verifiable evidence of minimal yellowfin and bigeye by-catch (cumulative <2%), with 100% observer coverage, and with a legitimate development plan, will be exempted. Any such plan shall restrict the use of FADs and implement other such management measures necessary to minimize impacts on bigeye and yellowfin tunas. These measures must be supported by adequate monitoring, control and surveillance to ensure their effective implementation. Existing plans shall be tabled at the Commission for information. The Commission is to be given the opportunity to comment on the plan before its approval. This measure does not apply to the domestic purse seine fisheries of small island developing states.

LONGLINE FISHERY

31. The total catch of bigeye tuna by longline fishing gear will be subject to a phased reduction such that by 1 January 2012 the longline catch of bigeye tuna is 70% of the average annual catch in 2001-2004 or 2004 (Attachment F).[3] The catch of yellowfin tuna is not to be increased in the longline fishery from the 2001-2004 levels.

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[3] The year 2004 shall apply only to China, the United States and Indonesia.

32. Paragraph 30 does not apply to members and participating territories that caught less than 2,000 tonnes in 2004. Each member that caught less than 2,000 tonnes of bigeye in 2004 shall ensure that their catch does not exceed 2,000 tonnes in each of the next 3 years (2009, 2010 and 2011). Consistent with paragraph 3 opportunities for non members will be decided by the Commission on a case by case basis.

33. Each member or cooperating non-Member that caught an average of more than 2,000 tonnes of bigeye shall be subject to the following catch limits for bigeye tuna for the years 2009 to 2011 inclusive:

2009: 10% reduction of the catch specified in Attachment F;
2010: 20% reduction of the catch specified in Attachment F;
2011: 30% reduction of the catch specified in Attachment F.

34. In accordance with paragraph 6, the limits for bigeye tuna established in paragraphs 31 to 33 above, shall not apply to small island developing State members and participating territories in the Convention Area undertaking responsible development of their domestic fisheries.

35. Further to paragraph 34, the reductions specified in paragraph 33 for 2010 and 2011 shall not apply to fleets of members with a total longline bigeye tuna catch limit as stipulated in Attachment F of less than 5,000 tonnes and landing exclusively fresh fish, provided that the details of such fleets and their operational characteristics are registered with the Commission by 31 December 2008 and that the number of licenses authorized in such fisheries does not increase from current levels. In such cases, catch limits specified in Attachment F shall continue to be applied.

36. The catch limit for China for 2009 and 2010 will remain at 2004 levels pending agreement being reached to develop an arrangement for the attribution of Chinese catch taken as part of domestic fisheries in the EEZs of Pacific Island Countries.

38. If such reductions would result in a catch limit less than 2,000 tonnes for a Member, then a catch limit of 2,000 tonnes shall apply to that Member or cooperating non member.

OTHER COMMERCIAL TUNA FISHING EFFORT RESTRICTIONS

39. Beginning in 2009, CCMs shall take necessary measures to ensure that the total capacity of their respective other commercial tuna fisheries for bigeye and yellowfin tuna, including purse seining that occurs north of 20ºN-or south of 20ºS, but excluding artisanal fisheries and those fisheries taking less than 2,000 tonnes of bigeye and yellowfin, shall not exceed the average level for the period 2001-2004 or 2004. CCMs shall provide the SC with estimates of fishing effort for these other fisheries or proposals for the provision of effort data for these fisheries for 2009 and future years.

DATA PROVISION

40. CCMs shall provide within the agreed timeframes each year, catch and effort data and size composition data for all fleets in the format required by the rules and requirements adopted by WCPFC as “Scientific Data to be Provided to the Commission”.

41. The Commission shall take into account the level of compliance by CCMs to the data reporting requirements in paragraph. 351 in implementing any additional reductions in fishing mortality that may be required to give effect to the precautionary approach.

PORT CONTROLS

42. Each CCM shall prohibit landings, transhipment and commercial transactions in tuna and tuna products that are positively identified as originating from fishing activities that contravene any element of the Commission's CMMs.

43. Monitoring shall be conducted at landing and transshipping ports to assess the amount of catch by species. The outcomes shall be reported annually to the Commission.

CAPACITY

44. Drawing on work that has been completed by CCMs, the Commission Secretariat shall present a report on measuring and monitoring fishing capacity in the Eastern and Central Pacific Ocean for consideration at the Fifth Regular Session of the Technical and Compliance Committee.

REPORTING

45. All CCMs will report to each regular session of the Technical and Compliance Committee, through their Annual Report Part 2, on the implementation of this Measure for their fishing vessels operating on the high seas and/or in waters under national jurisdiction. The Technical and Compliance Committee will prepare a template for reporting this requirement for the consideration of the Commission.

REVIEW OF MEASURES

46. The measures described above for the purse seine and longline fisheries shall be reviewed annually in conjunction with the scientific advice to measure the impact and compliance with the measure. The measure shall remain in place unless the Commission adopts alternative measures. This review shall consider, inter alia, whether the measures are having the intended effect and the extent to which all CCMs and fishing sectors are contributing to achieving the Commission's conservation goals.

FINAL CLAUSE

47. This Measure replaces CMM 2005-01 and CMM 2006-01.

ATTACHMENTS

Attachment A: Third Arrangement of the Nauru Agreement of May 2008
Attachment B: Baseline Effort Levels for Purse Seine Fisheries
Attachment C: Vessel Day Scheme limits on Total Days Fished
Attachment D: Map showing EEZs and the High Seas Pockets
Attachment E: Suggested Guidelines for Preparation of FAD Management Plans (WCPFC Circular 2007/14 Attachment 2)
Attachment F: Baseline Catch Levels for Longline Fisheries

Attachment A

A THIRD ARRANGEMENT IMPLEMENTING THE NAURU AGREEMENT SETTING FORTH ADDITIONAL TERMS AND CONDITIONS OF ACCESS TO THE FISHERIES ZONES OF THE PARTIES

Pursuant to Articles I, II, III, and IX of the Nauru Agreement Concerning Cooperation in the Management of Fisheries of Common Interest, hereafter referred to as the "Nauru Agreement", wherein the Parties thereto agreed to conclude arrangements to facilitate the implementation of the Nauru Agreement, the Federated States of Micronesia, the Republic of Kiribati, the Republic of the Marshall Islands, the Republic of Nauru, the Republic of Palau, Papua New Guinea, Solomon Islands and Tuvalu,

HAVE AGREED AS FOLLOWS:

ARTICLE I
Licensing Terms and Conditions

In addition to those terms and conditions provided in Article II of An Arrangement Implementing the Nauru Agreement Setting Forth Minimum Terms and Conditions of Access to the Fisheries Zones of the Parties, and Article I of A Second Arrangement Implementing The Nauru Agreement Setting Forth Additional Terms and Conditions of Access to the Fisheries Zones of the Parties, the Parties shall establish the following minimum terms and conditions in all of their subsequent foreign fishing agreements and their licensing requirements for vessels fishing the common stocks of fish within the Fisheries Zones and shall not issue licences unless the minimum terms and conditions are accepted and observed:

1. *Catch Retention*

All bigeye, skipjack and yellowfin tuna taken by a purse seine vessel shall be retained on board and then landed or transhipped, except for:

(a) fish clearly and demonstrably unfit for human consumption; and

(b) the final set of a trip when there may be insufficient wellspace to accommodate all fish caught in that set.

The Parties shall adopt appropriate procedures for the implementation of this measure, including reporting.

2. *FAD Closure*

There shall be no deployment or servicing of Fish Aggregating Devices and associated electronic equipment, or fishing by purse seine vessels on floating objects, between 0001 hours GMT on 1 July and 2359 hours GMT on 30 September each year, except that:

(a) a Party may exclude all or part of its Fisheries Zone from the closure if it determines that it has suffered a disproportionate burden from application of the closure and advises the depositary accordingly; and

(b) a Party may apply appropriate arrangements set out in a Management Plan to meet the requirements of domestic vessels that are highly dependent on fishing on floating objects within the Fisheries Zone.

3. *Closure of High Seas Areas*

A vessel shall not fish in the areas listed below during the period of validity of a licence issued by a Party:

(a) the area of high seas bounded by the national waters of the Federated States of Micronesia, Indonesia, Palau and Papua New Guinea; and

(b) the area of high seas bounded by the national waters of the Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Papua New Guinea, Solomon Islands and Tuvalu.

4. *Monitoring*

(a) In order to monitor compliance with the catch retention and FAD closure requirements, all foreign purse seine vessels shall carry at all times an observer from either the national observer programme of a Party or an existing sub-regional observer programme; and

(b) The owner, charterer, operator, master or any other person responsible for the operation of a licensed vessel shall ensure that the Automatic Location Communicator[4] of the vessel is switched on and is operating properly at all times during the period of validity of a licence issued by a Party.

ARTICLE II
Review and Implementation

Review

1. The Parties shall review the implementation of these measures at the annual meeting of the Parties, and decide on the future application of these measures, taking into account:

(a) the effectiveness of the measures in reducing fishing mortality, especially on juvenile bigeye and yellowfin tuna; and

[4] Automatic Location Communicator is also known as Mobile Transmitting Unit.

(b) the extent to which compatible measures are being applied on the high seas and in the waters of other Members of the Western and Central Pacific Fisheries Commission.

Implementation

2. These measures shall be implemented in accordance with a programme adopted by the Parties.

ARTICLE III
Signature and Effect

1. This Arrangement shall be open for signature by the Parties to the Nauru Agreement.

2. This Arrangement shall take effect 30 days following the signing of the Arrangement by at least five of the Parties to the Nauru Agreement. Thereafter, it shall take effect for any signing Party 30 days after its signature of the Arrangement.

3. This Arrangement shall be deposited with the Government of the Solomon Islands.

4. Reservations to this Arrangement shall not be permitted.

ARTICLE IV
Amendment and Withdrawal

1. Any Party may withdraw from this Arrangement by giving written notice to the Depositary. Withdrawal shall take effect one year after receipt of such notice.

2. Any amendment to this Arrangement proposed by a Party shall be adopted only by unanimous decision of the Parties to this Arrangement.

ARTICLE V
The Nauru Agreement

This Arrangement is subordinate to and governed by the Nauru Agreement.

IN WITNESS WHEREOF the undersigned, being duly authorised by their respective Governments have signed this Agreement.

DONE at Koror, Palau this 16th day of May 2008

Federated States of Micronesia	______________________________ ______________________________
Republic of Kiribati	______________________________ ______________________________
Republic of the Marshall Islands	______________________________ ______________________________
Republic of Nauru	______________________________ ______________________________
Republic of Palau	______________________________ ______________________________
Papua New Guinea	______________________________ ______________________________
Solomon Islands	______________________________ ______________________________
Tuvalu	______________________________ ______________________________

Attachment B

ESTIMATES OF PURSE SEINE EFFORT (DAYS FISHED) IN EXCLUSIVE ECONOMIC ZONES.

EEZ	2001	2002	2003	2004	Av. 2001-2004	CMM 2005-01	2005	2006	2007 (prov.)
COOK ISLANDS	46	232	8	6	73	73	4	8	2
FIJI	9	5	9	27	13	27	36	7	7
INDONESIA[1]	4,270	4,316	4,978	6,522	5,022	6,522	6,580	6,808	6,498
NIUE	0	0	1	0	0	0	0	0	0
PHILIPPINES[1]	3,620	3,861	5,367	5,603	4,613	5,603	5,255	5,290	5,787
SAMOA	7	12	3	4	7	7	3	1	4
TOKELAU	99	401	27	67	149	149	127	34	37
TONGA	2	0	0	1	1	1	1	0	0
USA	388	595	279	346	402	402	185	237	110
VANUATU	2	2	0	23	7	23	1	1	0
PNA EEZs[2]	23,902	26,304	28,438	29,144	26,947	29,144	32,028	31,600	29,881
TOTAL	32,345	35,728	39,110	41,743	37,232	41,950	44,220	43,986	42,326

1. Estimates for Indonesian and Philippines EEZs have been estimated as described in Attachment A of WCPFC-2008-13. These estimates may include effort in archipelagic waters.
2. Effort in PNA EEZs does not include effort in the archipelagic waters of Papua New Guinea or Solomon Islands.
3. The column labelled as CMM 2005-01 does not take into account Para. 6 and footnote 1 of CMM 2005-01.
4. Noting paragraph 5 of CMM 2005-01 and paragraph 2 of CMM 2008-01, the data reflected in the table is provisional. Pacific Island States and territories will work with the Executive Director and SPC-OFP to clarify the catch and effort that relates to fishing activities of foreign flagged vessels operating as an integral part of the domestic fleet and so should be considered vessels of the host State or Territory, particularly during the period 2001-2004.

TABLE 2. ESTIMATES OF PURSE SEINE EFFORT (DAYS FISHED) IN THE HIGH SEAS, BY VESSEL FLAG (INCLUDING RELEVANT CHARTER ARRANGEMENTS).

Flag	2001	2002	2003	2004	Av. 2001-2004	CMM 2006-01	2005	2006	2007 (prov.)
CHINA	95	126	149	428	200	428	494	230	367
EUROPEAN COMMUNITY[1]	38	63	86	103	73	103	52	135	245
FSM	241	228	175	383	257	383	222	63	169
INDONESIA	500	500	500	500	500	500	500	500	500
JAPAN	1,793	1,589	2,093	2,321	1,949	2,321	1,832	1,535	1,317
KIRIBATI	40	52	40	35	42	42	46	53	22
MARSHALL ISLANDS	173	208	435	398	304	398	400	154	194
NEW ZEALAND	23	323	342	210	225	225	98	291	180
PAPUA NEW GUINEA	382	570	580	1,005	634	1,005	1,240	405	700
PHILIPPINES[2]	13	55	435	452	239	452	306	153	17
REPUBLIC OF KOREA[3]	1,307	1,226	1,152	1,234	1,230	1,234	1,071	741	1,397
SOLOMON ISLANDS	32	37	0	0	17	17	16	15	11
CHINESE TAIPEI	1,969	1,865	1,487	1,913	1,809	1,913	1,262	1,238	1,493
USA[3]	968	1,333	863	987	1,038	1,038	771	534	782
VANUATU	66	163	181	571	245	571	376	392	361
TOTAL	7,640	8,338	8,518	10,540	8,759	10,629	8,686	6,439	7,755

1. VMS-based estimates for the European Community were provided by email subsequent to SC4, and 1 degree square aggregate fishing data were provided in December 2008. The aggregate catch and effort data were used as the basis for EC estimates in this table to provide consistency with the other flag estimates also based on operational or 1 degree square aggregate fishing data.
2. Estimates for Philippines are based on high-seas estimates for PNG-based or licenced vessels as described in Attachment A of WCPFC-2008-13. Philippines have provided an estimate of high-seas effort for 2004 only of 7,140 days but no supporting data have been provided.
3. Republic of Korea and USA have provided independent estimates that vary slightly from the figures shown here. These estimates will be reconciled between the WCPFC Scientific Services Provider and the national fisheries authorities of those CCMs. Table entries may be adjusted following the reconciliation process.
4. The column labelled as CMM 2006-01 does not take into account Para. 6 and footnote 1 of CMM 2005-01.
5. Noting paragraph 5 of CMM 2005-01 and paragraph 2 of CMM 2008-01, the data reflected in the table is provisional. Pacific Island States and territories will work with the Executive Director and SPC-OFP to clarify the catch and effort that relates to fishing activities of foreign flagged vessels operating as an integral part of the domestic fleet and so should be considered vessels of the host State or Territory, particularly during the period 2001-2004.

PALAU ARRANGEMENT FOR THE MANAGEMENT OF THE WESTERN PACIFIC PURSE SEINE FISHERY - MANAGEMENT SCHEME

(VESSEL DAY SCHEME)

PALAU ARRANGEMENT FOR THE MANAGEMENT OF THE WESTERN PACIFIC PURSE SEINE FISHERY - MANAGEMENT SCHEME (VESSEL DAY SCHEME)

(as amended by VDS Working Group Meeting-Honiara, 7 & 13 October 2005)

Article 1

Definitions

1.1 In this Management Scheme:

(i) *ALC* means Automatic Location Communicator.

(ii) *Adjusted PAE*, in relation to a Party, means that Party's PAE as adjusted pursuant to Article 6, 7 or 10.

(iii) *Fishing activities* includes the following:

(a) searching for, catching, taking or harvesting fish;

(b) attempting to search for, catch, take or harvest fish;

(c) engaging in any other activity which can reasonably be expected to result in the locating, catching, taking or harvesting of fish for any purpose;

(d) placing, searching for or recovering fish aggregating devices or associated electronic equipment such as radio beacons, or any other equipment used in the control, support or assistance of fishing operations of any description;

(e) any operations at sea directly in support of, or in preparation for, any activity described in paragraphs (a) to (d);

(f) use of any vessel in connection with any activity described in paragraphs (a) to (e), except for emergencies involving the health and safety of the crew or the safety of a vessel.

(iv) *Fishing day* means any calendar day, or part of a calendar day, during which a purse seine vessel is in the waters of a Party outside of a port, but does not include a calendar day, or part of a calendar day, referred to in Article 5.1(iii).

(v) *Length overall*, in relation to a vessel, means the distance in metres (with an accuracy of two decimal places) in a straight line between the foremost point of the bow and the aftermost point of the stern, provided that the bow shall be taken to include the watertight hull structure, forecastle, stem and forward bulwark, and the stern shall be taken to include the watertight hull structure, transom, poop, skiff ramp and bulwark.

(vi) *Management Period* means a period of three Management Years.

(vii) *Management Year* means a period of one calendar year commencing on the date of commencement of the vessel day scheme.

(viii) *Palau Arrangement* means the Palau Arrangement for the Management of the Western Pacific Purse Seine Fishery.

(ix) *Party Allowable Effort (PAE)*, in relation to a Party, means the total number of fishing days for a Management Year allocated to that Party calculated pursuant to the formula at Article 12, and presented to the Parties each year in accordance with the table at Schedule 1.

(x) *Total Allowable Effort (TAE)* means the maximum number of fishing days by all licensed purse seine vessels in the waters of the Parties to the Palau Arrangement in any Management Year.

(xi) *VDS Register* means the register established and maintained pursuant to Article 8.

(xii) *Vessel Day Scheme Management Area* means the waters of the Pacific Ocean bounded as follows:

(a) In the north by the 20° parallel of north latitude;

(b) In the south by the 20° parallel of south latitude; and

(c) In the east by a line due north along the 130° meridian of west longitude to its intersection with the 4° parallel of south latitude; thence due west along the 4° parallel of south latitude to its intersection with the 150° meridian of west longitude; thence due north along the 150° meridian of west longitude.

Article 2

Objectives and description

2.1 This Management Scheme is made pursuant to the Palau Arrangement for the management of purse seine fishing effort of the Western and Central Pacific. The objective of this Management Scheme is to enhance the management of purse seine fishing vessel effort in the waters of the Parties by encouraging collaboration between all parties, and:

i) promoting optimal utilization and conservation of tuna resources;

ii) maximizing economic returns, employment generation and export earnings from sustainable harvesting of tuna resources;

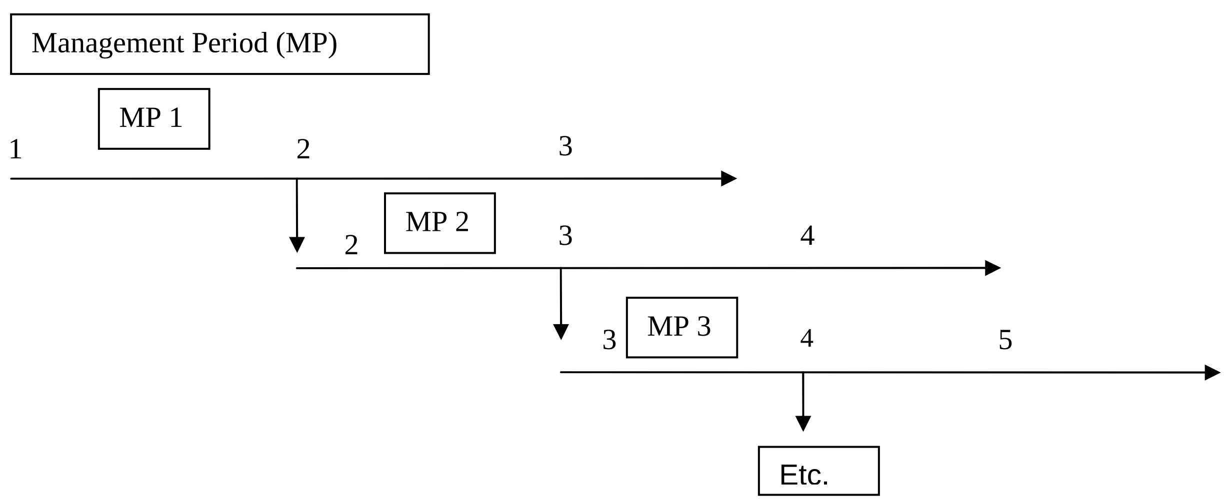
iii) supporting the development of domestic locally based purse seine fishing industries;

iv) promoting effective and efficient administration, management and compliance.

2.2 Through this Management Scheme the Parties shall seek to limit the level of fishing by purse seine vessels in the waters of the Parties to the levels of total allowable effort agreed by the Parties to the Palau Arrangement.

2.3 The Management Scheme will have a Management Period of three Management Years. At the end of each Management Year a new three year Management Period will commence. Management Years and Management Periods will be numbered sequentially. At the beginning of the scheme a Total Allowable Effort will be set by the Parties for each of the first three years. Prior to the end of the first year of the Management Scheme the Parties will meet to set the TAE for the fourth Management Year, as illustrated in Figure 1. Prior to the end of the second Management Year, and prior to the end of each subsequent Management Year, the Parties will meet to set the TAE for the fifth Management Year, and thereafter for each new Management Year. In the event that a TAE is not set for a new Management Year, the TAE for the previous Management Year will apply.

Figure 1 – Rolling 3 year Management Period



2.4 At the end of each Management Year any unused PAE from the corresponding Management Period may be carried forward to the new Management Period. In this respect the Parties to the Palau Arrangement may agree rules about the maximum number or maximum proportion of days that may be carried forward.

Establishment of a VDS Committee

2.5 Oversight of the Management Scheme will be the responsibility of a Vessel Days Scheme Committee (VDSC) comprising a nominee of each of the Parties to the Palau Arrangement. The VDSC will be a sub-committee of the Palau Arrangement Parties and be subject to their absolute control. The VDSC will meet as required and be subject to the following general procedures:

i) The VDSC will appoint a Chair and vice Chair for a period of no more than 3 years. At the end of the Chair's term the vice Chair will assume the Chair's role. Initial and ongoing appointments will be made in a manner that provides for the terms of the Chair and vice Chair to be staggered to provide continuity of experience.

ii) The VDSC may consider, discuss and make recommendation to any meeting of the Parties to the Palau Arrangement on any matter related to the administration of the VDS, and make decisions on matters delegated to them by the Parties to the Palau Arrangement.

Meeting procedures

iii) The committee can adopt meeting procedures as it sees fit from time to time bearing in mind that in establishing the VDSC it is the intention of the Parties to the Palau Arrangement that it operate in a manner that is as informal as is practical in order to conduct its business efficiently. In the event of any dispute over meeting procedures and in the absence of any otherwise agreed meeting procedures the meeting procedures that apply to the meetings of the Forum Fisheries Committee will apply. The Administrator will maintain a record of meeting procedures as agreed to from time to time.

Observers

iv) Observer status will only be granted to government officials representing members of the Forum Fisheries Agency. Any member wishing to attend as an observer will provide advice to the Chair of their intention to attend any meeting. As meetings of the VDSC will be informal and may be called at short notice, there may be no general notice of intended meetings to observers.

Guests

v) Any other person may be invited by the VDSC to attend certain sessions of the VDSC as a guest, on an agenda item by agenda item basis.

Confidentiality

vi) Other than for the purposes of official reporting within government observers and guests shall be bound to keep any matter discussed by the VDSC confidential other than where agreed on a case by case basis by the Chair.

Meeting agenda and record

vii) An agenda shall be prepared for each meeting. A record of each meeting shall be kept by the Administrator and cleared by the VDSC before it concludes any meeting. The record shall be brief and only record the broad points of discussion by the VDSC, along with any viewpoint expressly requested by any VDSC member to be formally recorded and the precise outcome of any discussions whether they be in the form of a recommendation to a meeting of the Parties to the Palau Arrangement, or a decision.

Annual meeting of Parties to the Palau Arrangement

2.6 The annual meeting of the Parties to the Palau Arrangement will consider matters relating to the administration of the VDS. In particular, but without limiting the matters the meeting can consider, it will be a function of the annual meeting to:

i) Consider any matter referred to it for decision by the VDSC.

ii) Receive a briefing from the Administrator on catch and effort levels and any observed or potential increase in average effective fishing effort for each fishing day since the introduction of the vessel day scheme (effort creep):

  a. In respect of any observed effort creep the Parties shall take the necessary management action to ensure such effort creep is not detrimental to the fishery.

  b. Options for management action by the Parties shall include controls on vessel length, vessel capacity, well size, the use of fish aggregating devices or any other necessary measure.

iii) Receive a briefing from the Administrator on any transfer of fishing days between Parties and between Management Periods.

  a. In respect of any transfer of fishing days between Management Periods the Parties may agree on any future restrictions that may apply to the proportion of fishing days that may be borrowed from or carried forward to future years.

  b. In respect of any deliberation on this matter the Parties will take into account the need to ensure that such transfers are not detrimental to the fishery or the fishery management scheme.

iv) Set the TAE in accordance with the provisions of this Management Scheme.

v) Consider the need to establish procedures to consult with distant water fishing nations, fishing parties, fishing organizations, and other relevant organizations and provide direction to the Administrator in that respect.

vi) Determine controls on high seas fishing to be applied to fishing parties operating under the Vessel Days scheme or other arrangements, treaties or agreements.

Article 3

Non-application to certain purse seine vessels

3.1 For clarification this Management Scheme does have effect with respect to fishing activities by a purse seine vessel operating under a valid license issued under the Federated States of Micronesia Arrangement for Regional Fisheries Access (FSMA) while it is in the national waters of the licensing home Party.

3.2 This Management Scheme shall not apply to or affect:

(i) fishing activities by a purse seine vessel while it is in the national waters of a Party, other than as described in clause 3.1, under a valid license issued under the Federated States of Micronesia Arrangement for Regional Fisheries Access (FSMA); or

(ii) fishing activities by a purse seine vessel while it is operating under a valid license issued under the Treaty on Fisheries Between the Governments of Certain Pacific Island States and the Government of the United States of America (UST);

3.3 Clause 3.2 does not apply to the deliberations of the Parties to the Palau Arrangement when calculating the TAE when it will be necessary to consider the catches of FSMA and UST fleets and make adjustments to the TAE in accordance with the TAE setting process.

3.4 Clause 3.2 does not apply where agreed to by the Parties to the FSMA or the UST.

Article 4

Obligation to limit fishing days

4.1 Each Party shall take all necessary measures to ensure that the number of fishing days by purse seine vessels in its waters does not exceed that Party's PAE or Adjusted PAE in any Management Year other than in accordance with Article 3.

Article 5

Calculation of fishing days

5.1 The following provisions shall govern the calculation of a Party's use of its PAE or Adjusted PAE during a Management Year, and shall be applied by the Administrator:

(i) If a purse seine vessel reports during any fishing day from positions in the waters of two or more Parties, that fishing day shall be apportioned between those Parties according to the distribution of reported positions of that vessel;

(ii) If a purse seine vessel reports during any fishing day from positions in the high seas or in the waters of non-Parties, and in the waters of one or more Parties, that fishing day shall be apportioned according to the distribution of reported positions;

(iii) If a Party has advised the Administrator, using the form in Schedule 2, that a purse seine vessel will be in its waters but will not be undertaking fishing activities, the days or parts of days spent by the vessel in that Party's waters will not be counted as fishing days provided the vessel does not undertake fishing activities during the period identified in the form. For that purpose, a vessel shall be deemed to be undertaking fishing activities during any time that its fishing gear is not completely stowed.

(iv) every fishing day by a purse seine vessel with a length overall of less than 50 metres shall equate to a deduction of one half of a fishing day;

(v) every fishing day by a purse seine vessel with a length overall of between 50 metres and 80 metres shall equate to a deduction of one fishing day;

(vi) every fishing day by a purse seine vessel with a length overall in excess of 80 metres shall equate to a deduction of one and one half fishing days.

(vii) there shall be no deduction of fishing days in respect of any period spent by a purse seine vessel within a port of a Party.

Article 6

PAE Adjustments: transfers between Parties

6.1 Any two Parties may agree to a transfer between themselves of all or part of their PAE for a Management Year, provided that

(i) A Party may not agree to transfer to other Parties more than 100% of its PAE;

(ii) A Party may not agree to transfer any part of its PAE which that Party has already used at the time the request is made.

6.2 A Party that proposes to receive a transfer of PAE pursuant to an agreement under Article 6.1 must provide a transfer notification to the Administrator, using the form set out in Schedule 3 (a) and according to any transfer administration procedures that have been agreed by the Parties on the recommendation of the Administrator, no later than 31 January of the Management Year following the Management Year that the proposed transfer relates to. The transfer will be approved by the Administrator providing it meets the requirements of the Vessel Day Scheme.

6.3 If the Administrator is satisfied that the Parties have complied with the requirements of Articles 6.1 and 6.2, the Administrator shall adjust the PAE of the relevant Parties in accordance with the transfer notification.

Article 7

PAE Adjustments: transfers between Management Years and Management Periods

7.1 A Party may instruct the Administrator to adjust its PAE for any Management Year in a Management Period by transferring to that Management Year up to 100% of its PAE from another Management Year of the same Management Period.

7.2 A Party may instruct the Administrator to adjust its PAE for the first Management Year in a Management Period by transferring to that Management Year up to 30% of its PAE from the final Management Year of the preceding Management Period.

7.3 An instruction under Article 7.1 or 7.2 is valid only to the extent that it relates to a Party's PAE which the Party has not already used at the time the request is made.

7.4 The Party instructing the Administrator to adjust its PAE under this Article must provide a transfer notification to the Administrator, using the form set out in Schedule 3 (b) and according to any transfer administration procedures that have been agreed by the Parties on the recommendation of the Administrator, no later than 31 January of the Management Year following the Management Year that the proposed transfer relates to.

7.5 If the Administrator is satisfied that the Party has complied with the requirements of this Article, the Administrator shall adjust that Party's PAE in accordance with the transfer notification.

Article 8

Register of Purse Seine Vessels

8.1 The Administrator shall establish and maintain a Register of Purse Seine Vessels under the Palau Arrangement Purse Seine Fishery Vessel Day Scheme (the VDS Register).

8.2 A purse seine vessel must be registered on the VDS Register in order to undertake fishing activities pursuant to this Management Scheme. Each Party shall ensure that every license of a purse seine vessel includes a condition that no fishing activity may be undertaken pursuant to the licence during any period when the vessel is not registered on the VDS Register.

8.3 A purse seine vessel may only be registered on the VDS Register if:

(i) An application for the vessel to be registered on the VDS Register is made to the Administrator using the form set out in Schedule 4; and

(ii) The application form is accompanied by payment of the Registration Fee set out in Schedule 5; and

(iii) The Administrator is satisfied that the vessel will be able to comply with the requirements of this Management Scheme; and

(iv) The vessel is in good standing on the FFA Vessel Register

8.4 The Administrator must register a purse seine vessel on the VDS Register if the requirements of Article 8.3 have been satisfied in relation to that vessel. Upon a purse seine vessel becoming registered on the VDS Register, the Administrator must notify the vessel owner and the relevant Party of that fact, and of the commencement date of the registration.

8.5 Subject to Article 8.6, the registration of a purse seine vessel on the VDS Register shall remain in effect until the end of the Management Period. A purse seine vessel that is registered on the VDS Register at the end of a Management Period shall be entitled to have its registration continued for the following Management Period, provided that the vessel fulfils the registration requirements, set out in Article 8.3, no later than 30 days prior to the commencement of that following Management Period.

8.6 The Administrator must delete a vessel from the VDS Register if:

(i) The vessel owner requests the Administrator to delete the vessel from the VDS Register; or,

(ii) A Party requests that a vessel be deleted from the VDS Register; or

(iii) The Administrator is satisfied that the vessel has failed to comply with the requirements of this Management Scheme.

8.7 The Administrator shall not delete a purse seine vessel from the VDS Register pursuant to Article 8.6 unless the Administrator first consults with the Parties about the proposed deletion, and no Party objects to the proposed deletion of the vessel from the VDS Register. If the Administrator deletes a vessel from the VDS Register, the Administrator must notify the vessel owner and any relevant Party of the fact and date of the deletion. A purse seine vessel that has had its registration on the VDS Register deleted must satisfy the requirements of Article 8.3 in order to be registered again on the VDS Register.

8.8 The Administrator shall provide monthly notifications to all Parties of changes to the VDS Register, including details of new vessel registrations and deletions of vessel registrations. The Administrator shall also maintain the VDS Register on a secure internet website that is accessible only by the Parties and the Administrator.

Article 9

Monitoring

9.1 A purse seine vessel must have an ALC operating at all times of a Management Period during which it is registered on the VDS Register and within the Vessel Day Scheme Management Area, and must ensure that the ALC provides location transmissions at intervals of at least every 4 hours.

9.2 If the Administrator does not receive either an ALC transmission from a purse seine vessel to which Article 9.1 applies, or a transmission failure report from a purse seine vessel pursuant to Article 9.3, the Administrator shall notify the vessel of the transmission failure no later than 12 hours after the ALC transmission was due, and require the vessel to submit transmission failure reports to the Administrator pursuant to Article 9.3.

9.3 If a purse seine vessel becomes unable to transmit by ALC for any reason, the operator of the vessel shall, as soon as practicable, submit a transmission failure report, in the form set out in Schedule 6, to the Administrator and to any Party in whose waters the vessel is undertaking fishing activities. The first transmission failure report shall account for the period from the time of the ALC transmission failure to the time of submission of the report. Subsequent transmission failure reports shall be submitted at intervals of 4 hours.

9.4 If at any time a purse seine vessel is unable to comply with the requirements of this Article, the master of that vessel must immediately stow the vessel's fishing gear and take the vessel directly to the nearest port, or such other port as the Administrator directs, and immediately report to the Administrator of its actions under this Article.

Article 10

Compliance

10.1 Each Party shall take all necessary measures to ensure that every purse seine vessel that is licensed to fish in its waters, and every purse seine vessel that is entitled to fly its flag, comply with the requirements of this Management Scheme.

10.2 If a Party exceeds its PAE or Adjusted PAE at any time during a Management Year, the Administrator shall, within 7 days, notify the Party of that fact. That Party shall report to the Administrator within 21 days on its measures to ensure adherence to its PAE or Adjusted PAE, including any arrangements for transfer of PAE pursuant to Article 6 or Article 7.

10.3 If the level of purse seine fishing in the waters of a Party exceeds its PAE for a Management Year, that Party's PAE for the following Management Year shall be adjusted by deducting:

(i) If the excess is less than 100 days – the amount of the excess;

(ii) If the excess is 100 days or more – 120% of the excess.

10.4 The Administrator shall promptly provide a report to all Parties with details of any PAE adjustment pursuant to this Article, and a statement of that Party's Adjusted PAE for any Management Year affected by the adjustment.

Article 11

Administrator

11.1 The Administrator of this Management Scheme shall be the Director- General of the Forum Fisheries Agency.

11.2 The Administrator shall have the following functions:

(i) performing any function that this Management Scheme requires the Administrator to perform;

(ii) receiving information and documents from the Parties;

(iii) receiving Registration Application Fees pursuant to Article 8.3(ii);

(iv) convening meetings of the Parties pursuant to this Article;

(v) performing any function that the Parties direct the Administrator to perform;

(vi) performing any function that is necessary for the effective administration of this Management Scheme.

11.3 The Administrator shall perform their functions consistently with any direction given by the Parties. The Administrator shall consult with the Parties as required and take all necessary steps to ensure that reports and information required to be provided by Parties are provided on time.

11.4 The Administrator shall apply fees collected pursuant to this Management Scheme as directed by the Parties. The Administrator shall prepare an annual budget for this Management Scheme, for consideration and approval by the Parties at the annual Management Meeting under the Palau Arrangement.

11.5 The Administrator shall convene a special meeting of the Parties to consider the operation of this Management Scheme if the Administrator receives a written request for such a meeting, and where that request is supported by a minimum of three (3) additional Parties.

Article 12

Calculation of TAE and PAE

12.1 The TAE is the maximum number of fishing days undertaken by all licensed purse seine vessels in all waters of the Parties to the Palau Arrangement in any Management Year.

Calculation of the TAE

12.2 The TAE will be set by the Parties at their annual meeting or at such other time agreed to by the Parties having regard to:

i) the best available scientific, economic, management and other relevant advice and information;

ii) the provisions of the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean;

iii) the objectives of the Vessel Day Scheme; and,

iv) any submission on this issue from any party, individual or organisation.

Allocation of the TAE among the Parties

12.3 Prior to the allocation of the TAE amongst the Parties the TAE shall be adjusted by making a deduction from the TAE in accordance with clause 12.7.

12.4 The adjusted TAE shall be allocated amongst the Parties as their Party Allowable Effort (PAE).

12.5 The PAE for each Party shall be expressed as a percentage. The formula for calculating the PAE of each Party shall be that 50 percent of the PAE is based on the distribution of the assessed relative biomass of skipjack and yellowfin within the waters of the Parties - for this purpose the average shall be taken over a ten (10) year period using the most recent available data; and 50 percent on the average of the annual distribution of the number of vessel days fished in the waters of the Parties - for this purpose the average shall be taken over a seven (7) year period using the most recent available data.

12.6 The Parties may have regard to the special circumstances of any member and agree to a temporary increase in the PAE on an annual basis. Such temporary increases shall not automatically be granted in the following year.

Allocation of TAE for the FSMA and the US Treaty Fleets

12.7 Prior to the allocation of the TAE amongst the Parties, an amount of fishing days will be allocated to each of two pools of fishing days. One pool will be maintained for the Federated States of Micronesia Arrangement for Regional Fisheries Access (FSMA) and one pool for the Treaty on Fisheries between the Governments of Certain Pacific Islands States and the Government of the United States of America (US Treaty). These pools of fishing days will be calculated on the basis of the average number of days fished by these fleets over a seven (7) year period using the most recent available data.

Updating of PAE

12.8 Each PAE shall be updated every year using the formula described in clause 12.5 using the most recent data.

Article 13

Amendment to the Vessel Days Scheme

13.1 This vessel day scheme may be amended in any respect by the agreement of the Parties to the Palau Arrangement.

Article 14

Fees for administration of the Vessel Day Scheme and charges for vessel days

14.1 The Parties to the Palau Arrangement may, at any meeting, agree upon or vary any fees to be charged by vessels registered to operate under the Vessel Day Scheme and the scheme for administration of any such fees.

14.2 The Parties to the Palau Arrangement may, at any meeting, agree upon a scheme for standardising fees for the sale of vessel days.

Article 15

Transitional Provisions

15.1 At the commencement of the Management Scheme the Parties agree that the Management Scheme be applied on a provisional basis for an agreed period which shall be known as the transitional period, for the purposes of providing time for negotiations with fishing parties, and to monitor and to trial the implementation. The Parties may extend the transitional period for a further duration if the Parties consider it necessary.

15.2 The first Management Period would commence at the end of the agreed transitional period.

15.3 The Parties agree to maintain Schedule 7 of the Management Scheme during the transitional period.

15.4 During the transitional period of the Management Scheme, decisions pertaining to the implementation of the Management Scheme may only be made by Parties who have agreed to apply the scheme.

PALAU ARRANGEMENT FOR THE MANAGEMENT OF THE WESTERN PURSE SEINE FISHERY - MANAGEMENT SCHEME (VESSEL DAY SCHEME)

SCHEDULE 1

MANAGEMENT SCHEME DETAILS			
Management Period: *(#)* **First Management Period:** *(date commencing)*			
Total Allowable Effort (TAE) for each year of First Management Period: *(as agreed by the Parties)*			
Party	**Annual Percentage Party Allowable Effort (PAE) for # Management Period**		
	Year #	Year #	Year #
Federated States of Micronesia			
Kiribati			
Marshall Islands			
Nauru			
Papua New Guinea			
Palau			
Solomon Islands			
Tuvalu			

(The formula for calculating the PAE of each party shall be that 50 percent of the PAE is based on the distribution of the assessed relative biomass of skipjack and yellowfin within the waters of the Parties - for this purpose the average shall be taken over a ten (10) period using the most recent available data; and 50 percent on the average of the annual distribution of the number of vessel days fished in the waters of the Parties - for this purpose, the average shall be taken over a seven (7) year period using the most recent available data).

SCHEDULE 2

REPORT TO ADMINISTRATOR ON VESSELS IN ZONE NOT ENGAGED IN FISHING ACTIVITIES

Party Submitting Report: ______________________________

Zone: ______________________________

Name of vessel: ______________________________

Vessel's International call sign: ______________________________

Vessel's VDS Register Registration No (if applicable): ______________________________

FFA Vessel Register No. (if applicable): ______________________________

Date and time of entry into Party's waters: ______________________________

Date and time of proposed exit from Party's waters: ______________________________

Date and time of cessation of fishing activity: ______________________________

Date and time of recommencement of fishing activity: ______________________________

State reason for vessel's presence in the Party's waters:

____

____

____

____

SCHEDULE 3 (a)

PART A

PAE TRANSFER NOTIFICATION:
PARTY-PARTY TRANSFER

[Name of Party from which PAE to be transferred] notifies the Administrator to effect a transfer of ….. fishing days of its PAE for Management Year 20.. to [name of Party to receive transfer].

Amount of PAE to be transferred
(in fishing days): ……………………………

…………………………….
[Authorised Officer]
Name: ……………………………….
Telephone: ………………………….
Facsimile: ………………………….
Email: ……………………………….

SCHEDULE 3 (b)

PART B

PAE TRANSFER NOTIFICAITON: TRANSFER BETWEEN MANAGEMENT YEARS

[Name of Party requesting transfer] notifies the Administrator to effect a transfer of fishing days of its PAE for Management Year 20.. as follows:

Management Year to which fishing days to be transferred: …………..................

Amount of fishing days to be transferred (tick relevant box):

□ Total fishing days available for transfer

□ ……. fishing days

…………………………….
[Authorised Officer]
Name: ……………………………….
Telephone: ………………………….
Facsimile: ………………………….
Email: ……………………………….

PALAU ARRANGEMENT FOR THE MANAGEMENT OF THE WESTERN PACIFIC PURSE SEINE FISHERY – MANAGAMENT SCHEME (VESSEL DAY SCHEME)

SCHEDULE 4

APPLICATION FOR REGISTRATION

FORUM FISHERIES AGENCY

Vessel Days Scheme Register

APPLICATION FOR REGISTRATION

VID Number - FFA use only

Vessel

Name of vessel

Flag of vessel

International Radio Call Sign

Flag State Registration Number

FFA Vessel Monitoring System Details

FFA VMS type-approved ALC installed?

No ☐ Yes ☐ Inmarsat number

Vessel Specifications

Vessel Length (please complete all lengths for which information is available)

Length Overall

Registered Length

Length between perpendiculars

Length specified as:

☐ metres ☐ feet

Please send your completed form to:

Forum Fisheries Agency

1 FFA Road, Kola'a Ridge
P.O. Box 629
Honiara
Solomon Islands

Phone: (+677) 21124
Fax: (+677) 23995
E-mail: mcs@ffa.int

Privacy and your information

Information provided to the Forum Fisheries Agency on this form is confidential. Further information about VDS Registration, including instructions regarding remittance of VDS Registration fees, will be provided in a separate notice.

Applicant details

Name

Mailing address

Phone number

Fax number

E-mail address

Tick the box that applies to you

☐ Owner ☐ Charterer ☐ Authorised agent

Application period

from Month / Year to Month / Year

Applicant declaration

I hereby apply for good standing of the (name of vessel)

on the Vessel Days Register maintained by the Forum Fisheries Agency.

I declare that, to the best of my knowledge, there are no outstanding matters pending in relation to this vessel or its use.

I declare that the information provided in this Application for Registration, signed by me, is true and complete.

Signature

Date

Day / Month / Year

SCHEDULE 5

SCHEDULE OF FEES PAYABLE PURSUANT TO THE MANAGEMENT SCHEME
(all fees are stated in United States Dollar)

Fee Description	Amount
Registration Fee	$2,400:00*

* The Registration Fee is for the 3 year Management Period and may be paid in equal annual instalments of $800, provided that each instalment must be paid in advance of the commencement date of the Management Year. Late payments will attract a 10% penalty charge. There will be no pro-rata reduction of fees for late payments or payments received part way through a fishing year.

SCHEDULE 6

INFORMATION FOR INCLUSION IN A TRANSMISSION FAILURE REPORT

THE FOLLOWING INFORMATION MUST BE INCLUDED IN ANY TRANSMISSION FAILURE REPORT:

Date (dd/mm/yyyy):

Vessel Name:

Call Sign:

ALC Make and model:

ALC Serial Number:

Position of last ALC transmission (at four -hour intervals):

Position of last manual transmission:

Operator/Captain Name:

Observer's Name (if applicable):

Schedule 7

Purse Seine Licence Numbers

(Revised May 2006)

Category	*Agreed, June 2005*	*Reported May 2006*	*Agreed May 2006*	*Variance*
1. Multilateral Access				
U.S. Treaty	40	13	40	-27
2. Bilateral Foreign Access				
Japan	35	34	35	-1
Taiwan	33	33	33	0
South Korea	27	27	27	0
Philippines	10	6	10	-4
China	4	4	4	0
European Union	4	2	4	-2
Sub-total (1+2)	153	119	153	-34
3. Domestic / Locally-based				
All parties	52	52	52	0
Total ((1+2) + 3)	**205**	**171**	**205**	**-34**

***Note: Fleets that fail to fully utilise their allocation will be liable to forfeit their unused allocation.**

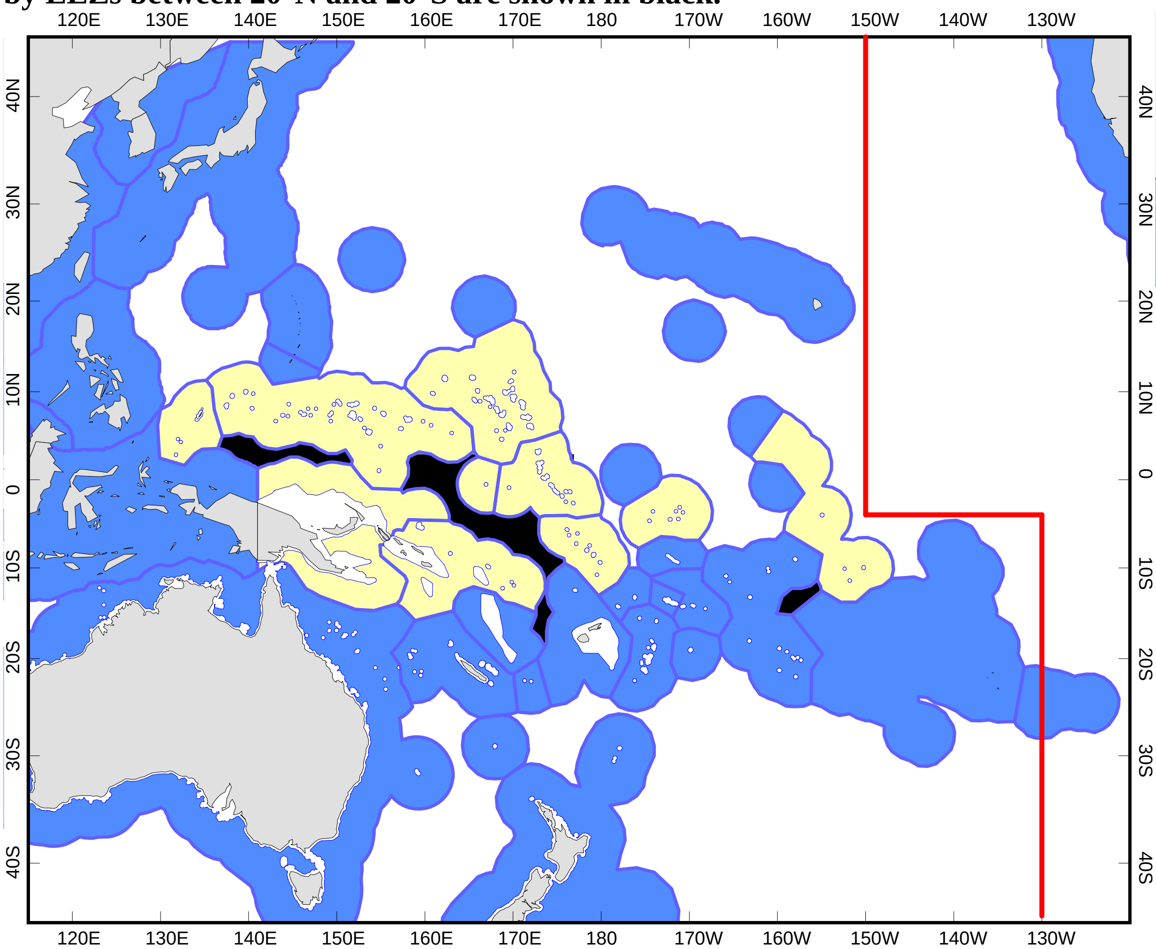
Special Arrangements[5]

Category	*Agreed, June 2005*	*Reported May 2006*	*Agreed May 2006*	*Variance*
1. EU vessels part-time in Kiribati waters only	2	0	2	-2
2. Domestic/Locally Based	15	13	15	-2
3. China	4	5	5	0
4. South Korea	1	0	1	-1
5. Philippines	1	0	1	-1
6. Taiwan	1	0	1	-
Totals	***24***	***18***	***25***	***-7***

Appendix D

[5] This category will remain in force as long as the number of US vessels is below its maximum allocation of 40 vessels.

The WCPFC Convention Area. The PNA Exclusive Economic Zones (EEZs) are shown in yellow (light), Archipelagic Waters and Territorial Seas for Pacific Island Countries and Territories, Australia and New Zealand are shown in white within the EEZs. Coordinates for Archipelagic Waters and Territorial Seas for other CCMs were not available and are not shown. The high-seas pockets wholly enclosed by EEZs between 20°N and 20°S are shown in black.



This map displays indicative maritime boundaries only. It is presented without prejudice to any past, current or future claims by any State. It is not intended for use to support any past, current or future claims by any State or territory in the western and central Pacific or east Asian region. Individual States are responsible for maintaining the coordinates for their maritime claims. It is the responsibility of flag States to ensure their vessels are informed of the coordinates of maritime limits within the Convention Area. Coastal States are invited to register the coordinates for their negotiated and agreed maritime areas with the Commission secretariat

Western and Central Pacific Fisheries Commission

GUIDELINES FOR PREPARATION OF FAD[6] MANAGEMENT PLANS

To support obligations in respect of FADs in CMM-2008-01, the FAD Management Plan (FAD-MP) for a CCM purse seine fleet to be submitted to the Commission could include, for example:

- An objective
- Scope:
  - Description of its application with respect to:
    - Vessel-types and support and tender vessels,
    - FAD types [anchored (AFAD) AND drifting (DFAD)],
    - maximum FAD numbers permitted to be deployed [per purse seine or ring net vessel per FAD type],
    - reporting procedures for AFAD and DFAD deployment,
    - catch reporting from FAD sets (consistent with the Commission's Standards for the Provision of Operational Catch and Effort Data),
    - minimum distance between AFADs,
    - incidental by-catch reduction and utilization policy,
    - consideration of interaction with other gear types,
    - statement or policy on "FAD ownership".
- Institutional arrangements for management of the FAD Management Plans
  - Institutional responsibilities,
  - application processes for FAD deployment approval,
  - Obligations of vessel owners and masters in respect of FAD deployment and use,
  - FAD replacement policy,
  - reporting obligations,
  - observer acceptance obligations,
  - relationship to Catch Retention Plans,
  - conflict resolution policy in respect of FADs.
- FAD construction specifications and requirements
  - FAD design characteristics (a description),
  - FAD markings and identifiers,
  - Lighting requirements,
  - radar reflectors,
  - visible distance,
  - radio buoys [requirement for serial numbers],
  - satellite transceivers [requirement for serial numbers].
- Applicable areas
  - Details of any closed areas or periods e.g. territorial waters, shipping lanes, proximity to artisanal fisheries, etc.
- Applicable period for the FAD-MP

[6] Fish aggregating devices (FAD) are drifting or anchored floating or submerged objects deployed by vessels for the purpose of aggregating target tuna species for purse seine or ring-net fishing operations.

- Means for monitoring and reviewing implementation of the FAD-MP.
- Means for reporting to the Commission

Attachment F

BASELINE LONGLINE BIGEYE TUNA CATCHES, BY FLAG

CCM	2001	2002	2003	2004	Av. 2001-04 or 2004*	2005	2006	2007 (prov.)
AMERICAN SAMOA	75	196	242	227	185	134	181	198
AUSTRALIA	1,307	1,002	1,024	892	1,056	791	563	777
BELIZE	1,322	812	782	297	803	425	254	158
CHINA	2,227	2,312	8,965	9,314	*9,314*	6,399	9,790	7,821
COOK ISLANDS	1	56	204	394	164	220	166	189
EUROPEAN COMMUNITY	0	0	0	42	11	17	62	0
FIJI	662	853	889	1254	915	423	771	639
FRANCE (FRENCH POLYNESIA)	745	649	439	502	584	606	498	481
FRANCE (NEW CALEDONIA)	128	189	142	90	137	76	35	53
FSM	651	759	656	542	652	182	172	1,394
INDONESIA	659	711	625	8413	8,413	7707	10,317	10,197
JAPAN	27,466	29,574	26,110	29,248	28,100	23,020	26,876	<u>26,876</u>
KIRIBATI	0	0	0	0	0	0	0	0
MARSHALL ISLANDS	0	0	0	1	0	0	0	3
NAURU	6	3	10	0	5	0	0	0
NEW ZEALAND	481	201	204	177	266	175	177	213
NIUE	0	0	0	0	0	10	0	0
PALAU	21	1	1	7	8	0	0	0
PAPUA NEW GUINEA	240	318	390	392	335	211	134	144
PHILIPPINES	264	310	394	403	343	729	804	927
REPUBLIC OF KOREA	22,172	28,533	17,151	17,941	21,449	15622	12,489	10,054
SAMOA	185	137	110	104	134	64	128	101
SOLOMON ISLANDS	187	393	967	357	476	<u>357</u>	<u>357</u>	<u>357</u>
CHINESE TAIPEI	12,435	16,645	13,345	20,992	15,854	15498	14,295	14,760
TONGA	191	215	94	40	135	125	117	129
USA	2,418	4,396	3,618	4,181	*4,181*	4,462	4,381	5,416
VANUATU	17	396	841	1,862	779	1,558	2,145	1,574
Total	73,860	88,661	77,203	97,672	94, 294	78,811	84,712	82,461

*2004 only applies to China, Indonesia and USA

Notes:
1. Source: Annual catch estimates, WCPFC Tuna Fishery Yearbook 2006.
2. Underlined catch estimates have been carried over from previous years.
3. Indonesia has recently revised the proportion of catch taken by gear type for their domestic fisheries which has resulted in a much larger allocation to their longline (at the expense of catches in the “unclassified” fisheries) since 2004 than has been reported in previous years.
4. Catches and effort of vessels operating under charters and similar arrangements have been attributed to host island states or territories in accordance with paragraph 5 of CMM 2005-01 using the best information available to SPC-OFP.

FIFTH REGULAR SESSION
8-12 December 2008
Busan, Korea

COOPERATING NON-MEMBERS

Conservation and Management Measure 2008-02[1]

REAFFIRMING the objective of the WCPF Convention is to ensure through effective management, the long-term conservation and sustainable use of highly migratory fish stocks in the Western and Central Pacific Ocean in accordance with the United Nations Convention on the Law of the Sea of 10 December 1982 and the Agreement on the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks;

RECALLING the 1999 MHLC Resolution on Future Participation in the Conference placed a limit on the number of participants in the Multilateral High Level Conference on the Conservation and Management of Highly Migratory Fish Stocks (MHLC), and confirmed the eligibility of MHLC participants to become members of the WCPFC;

RECALLING the Conservation and Management Measure 2004-02 on Cooperating Non-Members adopted at the inaugural session of the WCPFC December 9-10, 2004;

RECOGNIZING the continuing need to encourage non-Parties with vessels fishing for WCPFC species in the Convention Area to implement WCPFC conservation measures;

RECALLING Article 32(4) of the WCPF Convention that provides for members of the Commission to request non-Parties to this Convention whose vessels fish in the Convention Area to cooperate fully in the implementation of conservation and management measures adopted by the Commission;

TAKING INTO ACCOUNT the status of highly migratory fish stocks in the WCPF Convention Area and the existing level of fishing effort in the WCPF Convention Area;

REAFFIRMING that the Commission shall give full recognition to the special requirements of developing States Parties to this Convention, in particular small island developing States, and of territories and possessions, in relation to conservation and

[1] Replaces CMM 2004-02

management of highly migratory fish stocks in the Convention Area and development of fisheries for such stocks; and

GIVING EFFECT to Article 32 of the WCPF Convention:

1. A non-member of the Commission, with an interest in the fishery, or whose vessels fish or intend to fish in the Convention Area, may request the Commission for the status of Cooperating non-member (CNM). Any such request and supporting information shall be in English and shall be received by the Executive Director at least 60 days in advance of the annual meeting of the Technical and Compliance Committee meeting at which the request will be considered. The Executive Director shall notify all members of the Commission of any such request and circulate the full application to all members.

2. A non-member seeking the status of CNM shall include with its request:
    a. its reason for seeking CNM status,
    b. a commitment to cooperate fully in the implementation of conservation and management measures adopted by the Commission and to ensure that fishing vessels flying its flag and fishing in the Convention Area and, to the greatest extent possible, its nationals, comply with the provisions of the Convention and conservation and management measures adopted by the Commission;
    c. an explicit commitment to accept high seas boarding and inspections in accordance with the Commission's procedures on high seas boarding and inspection;
    d. full data on its historical fisheries in the Convention Area, including nominal catches, number/type of vessels, name of fishing vessels, fishing effort and fishing areas;
    e. all the data and information members of the Commission are required to submit, in accordance with the recommendations adopted by the Commission;details on its current fishing presence in the Convention Area, including the number of its vessels and their characteristics;results from research programmes it has conducted in the Convention Area; and
    f. any further relevant information as determined by the Commission.

3. The Technical and Compliance Committee (TCC) shall assess applications for CNM status and provide recommendations and technical advice to the Commission, which shall consider, *inter alia*:
    a. whether the CNM application includes all information required under paragraph 2;
    b. in the case of renewal, the record of compliance of the applicant with the provisions of the Convention and the conservation and management measures adopted by the Commission and the fisheries laws and regulations of coastal States in the Convention Area;

c. its record of responding to any IUU activities by vessels flying its flag that have been brought to its attention, in accordance with Article 25 of the Convention;
d. as appropriate, the record of compliance of the applicant with conservation and management measures of other Regional Fisheries Management Organizations (RFMOs); and
e. in the case of applications for renewal of CNM status, whether the applicant is meeting all paragraph 11 requirements for CNM.

4. The Executive Director shall forward a copy of the relevant TCC recommendations and advice to the non-member applicant as soon as practicable.

5. The non-member applicant shall have the opportunity to consider the recommendations and advice of the TCC, and to submit additional information if necessary in advance of the Commission's decision on its application.

6. The Commission shall, in determining whether a non-party is accorded CNM status have regard to the criteria outlined in paragraph 3.

7. The Commission shall also consider information available from other RFMOs relating to non-members seeking CNM status, as well as data submitted by such non-members to the Commission. Caution shall be used so as not to introduce into the Convention Area excess fishing capacity from other regions or IUU fishing activities in granting CNM status to such non-members.

8. The Commission shall accord CNM status on an annual basis. It may renew the CNM status subject to a review of the CNM's compliance with the Convention's objectives and requirements.

9. CNMs seeking to renew their status as a CNM shall comply with other requirements the Commission may prescribe to ensure compliance with conservation and management measures adopted by the Commission.

10. CNMs are entitled to participate at meetings of the Commission and its subsidiary bodies as Observers.

11. CNMs shall:
    a. comply with all conservation and management measures adopted by the Commission;
    b. provide all data members of the Commission are required to submit, in a timely manner, in accordance with the format and standards adopted by the Commission;
    c. inform the Commission annually of the measures it takes to ensure compliance by its vessels with the Commission's conservation and management measures;

d. respond in a timely manner to alleged violations of conservation and management measures adopted by the Commission and any IUU activities of vessels flying its flag , as requested by a member of the Commission or determined by the appropriate subsidiary bodies of the Commission and communicate to the member making the request and to the Commission, the actions it has taken against the vessels in accordance with the provisions of Article 25 of the Convention;
e. accept boardings in accordance with Commission high seas boarding and inspection procedures.

12. Without prejudice to the sovereign rights of coastal States for the purpose of exploring and exploiting, conserving and managing highly migratory fish stocks within areas under national jurisdiction, and following the granting of CNM status, the Commission shall, where necessary, determine how the participatory rights of CNMs will be limited by the conservation and management measures adopted by the Commission.. In giving effect to this paragraph, the Commission shall take into account *inter alia*:
    a. the status of the highly migratory fish stocks and the existing level of fishing effort in the fishery;
    b. the special requirements of developing States in the Convention Area, in particular small island developing States, and of territories and possessions, in relation to conservation and management of highly migratory fish stocks in the Convention Area and development of fisheries for such stocks;
    c. the respective interests, fishing patterns and fishing practices of new and existing members or participants;
    d. the respective contributions of new and existing members or participants to conservation and management of the stocks, to the collection and provision of accurate data and to the conduct of scientific research on the stocks;
    e. the needs of coastal fishing communities which are dependant mainly on fishing for the stocks;
    f. the needs of coastal States whose economies are overwhelmingly dependent on the exploitation of living marine resources; and
    g. the interests of developing States from the subregion or region in whose areas of national jurisdiction the stocks also occur.

13. The limits determined for CNMs under paragraph 12 may be reviewed by the Commission from time to time in accordance with this measure and other conservation and management measures adopted by the Commission.

14. The Commission shall invite CNMs to make a financial contribution commensurate with what its obligations would be as a member under Article 18(2) of the Convention,.The Commission shall monitor the activities of nationals and fishing vessels of CNMs, including their record of compliance with the

provisions of the Convention and conservation and management measures adopted by the Commission.

15. CNMs that fail to comply with any of the conservation and management measures adopted by the Commission shall be deemed to have undermined the effectiveness of the conservation and management measures adopted by the Commission. The Commission shall take appropriate action, which may include revocation of CNM status and/or sanctions and penaltiesagainst such CNMs, in accordance with the Convention and adopted conservation and management measures..
16. The members of the Commission shall, individually or jointly, request non-parties to this Convention whose vessels fish in the Convention Area to cooperate fully in the implementation of the conservation and management measures adopted by the Commission and urge them to apply for the status of CNM.

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8-12 December 2008
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CONSERVATION AND MANAGEMENT OF SEA TURTLES

Conservation and Management Measure 2008-03

The Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean;

In accordance with the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean:

Recognizing the ecological and cultural significance of all species of sea turtles in the western and central Pacific Ocean (WCPO);

Further recognizing that the five marine turtle species in the WCPFC Convention Area are threatened or critically endangered;

Considering the adverse effects of fishing for highly migratory fish stocks on some populations of sea turtles in the WCPO through capture, injury and mortality;

Recalling that the United Nations Food and Agriculture Organization (FAO) endorsed *Guidelines to Reduce Sea Turtle Mortality in Fishing Operations* at its twenty-sixth Session of the Committee on Fisheries, held in March 2005, and recommended their implementation by regional fisheries bodies and management organizations;

Noting that recent international scientific studies using large circle hooks in shallow-set pelagic longline fishing targeting swordfish show, when compared to conventional hooks, significantly lower sea turtle catch rates without undue adverse effects on catch rates of target species;

Further noting that scientific studies indicate circle hooks' further mitigative effects for sea turtles and other incidentally caught species in terms of post-release mortality, as the hooking locations tend to be such that resultant injuries are less severe than with conventional hooks;

Further noting that regardless of what hook type is used, international scientific studies using finfish bait show when compared to squid bait, significantly lower sea turtle catch rates in shallow-set pelagic longline swordfish fisheries;

Acknowledging that relatively simple proactive and reactive efforts on the part of fishermen can serve to both avoid sea turtle interactions and minimize the adverse consequences of such interactions when they occur;

Noting that shallow set longline fisheries also pose significant risks to vulnerable seabird populations in higher latitudes it necessary to achieve a balance in mitigation requirements across species vulnerable to longline interactions;

Recognizing that the Inter-American Tropical Tuna Commission (IATTC) adopted, at its 75th meeting, a *Resolution to Mitigate the Impact of Tuna Fishing Vessels on Sea Turtles* that includes mandatory provisions to apply to purse seine and longline vessels;

Recalling Article 22 of the Convention, which provides for cooperation with other organizations, particularly the IATTC, with a view to avoiding duplication of, and achieving consistency in, conservation and management measures;

Adopts, in accordance with Articles 5 and 10 of the Convention, that:

1. Commission Members, Cooperating non-Members and participating Territories (CCMs) will implement, as appropriate the FAO Guidelines to Reduce Sea Turtle Mortality in Fishing Operations and to ensure the safe handling of all captured sea turtles, in order to improve their survival.

2. Beginning in 2009, CCMs shall report to the Commission in Part 2 of their annual reports the progress of implementation of the FAO Guidelines and this measure, including information collected on interactions with sea turtles in fisheries managed under the Convention.

3. All data collected by the WCPFC Regional Observer Program (ROP), shall be reported to the Commission as provided in paragraph 2 above or as agreed to under other Commission data collection provisions.

4. CCMs shall require fishermen on vessels targeting species covered by the Convention to bring aboard, if practicable, any captured hard-shell sea turtle that is comatose or inactive as soon as possible and foster its recovery, including giving it resuscitation, before returning it to the water. CCMs shall ensure that fishermen are aware of and use proper mitigation and handling techniques, as described in WCPFC guidelines to be developed and provided to all CCMs by the Secretariat.

5. CCMs with purse seine vessels that fish for species covered by the Convention shall:

a. Ensure that operators of such vessels, while fishing in the Convention Area:

   i. To the extent practicable, avoid encirclement of sea turtles, and if a sea turtle is encircled or entangled, take practicable measures to safely release the turtle.

ii. To the extent practicable, release all sea turtles observed entangled in fish aggregating devices (FADs) or other fishing gear.

iii. If a sea turtle is entangled in the net, stop net roll as soon as the turtle comes out of the water; disentangle the turtle without injuring it before resuming the net roll; and to the extent practicable, assist the recovery of the turtle before returning it to the water.

iv. Carry and employ dip nets, when appropriate, to handle turtles.

b. Require that operators of such vessels record all incidents involving sea turtles during fishing operations and report such incidents to the appropriate authorities of the CCM.

c. Provide the results of the reporting under paragraph 5(b) to the Commission as part of the reporting requirement of paragraph 2.

d. Provide to the Commission the results of any research related to the development of modified FAD designs to reduce sea turtle entanglement and take measures to encourage the use of designs found to be successful at such reduction.

6. CCMs with longline vessels that fish for species covered by the Convention shall ensure that the operators of all such longline vessels carry and use line cutters and de-hookers to handle and promptly release sea turtles caught or entangled, and that they do so in accordance with WCPFC guidelines that are to be developed and provided to all CCMs by the Secretariat. CCMs shall also ensure that operators of such vessels are, where appropriate, required to carry and use dip-nets in accordance with these WCPFC guidelines.

7. Starting on 1 January 2010, CCMs with longline vessels that fish for swordfish in a shallow-set manner[1] shall:

a. Ensure that the operators of such vessels, while in the Convention Area, are required to employ or implement at least one of the following three methods to mitigate the capture of sea turtles:

i. Use only large circle hooks, which are fishing hooks that are generally circular or oval in shape and originally designed and manufactured so that the point is turned perpendicularly back to the shank. These hooks shall have an offset not to exceed 10 degrees.

ii. Use only whole finfish for bait.

iii. Use any other measure, mitigation plan[2] or activity that has been reviewed by the Scientific Committee (SC) and the Technical and Compliance Committee (TCC)

[1] "Shallow-set" fisheries are generally to be considered those in which the majority of hooks fish at a depth shallower than 100 meters; however, pursuant to paragraph 7(c) CCMs are to establish and enforce their own operational definitions.

and approved by the Commission to be capable of reducing the interaction rate (observed numbers per hooks fished) of turtles in swordfish shallow-set longline fisheries.

b. The requirements of paragraph 7(a) need not be applied to those shallow-set swordfish longline fisheries determined by the SC, based on information provided by the relevant CCM, to have minimal[3] observed interaction rates of sea turtles over a three-year period and a level of observer coverage of at least 10% during each of those three years.

c. For the purpose of implementing this paragraph (7), establish and enforce their own operational definitions of shallow-set swordfish longline fisheries, large circle hooks, and any measures under 7(a)(iii) or adopted by the Commission under paragraph 12, ensuring that they are as enforceable as possible, and report these definitions to the Commission in Part 2 of their annual reports.

d. Provide for their longline vessels to record all incidents involving sea turtles during fishing operations and report such incidents to the appropriate authorities of the CCM.

e. Provide the results of the reporting under paragraph 7(d) to the Commission as part of the reporting requirement of paragraph 2.

8. CCMs with longline fisheries other than shallow-set swordfish fisheries are urged to:

a. Undertake research trials of circle hooks and other mitigation methods in those longline fisheries.

b. Report the results of these trials to the SC and TCC, at least 60 days in advance of the annual meetings of these subsidiary bodies.

9. The SC and TCC will annually review the information reported by CCMs pursuant to this measure. Where necessary an updated suite of mitigation measures, specifications for mitigation measures, or recommendations for their application will be developed by these committees and provided to the Commission for its consideration and review.

10. This measure authorizes the Secretariat to obligate resources available to the Special Requirements Fund to be used to assist developing State Members and Territories in implementing the FAO Guidelines to Reduce Sea Turtle Mortality. These funds can be used to train and encourage fishers to adopt appropriate methods and technologies to reduce interactions with sea turtles and to mitigate their adverse effects.

11. The Commission urges CCMs to contribute to the Special Requirements Fund to support eligible members in their efforts to implement this measure, or to provide such support through bilateral arrangements.

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[2] A mitigation plan details the actions that will be taken to achieve specified reductions in sea turtle interactions.
[3] To be determined by SC5.

12. The Commission will regularly consider additional or new mitigation measures for other longline and purse seine fisheries, based on advice from the SC and TCC and on information provided by CCMs pursuant to this measure.

13. The Secretariat, in coordination with interested CCMs, shall develop guidelines for the handling of sea turtles and distribute them to CCMs no later than June 30, 2009.

14. Nothing in this measure shall prejudice the sovereignty and sovereign rights of coastal States, including for traditional fishing activities and the rights of traditional artisanal fishers, to apply alternative measures for the purpose of exploring, exploiting, conserving and managing sea turtles, including any national plans of action for the conservation and management of sea turtles, within areas under their national jurisdiction.

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CONSERVATION AND MANAGEMENT MEASURE TO PROHIBIT THE USE OF LARGE SCALE DRIFTNETS ON THE HIGH SEAS IN THE CONVENTION AREA

Conservation and Management Measure 2008-04

The Western and Central Pacific Fisheries Commission (WCPFC);

Recalling that the United Nations General Assembly (UNGA) Resolution 46/215 calls for a global moratorium on large-scale high seas driftnet fishing and the Wellington Convention seeks to prohibit driftnet fishing activities in its convention area;

Noting that a number of vessels continue to engage in large-scale high seas driftnet fishing in the North Pacific Ocean, including within the Western and Central Pacific Fisheries Convention area (Convention Area);

Mindful that any vessel fishing with large-scale driftnets on the high seas in the Convention Area, or configured to conduct large-scale high seas driftnet operations, has the capacity to take species of concern to the WCPFC and is likely to undermine the effectiveness of Conservation and Management Measures (CMMs) adopted by the WCPFC;

Noting with concern that recent information indicates that such vessels are interacting more frequently with highly migratory species, such as tunas, swordfish, sharks, and other species covered by the Convention; and that associated "ghost fishing" by lost or discarded driftnets have serious detrimental effects on these species of concern and the marine environment;

Aware that the WCPFC Northern Committee in its 4th Regular Session recommended that the WCPFC adopt a CMM prohibiting large-scale high seas driftnet fishing in the Convention Area;

Adopts the following CMM in accordance with Article 10 of the Convention:

1. The use of large-scale driftnets[1] on the high seas within the Convention Area shall be prohibited and such nets shall be considered prohibited fishing gear, the use of which shall constitute a serious violation in accordance with Article 25 of the Convention.

2. CCMs shall take all measures necessary to prohibit their fishing vessels from using large-scale driftnets while on the high seas in the Convention Area.

3. A CCM-flagged fishing vessel will be presumed to have used large-scale driftnets on the high seas in the Convention Area if it is found operating on the high seas in the Convention Area and is configured[2] to use large-scale driftnets or is in possession of large-scale drift-nets.

4. Paragraph 3 is not intended to apply to a CCM-flagged vessel that can demonstrate that it is duly authorized to use large-scale driftnets in waters under national jurisdiction and while on the high seas in the Convention Area all of its large-scale driftnets and related fishing equipment are stowed or secured in such a manner that they are not readily available to be used for fishing.

5. CCMs shall include in Part 2 of their Annual Reports a summary of monitoring, control, and surveillance actions related to large-scale driftnet fishing on the high seas in the Convention Area.

6. The WCPFC shall periodically assess whether additional measures should be adopted and implemented to ensure that large-scale driftnets are not used on the high seas in the Convention Area.

7. Nothing in this measure shall prevent CCMs from applying more stringent measures to regulate the use of large-scale driftnets.

[1] "Large-scale driftnets" are defined as gillnets or other nets or a combination of nets that are more than 2.5 kilometers in length whose purpose is to enmesh, entrap, or entangle fish by drifting on the surface of, or in, the water column.

[2] "Configured" to use large-scale drift-nets means having on board gear, either assembled or disassembled, that collectively would allow the vessel to deploy and retrieve large-scale driftnets.

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CONSERVATION AND MANAGEMENT OF SHARKS

Conservation and Management Measure 2008-06[1]

The Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean;

In accordance with the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean;

Recognizing the ecological and cultural significance of sharks in the western and central Pacific Ocean (WCPO);

Recalling that the United Nations Food and Agriculture Organization (FAO) International Plan of Action for the Conservation and Management of Sharks calls on FAO members, within the framework of their respective competencies and consistent with international law, to cooperate through regional fisheries organizations with a view to ensuring the sustainability of shark stocks as well as to adopt National Plans of Action for the conservation and management of sharks;

Recognizing the need to collect data on catch, effort, discards, and trade, as well as information on the biological parameters of many species, to enable effective shark conservation and management;

Recognizing further that certain species of pelagic sharks, such as basking shark and great white shark, have been listed on Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Resolves as follows:

1. Commission Members, Cooperating non-Members, and participating Territories (CCMs) shall implement, as appropriate, the FAO International Plan of Action for the Conservation and Management of Sharks (IPOA Sharks).

2. CCMs shall advise the Commission (in Part 2 of the annual report) on their implementation of the IPOA Sharks, including, results of their assessment of the need for a National Plan of Action and/or the status of their National Plans of Action for the Conservation and Management of Sharks.

3. National Plans of Action or other relevant policies for sharks should include measures to

[1] Replaces CMM 2006-05

minimize waste and discards from shark catches and encourage the live release of incidental catches of sharks.

4. Each CCM shall include key shark species[2], as identified by the Scientific Committee, in their annual reporting to the Commission of annual catch and fishing effort statistics by gear type, including available historical data, in accordance with the WCPF Convention and agreed reporting procedures. CCMs shall also report annual retained and discarded catches in Part 2 of their annual report. CCMs shall as appropriate, support research and development of strategies for the avoidance of unwanted shark captures (e.g. chemical, magnetic and rare earth metal shark deterrents).

5. The Commission shall consider appropriate assistance to developing State Members and participating Territories for the implementation of the IPOA and collection of data on retained and discarded shark catches.

And adopts, in accordance with Articles 5 and 10 of the Convention, that:

6. CCMs shall take measures necessary to require that their fishers fully utilize any retained catches of sharks. Full utilization is defined as retention by the fishing vessel of all parts of the shark excepting head, guts, and skins, to the point of first landing or transshipment.

7. CCMs shall require their vessels to have on board fins that total no more than 5% of the weight of sharks on board up to the first point of landing. CCMs that currently do not require fins and carcasses to be offloaded together at the point of first landing shall take the necessary measures to ensure compliance with the 5% ratio through certification, monitoring by an observer, or other appropriate measures. CCMs may alternatively require that their vessels land sharks with fins attached to the carcass or that fins not be landed without the corresponding carcass.

8. As finer resolution data become available, the specification of the ratio of fin weight to shark weight described in paragraph 7 shall be periodically reviewed by the Scientific Committee (SC) and the SC will recommend any appropriate revisions to the Commission for its consideration. The SC and the Technical and Compliance Committee (TCC) are directed to consider if additional appropriate measures that give affect to paragraph 7 are required.

9. CCMs shall take measures necessary to prohibit their fishing vessels from retaining on board, transshipping, landing, or trading any fins harvested in contravention of this Conservation and Management Measure (CMM).

10. In fisheries for tunas and tuna-like species that are not directed at sharks, CCMs shall take measures to encourage the release of live sharks that are caught incidentally and are not used for food or other purposes.

11. Nothing in this measure shall prejudice the sovereignty and sovereign rights of coastal States, including for traditional fishing activities and the rights of traditional artisanal fishers, to apply alternative measures for the purpose of exploring, exploiting, conserving and managing sharks, including any national plans of action for the conservation and management of sharks, within areas under their national jurisdiction.

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[2] The key shark species are blue shark, oceanic whitetip shark, mako sharks and thresher sharks.

12. CCMs shall advise the Commission in Part 2 of the annual report on the implementation of this CMM and any alternative measures adopted under paragraph 11.

13. On the basis of advice from the SC, the TCC and the Commission, CCMs shall review the implementation and effectiveness of this measure, and any alternative measures applied under paragraph 11 above, and shall consider the application of additional measures for the management of shark stocks in the Convention Area, as appropriate.

14. In 2010, the SC, and if possible in conjunction with the Inter-American Tropical Tuna Commission, provide preliminary advice on the stock status of key shark species and propose a research plan for the assessment of the status of these stocks.

15. This CMM shall apply to sharks caught in association with fisheries managed under the WCPF Convention, and to sharks listed in Annex 1 of the 1982 Convention.

16. The Commission shall consider appropriate assistance to developing State Members and participating Territories for the implementation of this measure, including, in accordance with Article 7 of the Convention, in areas under national jurisdiction.

17. This CMM shall replace 2006-05.

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RESOLUTION ON ASPIRATIONS OF SMALL ISLAND DEVELOPING STATES AND TERRITORIES

Resolution 2008-01

The Commission for the Conservation and Management of Highly Migratory Fish Stock in the Western and Central Pacific Ocean,

Recognizing the sovereign rights of coastal States, in particular Small Islands Developing States (SIDS) and Territories in the Convention Area, aspirations to develop and manage their domestic fisheries,

Acknowledging that nothing in the Convention or in measures adopted by the Commission shall prejudice the rights, jurisdiction and duties of States under the 1982 Convention and the Agreement,

Further recognizing that the Commission shall function without prejudice to the sovereign rights of the coastal States, in particular SIDS and Territories in the Convention Area, for the purpose of exploring and exploiting, conserving and managing highly migratory fish stocks within areas of national jurisdiction,

Conscious of the vulnerability of developing States, in particular SIDS and Territories, which are dependent on the exploitation of marine living resources, including for meeting the nutritional requirements of their populations or parts thereof,

Recognizing that the Commission shall give full recognition to the special requirements of developing States, in particular SIDS and Territories, in relation to the conservation and management of highly migratory fish stocks in the Convention Area and development of fisheries for such stocks,

Further recognizing that smaller Island Developing States and Territories in the Convention Area have unique needs which require special attention and consideration in the provision of financial, scientific and technological assistance,

Mindful that fifteen of twenty five members of the WCPFC are SIDS and Territories, and are members of the Pacific Islands Forum Fishery Agency (FFA members), in whose waters, a significant proportion of the catch of highly migratory fish stocks in the Convention Area is taken.,

Noting that these coastal States in the exercise of their sovereign rights have taken measures for the conservation and management of highly migratory fish stocks in the Convention Area, including the monitoring and control of fishing activities in the Convention Area,

Urging the Commission, in accordance with Article 8 of the Convention, to develop compatible measures for areas beyond national jurisdiction, including measures that effectively monitor and control fishing activities on the high seas.

Resolves in accordance to articles 4, 8, 10 and 30 of the Convention that:

1. CCMs will develop, interpret and apply conservation and management measures in the context of and in a manner consistent with the 1982 Convention and the Agreement. To this end, CCMs shall cooperate, either directly or through the Commission, to enhance the ability of developing States, particularly the least developed among them and SIDS and Territories in the Convention Area, to develop their own fisheries for highly migratory fish stocks, including but not limited to the high seas within the Convention Area.

2. To implement this resolution, developed CCMs shall make concerted efforts and consider innovative options to reduce and or restructure their fleet so as to accommodate
aspirations of SIDS and Territories in the Convention Area to develop their own fisheries.

3. Developed CCM's shall cooperate in investments in fishing vessels or other fishing related activities and facilities in SIDS and Territories, provided that such investments are directly linked to the onshore development of domestic fishing industries established in SIDS and Territories in accordance with their legislation.

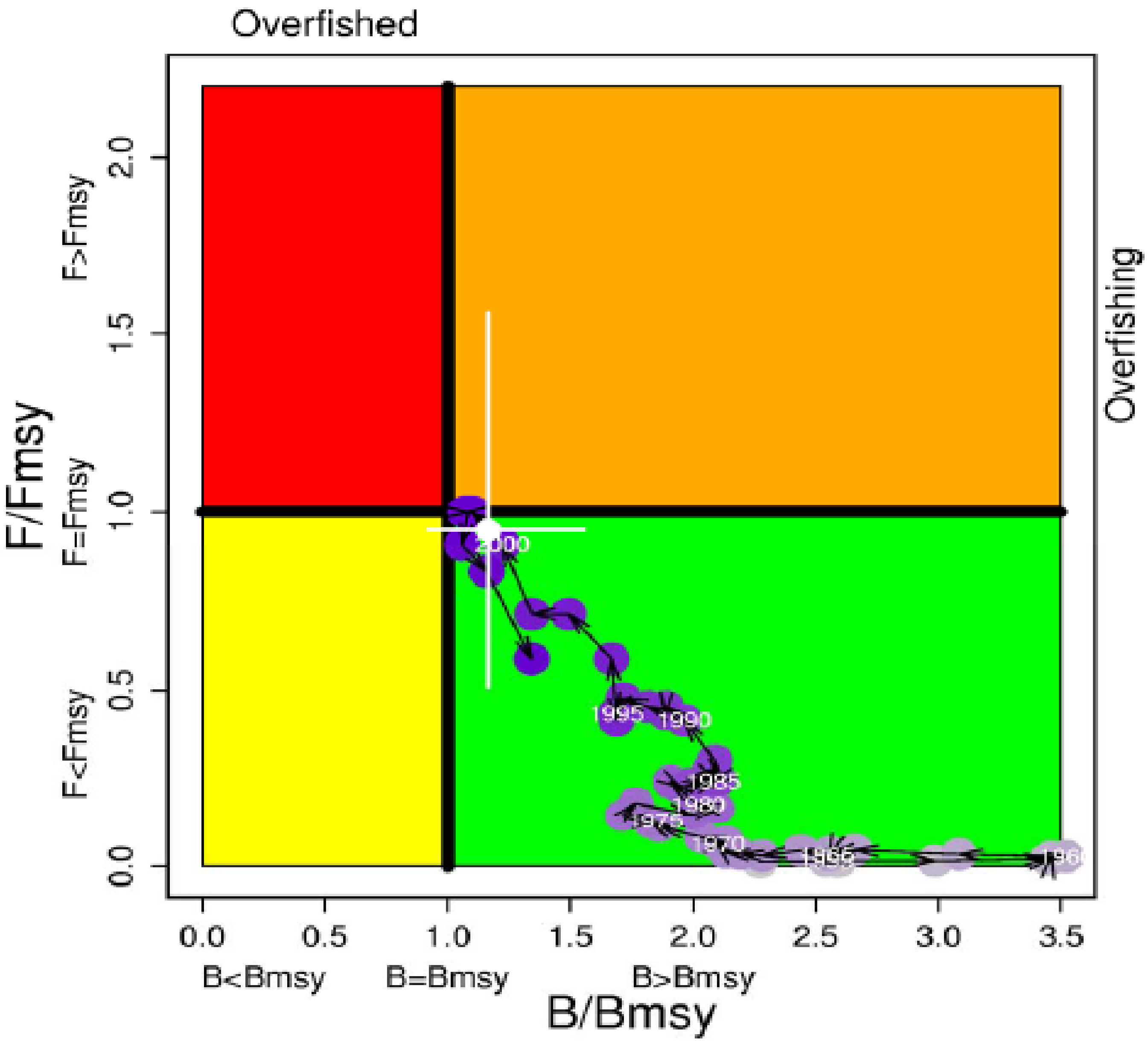
4. CCM's commit to achieve the goal of ensuring that by 2018, the domestic fishing and related industries of developing States, in particular, the least developed SIDS and Territories, accounts for a greater share of the benefit than what is currently realized of the total catch and value of highly migratory fish stocks harvested in the Convention Area.

5. When adopting Commission conservation and management measures the following
principles should be taken into account:

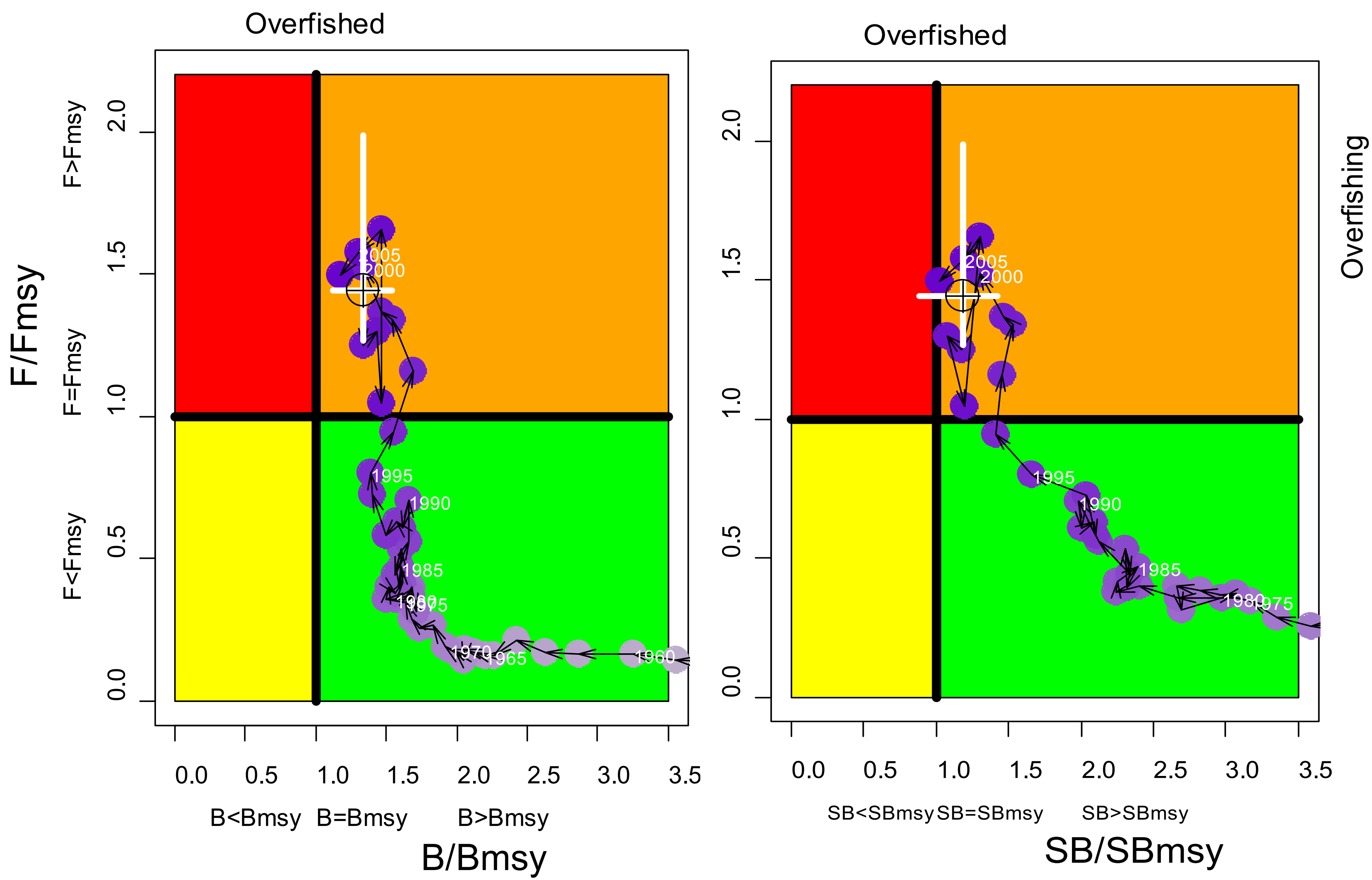
> a) CCMs shall ensure that measures do not result in transferring, directly or indirectly, a disproportionate burden of conservation action onto SIDS and Territories.
>
> b) CCMs shall implement measures, including through direct cooperation with SIDS and Territories that enhances the ability of developing States, particularly the least developed SIDS, to develop their own fisheries for highly migratory fish stocks, including but not limited to the high seas within the Convention Area.

6. Developed CCMs shall ensure that conservation and management measures will not be implemented to constrain coastal processing and transshipment facilities and associated vessels of SIDS and Territories, nor shall it be implemented to undermine legitimate investment that has occurred legally in FFA member countries.

Yellowfin Tuna – Kobe Plot



Bigeye Tuna – Kobe Plots



Memorandum of Understanding Regarding Regional Fishery Management Council Participation in International Regional Fishery Management Organizations Governing Pacific Ocean Highly Migratory Species (02-20-2009 DOC/DOS Joint Draft)

I. Parties

A. The parties to this Memorandum of Understanding (MOU) are the U.S. Department of Commerce (DOC), the U.S. Department of State (DOS), the Western Pacific Fishery Management Council (Western Pacific Council), the Pacific Fishery Management Council (Pacific Council) and the North Pacific Fishery Management Council (North Pacific Council).

II. Purpose

A. Pursuant to authority established in the Western and Central Pacific Fisheries Convention Implementation Act, Public Law 109-479 Section 503(f), the purpose of this MOU is to clarify the roles of the Western Pacific, Pacific, and North Pacific Councils (collectively, the Councils) with regard to international efforts by the United States to manage highly migratory species (HMS) in the Pacific Ocean, including:
   1. participation in U.S. delegations to international fishery organizations in the Pacific Ocean, including government-to-government consultations;
   2. providing formal recommendations to the DOC and DOS regarding necessary measures for both domestic and foreign vessels fishing for HMS species;
   3. coordinating positions within the U.S. delegation for presentation to the appropriate international fishery organization; and
   4. recommending those domestic fishing regulations that are consistent with the actions of the international fishery organization, for approval and implementation under the Magnuson-Stevens Fishery Conservation and Management Act.

III. Participation in U.S. Delegations to International Fishery Organizations in the Pacific Ocean, including Government-to-Government Consultations

A. Participation on U.S. delegations to the Inter-American Tropical Tuna Commission (IATTC) and Western and Central Pacific Fisheries Commission (WCPFC).

   1. The Councils are to be afforded the opportunity to participate directly on U.S. delegations to meetings of the IATTC and WCPFC and their subsidiary bodies. Such participation is to include at least one individual designated by each Council, but may include additional Council representatives consistent with

limits on the size of the U.S. delegation and the need to ensure balanced representation of all relevant stakeholders as determined by the Head of Delegation in consultation with the DOS.

2. The DOC and DOS will make their best efforts to avoid scheduling conflicts between meetings of the WCPFC and IATTC and their subsidiary bodies and meetings of the Fishery Management Councils, with the understanding among all parties to this MOU that such scheduling is often outside the control of the U.S. delegation to any meeting.

B. The Councils are to be afforded the opportunity to participate on U.S. delegations to bi-lateral or multi-lateral Government-to-Government consultations that are primarily on WCPFC and IATTC issues. In cases where a Council member is also a Commissioner or Alternate Commissioner, that Commissioner or Alternate Commissioner shall represent the Council in the Government-to-Government consultation. In cases where there is no Commissioner from the Council in question, the Council may designate a representative.

C. As a general rule, and to the extent practicable, the Councils are to be afforded the opportunity to participate on U.S. delegations to, and bi-lateral or multilateral Government to Government consultations at, other announced meetings of international fisheries organizations, in addition to the IATTC and WCPFC, dealing with fishery management issues for Pacific HMS stocks associated with a respective Council.

D. Should circumstances warrant, the Head of Delegation, in consultation with the DOS, may restrict participation in Government-to-Government consultations to Government personnel and appointed Commissioners or Alternate Commissioners.

E. The DOC and DOS will seek to minimize the number of IATTC or WCPFC meetings at which attendance by the full delegation is restricted. Where such restricted meetings cannot be avoided, and except for situations described in Section III.D of this Memorandum, DOC and DOS will afford the opportunity for a Council representative to attend any such restricted meetings.

IV. Providing Formal Recommendations to the DOC and DOS regarding Necessary Measures for both Domestic and Foreign Vessel Fishing for Pacific HMS Species

A. The IATTC forum.

1. The Councils may, at any time, provide formal recommendations to the DOC and DOS Secretaries, or their representatives, regarding necessary measures for the conservation and management of the HMS stocks under the purview of the IATTC.

2. Formal recommendations, if possible, shall be submitted to the DOC and DOS Secretaries at least two weeks prior to any noticed meeting of the IATTC, but may be submitted at any time prior to or following the conclusion of such meeting, including any direct follow up activities.

3. Formal recommendations, if completed prior to any meetings of the General Advisory Committee (GAC) of the IATTC, shall be submitted by the Councils to the GAC of the IATTC for evaluation and recommendation to the U.S. delegation.

B. The WCPFC forum.

1. The Councils may, at any time, provide formal recommendations to the DOC and DOS Secretaries, or their representatives, regarding necessary measures for the conservation and management of the HMS stocks under the purview of the WCPFC.

2. Formal recommendations, if completed prior to any meetings of the WCPFC Advisory Committee, established pursuant to the WCPFC Implementation Act, shall be submitted by the Councils to the Advisory Committee for their evaluation and recommendation to the U.S. delegation.

3. The Councils will submit recommendations pursuant to Magnuson-Stevens Act section 304(i) to the DOC and DOS Secretaries, or their representatives, in accordance with the process established in that section.

V. Coordinating Positions within the U.S. Delegation for Presentation to the Appropriate International Fishery Organization

A. <u>Coordination of potential U.S. postions at the advisory body level.</u>

1. The Pacific and the Western Pacific Councils shall be provided one seat each on the IATTC GAC.

2. The Pacific and Western Pacific Councils shall be afforded one seat each on the Advisory Committee for the WCPFC as ex-officio Committee members and shall have the same status and rights of participation as appointed members.

3. To provide, to the maximum extent possible, an equitable balance among individuals from the various groups concerned with the fisheries covered by the WCPFC Convention, the Secretary of Commerce, in consultation with the United States Commissioners, will appoint not less than 15 nor more than 20 individuals to the WCPFC Advisory Committee from the various groups in each of the Pacific and Western Pacific Council areas, including among others, the albacore troll, longline and purse seine fisheries, commercial fish processors, recreational fisheries, and conservation and consumer groups.

4. Formally established advisory bodies to aid U.S. delegations to International Fishery Organizations shall be convened in a timely manner relative to providing recommendations to a meeting of U.S. Commissioners in advance of formal meetings of the International Fishery Organizations.

B. Coordination of U.S. positions in advance of formal meetings.

Prior to meetings of the WCPFC and IATTC and their subsidiary bodies, or other international fishery organizations that deal with Pacific HMS stocks, the DOC and DOS shall meet with Council-designated representatives in a timely manner so as to provide the opportunity for discussion of relevant recommendations and the development of U.S. positions in advance of the meetings.

C. Coordination of final U.S. positions.

1. At meetings of the WCPFC or its subsidiary bodies, including the Northern Committee, U.S. Commissioners shall strive for consensus in developing final U.S. positions for presentation or motion making

VI. Recommending Domestic Fishing Regulations that are Consistent with the Actions of the International Fishery Organization, for Approval and Implementation under the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.)

Representatives of the Councils, DOC and DOS will, as soon as practicable after each WCPFC or IATTC plenary meeting, review the outcomes of the meetings and, in the event that the United States subsequently approves the decisions resulting from such meetings, identify regulatory actions that might be needed to ensure domestic fishing regulations are consistent with such approved decisions of the two organizations and appropriate legal authority(ies). To the extent permitted by Section 505(a) of the WCPFC Implementation Act, the Councils may recommend to the Secretary of Commerce those domestic fishing regulations that are consistent with the actions of the international fisheries organization for promulgation under that Section, the Magnuson-Stevens Fishery Conservation and Management Act, or other authorities as appropriate.

VII. Miscellaneous Matters

A. If any new international fishery organizations are formed that have a substantial interest in HMS in the Pacific, the Councils, DOS and DOC will review this MOU and modify, as appropriate.

B. Following U.S. ratification of the Antigua Convention, the elements of this MOU that refer to the IATTC shall apply, *mutatis mutandis*, to the Antigua Convention, unless enacted implementing legislation significantly alters existing U.S. responsibilities, protocols, or procedures, in which case the provisions of Section VII.A shall apply.

C. This MOU shall be reviewed for efficacy of the mechanisms and established protocols on a regular basis.

II. Agreement

The terms of this MOU are agreed to and remain in effect until notice of termination by any party with six months notice. By authorized signature and date,

Department of Commerce:

______________________	______________________	__________
Signature	Title	Date

Department of State:

______________________	______________________	__________
Signature	Title	Date

Western Pacific Fishery Management Council:

______________________	______________________	__________
Signature	Title	Date

Pacific Fishery Management Council:

______________________	______________________	__________
Signature	Title	Date

North Pacific Fishery Management Council:

______________________	______________________	__________
Signature	Title	Date

HIGHLY MIGRATORY SPECIES ADVISORY SUBPANEL REPORT ON INTERNATIONAL REGIONAL FISHERY MANAGEMENT ORGANIZATION MATTERS

The Highly Migratory Species Advisory Subpanel (HMSAS) strongly suggests that the adoption of the Memo of Understanding (MOU) be delayed for the following reasons:

- The MOU has only been released for review for a few days and the HMSAS has not had time to review it.
- There are suggested changes from the Western Pacific Fishery Management Council that are not fully understood.
- The HMSAS has identified concerns such as failing to properly describe albacore representation on the WCPFC Advisory Committee and failure to define how proposed regulations will be reviewed by the Councils.

PFMC
4/4/09

HIGHLY MIGRATORY SPECIES MANAGEMENT TEAM REPORT ON INTERNATIONAL REGIONAL FISHERY MANAGEMENT ORGANIZATION (RFMO) MATTERS

The Highly Migratory Species Management Team (HMSMT) met and discussed the Memorandum of Understanding (MOU) regarding Regional Fishery Management Council Participation in International Regional Fishery Management Organizations governing Pacific Ocean highly migratory species. Although the HMSMT has no specific recommendations on the MOU, the HMSMT highlights that interagency coordination and information exchange are key to effective HMS management and conservation.

The HMSMT suggests the Council provide recommendations to the U.S. delegation of the Inter-American Tropical Tuna Commission (IATTC) for the following HMS species: yellowfin tuna, bigeye tuna, striped marlin, and albacore tuna.

At their recent meetings, the IATTC failed to institute new management measures for yellowfin and bigeye tuna which are currently experiencing overfishing in the Eastern Pacific Ocean (EPO). The IATTC staff 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 to the IATTC that the lack of conservation measures on the international level is having serious consequences on our ability to manage fisheries domestically. The U.S. west coast fishers permitted under the Council's HMS plan can do little to curb overfishing given their minimal landings (less than one percent of EPO catch for each stock; 2007 HMS SAFE Report), and the problem can only be solved in the international arena. The U.S. delegation should recommend that the IATTC examine whether total allowable catch limits would be more effective than time and area closures in controlling yellowfin and bigeye tuna catch. That effectiveness would include, among other things, a better ability to monitor compliance with the resolution.

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. has shown that it remains in compliance with the IATTC's resolution on north Pacific albacore conservation by demonstrating that albacore fishing effort remains within the band of effort adopted by the Council to characterize the U.S. west coast albacore fishery. 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
04/04/09