WESTERN
PACIFIC
REGIONAL
FISHERY
MANAGEMENT
COUNCIL

MAGNUSON-STEVENS ACT DEFINITIONS AND REQUIRED PROVISIONS

BYCATCH PROVISIONS

Amendment 6 (Supplement) to the Fishery Management Plan for the Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region

Amendment 8 (Supplement) to the Fishery Management Plan for the Pelagic Fisheries of the Western Pacific Region

Including an Environmental Assessment

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Cover Sheet

Summary

On October 11, 1996 the Magnuson-Stevens Fishery Conservation and Management Act (MSA) was re-authorized and amended by the Sustainable Fisheries Act. As a result, the MSA contains new requirements, making it necessary for Fishery Councils to amend all of their existing Fishery Management Plans (FMP) to incorporate these requirements. The Western Pacific Fishery Management Council (Council) developed amendments to its four FMPs to address these requirements, which were published in September 1998 and submitted to the National Marine Fisheries Service (NMFS) for review and approval. NMFS partially approved the amendments, as described in a Federal Register notification published on April 19, 1999 (64 FR 19067). Among other elements, the bycatch provisions (including those required under MSA §301(a)(9) and §303(a)(11)) in Amendment 6 to the Bottomfish and Seamount Groundfish FMP and Amendment 8 to the Pelagics FMP were disapproved.

This document addresses the disapproved portions of those two FMP amendments that pertained to bycatch-related requirements. It replaces Sections 4.1.1 and 4.1.2 and supplements Section 4.1.5 of the 1998 submissions of those amendments. This document also provides an overview of bycatch rates, levels and reporting methodologies for all fisheries managed under the two FMPs

In disapproving the bycatch provisions in the 1998 amendments NMFS (64 FR 19067) cited the need for the amendments to describe in more detail: quantification of bycatch by all sectors of the fisheries, the adequacy and identification of any shortfalls in bycatch data, existing measures taken to minimize bycatch and the mortality of bycatch, the catch of sea turtles in the pelagics fisheries, data and estimates of seabird incidental catch and ongoing efforts to reduce interactions with seabirds, and proposed new measures to improve bycatch reporting, reduce bycatch and bycatch mortality, and reduce interactions with seabirds and sea turtles.

The purpose of these amendments is to fulfill the bycatch-related requirements of the MSA for the bottomfish and pelagics fisheries of the Western Pacific Region. The amendments describe recent bycatch levels and patterns in the bottomfish and pelagics fisheries, including interactions with protected species. The amendments describe improvements made since the passage of the Sustainable Fisheries Act (SFA) in bycatch reduction and bycatch reporting. The amendments also describe pre-existing management measures that provide for assessment and reporting of bycatch and that minimize bycatch and bycatch mortality. Finally, the amendments include new non-regulatory management measures to further reduce bycatch and bycatch mortality and further improve the measurement of bycatch.

Bottomfish fisheries occur throughout the Western Pacific region. The largest is in the Northwestern Hawaiian Islands (NWHI). Most of the bycatch in that fishery consists of three carangids (*Caranx ignobilis*, *Pseudocaranx dentex*, and *Seriola dumerili*) and sharks, all of which are discarded for economic reasons. The first two carangids and sharks have generally low market values and do not keep well. Most shark species require special on-board processing and storage to make their flesh marketable. The value of *S.dumerili* or kahala is very low because of its being implicated in ciguatera poisoning incidents. These species account for 80% to 90% by number of all bycatch in the fishery. It appears that no more than 25%, by number, of the catch in the NWHI bottomfish fishery is discarded. The mortality rate of discarded fish is

highly variable among species. Although bottom-dwelling teleost fishes generally suffer high mortality from the decompression undergone while being brought to the surface, the carangid species that make up most of the bycatch in the NWHI bottomfish fishery are usually released alive and apparently viable. Among protected species of sea turtles, marine mammals, and seabirds, only Hawaiian monk seals and Pacific bottlenose dolphins appear to have interactions with the NWHI bottomfish fishery, where they take fish from fishing lines. These species are rarely hooked and no fatal interactions have been documented. Seabirds have often been observed attempting to steal bait, but no hookings have been observed. Complete bycatch data are not yet available for the bottomfish fisheries in the Main Hawaiian Islands, American Samoa, Northern Mariana Islands, or Guam, but bycatch rates in those areas appear to be substantially less than in the purely commercial and distant-from-port NWHI bottomfish fishery. An additional source of bycatch in the bottomfish fisheries is unobserved mortality, stemming from fish that escape from the hook and fish that are taken from the hook by predators. Research suggests that losses due to predation in the NWHI bottomfish fishery amount to perhaps 23-27 fish lost for every 100 fish boated. Bycatch is assessed and reported in the bottomfish fisheries through logbook programs and creel surveys, many of which have undergone substantial improvements since the passage of the SFA. A vessel observer program in the NWHI has provided important information on bycatch and bycatch mortality, including interactions with protected species. Fishery-independent data sources, including experimental fishing projects in American Samoa and the Mariana Islands, have also provided bycatch-related data.

The Hawaii-based longline fishery is the largest pelagic fishery managed by the Council. The longline fishery in American Samoa has grown rapidly in the last three years with the entry of more and larger vessels. The largest component of the bycatch in the Hawaii-based longline fishery is sharks, particularly blue shark. Sharks and other finfish species are discarded for economic reasons. According to vessel observer data, during 1994-2001, about 40%, by number, of the total catch in the Hawaii-based longline fishery was discarded. The percentage discard rate was about 13% for tunas, 15% for billfish, 63% for sharks, 32% for other Management Unit Species (MUS), and 97% for non-MUS. In the past, many sharks were finned – that is, their fins were retained while their carcasses were returned to the sea. The finning rate peaked in 1999, when about 65% of all captured sharks were finned. The majority was blue sharks, representing 95% of all finned sharks. Two important regulatory changes in 2000 and 2001 substantially altered bycatch rates and bycatch mortality rates. State and federal prohibitions on shark finning had the effects of increasing the percent of blue shark that were discarded, decreasing blue shark absolute bycatch mortality rate (because blue sharks have relatively high post-hooking survival rates), and slightly increasing the retention rate of whole blue sharks. The 2000 closure of the swordfish-directed fishery also greatly decreased the catch of blue sharks and thereby decreased the fisheries overall bycatch rate. Vessel logbook indicate that in 2001, 96% of the approximately 45,000 sharks caught in the Hawaii-based longline fishery were discarded, 3% were retained whole, and 1% were discarded. Interactions between the Hawaii-based longline fishery and sea turtles were significant enough that the fishery, as managed in 1999, was determined to jeopardize the continued existence of three sea turtle species, the loggerhead, the leatherback, and the green. Subsequent regulations – particularly the closure of the swordfish-directed fishery – have resulted in substantially lower interaction rates with sea turtles. The Hawaii-based longline fishery interacts with several species of seabirds. Most interactions are with the black-footed albatross and the Laysan albatross. Regulatory changes aimed at decreasing the incidental catch of sea turtles, as well as new seabird-related measures, have led to substantially lower interaction rates with the two albatross species, and probably have substantially reduced the likelihood of interactions with a third, endangered, species, the short-tailed albatross. Reliable estimates of bycatch and bycatch mortality rates in the small-boat troll and handline fisheries of all the island areas are not yet available, but bycatch and bycatch mortality rates are believed to be relatively small because few species and sizes are unwanted and because when fish are discarded they are often in viable condition. An additional source of bycatch in the pelagic fisheries is unobserved mortality, but no estimates of likely mortality rates are available. Bycatch and protected species interactions are assessed and reported in the Hawaii-based longline fishery through a logbook program and a recently expanded vessel observer program. Bycatch in the American Samoa fishery is measured through creel surveys and a Federal logbook program, and will soon be further assessed through a vessel observer program. Bycatch in the other pelagic fisheries is monitored through local catch reports and creel surveys.

A variety of operational and management measures are used to minimize bycatch and bycatch mortality in the bottomfish and pelagics fisheries. In the bottomfish and troll and handline fisheries, the gear types and fishing strategies used tend to be relatively selective for desired species and sizes. Measures that serve to further reduce bycatch in the bottomfish fishery include prohibitions on the use of bottom trawls, bottom gillnets, explosives, and poisons. In the pelagic fisheries, a prohibition on the use of drift gillnets is aimed at reducing bycatch. New area closures and gear restrictions have been very successful in minimizing the bycatch of sharks, marlins and protected species interactions. Longline vessels are also required to employ specified mitigation measures to avoid catching sea turtles and seabirds and increase the likelihood of their survival after being released. An additional measure in the process of being developed that would further reduce bycatch and protected species interactions is restrictions on the use of bottom-set longline gear. Bycatch reduction is also achieved through non-regulatory means, including outreach to fishermen and engagement of fishermen in research activities and the management process.

These amendments include four types of non-regulatory measures aimed at further reducing bycatch and bycatch mortality and improving bycatch reporting: 1) outreach to fishermen and engagement of fishermen in management, including research and monitoring, in order to raise their awareness of bycatch issues and give them incentives to reduce bycatch, 2) research into fishing gear and method modifications to reduce bycatch and bycatch mortality, 3) research into the development of markets for discarded fish species, and 4) improvement of data collection and analysis systems to better measure bycatch.

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1. Introduction

1.1 Responsible Agencies

The Western Pacific Regional Fishery Management Council (Council or WPRFMC) was established by the Magnuson-Stevens Fishery Conservation and Management Act (MSA) to develop fishery management plans (FMPs) for fisheries operating around American Samoa, Guam, Hawaii, the Northern Mariana Islands and the Pacific Remote Island Areas (PRIAs).[1] Once an FMP is approved by the Secretary of Commerce (Secretary), it is implemented by federal regulations, which are enforced by the National Marine Fisheries Service (NMFS) and the US Coast Guard, in cooperation with state agencies.

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1.2 Public Review Process and Schedule

The original Comprehensive Amendment of all Council Fishery Management Plans (FMPs) was sent to NMFS for review and approval on September 18, 1998, and the partial approval notice was published in the Federal Register (FR 64, no. 74, 19067-19069) on April 19th 1999. The Council began revising the disapproved sections for bycatch (Pelagic and Bottomfish FMPs), fishing communities in Hawaii (all FMPs) and MSY/overfishing control rules (Crustacean, Pelagic and Bottomfish FMPs) in late 2001, and presented the revised drafts to its Scientific and Statistical Committee (SSC) on the 12th March 2002. The revisions were discussed at the Council's 112th meeting on March 19th 2002, at which time there was an opportunity for the public to comment on the revised sections of the Comprehensive Amendment. The Council voted to forward the revised sections on bycatch and fishing communities to NMFS for review and approval.

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[1] Howland Island, Baker Island, Jarvis Island, Johnston Atoll, Midway Island, Kingman Reef, Palmyra Atoll, and Wake Island.

1.3 List of Preparers

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2. Existing Management Measures

2.1 Bottomfish and Seamount Groundfish FMP

The FMP for Bottomfish and Seamount Groundfish Fisheries in the Western Pacific Region became effective by a final rule published on August 27, 1986 (51 FR 27413). The FMP prohibits certain destructive fishing techniques, including explosives, poisons, trawl nets, and bottom-set gillnets; establishes a moratorium on the commercial harvest of seamount groundfish stocks at the Hancock Seamounts, and implements a permit system for fishing for bottomfish in the EEZ around the Northwestern Hawaiian Islands (NWHI) (the current moratorium on the seamount groundfish fishery was published June 29, 1998 (63 FR 35162) and is in effect until 2004). The plan also establishes a management framework that provides for adjustments to be made, such as catch limits, size limits, area or seasonal closures, fishing effort limitation, fishing gear restrictions, access limitation, permit and/or catch reporting requirements, and a rules-related notice system.

Amendment 1 became effective on November 11, 1987 (52 FR 38102) and established limited access systems for bottomfish fisheries in the EEZ surrounding American Samoa and Guam within the framework measures of the FMP.

Amendment 2 became effective on September 6, 1988 (53 FR 299907). It was developed to reduce the risk of biological overfishing and improve the economic health and stability of the bottomfish fishery in the NWHI. The amendment divides the EEZ around the NWHI into two zones, the Hoomalu Zone and Mau Zone. A limited access system was established for the Hoomalu Zone, including landing requirements for permit renewal and for new entry into the fishery. One requirement for permit issuance is that the primary vessel operator must complete a protected species workshop. Access to the Mau Zone was left unrestricted, except for excluding vessel owners permitted to fish in the Hoomalu Zone. The Mau Zone is intended to serve as an area where fishermen can gain experience fishing in the NWHI, thereby enhancing their eligibility for subsequent entry into the Hoomalu Zone.

Amendment 3, which became effective on January 16, 1991 (56 FR 2503), defines recruitment overfishing as a condition in which the ratio of the spawning stock biomass per recruit at the current level of fishing to the spawning stock biomass per recruit that would occur in the absence of fishing is equal to or less than 20%. Amendment 3 also delineates the process by which overfishing is monitored and evaluated.

Amendment 4 became effective on May 26, 1991 (56 FR 24351). It requires vessel owners or operators to notify NMFS at least 72 hours before leaving port if they intend to fish in a protected species study zone that extends 50 nautical miles (nm) around the NWHI. This notification allows federal observers to be placed on board bottomfish vessels to record interactions with protected species if this action is deemed necessary.

Amendment 5 became effective on May 28, 1999 (64 FR 22810). It establishes a limited entry program for the Mau Zone in the NWHI, including landing requirements for permit renewal. One requirement for permit issuance is that the primary vessel operator must complete a protected species workshop.

Amendment 6 included new provisions required under the 1996 Sustainable Fisheries Act (SFA). Portions of the amendment that were approved included designations of essential fish habitat and descriptions of the various fishing sectors. Those provisions became effective on April 19, 1999 (64 FR 19067). Portions that were disapproved included provisions regarding fishing communities, overfishing definitions, and bycatch.

Of relevance to the management of the NWHI bottomfish fishery is the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve, established December 4, 2000 through Executive Order (EO) 13178 (65 FR 76903), as modified by EO 13196 on January 18, 2001 (66 FR 7395). The Reserve is managed by the Department of Commerce under the National Marine Sanctuaries Act. The EO includes provisions having to do with capping participation and catch in the NWHI bottomfish fishery within the Reserve and closing certain areas to fishing. The intent and effects of the fishing-related provisions, however, are not entirely clear. The EO calls for the Secretary of Commerce to initiate the process to designate the Reserve as a National Marine Sanctuary. The public scoping associated with that process began in April 2002.

In June 1998 the State of Hawaii implemented several management measures for bottomfish in the state waters of the MHI (Hawaii Administrative Rule, Chapter 13-94). Because bottomfish are managed under the FMP on an archipelagic-wide basis and because there are bottomfishing grounds in federal waters that are adjacent to state waters, these measures directly impact the stocks managed under the Bottomfish FMP. The new rules apply to seven species of bottomfish and include gear restrictions, bag limits for non-commercial fishermen, areas closed to fishing and possession of fish, and a requirement that bottomfishing vessels be registered with the state (see Section 5.1.2 for further details).

A number of FMP amendments and framework adjustments are in various stages of preparation and approval. Although they have not been approved or implemented through regulations, the following descriptions give an indication of the actions being proposed and considered.

Amendment 7 was prepared and submitted in parallel with the FMP for Coral Reef Ecosystems of the Western Pacific Region. NMFS issued a Record of Decision on June 14, 2002 that partially approves the Coral Reef Ecosystems FMP and Amendment 7 to the Bottomfish FMP, but a proposed rule has yet to be published. The amendment would prohibit the harvest of Bottomfish and Seamount Groundfish Management Unit Species (BMUS) in the no-take marine protected areas established under the Coral Reef Ecosystems FMP. The Coral Reef Ecosystems FMP would establish such areas at Rose Atoll in American Samoa, Kingman Reef, Jarvis Island, Howland Island, and Baker Island. No-take areas were also proposed in the NWHI, but all proposed measures in the Coral Reef Ecosystems FMP that would have applied to the waters around the NWHI (including Midway) were disapproved in the Record of Decision because of possible conflict and duplication with the management regime of the NWHI Coral Reef Ecosystem Reserve.

A proposed regulatory adjustment to the FMP would establish provisions for allowing new entry into the Mau Zone, with eligibility criteria based on historical participation in the Hawaii bottomfish fishery. The proposed adjustment was transmitted to NMFS for review and approval on January 31, 2002.

A proposed regulatory adjustment to the FMP would suspend the minimum landing requirements for annual permit renewal in the NWHI Hoomalu and Mau Zone limited access programs. The proposed adjustment was transmitted to NMFS for review and approval on July 19, 2002.

Draft Amendment 8, currently under development, would include the federal waters around the Commonwealth of the Northern Mariana Islands (CNMI) and the Pacific Remote Island Areas (PRIA) under the FMP and designate 49 additional bottomfish species as BMUS.

Two draft supplements to Amendment 6 (in addition to this supplement), currently under development, would include measures to address SFA requirements having to do with the identification of fishing communities and the specification of overfishing criteria.

2.2 Pelagics FMP

The FMP for the Pelagic Fisheries of the Western Pacific Region became effective by a final rule published on March 23, 1987 (52 FR 5987). The FMP includes initial estimates of Maximum Sustainable Yields (MSY) and sets Optimum Yield (OY) for the stocks. The Pelagic Management Unit Species (PMUS) at that time were billfish, wahoo, mahimahi, and oceanic sharks. The FMP prohibits drift gillnet fishing within the region's EEZ and foreign longline fishing within certain areas of the EEZ.

Amendment 1 was drafted in response to the Secretary of Commerce MSA National Standard Guidelines (see 50 CFR 600) requiring a measurable definition of recruitment overfishing for each species or species complex in an FMP. It became effective on March 1, 1991 (56 FR 9686). The OY for PMUS was also defined as the amount of fish that can be harvested by domestic and foreign vessels in the EEZ without causing local overfishing or economic overfishing.

Amendment 2 became effective on May 26, 1991 (56 FR 24731). It requires domestic longline fishing and transport vessels to have Federal permits, to maintain Federal fishing logbooks, and, if wishing to fish within 50 nm of the NWHI, to have observers placed on board if directed by NMFS. Amendment 2 also requires longline gear to be marked with the official number of the permitted vessel. It also incorporated the waters of the EEZ around the CNMI into the area managed under the FMP.

Amendment 3, which became effective on October 14, 1991 (56 FR 52214), creates a 50 nm longline exclusion zone around the NWHI to protect endangered Hawaiian monk seals. As defined at 50 CFR 660.12, this is a contiguous area extending 50 nm from named features in the NWHI and connected by corridors between those areas where the 50-nm-radius circles do not intersect. The amendment also contains framework provisions for establishing a mandatory observer program to collect information on interactions between longline fishing and sea turtles.

Amendment 4 became effective on October 16, 1991 (56 FR 14866). It establishes a three-year moratorium on new entry into the Hawaii-based domestic longline fishery.[2] The final rule implementing the amendment establishes an expiration date for the moratorium of April 22, 1994. The amendment included provisions for establishing a mandatory vessel monitoring system for domestic longline vessels fishing in the Western Pacific Region. On November 15, 1994 Hawaii-based longline vessels were specifically required to carry a NMFS-owned vessel monitoring system transmitter (59 FR 58789).

Amendment 5 creates a domestic longline vessel exclusion zone around the Main Hawaiian Islands (MHI) ranging from 50 to 75 nm and a similar 50 nm exclusion zone around Guam and its offshore banks. It became effective on March 2, 1992 (57 FR 7661). The zones are primarily intended to prevent gear conflicts and vessel safety issues arising from interactions between longline vessels and smaller fishing boats. A seasonal reduction in the size of the closure was implemented in October 1992; between October and January, longline fishing is prohibited within 25 nm of the windward shores of all islands except Oahu, where longline fishing is prohibited within 50 nm from the shore.

Amendment 6, which became effective on November 27, 1992 (57 FR 48564) specifies that all tuna species are designated as fish under US management authority. It also applies the longline exclusion zones of 50 nm around the island of Guam and the 50-75 nm zone around the Main Hawaiian Islands (MHI) to foreign vessels.

Amendment 7 became effective on June 24, 1994 (59 FR 26979). It institutes a limited entry program for the Hawaii-based domestic longline fishery. The number of vessels allowed in the fishery is limited to 164, and the length of these vessels is limited to being no greater than 101 feet.

Amendment 8 included new provisions required under the 1996 Sustainable Fisheries Act (SFA). Portions of the amendment that were approved included designations of essential fish habitat and descriptions of the various fishing sectors. Those provisions became effective on April 19, 1999 (64 FR 19067). Portions that were disapproved included provisions regarding fishing communities, overfishing definitions, and bycatch.

In August 2000, the State of Hawaii enacted a law prohibiting the retention of shark fins separate from the carcass (a practice called “finning”). In December 2000 the MSA was amended with a similar nation-wide prohibition.

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[2] Throughout this document the term “Hawaii-based longline vessels” (or longliners) refers to vessels fishing under a Hawaii longline limited access permit as described at 50 CFR 660.21.

In February 1999, the Earthjustice Legal Defense Fund filed a complaint on behalf of the Center for Marine Conservation and the Turtle Island Restoration Network in the U.S. District Court for the District of Hawaii. The complaint was centered on two issues involving the Endangered Species Act (ESA) and the National Environmental Policy Act (NEPA). First, the plaintiffs challenged NMFS' determination under Section 7 of the ESA that continued conduct of the Hawaii-based longline fishery is not likely to jeopardize the existence of leatherback, loggerhead, olive ridley, or green turtles. Second, the Plaintiffs argued that an EIS should have been prepared before the issuance of a 1998 Biological Opinion (BO) and its Incidental Take Statement for sea turtles.

The U.S. District Court for the District of Hawaii upheld NMFS' analyses and findings under the ESA that the fishery was not jeopardizing the existence of any protected species. However, the court determined that the agency had failed to prepare a comprehensive EIS for the fishery as required by NEPA. Subsequently, on November 23, 1999, the Court issued an injunction (entered on November 26, 1999, and amended by an order filed January 11, 2000) setting terms to apply during the period that NMFS prepares an EIS. This first injunction (64 FR 72290, December 23, 1999) led to the temporary closing of certain waters north of Hawaii to fishing by Hawaii-based pelagic longline vessels, as well as permanent requirements that all vessels follow prescribed techniques for handling and releasing turtles.[3]

While the EIS was being prepared NMFS re-initiated Section 7 consultations with respect to sea turtles and issued a new BO (NMFS 2001a). The terms and conditions of the BO were incorporated into the Final EIS (FEIS) as part of the preferred alternative, which was filed with the Environmental Protection Agency (EPA) on March 30, 2001. A concurrently issued court order made effective immediately those provisions in the preferred alternative meant to mitigate the Hawaii-based longline fishery's interactions with sea turtles. An emergency interim rule putting the substance of the preferred alternative and Court Order into regulation was published on June 12, 2001 (66 FR 31561), and revised and extended December 10, 2001 (66 FR 63630), with an expiration date of June 8, 2002. This rule also implemented the seabird mitigation measures mandated by the short-tailed albatross BO issued by the US Fish and Wildlife Service (see below).

The major elements of the new sea turtle related rules were a prohibition on swordfish-directed longlining fishing north of the equator (including several specific restrictions on gear configuration), closure of the area bounded by the equator and 15° N latitude and 145° W and 180° longitude to longline fishing during the months of April and May, a restriction on re-registration of vessels to Hawaii longline limited access permits to the month of October, requirements for vessels that fish for pelagic fish with hook-and-line gear to carry line clippers

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[3] This Order was substantially modified and new emergency regulations were implemented in August 2000. Several other minor modifications and supplements occurred during and after this period. For a detailed description of the litigation history through March 2001, see the Pelagics FMP FEIS (NMFS 2001b) and the relevant Federal Register notices issued on December 27, 1999 (64 FR 72290), March 28, 2000 (65 FR 16346), June 19, 2000 (65 FR 37917), August 25, 2000 (65 FR 51992), November 3, 2000 (65 FR 66186), and February 22, 2001 (66 FR 11120). Federal Register notices on March 19, 2001 (66 FR 15358), June 12, 2001 (66 FR 31561), December 10, 2001 (67 FR 63630), and June 12, 2002 (67 FR 40232) provide additional information on the management regime implemented since completion of the FEIS.

and bolt or wire cutters and to employ a number of sea turtle handling and resuscitation measures, and requirements for longline vessel operators to annually complete protected species educational workshops conducted by NMFS. On April 5, 2002 (67 FR 16323) NMFS published additional interim rules, including a landing and possession limit of 10 swordfish per trip by longline vessels fishing north of the equator and a longline fishing closure north of 26° N latitude. These regulations expired June 8, 2002 and were replaced with permanent regulations implemented through the FMP amendment process, as described below.

An FMP regulatory amendment published June 12, 2002 (67 FR 40232) incorporates the reasonable and prudent alternative of the March 2001 BO on sea turtles, replacing the interim emergency regulations described above for sea turtles, with the exception of the prohibition on longline fishing north of 26° N latitude, which was not included and has now expired. While the emergency regulations applied only to Hawaii-based longline vessels, the regulatory amendment applies to all longline vessels and to all vessels fishing for pelagic species with hook-and-line gear throughout the Western Pacific Region.

The March 2001 BO was superceded by a BO published by NMFS on November 15, 2002 (NMFS 2002a). This new BO examined the impact of Western Pacific pelagic fisheries on marine mammals and sea turtles listed under the ESA in light of the changes to the Hawaii longline fishery in 2001. The new BO did not propose any significant changes in the management of the Hawaii longline fishery, implemented in the June 12, 2002 regulatory amendment. It did conclude, however, that with these measures in place the fishery was not likely to jeopardize the continued existence of Pacific sea turtles.

A BO for the endangered short-tailed albatross, issued by the US Fish and Wildlife Service (USFWS) on November 28, 2000, contains terms and conditions that would require longline fishermen to institute a variety of line and bait handling techniques and to employ specific methods of handling incidentally caught short-tailed albatrosses. These terms and conditions were implemented by the same set of emergency rules mentioned above for sea turtles and published on June 12, 2001 (66 FR 31561). The BO was amended on October 18, 2001 to allow the use of traditional basket-style longline gear as an alternative to monofilament gear set with a line-setting machine and weighted branch lines.

An FMP framework adjustment published May 14, 2002 (67 FR 34408) incorporates the terms and conditions of the November 2000 BO on seabirds, replacing the interim emergency regulations regarding seabirds. The regulations include requirements to use several seabird mitigation practices: Hawaii-based longline vessels fishing north of 23° N must use thawed blue-dyed bait and strategically discard offal to distract birds during the setting and hauling of longlines. Hawaii-based longline vessels fishing north of 23° N must, when making deep sets, use a line-setting machine with weighted branch lines or basket-style longline gear. Vessels making shallow-sets (if allowed in the future) must begin setting the longline at least one hour after local sunset and complete the setting process by local sunrise, using only the minimum vessels lights necessary. The use of additional mitigation practices, such as towed deterrents, is optional. If a short-tailed albatross is brought on board, the crew must notify NMFS and ensure that the bird displays four specific traits before being released. All seabirds brought on board alive must be handled using certain techniques in order to maximize the probability of their long-term survival once released. Owners and operators of Hawaii-based longline vessels must annually complete a protected species educational workshop conducted by NMFS.

The November 2000 short-tail albatross BO was superceded by a new BO published by USFWS on November 18, 2002 (USFWS 2002). This new BO examined the potential impact of Western Pacific pelagic fisheries in light of the changes to the Hawaii longline fishery in 2001. The new BO noted the changes in the management of the Hawaii longline fishery, implemented in the June 12, 2002 regulatory amendment, specifically the ban on swordfish fishing. It concluded that the fishery was not likely to jeopardize the continued existence of short-tail albatross, and reduced the allowable take of this species in line with the reduction of the threat posed by the Hawaii-based longline fishery.

A regulatory adjustment published January 30, 2002 (67 FR 4369) establishes an area seaward of 3 nm out to approximately 50 nm around the islands of American Samoa in which fishing for PMUS is prohibited by vessels greater than 50 feet in length that did not land PMUS in American Samoa under a federal longline general permit prior to November 13, 1997. The measure is intended to prevent gear conflicts and catch competition between large fishing vessels and locally based small fishing vessels.

In anticipation of the possibility of establishing a limited access program for the American Samoa longline fishery, on June 3, 2002 (67 FR 38245) a revised control date of March 21, 2002 was established to provide notice that vessels entering the American Samoa longline fishery after that date would not be guaranteed future participation in the fishery should a limited access program be established. The new control date replaces two dates previously established by the Council, November 13, 1997 and July 15, 2000.

Of relevance to the pelagic troll and handline fishery in the NWHI is the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve, established December 4, 2000 through Executive Order (EO) 13178 (65 FR 76903), as modified by EO 13196 on January 18, 2001 (66 FR 7395). The Reserve is managed by the Department of Commerce under the National Marine Sanctuaries Act. The EO includes provisions having to do with capping participation and catch in the pelagic fisheries within the Reserve and closing certain areas to fishing. The intent and effects of the fishing-related provisions, however, are not entirely clear. The EO calls for the Secretary of Commerce to initiate the process to designate the Reserve as a National Marine Sanctuary. The public scoping associated with that process began in April 2002.

A number of FMP amendments and framework adjustments are in various stages of preparation and approval. Although they have not been approved or implemented through regulations, the following descriptions give an indication of the actions being proposed and considered.

Amendment 10 was prepared and submitted in parallel with the FMP for Coral Reef Ecosystems of the Western Pacific Region. NMFS issued a Record of Decision on June 14, 2002 that partially approves the Coral Reef Ecosystems FMP and Amendment 10 to the Pelagics FMP, but a proposed rule has yet to be published. The amendment would remove all species of shark except nine pelagic species, as well as dogtooth tuna, from the Pelagic MUS list. Dogtooth tuna and coastal shark species would be managed under the Coral Reef Ecosystem FMP. The amendment would also prohibit the harvest of PMUS in the no-take marine protected areas established under the Coral Reef Ecosystems FMP. The Coral Reef Ecosystems FMP would establish such areas at Rose Atoll in American Samoa, Kingman Reef, Jarvis Island, Howland Island, and Baker Island. No-take areas were also proposed in the NWHI, but all proposed measures in the Coral Reef Ecosystems FMP that would have applied to the waters around the NWHI (including Midway) were disapproved in the Record of Decision because of possible conflict and duplication with the management regime of the NWHI Coral Reef Ecosystem Reserve.

An FMP framework adjustment published as a proposed rule May 6, 2002 (67 FR 30346) would establish permit and reporting requirements for any vessel using troll or handline gear to catch PMUS in the Pacific Remote Island Areas.

Draft Amendment 9, under development since early 2000, would put controls on the harvest and/or retention of sharks in the Hawaii-based longline fishery. A version of the amendment was submitted to NMFS prior to the national ban on shark finning. It is now being re-drafted in the context of that ban, and the draft preferred measure is to establish a retention limit of one non-blue shark per trip. The amendment would also define bottom-set longline gear as a fishing gear.

Draft Amendment 11, currently under development, would limit longline fishing participation and/or effort in the EEZ around American Samoa; the draft preferred measure would do so through a limited access program.

Two draft supplements to Amendment 8 (in addition to this supplement), currently under development, would include measures to address SFA requirements having to do with the identification of fishing communities and the specification of overfishing criteria.

3. Purpose and Need for Action

On October 11, 1996 the MSA was re-authorized and amended by enactment of the Sustainable Fisheries Act (SFA). As a result, the MSA contains new requirements, making it necessary for Fishery Councils to amend all of their existing FMPs to incorporate these requirements. The requirements pertain to bycatch, fishing sectors, essential fish habitat, fishing communities, and overfishing. To address the requirements of the SFA, the Council prepared a comprehensive document with amendments to all four of its FMPs. Amendment 6 to the Bottomfish FMP, Amendment 8 to the Pelagics FMP, Amendment 10 to the Crustaceans FMP, and Amendment 4 to the Precious Corals FMP were published in September 1998 and submitted to NMFS for review. NMFS only partially approved the amendments, as described in a Federal Register notification published on April 19, 1999 (64 FR 19067). Three components of the amendments were disapproved: the bycatch provisions (under MSA §301(a)(9), §303(a)(11), and other sections) for the Bottomfish and Pelagics FMPs, the overfishing provisions (under MSA §303(a)(10) and other sections) for the Bottomfish, Pelagics, and Crustaceans FMPs, and for all four FMPs, the identification of the State of Hawaii as a single fishing community (under MSA §301(a)(8), §303(a)(9), and other sections).

This document addresses the disapproved sections of Bottomfish FMP Amendment 6 and Pelagic FMP Amendment 8 regarding the bycatch-related provisions of the SFA. It replaces Sections 4.1.1 and 4.1.2 and supplements Section 4.1.5 of the 1998 submissions of those amendments.

In disapproving the bycatch provisions in the 1998 amendments NMFS (64 FR 19067 and Hogarth 1999) cited the need for the amendments to describe in more detail:

- quantification of bycatch by all sectors of the fisheries;
- adequacy and identification of any shortfalls in bycatch data;
- existing measures taken to minimize bycatch and the mortality of bycatch once taken;
- the catch of sea turtles in the pelagics fisheries;
- data and estimates of seabird incidental catch and ongoing efforts to reduce the take of seabirds; and,
- proposed new measures to improve bycatch reporting, reduce bycatch and bycatch mortality, and reduce the take of seabirds and sea turtles.

NMFS indicated in further consultation and correspondence with the Council (Morehead 2001) that the Council should continue to improve bycatch reporting and reduction through non-regulatory means, including engaging fishermen in the Council management process, educating fishermen about bycatch and its effects, and, with NMFS, continuing outreach and product awareness programs.

The 1996 SFA amendments to the MSA added two key requirements of FMPs regarding bycatch. First, the new National Standard 9 (MSA §301(a)(9)) requires that:

> *Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.*

Second, MSA §303(a)(11) requires that FMPs:

> *Establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority—*
> *(A) minimize bycatch; and*
> *(B) minimize the mortality of bycatch which cannot be avoided.*

A related new provision in MSA §303(a)(12) requires that FMPs:

> *Assess the type and amount of fish caught and released alive during recreational fishing under catch and release fishery management programs and the mortality of such fish, and include conservation and management measures that, to the extent practicable, minimize mortality and ensure the extended survival of such fish.*

No catch and release fishery management programs have been established in the FMPs being amended here, so §303(a)(12) is not relevant at this point.

The purpose of these amendments is to describe existing conditions and management measures related to the MSA's bycatch-related requirements and to establish new measures to further improve bycatch reporting and reduction. Section 4 of this document describes bycatch patterns and trends and existing and in-progress measures to report and reduce bycatch and bycatch mortality. Section 6 presents new measures that will be implemented to further reduce bycatch and bycatch mortality and improve bycatch reporting.

This document is intended to fulfill NEPA requirements and is organized to incorporate an Environmental Assessment. Section 5 describes the affected environment. Section 6 describes a preferred alternative and three rejected alternatives (including the no-action alternative). Section 7 assesses the likely environmental consequences of the alternatives.

4. Bycatch in the Bottomfish and Pelagics Fisheries and Bycatch-related Management Measures

Bycatch is defined as follows in the MSA (§3 (2, 12, 9, and 33)):

> *The term "bycatch" means fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards. Such term does not include fish released alive under a recreational catch and release fishery management program.*[4]
>
> *The term "fish" means finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds.*
>
> *The term "economic discards" means fish which are the target of a fishery, but which are not retained because they are of an undesirable size, sex, or quality, or for other economic reasons.*
>
> *The term "regulatory discards" means fish harvested in a fishery which fishermen are required by regulation to discard whenever caught, or are required by regulation to retain but not sell.*

The National Standard Guidelines (50 CFR 600.350(c)) extend the definition of bycatch to include:

> *fishing mortality due to an encounter with fishing gear that does not result in capture of fish (i.e., unobserved fishing mortality).*

The National Standard Guidelines (50 CFR 600.350) provide guidance on fulfilling the requirements of National Standard 9 through measurement of bycatch and bycatch mortality, assessment of the effects of management measures on the amount and type of bycatch and bycatch mortality, selection of measures to minimize bycatch and bycatch mortality, and monitoring of selected management measures. The Guidelines also refer to the requirements of such laws as the Endangered Species Act, the Marine Mammal Protection Act, and the Migratory

[4] According to the National Standard Guidelines, "a catch-and-release fishery management program is one in which the retention of a particular species is prohibited" (50 CFR 600.350). No such programs exist in the FMPs being amended here.

Bird Treaty Act for the Councils to consider the impact of conservation and management measures on living marine resources other than fish, including marine mammals, sea turtles and birds.

In the following sub-sections, for each of the bottomfish and pelagics fisheries, bycatch and bycatch mortality rates are reviewed, standardized bycatch reporting methodology is described (along with ongoing improvements to the methodology and its data collection systems), weaknesses in the methodology are identified, existing and in-progress management measures that serve to minimize bycatch and bycatch mortality are reviewed, and areas in which bycatch and bycatch mortality might practicably be further reduced are identified. New measures to further improve bycatch reporting and the reduction of bycatch and bycatch mortality are presented in Section 6.

4.1 The Bottomfish and Seamount Groundfish Fisheries

A summary description of the bottomfish and seamount groundfish fisheries is provided in Section 5.1.

4.1.1 Review of Bycatch

This amendment addresses both bycatch as defined by the MSA (which includes the incidental capture and release of sea turtles) and interactions with marine mammals and seabirds, certain species of which are protected under other US law. This review is organized into three sections that correspond to the three types of bycatch identified under the MSA, as described at the beginning of Section 4, namely economic discards, regulatory discards, and unobserved mortality (the "economic discards" category is expanded here from its MSA definition to include fish that are not targeted in a fishery). A fourth section, "protected species interactions," reviews interactions with non-fish species that are protected under laws such as the Endangered Species Act, including marine mammals and seabirds (sea turtles, which are defined as "fish" under the MSA, are treated under "protected species interactions"). Data from before and after the passage of the SFA are presented wherever possible. A fifth section, "identification of areas for further bycatch reduction," identifies certain fisheries or aspects thereof in which it appears that bycatch and/or bycatch mortality rates might be further reduced from recent rates.

Discard, bycatch, and interaction rates are described here in both percentage and absolute terms. For example, a "percentage discard rate" refers to the percentage of all captured fish (by number or weight) that are discarded during a given period of time. An "absolute discard rate" refers to the absolute amount discarded, expressed as a number or weight per unit of time. The meaning of the term "interaction" varies somewhat among the various information sources that address interactions, but it generally refers to physical interactions between animals and fishing gear or fishing vessels, and in most cases refers to hooking or entangling events that may or may not result in the death of the animal.

4.1.1.1 Economic discards

The largest federally managed bottomfish fishery in the Western Pacific Region occurs in the NWHI. Two data sources have been used to assess bycatch rates in this fishery. Logbook data compiled by the Hawaii Division of Aquatic Resources (HDAR) indicate the reported disposition of the catch from all trips. Data were also compiled from 26 NWHI fishing trips that carried observers between October 1990 and December 1993 (Nitta 1999). The observer coverage represented 12% of the 209 trips made during that period. In Table 1 is a summary of the 1990-1993 observer data and the logbook data for the 1997-2001 period. The logbook figures are annual averages, while the observer figures are aggregates of all data collected during the three-year program.[5] The two data sets indicate the same general discard patterns. Two species, kahala (*Seriola dumerili*) and butaguchi (*Pseudocaranx dentex*), made up the majority of the bycatch. Less than 5% of the catch of kahala was retained, and between about 50 and 75% of the catch of butaguchi was retained. Relatively large percentages of the catch of certain other species, including white ulua (*Caranx ignobilis*), were discarded, but these species' contribution to the catch was relatively small so their contribution to absolute discards was relatively small. Non-BMUS that had relatively high percentage discard rates (but relatively low absolute discard rates) in the observer data included opelu (*Decapturus* spp.), sharks, and a number of reef-associated species.

Target species are often discarded if they are damaged by predators. Sharks are responsible for most damage, but Hawaiian monk seals and bottlenose dolphins also cause damage. The carangids tend to be discarded because of their short shelf life and low market value. Butaguchi, for example, is palatable but of generally low value. Kahala, once a major component of commercial and recreational landings, is now seldom retained because it has been implicated in incidents of ciguatera poisoning (Kasaoka 1990).

Although the logbook and observer data represent two different time periods and cannot be strictly compared, substantial differences between the two indicate probable shortcomings in the logbook data. The average overall discard rate indicated by the logbook data is 13%, compared to 25% for the observer data. The differences suggest that the logbook data – at least for some species – probably do not reliably reflect actual bycatch rates. The biggest differences were for the two most commonly discarded species, butaguchi and kahala. The two data sets indicated similar percentage discard rates for kahala, but the logbook data indicated a substantially lower contribution of kahala to the total catch. The same was true for butaguchi, but the percentage bycatch rates indicated in the two data sets were also substantially different. Thus, as is common in many fisheries, underreporting of commonly discarded species appears to be a shortcoming of the logbook data. NMFS should, therefore, redeploy observers on the NWHI bottomfish fishery to collect additional bycatch observations, and, to calibrate the shortfall in discard reporting similar to that for the Hawaii-based longline fishery (see Section 4.2.2).

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[5] The HDAR logbook data report "number released" and "number damaged." Assuming that all damaged fish were discarded, these two categories were combined to estimate total bycatch. The observer data report the number discarded and unknown disposition. Assuming that the discard rate where the disposition was unknown equaled the rate where the disposition was known, the values in the unknown category were reduced by the proportion of known discards to retained-plus-known discards. NWHI bottomfishing vessels often engage in pelagic trolling in addition to bottomfishing. The logbook data presented here include only fish recorded as being captured with bottom handline gear; the observer data include relatively small numbers of troll-caught fish.

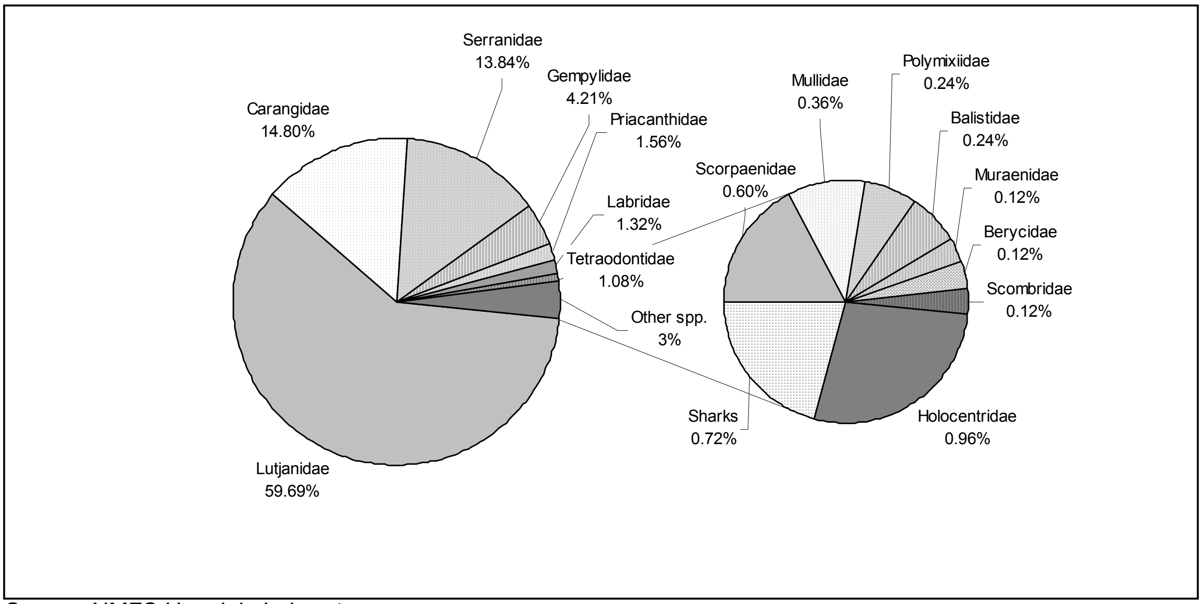
Table 1. Composition of the catch and bycatch in the NWHI bottomfish fishery, by number, from logbook and observer data

		Logbook data (1997-2001 annual averages)					Observer data (1990-1993 aggregated)		
		number caught	number discarded	percent of total catch	percent discarded	percent of all discards	percent of catch	percent discarded	percent of all discards
BMUS		**46,684**	**5,492**	**98.02**	**11.76**	**94.28**	**95.3**	**23.7**	**89.0**
Opakapaka	*Pristipomoides filamentosus*	10,653	99	**22.37**	**0.93**	**1.70**	25.9	2.1	2.2
Onaga	*Etelis coruscans*	9,836	70	**20.65**	**0.71**	**1.20**	5.8	0.7	0.2
Ehu	*Etelis carbunculus*	5,171	32	**10.86**	**0.62**	**0.55**	6.0	1.7	0.4
Uku	*Aprion virescens*	4,226	56	**8.87**	**1.33**	**0.96**	11.2	1.7	0.7
Butaguchi	*Pseudocaranx dentex*	3,851	1,090	**8.09**	**28.30**	**18.71**	17.5	48.3	33.2
Kalekale	*Pristipomoides sieboldii*	3,799	361	**7.98**	**9.50**	**6.20**	4.4	6.1	1.1
Hapuupuu	*Epinephelus quernus*	3,517	26	**7.38**	**0.74**	**0.45**	8.1	1.2	0.4
Kahala	*Seriola dumerili*	3,266	3,182	**6.86**	**97.43**	**54.63**	12.4	97.3	47.5
Gindai	*Pristipomoides zonatus*	1,391	22	**2.92**	**1.58**	**0.38**	2.3	0.7	0.1
White ulua	*Caranx ignobilis*	720	552	**1.51**	**76.67**	**9.48**	0.6	68.1	1.7
Taape	*Lutjanus kasmira*	132	0	**0.28**	**0.00**	**0.00**	0.6	36.7	0.8
Lehi	*Aphareus rutilans*	83	1	**0.17**	**1.20**	**0.02**	0.0	0.0	0.0
Black ulua	*Caranx lugubris*	32	0	**0.07**	**0.00**	**0.00**	0.1	50.0	0.2
Yellowtail kalekale	*Pristipomoides auricilla*	3	0	**0.01**	**0.00**	**0.00**	0.2	56.4	0.5
Armorhead	*Pseudopentaceros richardsoni*	3	1	**0.01**	**33.33**	**0.02**	0.0	0.0	0.0
Alfonsin	*Beryx splendens*	0	0	**0.00**	**0.00**	**0.00**	0.0	50.0	0.0
Non-BMUS		**943**	**334**	**1.98**	**35.42**	**5.73**	**4.7**	**59.9**	**11.0**
ALL SPECIES		**47,627**	**5,825**	**100.0**	**12.5**	**100.0**	**100.0**	**25.4**	**100.0**

Source: HDAR vessel logbook data and NMFS vessel observer data (Nitta 1999).

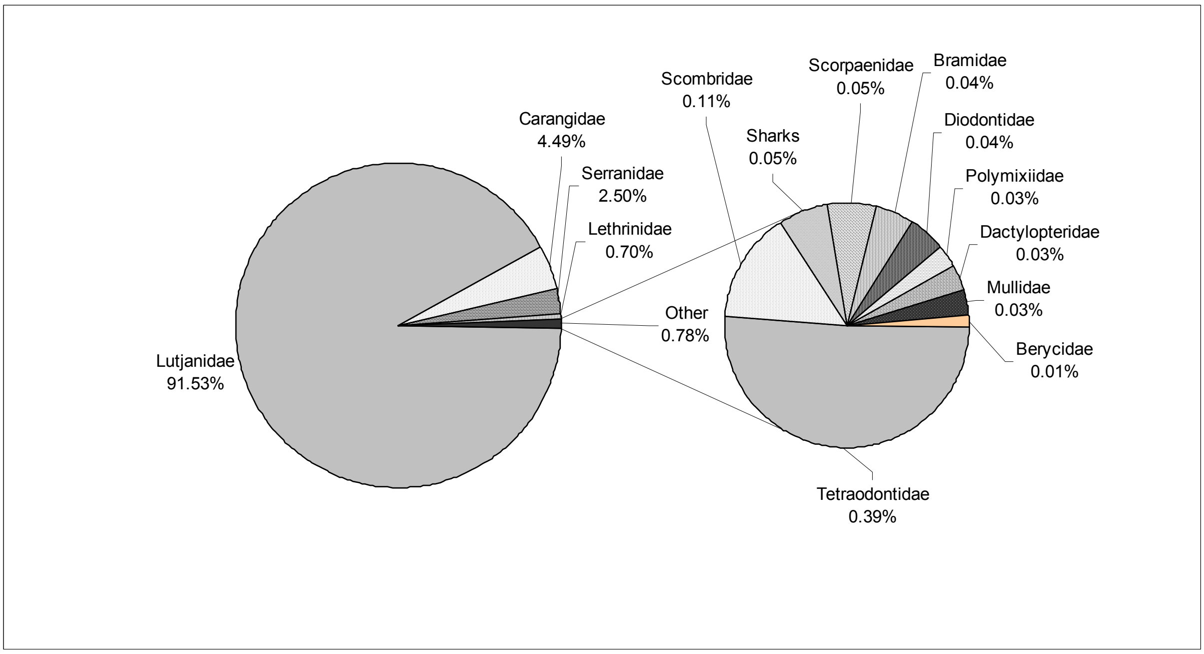
Fishery-independent data sources are another way to estimate bycatch rates. Experimental fishing data was collected during NMFS research cruises in Hawaii from 1982 through 1994 using fishing methods similar to those employed by commercial bottomfish fishermen (Haight et al 1993, and pers. comm.). Results indicate that species known to be typically discarded in commercial fisheries represented about 19% of the total catch, by number (Figure 1). This figure is about midway between those indicated by the fishery logbook and observer data discussed above. Secretariat of the Pacific Community (SPC) surveys in American Samoa in 1978 and 1988 suggest that the catch of typically discarded species amounts to less than 1% of the total bottomfish catch and consists mainly of snake mackerel (*Promethichthys prometheus*). Information gathered during the NMFS Resource Assessment and Investigation of the Mariana Archipelago (RAIOMA) project in Guam and the Northern Mariana Islands from 1982 through 1984 show that pufferfish (Tetraodontidae), gurnards (Dactylopteridae), beardfish (*Polymixia berndti*) and sharks are the main species typically discarded (Figure 2). Similar to the SPC American Samoa findings, the catch of these non-target species made up only about 1% of the total catch.

Figure 1. Composition of the bottomfish catch in the Hawaiian Islands, by number, from research cruise data, 1982-1994



Source: NMFS Honolulu Laboratory.

Figure 2. Composition of the bottomfish catch in the Northern Mariana Islands, by number, from research cruise data, 1982-1984



Source: NMFS RIOMA project.

A bottom longline fishery targeting demersal sharks operated in the NWHI and MHI during 1998 and 1999. The fishery consisted of a single vessel. An observer report based on one trip in the NWHI in September–October 1999 contains information on catch and bycatch for the 21 sets made during the 22-day trip (Vatter 2000). As shown in Table 2, five shark species were caught, as well as a variety of bottomfish MUS and invertebrates. The percentage discard rate for all species combined was 15%, by number. The discard rate for sharks was 10% and the discard rate for non-shark species, which comprised 36% of all discards, was 92%. Shark discards were recorded under three categories: predation (81% of all shark discards), tagged (15%), and released alive (4%). The "predation" category presumably refers to sharks that were discarded because of damage. The reasons that sharks were discarded under the other two categories were not reported. In addition to the discards shown in Table 2, vessel observers recorded fish "lost;" that is, fish that were observed on the hook while hauling but lost before being boated; see Section 4.1.1.4 on unobserved mortality for details.

Vatter (2000) noted that for all sharks retained, the products kept included the meat, fins, and the abdomen meat, which was used as bait. In the case of tiger sharks, additional products were retained, including jaws, hides, and gall bladders. As can be seen in Table 2, most catches of non-shark species were discarded. The retained spotted eagle rays and moray eels were used as bait. Uku (*Aprion virescens*) and the carangids were the most common fish bycatch. Invertebrates were also caught and discarded. Sea stars (*Luidia magnifica*), which actively competed for the bait, were the most common. Two crabs were also caught and discarded.

Table 2. Composition of the catch and bycatch in the NWHI bottom longline fishery, by number, from observer data, 1999

Common name	Scientific name	number caught	number discarded	percent discarded	percent of all discards
Sandbar shark	*Carcharhinus plumbeus*	684	47	6.87	30.72
Galapagos shark	*C. galapagensis*	182	26	14.29	16.99
Tiger shark	*Galeocerdo cuvier*	85	21	24.71	13.73
Grey reef shark	*C. amblyrhynchos*	20	4	20.00	2.61
Blacktip shark	*C. limbatus*	9	0	0.00	0.00
Black trevally	*Caranx lugubris*	4	4	100.00	2.61
Spotted eagle ray	*Actobatus narinari*	3	0	0.00	0.00
Great trevally	*Caranx sexfasciatus*	1	1	100.00	0.65
Hapuupuu	*Epinephelus quernus*	1	1	100.00	0.65
Kahala	*Seriola dumerili*	2	2	100.00	1.31
Moray eel	Muraenidae	2	0	0.00	0.00
Opakapaka	*Pristipomoides filamentosus*	1	1	100.00	0.65
Porcupine fish	Diodontidae	1	1	100.00	0.65
Uku	*Aprion virescens*	13	13	100.00	8.50
Ulua	Carangidae	4	4	100.00	2.61
Invertebrates		25	25	100.00	16.34
Other		3	3	100.00	1.96
ALL SPECIES		1,040	153	14.71	100.00

Source: Vatter (2000).
These observations were made during a single trip in September-October, 1999 that included 21 bottom longline sets over the course of 22 days.

Mortality rates of discarded bottomfish are difficult to estimate. The survival of bottom-dwelling teleost fish caught in anything but shallow water can be expected to be poor because the fish suffer from swollen swim bladders, eversion of the stomach, and swelling and extrusion of the eyes due to decompression while being brought to the surface. The carangid species that make up the great majority of the bycatch in the NWHI, however, are much less likely to suffer from decompression and can be expected to have relatively high survival rates if released alive. In the NWHI, kahala, which are generally discarded, are considered by fishermen to be competitors for their primary target species, such as opakapaka, so they are sometimes killed before being discarded. This practice, however, has apparently become less common, in part because dead discards attract sharks, monk seals, and dolphins, which often take fish from lines. Sharks, which lack a swim bladder, do not suffer from decompression and most species have high chances of survival when released. However, because of the difficulty in handling sharks and the perceived threat they represent to hooked fish, they are sometimes killed by bottomfish fishermen prior to being discarded. Also, in response to losses of fish to sharks, fishermen sometimes try to kill sharks using firearms, if available, or by setting a heavy duty "shark line."

Estimates of bycatch are not yet available for the bottomfish fisheries in the MHI, American

Samoa, CNMI, or Guam (but see Section 4.1.2 for a description of recently improved data collection systems for bycatch). As described above, fishery-independent surveys in American Samoa and the Mariana Islands resulted in little catch (about 1% of the total) of what can generally be considered non-target species. The NWHI data can be considered to represent the most conservative end of the likely range of bycatch rates in these three island areas. Fishing trips to the NWHI are distant and costly and purely for commercial purposes, thereby encouraging the retention of only the highest-value portion of the catch. Fisheries operating closer to home ports and fisheries that have recreational and subsistence motivations (including those in the MHI, American Samoa, CNMI, and Guam) are likely to retain a greater portion of the catch. Preliminary data from American Samoa's creel sampling program indicate only a few instances of bottomfish being discarded. In Guam, the charter component of the bottomfish fishery, which operates in shallow water, is known to release most of its catch alive (fish intentionally released in recreational bottomfish fisheries are considered bycatch under the MSA because their retention is not prohibited).

In summary, bycatch rates are relatively low in the bottomfish fisheries, but poor correspondence among observer data, logbook data, and experimental fishing data indicate a moderate level of uncertainty associated with bycatch estimates for the NWHI fishery, and reliable estimates are not yet available for the bottomfish fisheries of the other island areas (the fleets of which are mostly comprised of small boats). Only hook-and-line gears are used in the bottomfish fisheries, and these gears strongly select for carnivores, particularly aggressive predators. These types of species, with the exception of sharks, tend to be favored in markets, thus they tend to be target species. The flesh of many shark species is difficult to market and shark fins have recently become much more difficult to market because of the prohibition on finning. In Hawaii, important exceptions include kahala and some of the carangids, which are relatively difficult to market. Actual bycatch rates cannot be precisely estimated given the available data. The most conservative data (i.e., greatest bycatch rates), for the NWHI bottomfish fishery in the early 1990s, indicate a bycatch rate of about 25%. Bottomfishing bycatch rates in the other island areas are probably substantially less.

4.1.1.2 Regulatory discards

There are no finfish or invertebrate species captured in the bottomfish fisheries whose capture or retention is prohibited by law. Sea turtle species, which are protected under the Endangered Species Act, are the only fish (as defined by the MSA) that, if captured in the bottomfish fishery, would be considered regulatory discards. Sea turtle bycatch is treated in the following section with other protected species interactions.

4.1.1.3 Protected species interactions

Five species of sea turtles, all of which are listed as either threatened or endangered under the Endangered Species Act (ESA), occur in fishing areas that are subject to the FMP: the leatherback (*Dermochelys coriacea*), the olive ridley (*Lepidochelys olivacea*), the hawksbill (*Eretmochelys imbricata*), the loggerhead (*Caretta caretta*), and the green turtle (*Chelonia mydas*).

There is potential for fishery interactions with all five sea turtle species, but three of the species, the hawksbill, leatherback, and olive ridley, occur only very rarely in bottomfish fishing areas. There have been no reported or observed physical interactions with any of the species in any of the bottomfish fisheries, including during the 1990-1993 NWHI bottomfish vessel observer program.[6] Nitta (1999) reported that no sea turtles were even observed on the NWHI fishing grounds during the 1990-1993 observer program. No sea turtle interactions were observed in the single observer trip made in 1999 in the short-lived bottom longline fishery (Vatter 2000). No observer data are available regarding interactions with sea turtles in the bottomfish fisheries of the MHI, American Samoa, CNMI, or Guam. Green turtles nest in the NWHI at French Frigate Shoals and then migrate to, and forage around, the MHI. Vessel lighting and activity near nesting beaches has the potential to cause adverse impacts but no such impacts have been documented (NMFS 2002b). The NWHI green sea turtle population has increased in recent years without any corresponding increase in interactions with the bottomfish fishery (Laurs 2000). It was concluded in the 2002 Biological Opinion for the Bottomfish FMP (the result of the formal consultation required under Section 7 of the Endangered Species Act) that the fishery, as managed under the FMP, is not likely to adversely affect any of the five sea turtle species (NMFS 2002b).

Marine mammals listed under the ESA that are present in bottomfishing areas subject to the FMP include the blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), northern right whale (*Eubalaena glacialis*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephelus*), and the Hawaiian monk seal (*Monachus schauinslandi*).

All six of the whale species may be found in bottomfishing areas subject to the FMP, but there have been no reported or observed physical interactions with the bottomfish fisheries, including the bottom longline fishery (see Nitta 1999; Vatter 2000). Sightings of humpback whales were made during the 1990-1993 vessel observer program but no interactions were observed (Nitta 1999). It was concluded in the 2002 Biological Opinion that the probability of an encounter between any of these species and the bottomfish fishery is extremely low and that the fishery, as managed under the FMP, is not likely to adversely affect these species (NMFS 2002b).

During the vessel observer program conducted in the NWHI bottomfish fishery from 1990 through 1993, monk seals were observed taking and damaging hooked fish, with an average of one such interaction every 67 hours of fishing (Nitta 1999). A total of 23 monk seal interaction events were recorded during the program. Interactions occurred during 10 out of the 26 observed trips and were estimated to have involved a maximum of 26 seals. No entanglements or hookings of monk seals were observed (Nitta 1999).

NMFS has received a number of reports from various sources of monk seals with hooks embedded in their mouths or other body parts. Positively attributing a given hooking event to a particular fishery is difficult. A review of the reports led NMFS (2002b) to conclude that seven instances of hookings since 1982 may have been attributable to direct interactions with the bottomfish fishery. There has been one report by fishery participants of a hooking of a monk

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[6] The report of the NWHI bottomfish vessel observer program defined “interaction” to mean “instances in which fish caught during bottomfishing operations were stolen or damaged by marine mammals or marine mammals [sic] and/or other protected species were caught or entangled in bottomfishing gear” (Nitta 1999:5).

seal. In 1994 a bottomfish fisherman reported that a seal had stolen the catch and become hooked. The fisherman cut the leader line 12-18 inches from the seal. Given the hooking evidence and the observed behavior of monk seals around bottomfishing vessels, it was concluded in the 2002 Biological Opinion for the Bottomfish FMP that the fishery may incidentally hook monk seals, but "... NMFS expects that the rate of incidental hookings will be very low, notably less than one monk seal per year" (NMFS 2002b:51).

The Biological Opinion also examined the possible adverse effects associated with behavioral modifications of monk seals (following vessels and feeding on hooked fish), the consumption of discarded fish by monk seals, and the possible reduction of prey available to monk seals. With regard to behavioral modifications, adverse effects were found to be difficult to identify but recognized as possible. With regard to the consumption of discarded fish, it was found to be unlikely that monk seals are adversely affected, even if much of the discarded fish contain ciguatoxins. With regard to prey availability, it was found to be unlikely that bottomfish vessels are competing directly or indirectly with monk seals for the same fish species (NMFS 2002b).

The 2002 Biological Opinion concluded that the bottomfish fishery is not likely to "reduce appreciably the likelihood of both the survival and recovery of the Hawaiian monk seal in the wild by reducing the reproduction, numbers, or distribution of the species" (NMFS 2002b:54). The Biological Opinion found that the bottomfish fishery, as managed by the FMP, is not likely to jeopardize the continued existence of the Hawaiian monk seal or result in the destruction or adverse modification of its critical habitat.[7]

No interactions with monk seals were observed during the single bottom longline trip that was observed in 1999, but on two occasions monk seals were observed near the vessel (Vatter 2000).

Pacific bottlenose dolphins (*Tursiops truncatus*), which are not listed under the ESA, are known to damage and take hooked fish from bottomfishing gear. During the 1990-1993 NWHI vessel observer program, a total of 41 bottlenose dolphin interaction events were observed – an average of 1 bottlenose dolphin interaction for every 38 fishing hours (Nitta 1999). No hookings of dolphins were observed during the 26 observed trips (Nitta 1999). Several sightings of spinner dolphins (*Stenella longirostris*), which are not listed under the ESA, were also made during the 1990-1993 vessel observer program (Nitta 1999), but this species was not observed interacting with the gear or vessels. Vatter (2000) reported that no interactions with marine mammals were observed during the single observed bottom longline trip in 1999.

Of the 18 species of seabirds known to be present in the Hawaiian Islands, only the short-tailed albatross (*Phoebastria albatrus*) is listed under the Endangered Species Act. Others are protected under the Migratory Bird Treaty Act.[8] There are several seabird colonies in the MHI,

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[7] Any species listed as endangered or threatened under the Endangered Species Act (ESA), such as the Hawaiian monk seal, is considered to be depleted under the Marine Mammal Protection Act (MMPA), and any incidental take of that species must be authorized under Section 101(a)(5) of the MMPA, subject to a determination by the Secretary of Commerce that any incidental mortality or serious injury will have a negligible impact on the affected species or stock and that a recovery plan has been developed or is being developed under the ESA for the species or stock. Such incidental take for the Hawaiian monk seal has not yet been authorized.
[8] The Department of Interior has interpreted the Migratory Bird Treat Act as applying seaward of the US territorial sea, but has not enforced this interpretation with respect to fishing vessels.

but the NWHI colonies harbor more than 90% of the total Hawaiian archipelago seabird populations. The NWHI provide most of the nesting habitat for more than 14 million Pacific seabirds. More than 99% of the world's Laysan albatross (*Phoebastria immutabilis*) and 98% of the world's black-footed albatross (*P. nigripes*) return to the NWHI to reproduce. The short-tailed albatross population is the smallest of any of the albatross species occurring in the North Pacific. Land-based sighting records indicate that 15 short-tailed albatrosses have visited the NWHI over the past 60 years. Five of these visits were between 1994 and 1999 (WPRFMC 2001b). No interactions with, or sightings of, the short-tailed albatross have been reported from bottomfish vessels.

The 1990-1993 NMFS observer program for the NWHI bottomfish fishery reported a moderate level of interactions between seabirds and the bottomfish fishery, with Laysan and black-footed albatrosses described as aggressively stealing bait from hooks during deployment and retrieval of bottomfish gear, causing lost fishing time (Nitta 1999). Birds were reported as being easily scared away from handlines by waving a pole or gaff. No seabird injuries or mortalities were observed while fishermen were fishing for bottomfish.[9] Although there is a possibility of accidental hooking, the circle hooks used in the bottomfish fishery do not lend easily to snagging. One interaction involving a Laysan albatross occurred while a bottomfish fishing vessel was trolling for pelagic species. The bird became hooked but was subsequently released alive. Fishermen have reported that other species of birds, particularly juvenile boobies (*Sula* spp.), dive on trolling lures (Nitta and Henderson 1993). The potential for the bottomfish fishery to cause adverse impacts on seabirds due to competition for prey is negligible, as seabirds do not prey on bottomfish species. The level of fishery interaction with seabirds is expected to have no effect on seabird distribution, survival, or population structure (WPRFMC 2001b).

During the single observed trip in 1999 by a bottom longline fishing vessel, no interactions with seabirds were observed (Vatter 2000).

4.1.1.4 Unobserved mortality

Unobserved fishing mortality can be substantial with gears such as poisons, explosives, and nets (from which fish drop out before harvest either injured or dead and which, when lost, can continue to capture and kill fish). In general, hook-and-line gears can be expected to result in comparatively little unobserved mortality, since few fish drop off once hooked and fish taken by predators such as sharks are not completely consumed, with the head often remaining on the hook.

Potential sources of unobserved mortality in the bottomfish fisheries include: 1) fish that are hooked, but escape before being brought to the vessel; and, 2) hooked fish that are taken from the line by predators, such as sharks and marine mammals. Fish that escape may survive, but some could be expected to die as a result of injuries, especially if the hook is retained in the jaw. The mortality rate associated with escapees is difficult to measure, but it is certainly low compared to the mortality rate associated with captured fish. In most bottomfish fisheries, losses

[9] Although Nitta (1999) defined an interaction to mean instances in which an animal is "caught or entangled," the report's statement that "many interactions" with albatrosses were observed appears to refer to instances in which the seabirds were not actually caught or entangled (as none were injured).

to predators are probably the larger source of unobserved mortality. Again, these losses are difficult to estimate, but observations of interactions with predators during 1981-1982 (in 10 bottomfish charter trips made by HDAR for survey work) and 1990-1993 (in the NMFS observer program) revealed some indicative rates for the NWHI bottomfish fishery, as described below.

From a fisherman's point of view, fish "lost" to predators include both damaged fish that are boated but have no value and fish that are taken from the hook before being boated. Damaged fish that are boated then discarded are considered economic discards (reviewed above), so this discussion applies only to the latter – fish that are taken from the hook before being boated. Most such losses of fish (as well as of gear and time) in the NWHI bottomfish fishery were attributed by vessel observers to sharks, particularly gray reef sharks (*Carcharhinus amblyrhynchos*) and tiger sharks (*Galeocerdo cuvieri*). All other losses were attributed to either dolphins or monk seals (Nitta 1999). Some fishing areas were reported by Nitta (1999) as having so many sharks that the majority of hooked fish were either stolen or damaged. Although losses to sharks cannot be directly observed, rates of shark-damaged fish (i.e., brought on board) are indicative. The mean rate of shark-damaged fish was 1.5 fish per 1,000 boated fish during trips in 1981-1982 and 8.7 fish per 1,000 during the 1990-1993 observer program (Kobayashi and Kawamoto 1995).

During the 1990-1993 NWHI bottomfish observer program some monk seals were observed to repeatedly take fish from lines while others were observed consuming discarded fish but not taking fish from lines. Other seals observed in the vicinity had no interactions at all. In two instances, monk seals followed vessels for several days, and were believed to take up to 20 fish per day. Estimating the total fish lost to or damaged by predators like seals and dolphins was difficult, as most fish were taken at depth and out of sight of the observer. There is consequently some degree of uncertainty associated with the quantitative findings. Observers recorded one interaction event for monk seals every 67 hours of fishing and one bottlenose dolphin interaction event for every 38 hours of fishing. Nitta (1999) concluded that monk seals accounted for very little loss or damage to fish

Kobayashi and Kawamoto (1995) used a simulation model to estimate fish losses based on rates of predator-damaged fish and lost hooks, and estimated that an average of about 157 fish were lost to sharks per trip in the NWHI, or 231 fish for every 1,000 fish boated. Losses to dolphins and monk seals were not estimated, but it was noted that if the same ratio estimated for sharks of lost fish to damaged fish (27) were applied to dolphins and monk seals, there would be an average total of about 183 fish lost per trip, or 270 fish for every 1,000 fish boated (Kobayashi and Kawamoto 1995). Kobayashi and Kawamoto (1995) did not consider fish that but some could be expected to die as a result of injuries and this should receive consideration in future research.

Vessel observers on the NWHI bottom longline trip in 1999 recorded sharks that were observed on the hook while being hauled up but that were lost before being boated. These "losses" do not include fish that escaped or that were taken by predators before being hauled, and it is not known what proportion of the escapees are likely to have survived. In short, these observations are probably only marginally related to unobserved mortality rates in the fishery. Twenty-eight sharks were observed "lost" during a trip that boated 1,040 sharks, or 27 sharks for every 1,000 sharks boated (Vatter 2000).

No estimates have been made of unobserved mortality in the bottomfish fisheries in the MHI, Guam, Northern Mariana Islands, or American Samoa. It is not known to what degree the predation rates estimated for the NWHI fishery are indicative of those in the other island areas.

In summary, observations of likely predation events were recorded in the NWHI bottomfish fishery observer program, resulting in a rough estimate of 27 fish lost to predation for every 100 fish boated. It is not known to what degree these estimates reflect predation rates in the bottomfish fisheries in the other island areas. The mortality rates due to hooked fish escaping and subsequently dying as a result of being hooked are presently unknown.

4.1.1.5 Identification of areas for further bycatch reduction

Given that a large proportion of the catch is generally desired and utilized in the non-charter small-boat bottomfish fisheries, there is probably only a modest potential for proactively further reducing bycatch and bycatch mortality. Recreational fishermen, on the other hand, particularly the charter fleets, often intentionally release fish alive. In these fisheries, there may be opportunities to further increase the percentage bycatch rate (which would be contrary to National Standard 9 but consistent with MSA mandates to conserve fish stocks and achieve yields that provide the greatest overall benefit to the nation) and further reduce both percentage and absolute bycatch mortality. Releasing fish alive could be encouraged through outreach and other incentives, and bycatch mortality might be reduced through education of charter crew on best practices for handling and releasing fish.

The Western Pacific Council could, for example, follow the lead of the Pacific Council's Pelagic Fisheries Plan (PFMC 2002) which implements a framework procedure for bycatch reduction that includes a formal voluntary catch and release program for the recreational fishermen and for charter vessel skippers. The program is intended to increase angler awareness of the necessity to avoid bycatch, and if bycatch does occur, propose release methods which would minimize bycatch mortality.

Improvements in handling and release methods might also reduce the mortality of some species (e.g., sharks, kahala) discarded in the larger-vessel commercial bottomfish fisheries – particularly in the NWHI.

There might be opportunity to reduce bycatch of low-value species such as carangids and sharks through the development of new markets.

Fishermen already have considerable incentive to fish with methods and in areas that minimize interactions with marine mammals (which results in both the risk of mortality to marine mammals and unobserved mortality of fish taken by marine mammals, with attendant economic costs).

4.1.2 Measures to Assess and Report Bycatch

Section 303(a)(11) of the Magnuson-Stevens Act requires that a fishery management plan establish a standardized reporting methodology to ass the amount and type of bycatch occurring in the fishery. The proposed standardized reporting methodology to assess the amount and type of bycatch occurring in the bottomfish fishery will utilize a combination of data collection and analysis systems implemented by NMFS and local-level fisheries agencies. NMFS and the Western Pacific Fishery Information Network (WPacFIN) will coordinate the collection and analysis of data and the Council compiles and publish the relevant data in the Stock Assessment and Fishery Evaluation (SAFE) report, which is the Council's Bottomfish Fisheries Annual Report. Bycatch data and estimates from American Samoa, CNMI, and Guam will be included in the 2001 Stock Assessment and Fishery Evaluation (SAFE) report, which is the Council's Bottomfish Fisheries Annual Report, along with assessments of the level of certainty associated with the estimates. Bycatch data will be available for the MHI starting in mid-2002 through the State of Hawaii's logbook program and the recently reinitiated Hawaii Marine Recreational Fishing Survey (see Section 4.1.2).

Data collection systems currently used in the bottomfish fisheries that yield information about bycatch include vessel observer programs, vessel and trip logbook programs, and creel surveys. Fishery-independent sources of information, including experimental fishing studies and tagging studies, are also used on an as-needed and as-available basis. There are various systems to monitor sales of bottomfish species, but because they yield little information about bycatch they are not addressed here.

The most reliable and precise source of bycatch data (for a given trip) is vessel observer programs. The precision associated with fishery-wide catch and bycatch estimates derived from the data is a function of the proportion of fishing trips that are observed and the frequency of encounters for a given species.

Vessel logbook programs have the advantage of high degrees of coverage but have the disadvantage of relying solely on fishermen to record detailed information about many species, many of which are difficult to distinguish. In the case of protected species, fishermen may be disinclined to report interactions, such as if they believe a high interaction rate will lead to restrictions on the fishery.

Creel surveys, which rely on direct observations of landings and interviews with fishermen just after reaching port, yield highly reliable information about landings and somewhat reliable information about bycatch. The latter is limited by the memories (and sometimes truthfulness) of fishermen and the difficulties in accurately identifying fish, mammals, sea turtles, and seabirds to the species level. Like vessel observer data, the precision associated with fishery-wide estimates derived from creel surveys is a function of sampling intensity.

Experimental fishing data are useful for accurately measuring catch composition to the species level, which is useful for assessing the reliability of fishery logbook data (i.e., retentions and discards combined) and for generating correction factors for those data. They can also be used to measure the percentage of fish that is landed alive, which may be indicative of survival rates of discards. Tagging studies can be used to assess mortality rates of discarded species.

Data collected through any of these methods can be used independently, and where they overlap, they can be used to corroborate each other and generate corrected estimates. For example, a research project is underway to assess the level of concurrence among several sources of catch data (logbook, observer, and sales data) collected in the Hawaii-based longline fishery and to develop predictive models that can be used to generate corrected fishery-wide catch statistics that can be used for stock assessments and other purposes (Walsh 2000; Walsh 2002). The results of this and similar studies can be used to improve logbook and creel survey design in order to eliminate systematic recording errors and to generate correction factors that can be applied to logbook and creel data (e.g., see Walsh and Kleiber 2001 and Walsh et al. in press for blue shark). The resulting predictive models can serve as what Walsh (2002:1) termed "surrogate" observers for unobserved trips that are subject to logbook reporting or creel surveys. The results can also be used to refine the design of observer programs – for example, to determine the minimum frequency and degree of coverage needed to achieve a given level of accuracy and precision in fishery-wide statistics. Although the research to date has focused on the pelagic fisheries, it can also be applied to the bottomfish fisheries.

In summary, creel surveys and logbook programs will provide reasonably reliable data about finfish discards, but not about interactions with protected species. Observer programs provide more accurate and precise data, but at generally greater costs per unit of coverage. Observer programs with relatively small degrees of coverage, as well as fishery-independent research, can be used to adjust data gathered through creel surveys and logbooks through comparison of catch composition, particularly documenting the proportion of non commercial species likely to be discarded. This can then be used to fill the gaps in logbook and creel survey data, and ultimately to develop statistical means of estimating bycatch discards. Information on bycatch mortality, including mortality of discards and unobserved mortality, is difficult to obtain through any means. Observer data can provide reliable information on the proportions of a given species landed alive versus dead, but additional research is necessary to gauge the survival rates of fish and other species released alive. Interactions with protected species can be assessed most reliably through vessel observer programs, and the smaller the encounter rate for a given species, the greater the degree of coverage necessary.

The proposed standardized reporting methodology for bycatch in the bottomfish fisheries will utilize creel surveys and/or logbook programs to cover virtually all bottomfishing activity. In most cases these programs are continuous, but in some cases, in order to be as cost-effective as possible, they may be discontinuous. In cases where more accurate or precise information is needed on fish bycatch, protected species interactions, or other fishery attributes, information from the creel surveys and logbook programs is supplemented with (and/or adjusted by) data from vessel observer programs. Fishery-independent investigations are undertaken as needed to address bycatch and other issues. Observer programs and fishery-independent investigations are not necessarily continuous and are designed to be as cost-effective as possible (for example, intensive observer programs of limited duration may be implemented periodically in order to provide estimates that are applicable to longer time periods or that can be used to adjust continuous data from other sources). Data collected through each of these components are synthesized and interpreted in the annual SAFE report. The design details of each of these components (e.g., the frequency and coverage of observer programs) vary by area and gear type and may be occasionally adjusted over time in order to meet information targets in the most cost-effective manner. These information targets, such as the scope, accuracy, precision, and resolution of collected data, may also be occasionally adjusted as needed. Further detail is provided below on the basic design of the standardized reporting methodology for the bottomfish fisheries and on revisions that are currently underway. New measures to further improve the methodology are presented in Section 6.

4.1.2.1 Observer programs

In 1981 and 1982 the State of Hawaii commissioned ten observer trips in the NWHI fishery. NMFS administered a vessel observer program in the NWHI bottomfish fishery from October 1990 to December 1993 with about 13% vessel coverage. The mission of the program was to document protected species interactions and collect detailed catch and effort data, including discards. Results of the program were documented in Nitta (1999). Planning is underway by NMFS to reinitiate the NWHI observer program. Discards would be recorded by species, number of fish, reason for discard (e.g., undesired, damaged), and condition (dead, alive).

4.1.2.2 Logbook programs

The State of Hawaii requires that any person who takes marine life for commercial purposes obtain a Commercial Marine License. All holders of such licenses are required to complete and submit to HDAR one of several reporting forms. This requirement applies to fish caught in federal waters, including the Pacific Remote Island Areas (PRIAs), but landed in Hawaii. The default form for most fishermen is the Fish Catch Report (popularly known as the "C3" form), which is in the form of a daily log that is submitted monthly. The Fish Catch Report includes no bycatch information beyond fish tagged and released. Holders of federal NWHI bottomfish permits instead use HDAR's NWHI Bottomfish Trip Daily Log (there is no federal logbook for such permit holders but federal law requires permit holders to comply with state reporting requirements). That form includes information on the number of fish, by species, that are released, damaged, and lost to predation.

The data submitted by commercial fishermen to HDAR are compiled and analyzed by HDAR, which releases the information in the form of periodic reports. The results relevant to the Council-managed fisheries are incorporated into the annual SAFE reports. As noted earlier, bottomfish observer data suggests that bycatch rates, particularly for economic discards are likely to be under-reported, requiring adjustment of logbook reports based on observer data.

HDAR's commercial reporting system is in the process of being revised. The current system includes the collection of sales information from fishermen. The revised system shifts the burden of reporting sales to the fish dealers while improving the completeness and reliability of catch and effort data collected from fishermen. The revised reporting forms will include information about bycatch, recorded by species (to the extent possible), number, and disposition (released, lost to predator) (the information on fish lost to predation will provide estimates of unobserved mortality). If known, the type of predator can also be indicated by the fisherman, which will provide information about protected species interactions. The forms include detailed instructions and standardized lists of species and fishing methods to ensure consistent, complete, and accurate reporting. HDAR is planning to implement the revised system in late 2002. In preparation, HDAR is conducting extensive outreach efforts, including testing the revised forms with selected fishermen and producing and disseminating to all license holders a video that includes reporting instructions and emphasizes the value of accurate reporting. HDAR will maintain a hotline to assist fishermen with the revised system. The agency is also considering the production of a booklet with illustrations of fish species in order to facilitate accurate reporting. Under the revised system, all bottomfish vessel operators will be required to complete a special Deep-Sea Handline Fishing Trip Report (with bycatch information) instead of the Fish

Catch Report for any trip longer than two days. The NWHI Bottomfish Trip Daily Log, which already collects information on bycatch, will be slightly revised to include recording of the condition of discards (live, dead). The performance of the new HDAR catch reporting forms will be evaluated throughout 2003 (R. Kokubun, HDAR, pers comm.).

Charter vessels based at Midway are required by the USFWS to complete and submit the Midway Sports Fishing Boat Trip Log on a per-trip basis (anglers are not allowed to target bottomfish species at Midway, but some are captured when targeting pelagic species or ulua). The catch is recorded by the number of fish caught and the number released, by species (generally, anglers may retain only one fish per day, and only pelagic species may be retained). Also recorded are interactions with protected species, including hooking events and observations of monk seals. The data are compiled and reported by the USFWS. NMFS and the Council are in the process of reaching an agreement with the USFWS for sharing the data, and if needed, for modifying the reporting requirements in order to record bycatch and protected species interactions. The primary purpose of the improvements and data sharing would be to identify and measure any fishery interactions with the Hawaiian monk seal and with seabirds—particularly with the large Laysan and black-footed albatross populations that nest there. If and when charter bottomfish fishing starts at Palmyra, NMFS and the Council will seek the same type of reporting agreement as the one being arranged for Midway.

4.1.2.3 Creel surveys

Creel Surveys (shore-side surveys of vessel-based and/or shore-side fishery participants) are conducted year-round in American Samoa, Guam, and the CNMI (the surveys in American Samoa and Guam include components for both vessel-based and shore-side fishing; the CNMI currently has a component only for vessel-based fishing). These surveys cover fishing by persons and vessels engaged in subsistence, recreational, charter, and commercial bottomfishing. The creel survey programs have been in place in American Samoa and Guam since 1985 and 1983, respectively. The creel survey in the CNMI, started in 1988, was discontinued in 1996. The “offshore” component for vessel-based fishing was reinitiated in mid-2000. It is assumed that fishermen recall of discards made during a fishing trip will be accurate immediately following the trip, but nonetheless, fishermen may be reluctant to report discards if they believe that this information may be used to constrain fishing in the future.

The creel survey data are collected by the respective fisheries agencies of each of the three island areas (the CNMI Division of Fish and Wildlife, the Guam Division of Aquatic and Wildlife Resources, and the American Samoa Department of Marine and Wildlife Resources). Each of the three agencies uses creel sample data to generate annual effort and catch estimates using algorithms developed with the assistance of WPacFIN. The agencies submit annual report modules to the Council and the respective Plan Teams compile them into the annual SAFE reports.

In response to the 1998 SFA amendments regarding bycatch reporting, the creel survey instruments in the three island areas were modified in 1999 (2000 in the CNMI) in order to collect bycatch data, which is recorded by species, number and/or weight, and condition (live, dead/injured). Fishery-wide bycatch estimates are derived from the sample data and expressed in the annual SAFE report in absolute terms (by number or weight), and as a percent of the total catch, by species and condition. The bycatch estimates generated in the creel surveys are expected to have relatively high levels of precision, accuracy, and reliability, but the bycatch data have not, until recently, been rigorously collected or subjected to routine examination or reporting. With continuing assistance from the WPacFin, the three island fisheries agencies are in the process of incorporating the bycatch data into their data processing routines used to generate the catch estimates for their annual reports. All three agencies are expected to start including bycatch data and estimates from their bottomfish fisheries in their year-2002 reports.

In Hawaii, recreational fishing is not subject to any permitting or reporting requirements, yet recreational effort and catches—particularly of pelagic species—are known to be relatively large. NMFS and HDAR are in the process of conducting the Hawaii Marine Recreational Fishing Survey (HMRFS). The last time the survey was conducted in Hawaii was 1981. The survey is an ongoing effort that will continue at least through 2004, with subsequent work dependent on available funding. Field interviews with fishermen at boat ramps, marinas, and with charter boats are used to examine both landings and discards. Information about discards is recorded by species, number, and condition on release (dead, alive). Also recorded are fish that the fishermen plan to throw away (which would constitute bycatch). The survey results are analyzed and disseminated in two forms. NMFS publishes on the web those portions of the results that are part of the associated nationwide Marine Recreational Fishery Statistics Survey. The data are collected during two-month "waves" and the results for each wave are released 90 to 120 days after the end of the wave. The results of the first wave (November-December 2001) will be available in mid-2002. HDAR also publishes the results, but with a broader scope than the national-level results—including, for example, the catch of non-finfish species, including invertebrates caught for food and protected species such as sea turtles, seabirds, and marine mammals. HDAR plans to publish the survey reports on a semi-annual basis. The survey results will be useful in cross-checking the results of the HDAR commercial trip reports, and vice versa, since the HMRFS will not limit itself to recreational fishing trips and because there is substantial overlap in participation and fishing effort between the two sectors (mixed-motivation trips, or "expense trips," comprise a large portion of small boat pelagic fishing effort in Hawaii).

4.1.2.4 Fishery-independent data

The bycatch reporting methodology does not include any routine fishery-independent data collection programs, but relevant data occasionally become available from studies conducted for various purposes. For example, several research cruises in the Hawaiian Islands and other parts of the western Pacific conducted by NMFS and other fishery agencies have collected detailed information on the status and dynamics of bottomfish stocks, as well as catch patterns using bottomfishing gear. These type of surveys produce baseline information which can be used to evaluate logbook and observer programs. Results from these types of investigations will, therefore, continue to be used to assess bycatch and bycatch mortality rates.

4.1.2.5 Summary of bycatch reporting methodology

Bycatch data sources in the bottomfish fisheries are listed in Table 3. Indicated for each program or survey instrument is the main agency responsible for implementing the data collection program. Also indicated are the years for which data are available. Additional agencies may be involved in collecting, managing, interpreting, and disseminating the data, as described above.

Not included in the table are fishery-independent sources of bycatch data and sources of fisheries data that do not generally provide information on bycatch, such as programs that monitor fish sales. The bycatch-related forms used in each of these data collection programs are included in Appendix 1. Ensuring compliance with reporting requirements is difficult as data collection for these fisheries is conducted via non-Federal programs over which the Council and NMFS have limited authority.

Table 3. Data sources in the bycatch reporting methodology for the bottomfish fisheries

	Observer programs	Logbook programs	Creel surveys
NWHI bottomfish	various; new program undergoing planning (NMFS) 1981-1982 (HDAR) 1990-1993	NWHI Bottomfish Trip Daily Log (HDAR) 1995-present	none
MHI bottomfish	none	Fish Catch Report* (HDAR) (commercial only) 1948-present (bycatch beginning in late 2002)	HI Marine Recreational Fishing Survey (NMFS, HDAR) late 2001-present
American Samoa bottomfish	none	none	Offshore Survey, Inshore Survey (ASDMWR) 1985-present (bycatch since 1999)
Guam bottomfish	none	none	Offshore Creel Census, Inshore Creel Survey (GDAWR) 1983-present (bycatch since 1999)
CNMI bottomfish	none		Offshore Creel Census (CNMIDFW) 1988-1996; 2000- (bycatch since 2000)
PRIA bottomfish	none	Fish Catch Report* (HDAR) (comm. Hawaii landings only) 1948-present (bycatch beginning in late 2002) Midway Sports Fishing Boat Trip Log (USFWS) (Midway only) 1997-2001 (currently inactive)	none

Indicated in parentheses for each data collection program or survey instrument is the primary agency responsible for data collection (ASDMWR = American Samoa Department of Marine and Wildlife Resources; CNMIDFW = CNMI Division of Fish and Wildlife; GDAWR = Guam Division of Aquatic and Wildlife Resources; HDAR = Hawaii Division of Aquatic Resources; NMFS = National Marine Fisheries Service; SPC = Secretariat of the Pacific Community; USFWS = US Fish and Wildlife Service).
The dates indicate the years for which data from the program are available.
* Starting in late 2002, bottomfish trips longer than two days will require completion of the specialized Deep-Sea Handline Fishing Trip Report.

4.1.2.6 Identification of weaknesses in bycatch assessment

Weak aspects of the bycatch assessment systems in the bottomfish and seamount groundfish fisheries include:

- Assessment of the amount and type of bycatch in the small boat recreational, charter, commercial, and mixed-motivation fisheries in all the island groups.
- Assessment of post-interaction mortality and morbidity of marine mammals.
- Routine analysis, synthesis, and interpretation of bycatch data.

New measures to address these weaknesses and other aspects of the bycatch reporting methodology are presented in Section 6.

4.1.3 Measures to Minimize Bycatch and Bycatch Mortality

This section describes existing and in-progress management measures that serve to minimize bycatch and bycatch mortality in the bottomfish fisheries (see Section 2 for a review of all management measures in the fishery). Proposed new measures are described in Section 6.

Mechanisms that serve to minimize bycatch include both regulatory measures and factors intrinsic to a given fishery having to do with the way specific fishing gears interact with the biological communities in which they are deployed and the extent to which fishermen can influence those interactions. For example, bycatch rates are affected by the skills of fishermen. Generally, bycatch reduction is in fishermen's interest to the degree that bycatch reduces fishing efficiency and profits. When catches of undesirable species become excessive, fishermen tend to move to new fishing grounds.

Only hook-and-line gears are used in the bottomfish fishery, and these gears strongly select for carnivores, particularly aggressive predators. These types of species tend to be favored in markets.. In general, hook sizes are selected in order to target desired fish sizes, thereby minimizing the catch of unwanted (e.g., small) sizes. In the NWHI bottomfish fishery, circle hooks rather than straight-shank hooks are used. This serves to minimize non-jaw hooking and thus minimizes the mortality of any discards. In 2001 bottomfish fishermen in the NWHI bottomfish fishery voluntarily implemented several measures aimed at minimizing interactions with Hawaiian monk seals and other marine mammals. These measures included: pulling up fishing gear anytime that a monk seal is sighted within a ten yard radius; moving fishing stations if monk seals remain in the vicinity for more than two hours; retention of all injured and dead organisms at all times to discourage predation by seals, dolphins, sharks and other large predatory fish; offal discards to only be conducted after fishing has ceased, and if monk seals are not present; and, release of all healthy unwanted organisms captured during bottomfishing operations only when monk seals, dolphins, and sharks are absent from the vicinity.

Important regulatory measures to minimize bycatch are limited entry systems that restricts NWHI fishing to no more than 17 participants, the prohibitions that have been implemented on the use of bottom trawls, bottom-set gillnets, explosives, and poisons, all of which produce substantially more bycatch than do hook-and-line gear. Although bottom trawls and bottom-set gillnets were not known to be used in the US EEZ at the time of their prohibition, they were proactively banned with the implementation of the Bottomfish FMP in 1986 because of concerns over their relatively poor species selectivity and their capacity to degrade habitat. Other rationales were that the quality and value of netted fish are lower than those of hook-caught fish, that lost nets cause habitat degradation and waste from ghost fishing, and that Hawaiian monk seals and sea turtles could be captured by lost nets or net fragments (WPRFMC 1986).

A measure that could allow monitoring of protected species interactions is the protected species study zone in the NWHI. Bottomfish vessels intending to fish in the zone must notify the PIAO at least 72 hours before departure in order to give NMFS the option of placing an observer aboard.

An amendment being developed for the Pelagics FMP would define bottom-set longline gear as a gear subject to the FMP, thereby prohibiting its use in the longline closed areas around the NWHI and MHI. This gear targets sharks managed under the Pelagics FMP and produces bycatch of non-shark bottomfish species (estimated in from limited observer data to comprise about 15% of the total catch by number, as indicated in Table 2).

Actions recently recommended to NMFS as part of a new Coral reef Ecosystems FMP would include a series of no-take marine protected areas that would apply to all Council managed fisheries. The impacts of these measures are difficult to predict but are anticipated to provide protection to species found in these ecologically sensitive areas.

4.2 The Pelagics Fisheries

A summary description of the pelagic fisheries is provided in Section 5.2.

4.2.1 Review of Bycatch

This amendment addresses both bycatch as defined by the MSA (which includes the incidental capture and release of sea turtles) and interactions with marine mammals and seabirds, certain species of which are protected under other US law. This review is organized into three sections that correspond to the three types of bycatch identified under the MSA, as described at the beginning of Section 4, namely, economic discards, regulatory discards, and unobserved mortality (the “economic discards” category is expanded here from its MSA definition to include fish that are not targeted in a fishery). A fourth section, “protected species interactions,” reviews interactions with non-fish species that are protected under laws such as the Endangered Species Act, including marine mammals and seabirds (sea turtles, which are defined as “fish” under the MSA, are treated under “protected species interactions”). Data from before and after the passage of the SFA are presented wherever possible. A fifth section, “identification of areas for further bycatch reduction,” identifies certain fisheries or aspects thereof in which it appears that bycatch and/or bycatch mortality rates might be further reduced from recent rates.

Discard, bycatch, and interaction rates are described here in both percentage and absolute terms. For example, a “percentage discard rate” refers to the percentage of all captured fish (by number or weight) that are discarded during a given period of time. An “absolute discard rate” refers to the absolute amount discarded, expressed as a number or weight per unit of time.

Several regulatory changes since the passage of the SFA have had important impacts on economic discard rates and interactions with protected species in the pelagics fishery. First, in August 2000, the State of Hawaii banned the landing of shark fins without the corresponding carcass, and a similar national prohibition followed in December 2000. A shark whose carcass is not retained but whose fins are retained ("finned") is not considered a discard and therefore not considered bycatch. Although the prohibition on the retention of shark fins without the corresponding carcass influences shark bycatch rates, it does not require the discarding of sharks. Therefore shark discards, even those made as an indirect result of the prohibition, are not regulatory discards.

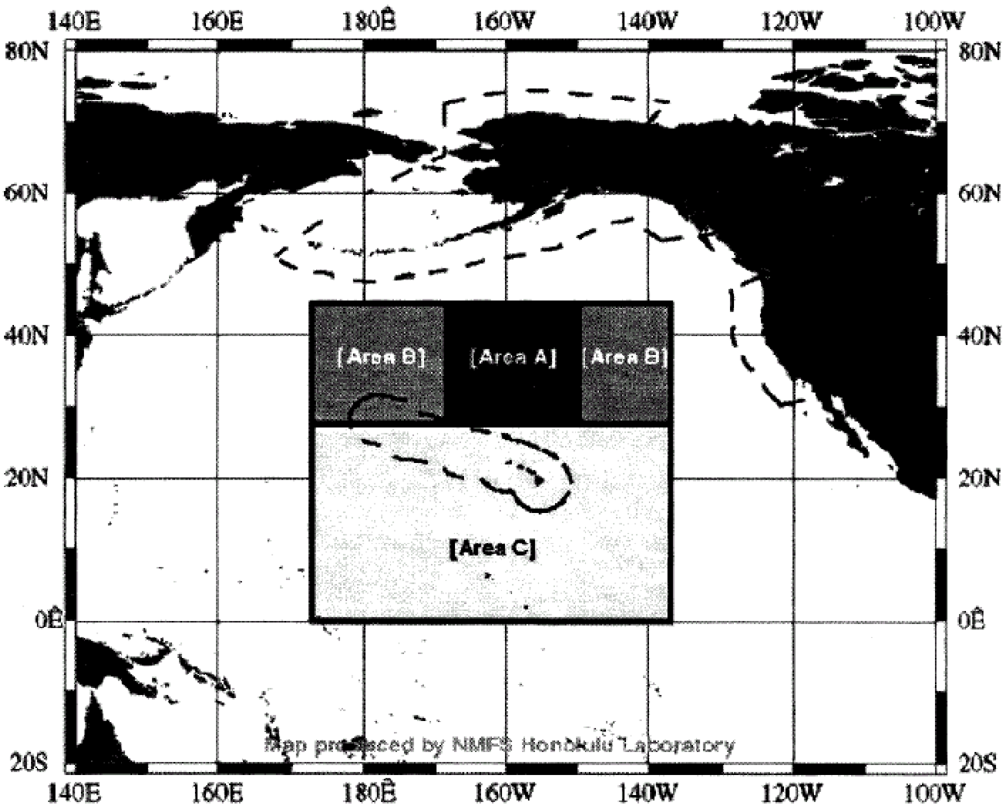
Second, a series of court orders and subsequent emergency rules having to do with protected species interactions imposed a number of area, period, and gear restrictions on the Hawaii-based longline fishery. In December 1999 (64 FR 72290, extended in June 2000 by 65 FR 37917), the area north of 28^o N and between 150^o W and 168^o W was closed to fishing by the Hawaii-based longline fleet. In late August 2000, an emergency rule changed the regime such that the closed area established the previous December remained closed ("Area A," now bounded on the north by 44^o N) and longlining within the areas on either side of Area A and bounded by 28^o N and 44^o N and between 173^o E and 168^o W ("Area B") was further limited to a total of 231 sets from that time until March 14, 2001. At the same time, swordfish-directed longlining (shallow setting) was prohibited in waters between the equator and 28^o N, between 173^o E and 137^o W ("Area C"). In March 2001, the regime was changed via another emergency rule such that swordfish-directed longlining was prohibited north of the equator and all longlining was prohibited between the equator and 15^o N during April and May each year (Figures 3 and 4).

More significantly, during 2002, The Council recommended actions to amend the Pelagics FMP to incorporate the terms and conditions of the two Biological Opinions were approved and implemented by NMFS. The first of these promulgated measures to reduce and mitigate interactions between Hawaii-based longline vessels and seabirds (65 FR 34408, May 14, 2002), as contained in a Biological Opinion of the US Fish and Wildlife Service for the effects of the Hawaii-based domestic longline fleet on the short-tailed albatross.

The second Council action implemented these measures contained in a Biological Opinion of NMFS concerning the authorization of ongoing activities o pelagic fisheries under the Pelagics FMP. These measures apply to all vessels using hooks to target pelagic management species in the management area, as well as to all pelagic participants on vessels registered to regional longline permits (65 FR 40232, June 12, 2002).

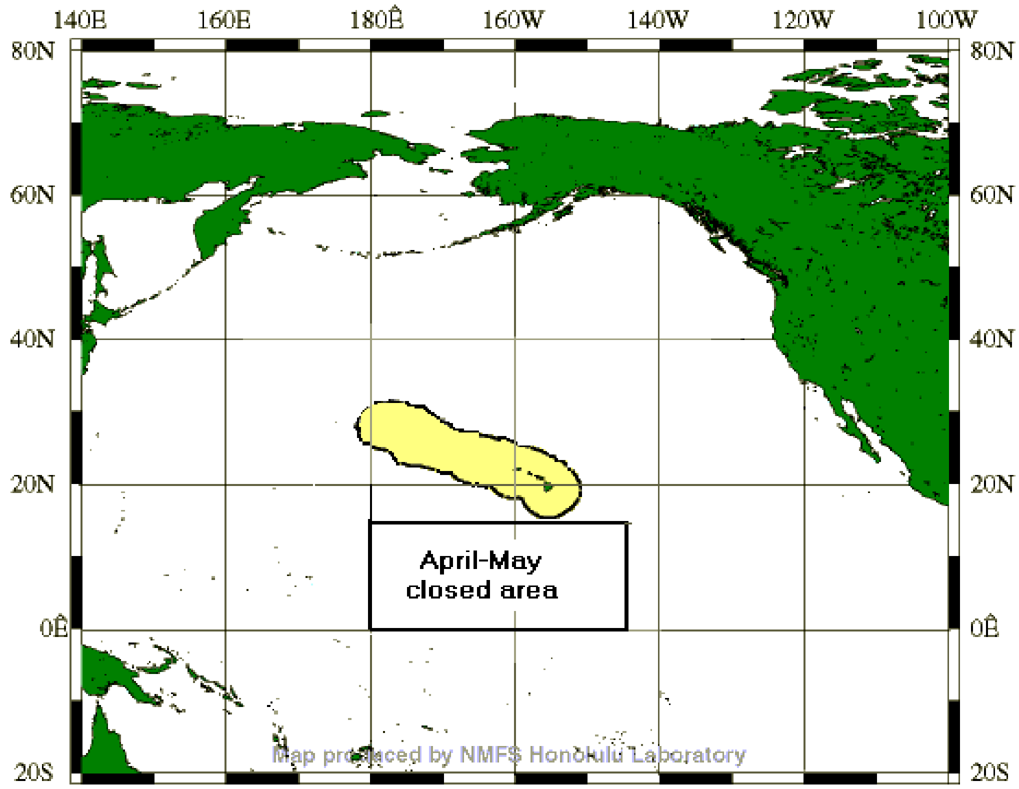
These measures are discussed in detail in section 2.2.

Figure 3. Longline fishing areas restricted between December 1999 and March 2001



From: Notice published at 65 FR 51992, August 25, 2000.

Figure 4. Longline fishing area restricted since March 2001



4.2.1.1 Economic discards

Information about bycatch in the Hawaii-based longline fishery is available from vessel logbook and vessel observer data. NMFS observers have recorded more 60 species caught by the Hawaii-based longline fleet since the program started in 1994. A number of species are typically discarded because they are generally unmarketable. Other species are marketable but not always worth retaining. For example, marlins are often discarded at the beginning of a trip to leave hold space for more valuable species.

Table 4 shows the composition of the catch and the bycatch in the fishery, by number, as indicated by the logbook and observer data. The logbook data are expressed as annual averages for the 1992-2001 period. The observer data, which covered 610 trips and 6,450 longline sets (about 7% of all sets made during the period), are aggregated for the 1994-2001 period. The two sources of data are in fair agreement with regard to catch and disposition of the main target species, but for the less-valuable PMUS there are substantial differences between the two sources – the logbook data generally indicating lower catch and discard rates than the observer data. There is poor agreement with regard to the catch and disposition of non-PMUS because the logbook forms are designed to focus on PMUS, resulting in substantial underreporting of non-PMUS.

Patterns of concurrence between the logbook and observer data (and sales data) collected in the Hawaii-based longline fishery are being investigated in a research project being conducted under the Pelagic Fisheries Research Program (Walsh 2000; Walsh 2002). The results are being used to develop predictive models that can be used to generate corrected fishery-wide catch statistics that can be used for stock assessments and other purposes. General findings to date include: the accuracy of logbook reporting tended to be inversely related to the value of a given species; the precision of logbook reporting varied among species in inverse proportion to the species' contribution to the total catch, and; the misidentification of certain species – particularly the marlins – resulted in systemic inaccuracies in logbook reporting. The results are being used to improve the logbook design in order to eliminate systematic recording errors and to generate correction factors that can be applied to the logbook data (e.g., see Walsh and Kleiber 2001 and Walsh et al. in press for blue shark).

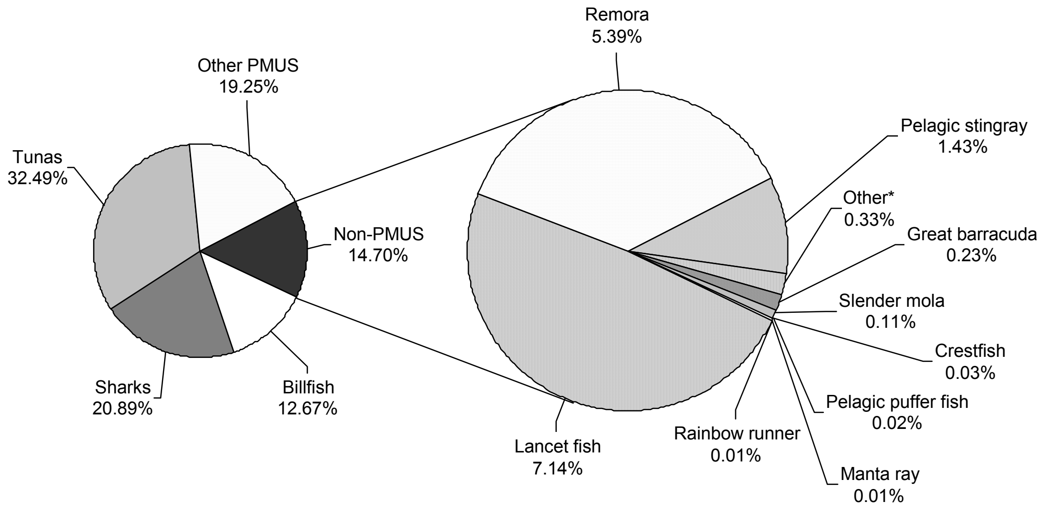
Table 4. Composition of the catch and bycatch in the Hawaii-based longline fishery, by number, from logbook and observer data

	Logbook data (1992-2001 annual averages)					Observer data (1994-2001 aggregated)		
Species	**number caught**	**number discarded**	**percent of total catch**	**percent discarded**	**percent of all discards**	**percent of catch**	**percent discarded**	**percent of all discards**
Billfish	**73,616**	**3,161**	**18.92**	**4.29**	**3.94**	**12.7**	**14.8**	**4.7**
Black marlin						0.0	9.1	0.0
Blue marlin	5,926	186	**1.52**	**3.14**	**0.23**	0.9	7.7	0.2
Sailfish			**0.00**		**0.00**	0.1	21.2	0.0
Shortbill spearfish	7,671	152	**1.97**	**1.98**	**0.19**	1.7	10.8	0.5
Striped marlin	14,967	591	**3.85**	**3.95**	**0.74**	2.3	7.8	0.5
Swordfish	43,555	2,174	**11.19**	**4.99**	**2.71**	7.8	18.0	3.4
Unidentified	1,497	59	**0.38**	**3.94**	**0.07**	0.1	94.7	0.2
Sharks	**96,620**	**65,063**	**24.83**	**67.34**	**81.14**	**20.9**	**63.4**	**33.3**
Blue	90,139	61,914	**23.17**	**68.69**	**77.21**	17.9	62.6	28.3
Makos	1,290	376	**0.33**	**29.15**	**0.47**	0.3	41.1	0.4
Threshers	2,356	1,543	**0.61**	**65.49**	**1.92**	0.7	78.5	1.5
Other/unidentified	2,835	1,230	**0.73**	**43.39**	**1.53**	1.9	69.1	3.3
Tunas	**147,443**	**7,384**	**37.90**	**5.01**	**9.21**	**32.5**	**12.7**	**10.4**
Albacore	46,298	4,861	**11.90**	**10.50**	**6.06**	10.0	21.9	5.5
Bigeye	68,252	1,685	**17.54**	**2.47**	**2.10**	11.6	6.5	1.9
Bluefin	128	9	**0.03**	**7.03**	**0.01**	0.0	2.5	0.0
Skipjack	9,431	202	**2.42**	**2.14**	**0.25**	4.0	10.6	1.1
Yellowfin	22,188	602	**5.70**	**2.71**	**0.75**	6.7	7.6	1.3
Other/unidentified	1,146	25	**0.29**	**2.18**	**0.03**	0.3	96.8	0.7
Other PMUS	**68,253**	**3,993**	**17.54**	**5.85**	**4.98**	**19.3**	**31.9**	**15.5**
Mahimahi	41,727	3,006	**10.72**	**7.20**	**3.75**	9.8	25.9	6.4
Moonfish	7,123	66	**1.83**	**0.93**	**0.08**	1.2	2.7	0.1
Oilfishes	2,346	715	**0.60**	**30.48**	**0.89**	4.1	77.0	7.9
Pomfrets	10,213	123	**2.62**	**1.20**	**0.15**	2.7	12.1	0.8
Wahoo	6,845	84	**1.76**	**1.23**	**0.10**	1.5	6.9	0.3
Tuna relatives						0.0	50.0	0.0
Non-PMUS	**3,145**	**584**	**0.81**	**18.57**	**0.73**	**14.7**	**97.4**	**36.1**
ALL SPECIES	**389,077**	**80,184**	**100.00**	**20.61**	**100.00**	**100.0**	**39.7**	**100.0**

Source: Vessel logbook data and vessel observer data compiled by NMFS Honolulu Laboratory.

Further detail on the composition of non-PMUS caught in the Hawaii-based longline fishery is illustrated by the vessel observer data shown in Figure 5. Again, the data are aggregated for the 1994-2001 period and covered about 7% of all fishing effort. As indicated by the observer data in Table 4, non-PMUS, of which about 97% were discarded, made up about 15% of the catch and 36% of all discards, by number.

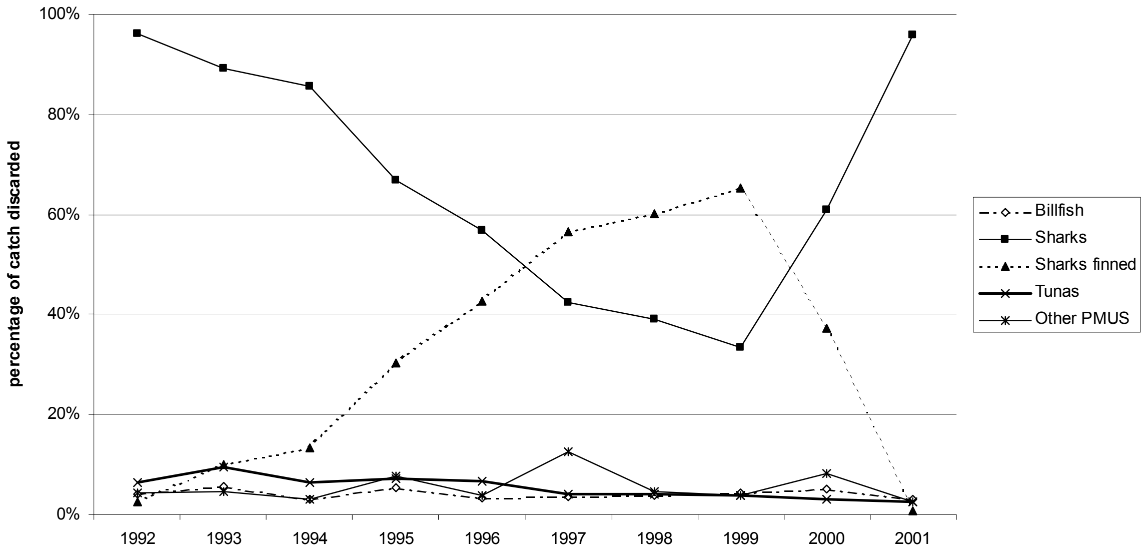
Figure 5. Composition of the catch in the Hawaii-based longline fishery, by number, from observer data, 1994-2001



* "Other" included king of the salmon, oarfish, bigeye scad, flying fishes, triggerfishes, louvar, and unidentified species.

There have been some important changes over time in bycatch patterns that are not reflected in the summary data in Table 4. Figure 6 shows annual percentage discard rates from 1992 through 2001 for four categories of PMUS, as indicated by the logbook data (non-PMUS are not included in the figure because the logbook data are not reliable indicators for those species; as indicated in Table 4, the aggregated observer data indicate a percentage discard rate of about 97% for the non-PMUS). Also shown for each year is the percentage of captured sharks that were finned. It can be seen that the percentage discard rates for the billfish and tunas were less than 10% through the entire period. The percentage discard rate for “other PMUS” was of the same magnitude but more variable. As a group, the sharks had the highest percentage discard rate, ranging from 34% to 96% during the period.

Figure 6. Percentage discard rates and shark finning rates in the Hawaii-based longline fishery, by number, from logbook data, 1992-2001



Source: logbook data compiled by the NMFS Honolulu Laboratory.

As seen in Table 4, sharks, particularly the blue shark (*Prionace glauca*), have comprised a significant part of the catch in the Hawaii-based longline fishery, averaging about 25% of the catch by number from 1992 through 2001. They have also comprised the largest component of the bycatch. As can be seen in Figure 6, discard rates and finning rates are inversely related because sharks that would otherwise be discarded tend to be finned, while few whole sharks are retained in any case. The finning rate peaked in 1999 when about 65% of all captured sharks were finned. The majority of these were blue sharks, representing 95% of all sharks finned. A small fraction, mainly makos and threshers, were headed and gutted and retained for later sale, but most blue shark carcasses were discarded, presumably because they could not be sold for a profit.

Shark landings (including finned sharks) in the Hawaii longline fishery increased substantially during the 1990s as the demand for shark fins grew. Logbook data indicate that the number of sharks retained increased from less than 4,000 in 1992 to a peak of about 61,000 in 1998, of which about 98% were finned.

The finning prohibitions in 2000 have had the effects of dramatically decreasing the finning rate and apparently slightly increasing the retention rate of whole sharks, with a net result of a large increase in the percentage discard rate for sharks, as illustrated in Figure 6.

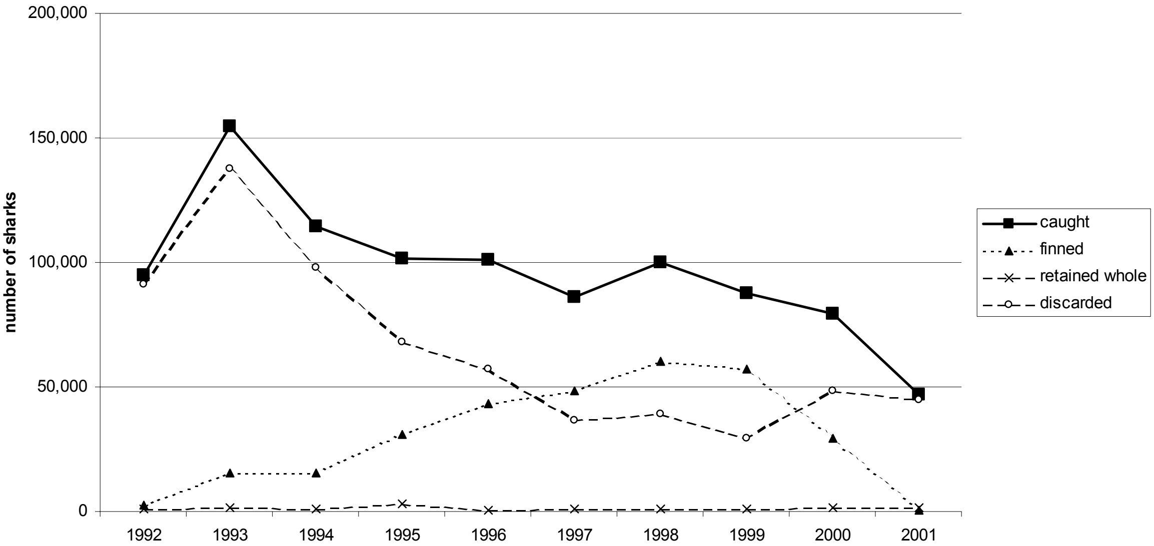
To further illustrate, logbook data indicate that the percentage of sharks finned in the first half of 2000 was 56%, compared to only 11% in the second half of 2000 (after the Hawaii State finning ban took effect). The percentage of whole sharks retained increased from about 1.5 to 2 percent between the two periods. More telling was the increase in the contribution of blue sharks to all retained whole sharks: from 24% to 45% between the two halves of 2000. Given that the flesh of blue shark is still difficult to market, it is likely that many of these retained carcasses were thrown away after landing (i.e., they constitute bycatch as defined by the MSA). The net effect of these changes on the shark discard rate (as a percentage of the shark catch) was an increase from 43% to 87% between the two halves of 2000 and a further increase to 96% in 2001.

It is too early to accurately assess the magnitude of the effect of the finning bans on absolute shark bycatch (in numbers) or on fishing mortality rates of sharks. The proportion of the shark catch that is released alive can be expected to be much greater after the finning bans than before. The finning prohibitions have also increased the incentive to market more than just the fins of sharks. If and when such markets develop, the proportion of the shark catch discarded would be likely to decrease but the mortality rate would be likely to increase.

It appears that the closure of the swordfish-directed fishery under the Council's turtle mitigation measures is having a greater impact on the fishing mortality of pelagic sharks than are the finning bans. The closure has had the effect of reducing both the catch and absolute discard rate of pelagic sharks.

The combined effects of the finning and swordfishing-related rules are evident in Figure 7, which shows absolute rates of shark catch, discards, and finning. Logbook data indicate that in 2000 about 79,000 sharks were caught in the Hawaii longline fishery, of which 37% were finned. In 2001, in contrast, only about 47,000 sharks were caught and only 1% were finned — 90% of those occurring in the first quarter. Although the number of sharks discarded increased in 2000 in close correspondence with the decrease in the finning rate, the number of discards did not continue to increase in 2001 in spite of the finning rate continuing to drop to near zero in 2001. The reason is that although longline fishing effort and total catch remained relatively steady through that period, the contribution of sharks to the total catch decreased substantially in late 2000 and 2001 as a result of the ceasing of swordfish-directed effort. In fact, the decrease in shark catch seen through the mid and late 1990s is largely attributable to the steady decrease in swordfish-directed effort during that period (e.g., swordfish-directed trips declined from 319 in 1993 to 65 in 1999 while tuna-directed trips and mixed trips remained relatively steady). The shifts in shark bycatch patterns after the finning bans and the closure of the swordfish-directed fishery are summarized in Table 5, which compares 2001 with the 1992-2000 period (although 2000 saw substantial changes, it is grouped with the earlier period).

Figure 7. Absolute rates of shark finning and discarding in the Hawaii-based longline fishery, by number, from logbook data, 1992-2001



Source: logbook data compiled by the NMFS Honolulu Laboratory.

Table 5. Recent changes in shark discard patterns in the Hawaii-based longline fishery

	1992-2000 annual average	2001
Sharks as percentage of catch by number	26 %	13 %
Number of sharks caught	102,000	47,000
Percentage of caught sharks finned	35 %	1 %
Number of sharks finned	34,000	300
Percentage of caught sharks retained whole	1 %	3 %
Number of sharks retained whole	1,000	2,000
Percentage of caught sharks discarded	63 %	96 %
Number of sharks discarded	67,000	45,000

Source: logbook data compiled by the NMFS Honolulu Laboratory.

Recent (pre-2000) catch levels of blue shark are believed to be well below MSY. A recent stock assessment of the North Pacific blue shark stock (using 1992-1998 catch data) conducted collaboratively by the NMFS Honolulu Laboratory and the Japan National Research Institute of Far Seas Fisheries concluded that the most conservative MSY estimate indicated that the current rate of fishing mortality was about half of that required to generate MSY (Kleiber et al. 2001).

Shark bycatch in the pelagics (and bottomfish) fisheries can be examined in the context of the National Plan of Action for the Conservation and Management of Sharks (NPOA-Sharks)

(NMFS 2001c). The NPOA-Sharks was developed under the International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks), an international instrument elaborated within the framework of the Code of Conduct for Responsible Fisheries and developed through the UN Food and Agriculture Organization (FAO).[10] The IPOA-Sharks calls for member nations to voluntarily develop, implement, and monitor a national plan of action if their vessels conduct directed fisheries for sharks or if their vessels regularly catch sharks in non-directed fisheries. The objective of the IPOA-Sharks is to ensure the conservation and management of sharks and their long-term sustainable use. The IPOA-Sharks specifies a number of aims for national plans, including ensuring sustainable catches and rational long-term economic use, protecting critical habitats, consulting with national and international stakeholders, improving utilization of incidental catches, protecting biodiversity and ecosystem function, minimizing waste and discards, encouraging full use of dead sharks, and improving the collection of shark catch and trade data. The NPOA-Sharks is implemented in large part through the MSA (and the authority of the Councils and NMFS), the objectives and requirements of which overlap substantially with the objectives and strategies of the IPOA-Sharks. The NPOA-Sharks calls for action in the areas of data collection, stock assessment, management measures to prevent overfishing, research and development of mitigation measures and methods, and education and outreach.

As described in this document, a number of post-SFA management measures for the Western Pacific pelagic (and bottomfish) fisheries have resulted in substantial progress towards the objective and aims of the IPOA-Sharks, particularly in the dramatic reduction in the number of pelagic sharks captured and finned (in the context of the IPOA-Sharks and the Code of Conduct for Responsible Fisheries, waste and the catch of non-target species have been reduced). At the same time, given that western Pacific pelagic shark stocks are not overfished, the recent management measures have not necessarily improved rational long-term economic use. They have also resulted in a greater percentage of captured sharks being discarded (but fewer killed), and there appears to have been little progress in improving fuller utilization of incidental shark catches and dead sharks. Ongoing and proposed new measures to improve in these areas are further described in later sections.

In the American Samoa longline fishery bycatch data are available from vessel logbooks. Starting with the 2001 SAFE report, they will also be available from the creel survey, and a vessel observer program is being planned that will soon provide observer data. Table 6 shows the average annual composition of the catch and bycatch by species as indicated by logbook data for the period 1996 through 2001. The fishery is very selective for the primary species, albacore tuna, which on average made up 76.4% of the catch and 4.39% of the bycatch, by number. The overall discard rate was 5.62%. The percentage of captured albacore that was discarded was less than half of one percent. Yellowfin, skipjack, and bigeye tuna together comprised an annual average of 14.63% of the catch and 40.21% of total discards. In interviews with fishery participants in 2001 regarding management options for the fishery, three of ten respondents indicated that due to the low cannery prices for bigeye and yellowfin tuna and the lack of alternative markets (e.g., for sashimi-grade fish), bigeye and yellowfin tuna were often released alive when fishermen believed that they would survive (O'Malley 2002). The logbook data

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[10] The International Plan of Action for the Conservation and Management of Sharks was adopted at the 23rd Session of the FAO Committee on Fisheries, 15-19 February 1999, Rome.

indicate that billfish and sharks comprised relatively small portions of the catch, at 1.44% and 1.48%, respectively. The percentage bycatch rates for the non-tuna species, which together contributed an average of 55.40% of the total bycatch, were quite variable by species. The average bycatch rate for billfish species as a group was 46.36%, for sharks 96.74%, for other PMUS 16.88%, and for non-PMUS 38.14%. The annual average percentage of sharks finned was 14.92%.

Table 6. Composition of the catch and bycatch in the American Samoa longline fishery, by number, from logbook data, 1996-2001 annual averages

Species	percent of catch	percent discarded	percent of all discards	percent finned
BILLFISH	**1.44**	**46.36**	**11.87**	
Black marlin	0.08	45.71	0.65	
Blue marlin	0.79	43.36	6.07	
Sailfish	0.12	67.54	1.44	
Spearfish	0.10	64.52	1.11	
Striped marlin	0.17	70.90	2.12	
Swordfish	0.09	20.86	0.34	
other	0.10	8.06	0.14	
SHARKS	**1.48**	**96.74**	**25.53**	**18.27**
Blue	0.91	98.29	15.99	14.92
Mako	0.13	87.08	2.08	10.38
Thresher	0.12	98.10	2.09	3.80
White-tip	0.14	99.80	2.54	0.2
other	0.17	92.60	2.85	67.11
TUNAS	**91.02**	**2.75**	**44.60**	
Albacore	76.40	0.32	4.39	
Bigeye	2.08	19.19	7.11	
Bluefin	0.01	59.09	0.13	
Skipjack	6.25	20.55	22.85	
Yellowfin	6.28	9.06	10.12	
OTHER PMUS	**5.39**	**16.12**	**16.88**	
Mahimahi	2.63	9.51	4.45	
Moonfish	0.22	48.29	1.93	
Oilfish	0.41	92.93	6.78	
Pomfret	0.19	33.58	1.14	
Wahoo	2.43	5.96	2.57	
Non-PMUS	**0.17**	**38.14**	**1.12**	
TOTAL	**100.00**	**5.62**	**100.00**	

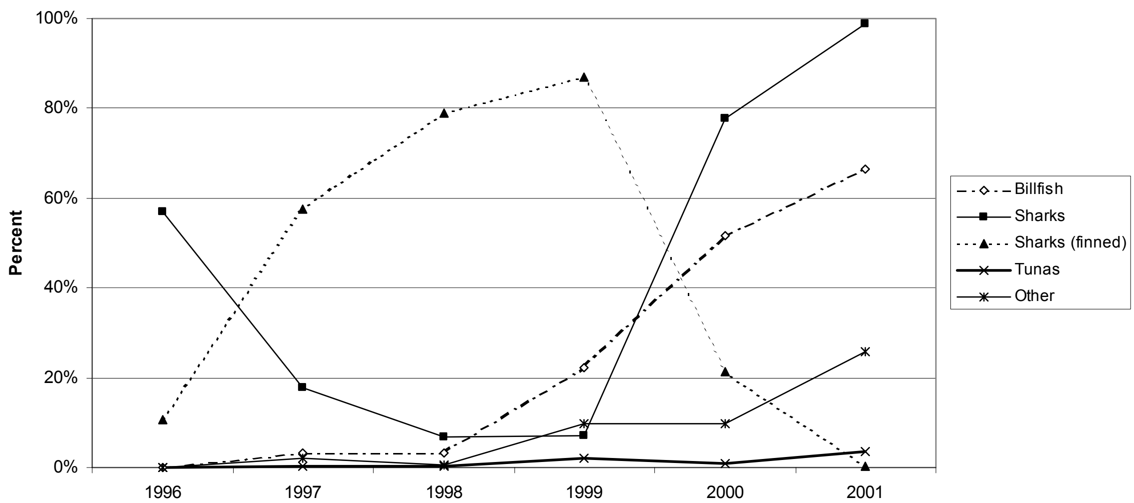
Source: Logbook data compiled by the NMFS Honolulu Laboratory.

Although vessel observer data are not available for the American Samoa longline fishery, the data from a few observed longline trips in neighboring Samoa might be indicative of bycatch rates in American Samoa. Observer data compiled by the Secretariat for the Pacific Community (SPC) for 7 longline sets by *alia* catamarans and 13 sets by monohull vessels indicated overall discard rates of between 15 and 20 percent for both vessel types. Although these figures should be considered preliminary because they come from a different fishery and contain few observations, it is notable that the overall discard rates were substantially greater than the 3 percent rate indicated by the logbook data in Table 6. The observer data also indicated somewhat smaller contributions of the target tuna species to the total catch than did the logbook data.

The annual averages shown in Table 6 do not show the substantial changes in catch and bycatch patterns that occurred during the 1996 through 2001 period. Participation, fishing effort, and catch grew during the period, and catch dramatically increased in 2001 with the entry of a number of relatively large vessels. For example, the catch of tunas increased from about 40,000 in 2000 to more than 200,000 in 2001. The percentage bycatch rates for particular species also changed, as shown in Figure 8. Percentage bycatch rates increased substantially over the period for billfish and "other" species, and increased slightly for tunas. The reasons for these changes are not clear but might be related to the different fishing strategies and retention patterns of the larger vessels that have been entering the fishery, relative to the smaller *alia* catamaran vessels that had dominated the fishery until recently.[11]

Although the relative contribution of sharks to the total catch is small in the American Samoa longline fishery compared to the Hawaii-based longline fishery, the trends in percentage shark bycatch rates in the two fisheries were similar. As shown in Figure 8, the proportion of sharks that were finned increased (and bycatch thereby decreased) through 1999. The finning rate then dropped dramatically to about 20% in 2000 and to 0% in 2001 as a result of the shark finning prohibitions. The combination of increasing catches and changes in percentage discard rates resulted in the absolute bycatch rates shown in Figure 9.

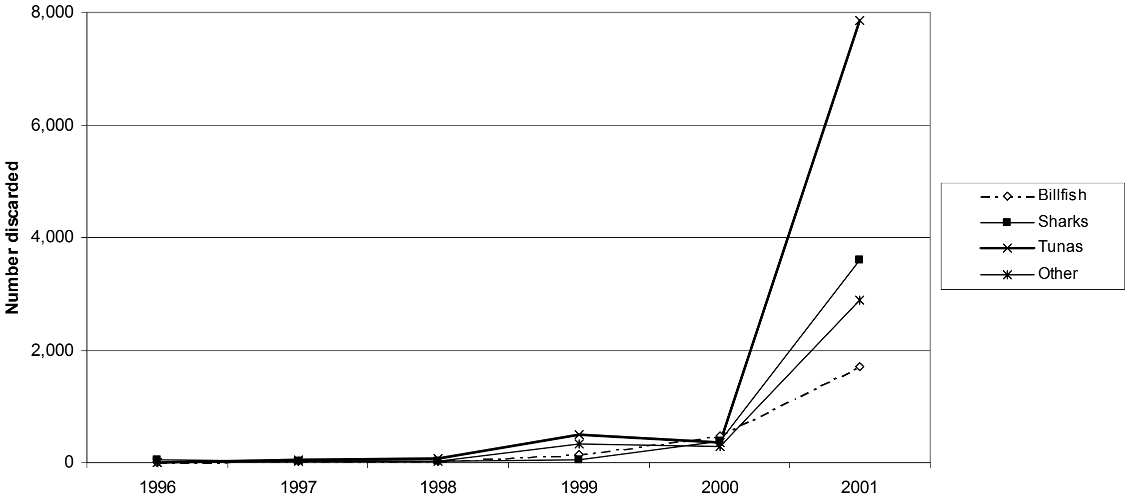
Figure 8. Percentage discard rates and shark finning rates in the American Samoa longline fishery, by number, from logbook data, 1996-2001



Source: Logbook data compiled by the NMFS Honolulu Laboratory; rates are by number of fish.

[11] The observer data from the longline fishery in neighboring Samoa, although few in number, do not indicate any substantial difference between the discard rates of the *alia* catamarans and the monohull vessels.

Figure 9. Absolute discard rates in the American Samoa longline fishery, from logbook data, 1996-2001



Source: Logbook data compiled by the NMFS Honolulu Laboratory.

The albacore troll fishery occurring in the North and South Pacific outside the EEZ has reported incidental catches of skipjack tuna, striped marlin, mahimahi, and louvars. However, the largest bycatch component in this fishery is probably small-sized albacore (smaller than 60 cm in length), which are discarded for economic reasons (N. Bartoo, NMFS Southwest Fisheries Science Center, pers. comm., cited in NMFS 2001b). The volume of discards is estimated to be about 10% of the catch (NMFS 2001b).

Although not currently regulated under the Pelagics FMP, bycatch by purse-seine vessels in US EEZ waters is monitored through vessel logbooks and vessel observers. The average annual discard rates, by weight, as indicated from each of the two sources for the 1997-2001 period, are shown in Table 7. The areas fished include the waters of American Samoa, Guam, Howland and Baker, Jarvis, and Palmyra. The two data sources agree that tuna species made up both the majority of the catch (more than 99 percent) and the majority of the bycatch (more than 90 percent), but there are substantial differences between the two sources regarding percentage bycatch rates by species. The logbook data indicate that only tuna species were retained, while the observer data indicate that there was some retention of virtually all species. The logbook data indicate that about 1 percent of tunas were discarded; the observer data indicate that about 12 percent of tunas were discarded. The logbook data indicate that the overall discard rate for all species was about 1 percent; the observer data indicate that the overall discard rate for all species was about 12 percent. Within the "non-PMUS" category, the dominant species in the logbook data were "baitfish," rainbow runner, and mackerel. In the observer data, the dominant species in the non-PMUS group were rainbow runner, oceanic triggerfish, and mackerel. From these comparisons, the logbook data appear to be relatively poor indicators of bycatch rates.

The observer data also indicate the proportion of sharks that were finned (52 percent). Reasons cited in the 1997-2001 observer data for discarding target tuna species included fish too small, gear damage, shark damage, vessel completely loaded, and escaped. A review of bycatch in the western Pacific tuna fisheries (Bailey et al. 1996) reported that gear failure (sack ripping) and storage/refrigeration problems are additional reasons for discarding target tuna species in purse seine fisheries, but that such occurrences are rare.

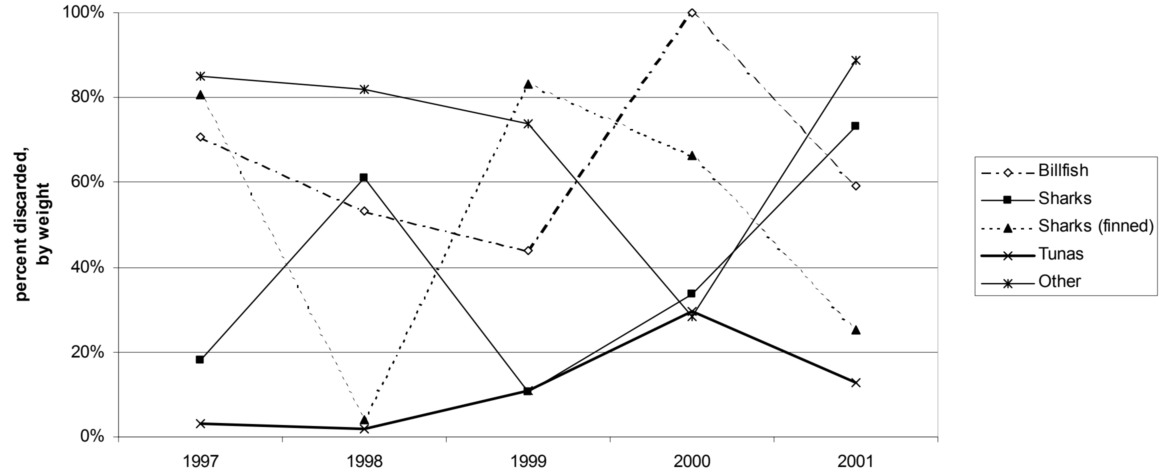
Table 7. Composition of the catch and bycatch in the purse seine fishery in the EEZ of the US Pacific Islands, by weight, from logbook and observer data, 1997-2001 annual averages

	Logbook data			Observer data			
	percent of total catch	percent discarded	percent of all discards	percent of total catch	percent discarded	percent of all discards	percent finned
BILLFISH	**0.01**	**100.00**	**1.22**	**0.04**	**65.42**	**0.36**	
Black marlin	0.00	100.00	0.00	0.01	86.03	0.13	
Blue marlin	0.00	100.00	0.09	0.03	57.00	0.22	
Sailfish	0.00	100.00	0.04	0.00	18.75	0.00	
Striped marlin				0.00	0.00	0.00	
Swordfish	0.00	100.00	0.01	0.00	0.00	0.00	
other/unidentified	0.01	100.00	1.07	0.00	100.00	0.01	
SHARKS	**0.02**	**100.00**	**3.07**	**0.25**	**39.28**	**1.81**	**51.84**
Oceanic white-tip				0.06	27.52	0.10	38.02
Silky				0.12	46.84	0.74	37.26
other/unidentified				0.07	41.86	0.97	51.47
TUNAS	**99.95**	**1.11**	**91.93**	**99.49**	**11.63**	**94.71**	
Bigeye				10.03	9.00	4.65	
Skipjack			53.03	50.41	12.52	51.63	
Yellowfin			30.71	33.35	6.39	26.85	
other/unidentified			8.19	5.71	50.0	11.58	
OTHER PMUS	**0.00**	**100.00**	**0.06**	**0.09**	**37.94**	**0.61**	
Mahimahi	0.00	100.00	0.03	0.02	30.73	0.38	
Wahoo	0.00	100.00	0.03	0.07	38.00	0.23	
Non-PMUS	**0.03**	**100.00**	**3.72**	**0.12**	**91.13**	**2.50**	
TOTAL	**100.00**	**1.17**	**100.00**	**100.00**	**11.83**	**100.00**	

Source: Logbook data compiled by the NMFS Southwest Fisheries Science Center and vessel observer data compiled by the Forum Fisheries Agency.
2001 logbook figures are based on preliminary data. Some observer data were converted from numbers to weights using average weights from the observer data.
Sharks whose fins are retained but trunks discarded (finned) are considered retained, and their whole body weight is accounted for in the “percent finned” figures.

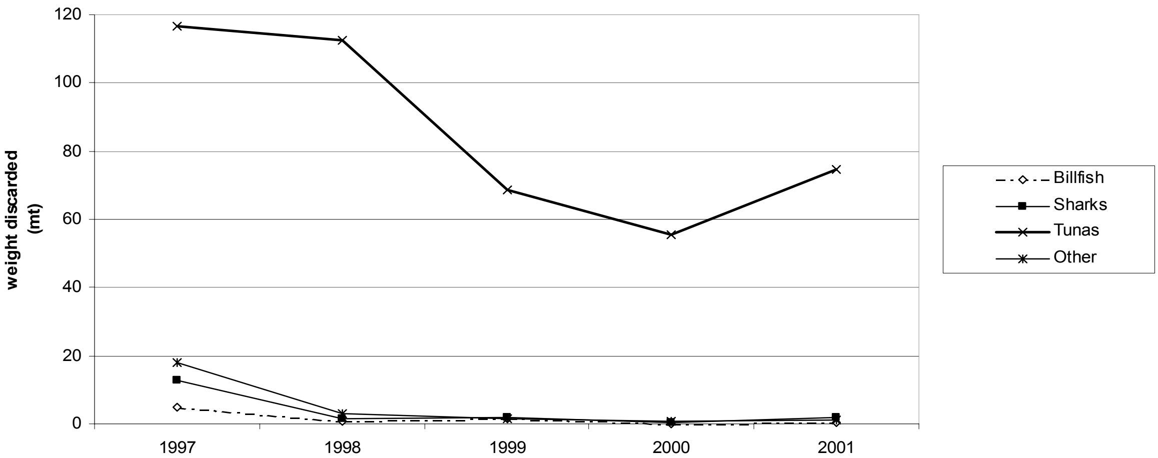
Figure 10 shows the relative discard rates as indicated by the observer data for the period 1997 through 2001, as well as the percent of captured sharks that were finned (the entire whole weight of which is considered for the purposes of these data to be retained). Figure 11 shows the absolute discard rates as recorded in vessel logbooks for the same period (as indicated in Table 7, the logbook data appear not to be very reliable indicators of discard rates, but they are more useful than the observer data for showing trends in absolute bycatch rates). It should be noted that the EEZ of the US Pacific makes up a small portion of the fishing grounds of the fleet, so catches in the US EEZ are quite variable from year to year.

Figure 10. Percentage discard rates in the purse seine fishery in the EEZ of the US Pacific Islands, by weight, from observer data, 1997-2001



Source: Vessel observer data compiled by the Forum Fisheries Agency.
Some data were converted from numbers to weights using average weights from the observer data.

Figure 11. Absolute discard rates in the purse seine fishery in the EEZ of the US Pacific Islands, by weight, from logbook data, 1997-2001



Source: Logbook data compiled by the NMFS Southwest Fisheries Science Center (2001 data are preliminary).

The pole-and-line gear used by aku, or skipjack, boats in Hawaii is highly selective. Non-target species that are occasionally caught—such as kawakawa, blue and striped marlin, and rainbow runner—are usually either sold or retained for personal consumption by the crew (NMFS 2001b).

Bycatch in the small-boat troll and pelagic handline fisheries in all the island groups is, in general, small because the gears are very selective and most captured species are desired for sale or personal consumption. Bycatch data are collected in the creel surveys in American Samoa, the CNMI, and Guam. The initial results from the three surveys are given below, but because the data collection routines have yet to be well established and the precision and reliability of the results have not been assessed, these results should be considered preliminary.

In American Samoa, bycatch was first reported in the 2001 SAFE report. Zero bycatch was encountered among the trolling trips that were sampled in the creel survey (an estimated 23,000 lb were landed in the troll fishery) (WPRFMC 2002d).

In the CNMI, bycatch was first reported in the 2001 SAFE report, but problems in implementing the bycatch aspects of the creel survey make the 2001 results unreliable (WPRFMC 2002d).

In Guam, creel survey results for 2000 and 2001 indicate that out of a total of 1.4 million pounds (lb) of pelagic species caught during the two years, an estimated 3,800 lb were discarded, or about 0.3% of the catch by weight (WPRFMC 2002a and 2002d). 89% of the discards were made on charter vessels and 11% on non-charter vessels. Species discarded in the charter fishery included blue marlin, shortbill spearfish, and mahimahi. Species discarded in the non-charter fishery included silky shark, jacks, wahoo, and yellowfin tuna.

Bycatch data are not available for the small-boat troll and handline fisheries in the MHI, but the first results of the Hawaii Marine Recreational Fishery Survey, which will measure discard rates, are anticipated to be available in late 2002. One sector for which partial bycatch data are available is the charter fleet based on the island of Hawaii. The practice of tag-and-release is actively encouraged within the charter industry, and fishing tournaments, such as the Hawaii International Billfish Tournament, have provided various incentives for participants to release their catch alive. Data on both landings and releases by the charter fleet based on the west coast of the island of Hawaii are compiled by The Charter Desk, a private booking agent based in Kailua-Kona. Although reporting is voluntary and probably covers less than 100% of all activity, the data indicate that from 1996 through 2001 3,734 billfish, or 21% of all billfish captured, were tagged and released alive. The proportion released increased from 15% in 1996 to 42% in 2001.

Trolling is sometimes done by large commercial vessels that fish primarily with other gears, such as longline vessels and NWHI bottomfish fishing vessels. Logbook data from these fisheries have not generally included catch and bycatch from trolling, but the federal logbook for longliners is in the process of being revised in order to do so.

The post-release mortality of discarded fish is difficult to estimate for most gear types. One exception is purse seine fisheries, which result in close to 100% mortality of discards. Longline vessel observer records of the proportion of a given species that is alive when brought onboard can provide indications of likely survival rates. Data from the NMFS vessel observer program for the Hawaii-based longline fishery in 1998 and 1999 indicate that 86% of sharks were captured alive. This figure matches well with observer data compiled by SPC for the distant water longline fishery operating in the western Pacific from 1990 through 1998, which indicate that 87% of sharks were captured alive. The same SPC data set indicates that 56% of billfish were captured alive, 67% of bigeye and yellowfin tuna, 29% of other tunas, and 55% of other species (observer coverage was less than 1% of all fishing so these data should be interpreted with caution). The percent-landed-alive for blue sharks was even higher at 93%, so with the finning bans now causing a very low retention rate of blue shark, the fishing mortality rate of blue shark is likely to be small in spite of the relatively large numbers caught.

Given the short amount of time that fish typically spend on troll and handline gear and being handled, post-release survival rates in those small-boat fisheries are probably relatively high. Survival rates can be expected to be especially high in recreational fisheries. For example, 95% of the bycatch, by weight, reported in 2000 and 2001 in the Guam troll fishery through the creel survey was reported to have been released alive (most of the reported discards occurred in the charter fishery) (WPRFMC 2002a and 2000d). The discarded species included billfish, tunas, mahimahi, wahoo, jacks, and sharks.

4.2.1.2 Regulatory discards

Until recently there have been no finfish species that must be discarded by law in the pelagic fisheries. Beginning with an interim rule in April 2002 and a final rule in June 2002, however, swordfish caught by Hawaii-based longliners became subject to a possession and catch limit of 10 fish per trip. Swordfish discarded as a result of that limit would be considered regulatory discards. Data on such discards are not yet available, but based on the historical catch rate of swordfish in the (tuna-directed) longline fishery, the number of swordfish discards is likely be small. An FMP amendment currently under development would establish a limit of one non-blue shark per trip for longliners. Sharks discarded as a result of the measure would be regulatory discards. Given recent non-blue shark retention rates, the number of those discards is likely to be small.

The bycatch of sea turtle species, which are protected under the Endangered Species Act, is reviewed in the following section with other protected species interactions.

4.2.1.3 Protected species interactions

All sea turtles species are listed under the ESA as either threatened or endangered. The breeding populations of Mexico olive ridley turtles are currently listed as endangered, while all other olive ridley populations are listed as threatened. Leatherback turtles and hawksbill turtles are also listed as endangered. Loggerhead turtles and green turtles are listed as threatened (the green turtle is listed as threatened under the ESA throughout its Pacific range, except for the population nesting on the Pacific Coast of Mexico, which is endangered). These five species of sea turtle are highly migratory, or have a highly migratory phase in their life history. All five sea turtle species of concern forage in the waters surrounding the Hawaiian Archipelago. However, leatherback, loggerhead, and green sea turtles are the species of principal concern with regard to incidental take in the Hawaii-based pelagic longline and other commercial fisheries of the Pacific. These fisheries are conducted mainly by Japan, Taiwan, Korea, and the U.S. It is estimated that on average, about 570 million longline hooks are set by all fleets in the Pacific each year (NMFS 2001b).

There have been a series of ESA Section-7 consultations addressing the take of sea turtles and other protected species by fisheries managed under the Pelagics FMP. A Biological Opinion (BO) issued in March 2001 (NMFS 2001a) addressed the impacts of the Western Pacific region's pelagics fisheries (as managed in 1999) on five species of sea turtles (as well as seven species of marine mammals, addressed in the following section). The BO concluded that the pelagic fisheries are unlikely to adversely affect hawksbill turtles but are likely to adversely affect green, leatherback, loggerhead, and olive ridley turtles. The March 2001 BO concluded that the pelagics fisheries (specifically the Hawaii-based longline fishery) as managed in 1999 would jeopardize the continued existence of the first three turtle species but not olive ridley turtles. The BO specified a set Reasonable and Prudent Alternatives for reducing and monitoring the take of sea turtles. These measures were incorporated into the preferred alternative analyzed in the FEIS (NMFS 2001b), implemented in June 2001 through an interim rule, and ultimately codified in regulations in June 2002 pursuant to an FMP regulatory adjustment.

Sea turtles can be injured or killed from three broad categories of effects: forcible submergence, entanglement, trailing gear and hooking. Although sea turtles can drown due to forcible submergence, respiratory and metabolic stress leading to severe disturbance of their acid-base balance (acidosis) is a more likely effect. This condition can be lethal by itself and can also reduce overall fitness. Because of their body configuration, turtles are prone to entanglement in lines, nets and marine debris (including discarded gear). Entanglement can injure turtles by causing lesions or constricting blood flow to limbs. Trailing gear can entangle other objects or lodge on the bottom, preventing the turtle from moving. It can also be ingested by the turtle (if attached to an ingested hook), possibly causing intestinal blockage. Turtles can be hooked externally or internally. External hooking is less serious, although it can result in lesions and allow infection. Although turtles may eventually expel ingested hooks, there is a chance of internal organ damage. In estimating mortality rates for the BO, researchers assigned a range of mortality rates for different hooking conditions that could lead to post-release mortality; these ranged from 42% for various deeply hooked conditions to 0% for line entanglement.

In Table 8 are the estimated numbers of sea turtle interactions and the number of mortalities resulting from interactions for the 1994-2000 period (mortality rates have not been estimated for 2000).[12] It can be seen that the year 2000 saw mixed and not very dramatic changes in the number of sea turtle interactions compared to previous years. However, not apparent in the 2000 estimate is the fact that the new longline-related rules put in place in late August (no longlining in Area A, effort limit in Area B, no shallow-setting in Area C) resulted in dramatically fewer interactions during the last four months of the year compared to the first eight months (when

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[12] An interaction was defined in WPRFMC (2002a) as "a fishing event that resulted in a hooking or entanglement in longline gear that may or may not result in a serious injury or mortality to that species." The interaction estimates for 1994-1999 are actually described as "takes" in the BO (NMFS 2001b), with take defined to mean "any interaction between a turtle and the fishing vessel or its gear." The way that such takes are observed and recorded in practice limits them to physical interactions that involve turtles getting hooked or entangled in the line; in other words, the terms "interaction" as used here and in WPRFMC (2002a) and "take" as used in NMFS (2001b) are virtually equivalent.

only Area A was closed). In Table 9 is a comparison of sea turtle captures between the two relevant periods of 2000.

Tables 8 and 9 show (estimated) absolute numbers of interactions. In terms of interactions per unit of fishing effort, the estimated rates for the second period of 2000 were less than the estimated rates for the first period of 2000 for all species but green, although the difference was statistically significant at a confidence level of 95% only for leatherback. The number of interactions per unit of fishing effort in the last four months of 2000 was significantly lower than in 1999 for all species except for green (WPRFMC 2002a).

Table 8. Estimated interactions and mortality of sea turtles in the Hawaii-based longline fishery, 1994-2000

		loggerhead		olive ridley		leatherback		green	
		inter-actions	mortality	inter-actions	mortality	inter-actions	mortality	inter-actions	mortality
1994		501	88	107	36	109	9	37	5
1995		412	72	143	47	99	8	38	5
1996		445	78	153	51	106	9	40	5
1997		371	65	154	51	88	7	38	5
1998		407	71	157	52	139	12	42	5
1999		369	64	164	55	132	11	45	6
2000		114		113		132		65	

Source: 1994-1999 from NMFS 2001b; 2000 from WPRFMC 2002a; based on NMFS vessel observer data.
A substantial degree of uncertainty is associated with these estimates; see original sources for confidence intervals.

Table 9. Estimated interactions of sea turtles in the Hawaii-based longline fishery, two periods of 2000

Period of 2000	loggerhead		olive ridley		leatherback		green	
	inter-actions		inter-actions		inter-actions		inter-actions	
Jan 1 - Aug 24	105		100		124		43	
Aug 25 - Dec 31	9		13		8		22	

Source: WPRFMC 2002a; based on NMFS vessel observer data.
A substantial degree of uncertainty is associated with these estimates; see original source for confidence intervals.

Interaction and mortality rates have not yet been estimated for 2001, but in order to provide a rough indication of the effects of the most recent regulatory regime on interaction rates for sea turtles, the numbers of sea turtle interactions recorded by vessel observers in 2001 are shown, along with those for 1994 through 2000, in Table 10. These observer data cannot be directly extrapolated according to the level of observer coverage, but they provide a tentative indication that sea turtle interaction rates in 2001 were even lower than in the last four months of 2000, presumably as a result of the complete closure of the swordfish-directed fishery in March 2001. In fact, all but three of the 23 observed sea turtle interactions in 2001 took place during the first quarter (before the swordfish-directed fishery was completely closed) in only 8% of the year's observed trips. None of the three observed interactions during the last three quarters occurred in the second quarter, when the April-May longlining closure between the equator and 15° N was in force.

Table 10. Observed sea turtles interactions in the Hawaii-based longline fishery, 1994-2001

	Observer coverage (%)	loggerhead		olive ridley		leatherback		green	
		released alive	released dead	released alive	released dead	released alive	released dead	released alive	released dead
1994	5.3	11	0	3	0	8	0	2	0
1995	4.5	19	0	3	1	4	0	0	0
1996	4.9	27	0	8	1	8	1	3	0
1997	3.6	22	0	3	0	12	0	0	0
1998	4.1	47	1	2	3	4	1	2	0
1999	3.3	16	0	6	1	1	1	2	1
2000	10.4	27	0	8	3	11	0	3	2
2001	22.5	6	0	6	4	2	0	2	1

Source: NMFS Honolulu Laboratory; data from NMFS vessel observer program.
Note that the numbers of interactions cannot be simply extrapolated fishery-wide according to the amount of observer coverage.
An additional 10 “unknown hard shell” turtles were released alive and one additional “unknown hard shell” turtle was “released unknown” during this period.

In the American Samoa-based longline fishery, logbook data from 1992 to 1999 indicate a range of interactions with sea turtles, including hooking and entanglement events. From 1992-1999, interactions with sea turtles by the American Samoa-based longline fishery included at least four hardshelled turtles (with three released alive, one mortality), one leatherback, and one unidentified sea turtle (NMFS 2001a). Because there has been no observer coverage of this fishery, interactions could not be identified to the species level. Logbook data alone are probably not reliable indicators of actual rates of sea turtle interactions.

Based on observer data, logbook data, and information from the Forum Fisheries Agency (K. Staisch, pers. comm., February 2001, cited in NMFS 2001a), NMFS cannot quantitatively estimate the amount or extent of sea turtle take by the central and western Pacific purse seine fishery. Observer coverage in the fishery is relatively high, with a minimum of 20%. Until about 1996, recording sea turtle interactions was a relatively low priority for the purse seine observers. Logbook data for the same period indicate zero incidental captures of sea turtles, so they clearly cannot be relied on for sea turtle interactions.

Based on information collected in the eastern tropical Pacific tuna purse seine fishery (with 100% coverage), the mortality of sea turtles taken by purse seine is low (about 10%). Most sea turtles taken by purse seine fishery are able to reach the surface to breathe, and therefore they are not forcibly submerged. In addition, the mesh is small enough that the likelihood of entanglement is low. Purse seiners setting on fish aggregating devices tend to take more turtles because of the close association that exists between floating objects and sea turtles in the open ocean (SPREP 2001). Since 1997, U.S. purse seiners fishing in the central and western Pacific Ocean begun shifting their strategy to setting more often on drifting FADs, although more recently, use of drifting FADs has declined (Coan et al 2002). Setting more often on drifting

FADs may increase the likelihood of sea turtle interactions in the fishery. NMFS declined to speculate as to what effect this change in fishing strategy may have on sea turtles in the central and western Pacific (NMFS 2001a).

There have been no reported interactions with sea turtles in the pelagic fisheries other than in the Hawaii-based longline fishery, the American Samoa-based longline fishery, and the central and western Pacific U.S. purse seine fishery. It is possible that the small-boat hook-and-line fisheries interact with sea turtles. Due to the relatively low levels of fishing effort in these fisheries and the relatively high target-species selectivity of the gear, incidental take and mortality of sea turtles in these fisheries is likely to be minimal and to have an insignificant effect on the survival and recovery of sea turtle populations (NMFS 2001a).

The March 2001 BO (NMFS 2001a) addressed the impacts of the Western Pacific region's pelagics fisheries (as managed in 1999) on six whale species and the Hawaiian monk seal, in addition to the five species of sea turtles discussed in the previous section. Two incidents of whale entanglement in the pelagics fisheries have been reported by fishery observers, one for a humpback whale and one for a sperm whale. In both cases the animals escaped, the humpback whale trailing some entangled gear. No interactions with Hawaiian monk seals have been reported. The BO concluded that the pelagics fisheries are not to likely adversely affect the seven marine mammal species or the critical habitat that has been designated for them. A more recent BO was published on November 15, 2002 to assess the impacts of the Western Pacific region's pelagics fisheries following management measures implemented stemming from the March 2001 BO. The more recent BO also concluded that the pelagics fisheries are not to likely adversely affect the seven marine mammal species or the critical habitat that has been designated for them.

The Hawaii-based longline fishery is known to interact with seabirds. The NMFS vessel observer program has recorded seabird interactions in the fishery since 1994. By far the most commonly caught species are the Laysan and black-footed albatrosses (*Phoebastria immutabilis* and *P. nigripes*). Neither is listed under the ESA but both are protected under the US Migratory Bird Treaty Act. Other seabird species, including shearwaters, are relatively rarely caught (less than 1% of the total). There is concern of fishery interactions with the endangered short-tailed albatross (*P. albatrus*). A Biological Opinion issued in November 2000 (USFWS 2000) and implemented by Council action addressed the impacts of the region's pelagics fisheries on that species.

Seabirds such as the albatrosses tend to follow longline vessels while they are deploying and retrieving gear and attempt to steal bait from hooks during these operations. If a seabird is snagged or hooked during gear deployment it can be pulled underwater by the gear and drowned. Even if not pulled under and drowned, birds can be seriously injured or killed due to hook ingestion or snagging. Although a seabird would not be drowned if caught in gear during retrieval, it can still be killed or injured.

No interactions with short-tailed albatrosses have been observed or reported by fishermen or vessel observers in the Hawaii-based longline fishery. However, various factors suggest that some level of interaction is possible. Foremost, this species is known to visit the area where longline operations occur. Since it is likely that the short-tailed albatross engages in behavior similar to the two more common albatross species, the possibility of incidental capture exists. Finally, the absence of recorded incidents does not confirm that no interactions occurs, since the degree of observer coverage has been relatively low until recently and fully documenting the occurrence and behavior of seabirds has not been one of the observers' primary duties. Since the rate of interaction for this rare species is low, the likelihood of observing an interaction is also low. Also, it is possible that not all seabirds killed during fishing operations are retrieved with the gear. Thus, close observation of the type and behavior of seabirds encountered during operations would be necessary to definitively document interactions.

The incidental capture of seabirds is, like that of sea turtles, greater in swordfish-directed longlining than in tuna-directed longlining. The catch rate in tuna-directed longlining has been estimated at about 0.013 seabirds per set, compared to 0.758 seabirds per set in swordfish-directed longlining (NMFS 2001b). The difference is due both to the location of fishing grounds relative to seabird foraging grounds and to differences in gear configuration and deployment methods. Seabirds have a greater chance to interact with the gear as swordfish longline gear sinks more slowly due to fewer branch lines between each float, and the greater buoyancy of squid bait and light sticks.

The average annual captures of black-footed and Laysan albatrosses in the Hawaii-based longline fishery have been estimated to represent about 0.6 and 0.06% of the population sizes of the two species, respectively (NMFS 2001b). The BO allowed that up to 15 short-tailed albatross might be taken during the seven-year period addressed by the consultation (2000-2006) without jeopardizing the continued existence of the species.

NMFS estimates of the number of albatross interactions (hooked or entangled) from 1994 through 2000 are reproduced in Table 11. It can be seen that 2000 saw about the same number of interactions as did 1999 and previous years. However, not apparent in the 2000 estimate is the fact that the new longline-related rules put in place in late August (no longlining in Area A, effort limit in Area B, no shallow-setting in Area C) resulted in dramatically fewer interactions during the last four months of the year compared to the first eight months (when only Area A was closed). In Table 12 is a comparison of albatross interactions between the two relevant periods of 2000.

Also shown in Tables 11 and 12 are the estimated numbers of interactions per unit of fishing effort. The differences in the number of interactions per longline set between the two periods of 2000 were large and statistically significant at a confidence level of 95% for both species. Further, the numbers of interactions per longline set in the last four months of 2000 were significantly lower than in 1999 for both albatross species (WPRFMC 2002a). Interestingly, the interaction rates during the first period of 2000 were greater (but not significantly so) than in 1999. It appears that the closure of Area A during the first period of 2000 caused the fleet to fish closer to the albatross nesting grounds in the NWHI than it otherwise would have, resulting in more frequent interactions.

Table 11. Estimated interactions with albatrosses in the Hawaii longline fishery, 1994-2000

	Black-footed albatross		Laysan albatross	
	total interactions	interactions per set	total interactions	interactions per set
1994	1,830		2,067	
1995	1,134		844	
1996	1,472		1,154	
1997	1,305		985	
1998	1,283		981	
1999	1,301	0.1018	1,019	0.0798
2000	1,339	0.1031	1,094	0.0843

Source: WPRFMC 2001a and WPRFMC 2002a; based on NMFS vessel observer data.
A substantial degree of uncertainty is associated with these estimates; see original sources for confidence intervals.

Table 12. Estimated interactions with albatrosses in the Hawaii-based longline fishery, two periods of 2000

	Black-footed albatross		Laysan albatross	
Period of 2000	total interactions	interactions per set	total interactions	interactions per set
Jan 1 – Aug 24	1,262	0.1378	1,081	0.1181
Aug 25 - Dec 31	77	0.0191	13	0.0034

Source: WPRFMC 2002a; based on NMFS vessel observer data.
A substantial degree of uncertainty is associated with these estimates; see original sources for confidence intervals.
Number of interactions per set was significantly lower in the second period than in the first period for both species.

Seabird interaction rates have yet to be estimated for 2001, but in order to provide a rough indication of the effects of the most recent regulatory regime on the incidental capture of albatrosses, the numbers of albatross interactions recorded by vessel observers in 2001 are shown, along with those in 1998 through 2000, in Table 13. These observer data cannot be directly extrapolated according to the level of observer coverage, but they provide a tentative indication that seabird interaction rates in 2001 were even lower than in late 2000, presumably as a result of the complete closure of the swordfish-directed fishery in March 2001. In fact, 83% of the observed seabird interactions in 2001 took place during the first quarter (before the swordfish-directed fishery was completely closed) in only 8% of the year's observed trips. Most (26 of 28) of the observed interactions during the last three quarters occurred in the second quarter, when the April-May longlining closure between the equator and 15^{o} N was in force.

Table 13. Observed seabird interactions in the Hawaii-based longline fishery, 1998-2001

	Observer coverage (%)	Black-footed albatross		Laysan albatross	
		released alive	released dead	released alive	released dead
1998	4.1	6	39	26	30
1999	3.3	7	36	7	21
2000	10.4	29	133	30	55
2001	22.5	6	76	13	63

Source: NMFS Hawaii Longline Observer Program data.
Note that numbers of interactions cannot be simply extrapolated according to the amount of observer coverage. Two other seabird species were captured during the 1998-2001 period; in 2001, observers recorded two sooty shearwaters released dead and one unidentified shearwater released dead.captured captures.

The incidental catch of seabirds in the longline fisheries can be examined in the context of the National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries (NPOA-Seabirds) (NMFS 2001d). The NPOA-Seabirds was developed under the framework of the International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries (IPOA-Seabirds), an international instrument elaborated within the framework of the Code of Conduct for Responsible Fisheries and developed through the UN Food and Agriculture Organization (FAO).[13] The IPOA-Seabirds calls for member nations to voluntarily develop, implement, and monitor a national plan of action if they determine, based on an assessment, that a problem exists with respect to the incidental catch of seabirds in their longline fisheries. The objective of the IPOA-Seabirds is to reduce the incidental catch of seabirds in longline fisheries. The NPOA-Seabirds does not prescribe specific mitigation measures for each longline fishery. Rather, it provides a framework of actions that NMFS, USFWS, and the Councils should undertake for each longline fishery. Action items in the NPOA-Seabirds include detailed assessments of the nation's longline fisheries for seabird bycatch and, if warranted by the assessment, implementation of measures to reduce seabird bycatch within two years, including data collection, prescription of mitigation measures, research and development of mitigation measures and methods, and outreach, education, and training about seabird bycatch.

As described above, recent management measures affecting the Western Pacific longline fisheries – particularly the closure of the swordfish-directed fishery – have resulted in substantial progress towards the objective of the IPOA-Seabirds, most notably the dramatic reduction in the number of albatrosses incidentally caught in the Hawaii-based longline fishery. The additional seabird incidental take mitigation measures prescribed as terms and conditions of the November 2000 BO and subsequently codified through regulations pursuant to an FMP framework adjustment are likely to further reduce the capture and mortality of seabirds and reduce the likelihood of interactions with the endangered short-tailed albatross.

The impacts of the purse seine fishery were not addressed in the BOs for the Pelagics FMP. The capture of marine mammals, sea turtles, and seabirds in the purse seine fishery is briefly

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[13] The International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries was adopted at the 23rd Session of the FAO Committee on Fisheries, 15-19 February 1999, Rome.

reviewed here. Vessel observers have recorded the capture of sea turtles and marine mammals, including whales, by US purse seine vessels in the central-western Pacific (e.g., see Coan et al. 2002 for 2001 data), but no such interactions were reported in logbook data (compiled by the NMFS Southwest Fisheries Science Center) or observer data (compiled by the Forum Fisheries Agency) for the EEZ of the US Pacific Islands in the years 1997 through 2001. The logbook and observer data for 1997-2001 reported no seabirds captured. A review of bycatch in the western Pacific tuna fisheries reported finding no records of seabirds being caught in the region's purse seine fisheries (Bailey et al. 1996).

4.2.1.4 Unobserved mortality

Unobserved mortality of fishes can be substantial with gears such as poisons, explosives, and nets (from which fish drop out before harvest either injured or dead and which, when lost, can continue to capture and kill fish). The hook-and-line gears used in the pelagics fisheries cause relatively little unobserved fishing mortality.

When using troll and pole-and-line gear, fish are taken at the surface and spend very little time before being brought on board. Unobserved losses are consequently rare, but some of the hooked fish that are lost before being brought on board could be expected to die as a result of injuries, especially if the hook is retained in the jaw. The mortality rate from such losses is very difficult to measure, but it is certainly low compared to the mortality rate associated with captured fish.

Purse seine gear does not generally result in unobserved mortality, although it is possible that some fish, particularly small fish, escape from a set with fatal injuries.

Longline gear, which is generally set for many hours, has the potential to result in unobserved mortality. Fish hooked on longlines are sometimes taken by predators, including cetaceans and sharks (the source of loss is sometimes recognizable by fishermen by the characteristic remnants of the fish left on the hook). Although the extent of such losses is unknown, they are large enough that longline fishermen are wary when certain cetacean species are observed in the area. A second source of unobserved mortality is fish that free themselves or fall from the hook before capture and die as a result of injuries. Some of the losses due to predation can be counted when parts of the fish are left on the hook. Some of the losses from escapees can be counted when the gear, such as a hook or leader, is broken. No quantitative estimates for either of these sources of unobserved mortality are available for the longline fisheries. Research is underway in Australia to develop methods for mitigating losses from marine mammals, including an acoustic array for tracking marine mammals in the vicinity of fishing vessels (G. McPherson, Department of Primary Industries, Queensland, Australia, pers. comm.).

The estimated interaction rates for seabirds described in the previous subsections may underestimate actual interaction rates because they do not take into account unobserved interactions. Although it is difficult to assess the magnitude of such interactions, the results of several studies suggest that it may be important. Two potential sources of unobserved catch are birds that fall from the hook before being brought aboard and the failure of observers to count birds that are discarded by the crew before being brought aboard. For example, with regard to the first source, while conducting research on an underwater setting chute on a Hawaii-based longliner targeting tuna, it was estimated that between 26 and 37% of seabirds observed hooked during control sets (when the chute was not deployed) were not hauled aboard (the range reflects the varying degree of confidence in the observations of hooking events during setting – the low end of the range accounts only for those birds for which there was a high degree of confidence in the observations of their being hooked during the set) (Gilman et al. 2002). Gilman et al (2002) that a comprehensive study employing direct observations of a known number of hooked bird carcasses being set and hauled on a longline is required to determine a precise measure of the percentage of bird fall-off. With regard to the second source, in a study of Japanese longliners in the waters off Tasmania in 1995, Gales et al. (1998) found that the seabird catch rate was 95% greater on hauls that were subject to direct observations of seabirds being cut off by crew members during hauling than on hauls that were subject to only routine observations. Although useful examples, these findings are not necessarily indicative of what occurs in the Council-managed longline fisheries.

4.2.1.5 Identification of areas for further bycatch reduction

Given that a very large proportion of the catch is generally desired and utilized in the non-charter troll, pelagic handline, and pole-and-line fleets, there is probably only a modest potential for practicably further reducing bycatch and bycatch mortality. The charter fleets, on the other hand, often intentionally release desired species such as billfish, and there may be potential for further reducing bycatch mortality, such as through education of charter crew on best practices for handling and releasing fish.

The percentage of captured sharks that is discarded has increased dramatically as a result of the finning prohibitions. The finning prohibitions greatly limit the ability to reduce bycatch through other management measures. Still, shark (especially blue shark) bycatch might be reduced through the development of markets for body parts other than fins, and shark bycatch mortality might be further reduced through improvements in handling and release methods. Shark bycatch rates might also be reduced through the identification, through research, of fishing methods and strategies that would reduce shark capture rates.

Interactions with, and mortality rates of, seabirds and sea turtles have decreased dramatically in the Hawaii-based longline fishery as a result of the closure of the swordfish-directed fishery. Such interactions might be further reduced through the adoption of mitigation measures such as those currently being tested for sea turtles and seabirds. If found to be effective, the adoption of such mitigation measures might allow the resumption of swordfish-directed longline fishing. Interaction rates in the American Samoa longline fishery have yet to be fully assessed, but a range of mitigation measures might be available to reduce interaction rates in that fishery, if necessary.

4.2.2 Measures to Assess and Report Bycatch

The standardized reporting methodology used to assess the amount and type of bycatch occurring in the pelagics fishery utilizes a combination of data collection and analysis systems implemented by NMFS and local-level fisheries agencies. NMFS and the Western Pacific Fishery Information Network (WPacFIN) coordinate the collection and analysis of data and the

Council compiles and publishes the relevant data in the Stock Assessment and Fishery Evaluation (SAFE) report, which is the Council's Pelagic Fisheries Annual Report.

Data collection systems used in the pelagics fisheries that yield information about bycatch vary between the different fishery sectors, and include vessel observer programs, vessel and trip logbook programs, and creel surveys. Fishery-independent sources of information, including experimental fishing studies and tagging studies, are also used on an as-needed and as-available basis. There are various systems to monitor sales of pelagic species, but because they yield little information about bycatch they are not addressed here.

The most reliable and precise source of bycatch data (for a given trip) is vessel observer programs. The precision associated with fishery-wide catch and bycatch estimates derived from the data is a function of the proportion of fishing trips that are observed and the frequency of encounters for a given species.

Vessel logbook programs have the advantage of high degrees of coverage but have the disadvantage of relying solely on fishermen to record detailed information about many species, many of which are difficult to distinguish. In the case of protected species, fishermen may be disinclined to report interactions, such as if they believe a high interaction rate will lead to restrictions on the fishery.

Creel surveys, which rely on direct observations of landings and interviews with fishermen just after reaching port, yield very reliable information about landings and somewhat reliable information about bycatch. The latter is limited by the memories (and sometimes truthfulness) of fishermen and the difficulties in accurately identifying fish, mammals, sea turtles, and seabirds to the species level. Like vessel observer data, the precision associated with fishery-wide estimates derived from creel surveys is a function of sampling intensity.

Experimental fishing data are useful for accurately measuring catch composition to the species level, which is useful for assessing the reliability of fishery logbook data (i.e., retentions and discards combined) and for generating correction factors for those data. They can also be used to measure the percentage of fish that is landed alive, which may be indicative of survival rates of discards. Tagging studies can be used to assess mortality rates of discarded species.

Data collected through any of these methods can be used independently, and where they overlap, they can be used to corroborate each other and generate corrected estimates. For example, a research project is underway to assess the level of concurrence among several sources of catch data (logbook, observer, and sales data) collected in the Hawaii-based longline fishery and to develop predictive models that can be used to generate corrected fishery-wide catch statistics that can be used for stock assessments and other purposes (Walsh 2000; Walsh 2002). The results of this and similar studies can be used to improve logbook and creel survey design in order to eliminate systematic recording errors and to generate correction factors that can be applied to logbook and creel data (e.g., see Walsh and Kleiber 2001 and Walsh et al. in press for blue shark). The resulting predictive models can serve as what Walsh (2002:1) termed "surrogate" observers for unobserved trips that are subject to logbook reporting or creel surveys. The results can also be used to refine the design of observer programs – for example, to determine the minimum frequency and degree of coverage needed to achieve a given level of accuracy and precision in fishery-wide statistics.

In summary, creel surveys and logbook programs provide reasonably reliable data about finfish discards, but not about interactions with protected species. Observer programs provide more accurate and precise data, but at generally greater costs per unit of coverage. Observer programs with relatively small degrees of coverage, as well as fishery-independent research, can be used to adjust data gathered through creel surveys and logbooks. Information on bycatch mortality, including mortality of discards and unobserved mortality, is difficult to obtain through any means. Observer data can provide reliable information on the proportions of a given species landed alive versus dead, but additional research is necessary to gauge the survival rates of fish and other species released alive. Interactions with protected species can be assessed most reliably through vessel observer programs, and the smaller the encounter rate for a given species, the greater the degree of coverage necessary.

The standardized reporting methodology for bycatch in the pelagics fisheries utilizes creel surveys and/or logbook programs to cover virtually all pelagic fishing activity. In most cases these programs are continuous, but in some cases, in order to be as cost-effective as possible, they may be discontinuous. In cases where more accurate or precise information is needed on fish bycatch, protected species interactions, or other fishery attributes, information from the creel surveys and logbook programs is supplemented with (and/or adjusted by) data from vessel observer programs. Fishery-independent investigations are undertaken as needed to address bycatch and other issues. Observer programs and fishery-independent investigations are not necessarily continuous and are designed to be as cost-effective as possible (for example, intensive observer programs of limited duration may be implemented periodically in order to provide estimates that are applicable to longer time periods or that can be used to adjust continuous data from other sources). Data collected through each of these components are synthesized and interpreted in the annual SAFE report. The design details of each of these components (e.g., the frequency and coverage of observer programs) vary by area and gear type and may be occasionally adjusted over time in order to meet information targets in the most cost-effective manner. These information targets, such as the scope, accuracy, precision, and resolution of collected data, may also be occasionally adjusted as needed. Further detail is provided below on the basic design of each of the components of the standardized reporting methodology for the pelagic fisheries and on revisions that are currently underway. New measures to further improve the methodology are presented in Section 6.

4.2.2.1 Observer programs

NMFS has operated since 1994 an observer program on the largest source of bycatch in the pelagic fisheries, the Hawaii-based longline fishery. The focus of the program is on interactions with sea turtles, marine mammals, and seabirds, but also recorded are details on fishing effort and retention and discards of finfish by species. The condition of released protected species is recorded. Observers have also fitted a number of live released turtles with satellite tags, in part to assess their post-hooking mortality rates. Observer coverage in the Hawaii-based longline fishery was between 3% and 5% from 1994 through 1999 and increased to 10% in 2000. Because of the difficulty in estimating interaction rates for sea turtles (which have low encounter rates), observer coverage was increased by court order to a minimum of 20%. Coverage in 2001 was 22%. Bycatch is recorded by species, number, and condition (alive, dead). Data from the observer programs are compiled by the NMFS Honolulu Laboratory, which generates quarterly and annual reports regarding both finfish catches and protected species interactions. The results are incorporated into the annual SAFE report. More rigorous analyses are needed to extrapolate the observations to estimates of actual bycatch; NMFS performs these analyses on an as-needed basis.

The March 2001 sea turtle BO made the establishment of observer programs in other longline fisheries advisable but not mandatory. The growing size of the American Samoa longline fishery has prompted interest in establishing a vessel observer program, and NMFS is currently planning an observer program that will focus first on the larger vessels and consider later the possibility of extending coverage to the smaller *alia*. The results from a small observer program on the *alia* in neighboring Samoa will be used to help design the program for American Samoa.

Pursuant to the 1988 South Pacific Tuna Treaty Act, there is an observer program for US purse seiners in the treaty area. Observers complete the South Pacific Regional Purse Seine Observer Set Details form. Discards are recorded by species, weight and/or number, and reason for discard. Sharks that are finned are also recorded, by whole weight and/or number. The data collection program started with the Treaty in 1988 but bycatch apparently did not become rigorously reported until 1996. The observer program is administered by the South Pacific Forum Fisheries Agency (FFA). The data are stored at the SPC and at the NMFS Southwest Regional Science Center. The results are periodically published in SPC reports and incorporated into the annual SAFE report.

4.2.2.2 Logbook programs

Holders of Hawaii longline limited access permits and general longline permits (i.e., all longliners in the region) are required to record catch and effort data in the NMFS Western Pacific Daily Longline Fishing Log. Vessel operators are required to record the number, by species, of the PMUS kept and discarded in a given set. The form also requires data on the numbers of sharks finned, kept whole, and discarded. There is also space for recording the number of non-PMUS kept and discarded, but because the space is limited, the catch and bycatch of non-PMUS are substantially underreported (this shortcoming in the log is by design, as modifying the log to accommodate full reporting of non-PMUS would place an additional burden on fishermen and likely compromise the reliability of the PMUS data). The first full year of logbook data from the Hawaii-based longline fishery is 1991, and from the American Samoa fishery, 1996. Revisions to the logbook form were made in 1995 and 2000, and further revisions are being considered in order to record catches made with gears other than longline (e.g., longliners sometimes engage in trolling). Data from the logbook programs are compiled by the NMFS Honolulu Laboratory, which generates annual reports. The results are incorporated into the annual SAFE report.

Pursuant to the High Seas Compliance Act, albacore troll vessels are required to complete logbooks, the data from which go to the NMFS Southwest Fisheries Science Center, which shares them with HDAR and the Council.

Pursuant to the 1988 South Pacific Tuna Treaty Act, US purse seine vessels fishing in the treaty area must complete the South Pacific Regional Purse-Seine Logsheet. The form provides for the reporting of discards by species, number, and weight. The data collection program started with the Treaty in 1988 but bycatch apparently did not become rigorously reported until 1996, after a revision of the logbook format and after more emphasis was placed on the reporting of bycatch in training sessions with fishermen. The reporting requirements do not apply in the US EEZ, including the PRIA waters, where purse seine effort is sometimes substantial. To date, however, the vessels have generally been recording their activity in the US EEZ. The logbook program is administered by the SPC and the FFA. The data are stored at the SPC and at the NMFS SW Regional Science Center. The results are periodically published in SPC reports and incorporated into the annual SAFE report.

Hawaii State requires that any person who takes marine life for commercial purposes obtain a commercial marine license. All holders of such licenses are required to complete and submit to HDAR one of several catch reporting forms. This requirement applies to fish caught in federal waters, including the PRIAs, but landed in Hawaii. The default form for most fishermen is the Fish Catch Report (popularly known as the "C3" form), which is in the form of a daily log that is submitted monthly. Aku pole-and-line boats instead use the HDAR's Aku Catch Report. Until 2000, vessels landing albacore in the state used the Albacore Trolling Trip Report, but that was discontinued because HDAR already receives logbook data that are required of those vessels under the High Seas Compliance Act. Longline vessels were, until the beginning of 2002, required to complete HDAR's Longline Trip Report, but that requirement was dropped because the information was already being collected through the federal logbook program. None of these State of Hawaii reports include bycatch information beyond fish tagged and released.

The data submitted by commercial fishermen to HDAR are compiled and analyzed by HDAR, which releases the information in the form of periodic reports. The results relevant to the Council-managed fisheries are incorporated into the annual SAFE report.

HDAR's commercial reporting system is in the process of being revised. The current system includes the collection of sales information from fishermen. The revised system will shift the burden of reporting sales to the fish dealers while improving the completeness and reliability of catch and effort data collected from fishermen. The revised reporting forms will include information about bycatch, recorded by species (to the extent possible), number, and disposition (released, lost to predator) (the information on fish lost to predation will provide estimates of unobserved mortality). If known, the type of predator can also be indicated by the fisherman, which will provide information about protected species interactions. The forms include detailed instructions and standardized lists of species and fishing methods to ensure consistent, complete, and accurate reporting. HDAR is planning to implement the revised system in late 2002. In preparation, HDAR is conducting extensive outreach efforts, including testing the revised forms with selected fishermen and producing and disseminating to all license holders a video that includes reporting instructions and emphasizes the value of accurate reporting. HDAR will maintain a hotline to assist fishermen with the revised system. The agency is also considering the production of a booklet with illustrations of fish species in order to facilitate accurate reporting. Under the revised system, troll and handline vessels will be required to complete a specialized Tuna Handline Fishing Trip Report (with the same information on bycatch) instead of the Fish Catch Report for any trip longer than two days.

Charter vessels based at Midway are required by the USFWS to complete and submit the Midway Sports Fishing Boat Trip Log on a per-trip basis. The catch is recorded by the number of fish caught and the number released, by species (generally, anglers may retain only one fish per day, and only pelagic species may be retained). Also recorded are interactions with protected species, including hooking events and observations of monk seals. The data are compiled and reported by the USFWS. NMFS and the Council are in the process of reaching an agreement with the USFWS for sharing the data, and if needed, for modifying the reporting requirements in order to record bycatch and protected species interactions. The primary purpose of the improvements and data sharing would be to identify and measure any fishery interactions with the Hawaiian monk seal and with seabirds—particularly with the large Laysan and black-footed albatross populations that nest there. If and when charter pelagic fishing starts at Palmyra, NMFS and the Council will seek the same type of reporting agreement as the one being arranged for Midway.

There are currently no federal reporting requirements for troll or handline vessels operating in the PRIAs (except Midway, through the USFWS). Concurrent with the expanding longline effort in the PRIAs, several troll and handline vessels have recently become active in those waters, but reporting (through the State of Hawaii system) has been poor. Through an FMP framework adjustment, a proposed rule was published in May 2002 that would require catch and effort reporting by troll and handline vessels operating in PRIA waters.

4.2.2.3 Creel surveys

Creel surveys (shore-side surveys of vessel-based and/or shore-side fishing) are conducted year-round in American Samoa, the CNMI, and Guam (the surveys in American Samoa and Guam include components for both vessel-based and shore-side fishing; the CNMI currently has a component only for vessel-based fishing). These surveys cover fishing by vessels engaged in subsistence, recreational, charter, and commercial pelagic fishing. The creel survey programs have been in place in American Samoa and Guam since 1985 and 1983, respectively. The creel survey in the CNMI, started in 1988, was discontinued in 1996 and reinitiated in mid-2000.

The creel survey data are collected by the respective fisheries agencies of each of the three island areas (the CNMI Division of Fish and Wildlife, the Guam Division of Aquatic and Wildlife Resources, and the American Samoa Department of Marine and Wildlife Resources). Each of the three agencies uses creel sample data to generate annual effort and catch estimates using algorithms developed with the assistance of WPacFIN. The agencies submit annual report modules to the Council and the respective Plan Teams compile them into the annual SAFE report.

In response to the 1998 SFA amendments regarding bycatch reporting, the creel survey instruments in the three island areas were modified in 1999 (2000 in the CNMI) in order to collect bycatch data, which is recorded by species, number and/or weight, and condition (live, dead/injured). Fishery-wide bycatch estimates are derived from the sample data and expressed in the annual SAFE report in absolute terms (by number or weight), and as a percent of the total catch, by species and condition. The bycatch estimates generated in the creel surveys are expected to have relatively high levels of precision, accuracy, and reliability, but the bycatch data have not, until recently, been rigorously collected or subjected to routine examination or reporting. Guam started including bycatch data in its reports for 2000. American Samoa and the CNMI started with their year-2001 reports. With continuing assistance from the WPacFin, the three island fisheries agencies are in the process of incorporating the bycatch data into their data processing routines used to generate the fishery-wide catch (and bycatch) estimates for their annual reports. The creel survey in American Samoa will be useful as an additional source of information for the longline fishery, which is subject to a logbook program and will soon be subject to a vessel observer program.

In Hawaii, recreational fishing is not subject to any permitting or reporting requirements, yet recreational effort and catches—particularly of pelagic species—are known to be relatively large. NMFS and HDAR are in the process of conducting the Hawaii Marine Recreational Fishing Survey (HMRFS). The last time the survey was conducted in Hawaii was 1981. The survey is an ongoing effort that will continue at least through 2004, with subsequent work dependent on available funding. Field interviews with fishermen at boat ramps, marinas, and with charter boats are used to examine both landings and discards. Information about discards is recorded by species, number, and condition on release (dead, alive). Also recorded are fish that the fishermen plan to throw away (which would constitute bycatch). The survey results are analyzed and disseminated in two forms. NMFS publishes on the web those portions of the results that are part of the associated nationwide Marine Recreational Fishery Statistics Survey. The data are collected during two-month "waves" and the results for each wave are released 90 to 120 days after the end of the wave. The results of the first wave (November-December 2001) will be available in mid-2002. HDAR also publishes the results, but with a broader scope than the national-level results—including, for example, the catch of non-finfish species, including invertebrates caught for food and protected species such as sea turtles, seabirds, and marine mammals. HDAR plans to publish the survey reports on a semi-annual basis. The survey results will be useful in cross-checking the results of the HDAR commercial trip reports, and vice versa, since the HMRFS will not limit itself to recreational fishing trips and because there is substantial overlap in participation and fishing effort between the two sectors (mixed-motivation trips, or "expense trips," comprise a large portion of small boat pelagic fishing effort in Hawaii).

4.2.2.4 Fishery-independent data

The NMFS Cooperative Marine Game Fish Tagging Program generates information about the mortality of discarded billfish. Some recreational vessels, particularly those in the Hawaii-based charter fleet, routinely participate in the program on a voluntary basis. NMFS also conducts tagging of sea turtles, including satellite tagging by observers in the longline observer program. The program generates information about the post-hooking mortality of sea turtles.

4.2.2.5 Summary of bycatch reporting methodology

Bycatch data sources in the pelagic fisheries are listed in Table 14. Indicated for each program or survey instrument is the main agency responsible for implementing the data collection program. Also indicated are the years for which data are available. Additional agencies may be involved in collecting, managing, interpreting, and disseminating the data, as described above. Not included in the table are fishery-independent sources of bycatch data and sources of fisheries data that do not generally provide information on bycatch, such as programs that monitor fish sales. The bycatch-related forms used in each of these data collection programs are included in Appendix 1.

In general, ensuring compliance with reporting requirements has been difficult as the majority of data collection programs in place are non-Federal. However, successful Federal enforcement actions have been carried out related to under-reporting in the Federal longline logbooks.

Table 14. Data sources in the bycatch reporting methodology for the pelagic fisheries

	Observer programs	Logbook programs	Creel surveys
Hawaii-based longline	Hawaii Longline Observer Program (NMFS) 1994-present	W. Pacific Daily Longline Fishing Log (NMFS) 1991-present Longline Trip Report (HDAR) 1950s-2001	none
American Samoa longline	new program undergoing planning (NMFS)	W. Pacific Daily Longline Fishing Log (NMFS) 1996-present	Offshore Survey (ASDMWR) 1985-present (bycatch since 2001)
Albacore troll	none	Albacore Trolling Trip Report (HDAR) 1990s-2000 High Seas Compliance Act log (NMFS)	none
Purse seine	S. Pac. Reg. Purse-Seine Observer Set Details (SPC) 1988-present (bycatch since 1996)	South Pacific Regional Purse-Seine Logsheet (SPC) 1988-present (bycatch since 1996)	none
Hawaii small boat pelagic	none	Fish Catch Report*, Aku Catch Report (HDAR) (commercial only) 1948-present (bycatch since late 2002)	HI Marine Recreational Fishing Survey (NMFS, HDAR) late 2001-present
Am Samoa small boat pelagic	none	none	Offshore Survey (ASDMWR) 1985-present (bycatch since 1999)
Guam small boat pelagic	none	none	Offshore Creel Census (GDAWR) 1983-present (bycatch since 1999)
CNMI small boat pelagic	none	none	Offshore Creel Census (CNMIDFW) 1988-1996; 2000- (bycatch since 2000)
PRIA small boat pelagic	none	Fish Catch Report* (HDAR) (comm. Hawaii landings only) 1948-present (bycatch since late 2002) Midway Sports Fishing Boat Trip Log (USFWS) 1997-2001 (currently inactive) new federal logbook pending approval (NMFS)	none

Indicated in parentheses for each data collection program or survey instrument is the primary agency responsible for data collection (ASDMWR = American Samoa Department of Marine and Wildlife Resources; CNMIDFW = CNMI Division of Fish and Wildlife; GDAWR = Guam Division of Aquatic and Wildlife Resources; HDAR = Hawaii Division of Aquatic Resources; NMFS = National Marine Fisheries Service; SPC = Secretariat of the Pacific Community; USFWS = US Fish and Wildlife Service).
The dates indicate the years for which data from the program are available.
* Starting in late 2002, pelagic handline and troll trips longer than two days will require completion of the specialized Tuna Handline Fishing Trip Report.

4.2.2.6 Identification of weaknesses in bycatch assessment

Weak aspects of the bycatch assessment systems in the pelagic fisheries include:

- Assessment of the amount and type of bycatch in the small boat recreational, charter, commercial, and mixed-motivation fisheries in all the island groups.
- Assessment of mortality of discarded finfish in the pelagic fisheries.
- Assessment of unobserved mortality in the longline fisheries.
- Assessment of bycatch in the American Samoa longline fishery.
- Assessment of post-interaction mortality and morbidity of sea turtles and marine mammals.
- Routine analysis, synthesis, and interpretation of bycatch data.

New measures to address these weaknesses and other aspects of the bycatch reporting methodology are presented in Section 6.

4.2.3 Measures to Minimize Bycatch and Bycatch Mortality

This section describes existing and in-progress management measures that serve to minimize bycatch and bycatch mortality in the pelagic fisheries (see Section 2 for a review of all management measures in the fishery). Proposed new measures are described in Section 6.

Only hook-and-line gears are used in the pelagics fisheries managed under the FMP, and these gears strongly select for carnivores, particularly aggressive predators. These types of species tend to be favored in markets, thus they tend to be target primary species.

Among the first management measures implemented through the Pelagics FMP was a prohibition on the use of drift gillnet (or driftnet) gear (50 CFR 660.30). The gear was used from the 1970s until the early 1990s in the central and western Pacific by foreign fleets to target tuna and billfish, and in higher latitudes, squid. In the South Pacific the drift gillnet fishery targeted albacore tuna starting in the early 1980s. All these fisheries closed by 1991 following international and regional agreements to ban the use of these methods. Swordfish and thresher shark have been targeted in a domestic drift gillnet fishery off the west coast of the US. Drift gillnetting is a relatively non-selective method and in the central and western Pacific it has resulted in relatively frequent interactions with, and killings of, marine mammals, sea turtles, and seabirds (e.g., Wright and Doulman 1991; Wetherall and Seki 1991; Johnson et al. 1993; Paul 1994; Julian and Beeson 1998; McKinnell and Seki 1998; Bailey et al. 1996). Because of the relatively long soak times used, the method also tends to result in relatively large amounts of target species being damaged, dropping out of nets (both observed and unobserved), and being discarded. For example, Bailey et al. (1996) reviewed sources that reported an observed drop-out rate of albacore on the Tasman Sea of about 9 percent. International concern over excessive catch, fish bycatch, waste, and killings of non-fish species led in 1989 to UN General Assembly Resolution 44/225 on Large-scale Pelagic Drift-net Fishing and its Impact on the Living Marine Resources of the World's Oceans and Sea, calling for moratoria on large-scale pelagic drift gillnet fishing on the high seas and in the South Pacific. The Convention for the Prohibition of Fishing with Long Driftnets in the South Pacific, or the Wellington Convention, was endorsed in

1989.

The protected species zone in the NWHI, although not specifically intended to reduce fish bycatch, reduces the likelihood of interactions with several protected species, particularly the Hawaiian monk seal. These closed areas also serve to reduce seabird interactions because the most important breeding colonies for black-footed and Laysan albatrosses are in the NWHI. These seabirds are present around the islands in large numbers during certain times of year. The closed area also serves to reduce the catch of green sea turtles, which nest in the NWHI.

The longline closed area around the MHI was established to reduce gear conflicts between pelagic longline fisheries and other, state-managed, inshore fisheries. It also serves to reduce the likelihood of interactions with protected species that are common in those waters, including the humpback whale, which prefers waters less than 100 fm deep. The MHI longline closed area probably also serves to reduce bycatch of large blue marlin, which are known to be present in relatively high numbers in waters close to the west coast of the island of Hawaii. The closed area also serves to reduce the catch of green sea turtle, which forages and is present in high densities in nearshore areas of the MHI.

It appears that the MHI and NWHI area closures may serve to reduce the catch of small swordfish, and because the smallest sized swordfish tend to be discarded because of their size, they would also serve to reduce the percentage and absolute bycatch of swordfish. Swordfish length data from port sampling indicate a substantial reduction in 1992 and subsequent years in the percentage contribution of the smallest weight class (<26 lb) to total landings (Ito and Machado 2001). Although the cause of the reduction has not been rigorously investigated, it appears that it may be at least partly a result of the NWHI (late 1991) and MHI (early 1992) area closures. If that smallest weight class of swordfish tends to be proportionately more abundant in relatively nearshore waters – and anecdotal evidence from fishermen suggests that it is – then the area closures would serve to reduce the catch of that weight class and the bycatch of swordfish in general.

Although less evidence is available regarding the effects of the closed areas in Guam (longline vessels) and American Samoa (pelagic vessels greater than 50 feet long), it is probable that like the NWHI and MHI closed areas, they serve to minimize bycatch and protected species interactions. Such closures would, for example, minimizing interactions between longliners and turtle species such as greens and hawksbills.

The Council is in the process of developing a Pelagics FMP amendment that would define bottom-set longline gear as a longline gear subject to the Council's FMPs. This gear would not be included in the list of gears permitted under the Council's Coral Reef Ecosystems FMP. This would have the effect of reducing the likelihood of interactions with protected species, particularly the Hawaiian monk seal, and reduce the absolute bycatch of a number of bottomfish species (see Table 2).

The state and federal bans on shark finning were primarily intended to reduce waste and to reduce the possibility of overfishing. While the bans have effectively reduced the fishing mortality rate of pelagic sharks in the western pacific management area, particularly that of blue sharks, they have served to substantially increase the bycatch rate of sharks. That increase has been countered by the effects of the recent closure of the swordfish-directed longline fishery, which has served to decrease the contribution of sharks to the catch and thus reduce the total catch of sharks. As summarized in Table 5, based on preliminary data for 2001, the combined effects of the finning bans and swordfish closure have been to increase the percentage of sharks discarded but decrease the absolute numbers of sharks discarded. But with roughly 40,000 sharks discarded in the Hawaii-based longline fishery in 2001, the number is still substantial. The finning bans appear to have caused a slight increase in the number of whole sharks retained, and although the carcasses of many of them are probably thrown away after landing, this is a bycatch-reducing effect. The finning bans have increased the incentive to market the flesh and other parts of sharks, so the whole-shark retention rate is likely to increase in the future. As for the mortality rate of discarded sharks, the finning bans and swordfish closure are unlikely to have any substantial effects one way or the other.

Prior to the enactment of the state and federal finning bans the Council was developing precautionary management measures for ensuring that stocks of pelagic sharks, particularly blue shark, do not become overfished. The proposal under consideration was a harvest guideline for blue sharks in the Hawaii-based longline fishery. The finning bans have since made such a measure unnecessary, and the Council is currently modifying the proposed amendment so that it would address only the harvest of shark species other than blue sharks. In its current form, the draft amendment would establish a retention limit of one non-blue shark per trip in the Hawaii-based longline fishery. Given the current shark retention rate, which averages less than one shark per trip, the measure would have little impact on the catch or bycatch of sharks. However, if in the future the incentive to retain non-blue sharks increases (i.e., if bycatch decreases, such as through an improvement in marketability), the measure would effectively cap the decrease in bycatch and cap the associated increase in mortality rate.

The closure of the swordfish fishery appears to have already had substantial impacts on the bycatch of sea turtles, which was the primary intent, as well as on interactions with seabirds (interactions with which are greatest in the zone between 25° N and 40° N and between 150° W and the international date line; WPRFMC 2001a). As described in Section 4.2.1, the Hawaii-based longliner observer program reported only three interactions with sea turtles and two interactions with seabirds during the last three quarters of 2001 (with about 20% vessel coverage).

The other recently implemented sea turtle mitigation measures can also be expected to reduce the capture and mortality of sea turtles. These include the seasonal closure of a large area between the equator and 15° N latitude to longline fishing, requirements for all vessels that target pelagic fish to carry line clippers and bolt or wire cutters and to employ a number of methods to reduce harm to, and expeditiously release, sea turtles hooked by or entangled in their gear, and requirements for longline vessel owners and operators to annually complete protected species educational workshops.

Prior to the dramatic changes associated with the swordfish fishery, the Council began to encourage voluntary compliance with several mitigation measures aimed at reducing seabird interactions. Although most fishermen implemented some form of mitigation, the response was deemed insufficient in light of the continued estimated high seabird interaction rate and the possibility that the endangered short-tailed albatross would be incidentally caught. In 1998 the

Council commissioned a study to identify effective mitigation measures, some of which were subsequently field-tested aboard the NOAA research vessel Townsend Cromwell. Based on the results, in 1999 the Council began developing a framework measure to require the use of certain mitigation measures. The framework measure was nearing completion at the time that the BO was issued. The framework measure was submitted to NMFS for review on November 16, 1999, and a proposed rule appeared in the Federal Register on July 5, 2000 (65 FR 41424). However, there were significant differences between the preferred alternative in the framework measure and the provisions of the BO, mainly having to do with the degree to which adoption of specific mitigation measures by fishermen would be mandated. In addition, the framework measure required seabird mitigation measures in areas north of 25° N while the BO required their use north of 23° N. The framework measure was subsequently revised so that the preferred alternative reflected the provisions of the BO and it was resubmitted to NMFS in March 2001. The June 12, 2001 publication of the emergency interim rule covering sea turtles and seabirds necessitated still another round of revisions to the framework document. NMFS and USFWS re-initiated Section 7 consultations in light of the changes in the fishery, and thus the potential for short-tailed albatross incidental catch, due to the closing of the swordfish-directed fishery. The FMP framework amendment was subsequently revised and became effective in May 2002, replacing the interim regulations. The framework amendment's management measures that serve to reduce the capture and mortality of seabirds are summarized in Section 2.2.

A collaborative research project and commercial demonstration related to seabird interactions is being carried out by NMFS, the Hawaii Longline Association, the National Audubon Society, the USFWS, and the Council. The project is testing the efficacy of using underwater setting chutes on tuna longliners in order to reduce interactions with seabirds. The technology was developed in New Zealand and Australia. The developers of the technology helped install and modify the chute on a Hawaii longline vessel and assisted in the first at-sea trial in Hawaii. The first trials on a Hawaii-based longline vessel occurred in March 2002, and the results are encouraging. No seabirds were captured while using the chute, and compared to a control, the chute was 95% effective at reducing albatross contacts with fishing gear near baited hooks (Gilman et al. 2002).

Another NMFS-led research program currently underway is aimed at testing the efficacy of various modifications in gear and methods in order to reduce the incidental catch of sea turtles while longlining. Modifications being tested include setting deep in the daytime for swordfish and using darkly colored gear that will be less attractive to sea turtles. The project is likely to reveal possible methods for reducing bycatch of other species. Both this and the underwater setting chute project are making use of commercial longline vessels and crew, which will facilitate the eventual adoption of new gears and methods by the industry.

Another recent development highlights the role that gear configuration could play in reducing interactions with protected species. One Hawaii-based longline vessel has continued to fish with basket-type gear to target deep swimming tunas, which was used by Hawaii longline vessels until the late 1980s. This old-style is gear used without a mechanized line shooter. This makes gear deployment and retrieval more labor intensive than the more modern configuration, which has limited its adoption. Rather than a continuous monofilament mainline, the gear is composed of many pieces of rope tied together to make one long mainline with branch lines attached at regular intervals between two floats. Because of its heavy rope mainline, basket gear sinks faster and has a target depth of 170 fm. According to observer reports, the vessel using this gear has not experienced any interactions with sea turtles or seabirds, due to its target depth and fast sink rate, even when fishing in areas where other vessels have experienced high interaction rates. In response to these findings, on October 18, 2001 the USFWS amended the BO to include traditional basket-style, tarred mainline gear as an alternative to monofilament gear set with a line-setting machine and weighted branch lines.

There are no regulatory measures directed at bycatch in the recreational fishing sector, but there exist incentives within the recreational fishing community for fishermen to release fish alive. Many participants in recreational charter fisheries routinely release their catch. The practice of tag-and-release is actively encouraged within the charter industry in Hawaii. As indicated in Section 4.2.1, the proportion of captured billfish that were tagged and released alive by the Kona-based charter fleet increased from 15% in 1996 to 42% in 2001.

The Council is developing a proposed amendment to the Pelagics FMP that would establish a limited access program in the American Samoa longline fishery. Such a measure would serve to limit total effort and catch, thereby effectively capping absolute bycatch rates. Because the fishery has only recently developed, there is the potential to develop new markets for species that are currently discarded. Anecdotal information indicates that local dealers have recently been pursuing new export markets for frozen product from the longline fishery, including opah, monchong, shortbill spearfish, mahimahi, and ono.

Actions recently recommended to NMFS as part of a new Coral reef Ecosystems FMP would include a series of no-take marine protected areas that would apply to all Council managed fisheries. The impacts of these measures are difficult to predict but are anticipated to provide protection to species found in these ecologically sensitive areas.

5. Affected Environment Given Cumulative Impacts to Date

5.1 Bottomfish FMP Fisheries

A summary of available information on the environment associated with the bottomfish fisheries of the Western Pacific is provided in this section. The Preliminary Draft EIS for the Bottomfish and Seamount Groundfish FMP (WPRFMC 2001b) can be referred to for additional detail.

5.1.1 Description of the Fisheries

5.1.1.1 Fishing methods and current use patterns

The Bottomfish and Seamount Groundfish FMP manages two fisheries. The seamount groundfish fishery, targeting armorhead and alfonsin at the southeast Hancock Seamount in the NWHI, was conducted by foreign trawlers since the late 1960s. The fishery was closed with FMP implementation in 1986 because of the poor condition of the target stocks and their vulnerability to overfishing. The current moratorium is in effect until 2004, subject to further extension. No seamount groundfish fishing currently occurs in waters under Council jurisdiction. Bottomfish fisheries target etiline snappers, carangids, and groupers in waters mostly between 30 and 150 fathoms (fm) deep. There is also a shallow-water bottomfish fishery throughout the region, but it occurs almost exclusively in state and territorial waters.

Bottomfishing grounds in Hawaii are divided into three management zones, the Mau and Hoomalu Zones in the NWHI and the Main Hawaiian Islands. In the MHI, about 80% of bottomfish habitat lies in state waters. Penguin Banks is the largest and most important bottomfishing grounds in the federal waters around the MHI. In the NWHI all participants fish commercially on a full- or part-time basis, while in the MHI fishery there are also recreational fishermen. Independent, owner-operator fishing operations prevail in both zones of the NWHI. The Mau Zone fleet tends to be comprised of smaller operations than in the Hoomalu Zone, and most of the Mau Zone vessels are part-time and multi-gear operations. Many vessels typically conduct mixed fishing trips (bottomfish, troll and pelagic handline), focusing on the most productive fishing method at any given time.

Bottomfishers in Hawaii use a hook-and-line method of fishing where weighted and baited lines are lowered and raised with electric, hydraulic, or hand-powered reels. The main line is typically 400-450 lb test, with hook leaders of 80-120 lb test monofilament. The hooks are circle hooks, and a typical rig uses 6 to 8 hooks branching off the main line. The weight is typically 5-6 lb. The hook leaders are typically 2-3 feet long and separated by about 6 feet along the main line. Squid is the bait typically used. It is sometimes supplemented with a chum bag containing chopped fish or squid suspended above the highest hook.

Vessels used in the NWHI fishery are typically 40-60 feet in length, and usually equipped with electronic navigation and fish-finding equipment that allow a skilled captain to harvest target species with relatively little bycatch. Fishing trips to the NWHI typically last 10-25 days, with vessels reaching as far as Kure Atoll.

A single bottom longline vessel operated briefly in the NWHI in 1998-1999, targeting sharks. Although pelagic longlining is prohibited within a protected species zone surrounding the NWHI, this gear, because it is deployed on the bottom and not considered a pelagic gear, was not subject to the closed-area restrictions. The gear consists of a heavy (700- to 1,400-pound test) monofilament groundline. Gangions, buoys, and lead weights are attached to this during deployment. The 10-12 foot long gangions, spaced every 20 fm along the groundline, terminate in baited circle hooks. Buoys allow gear retrieval while weights anchor the groundline to the bottom. The gear was set at an average depth of 34.5 fm.

In American Samoa small skiffs and *alia* catamarans equipped with handlines and hand-powered reels, most without electronic navigation or fish-finding equipment, fish on the deep outer-reef slope. Few boats carry ice, so fishing trips tend to be brief and not venture far from port. Most vessels are used for both bottomfishing and trolling. In recent years a few larger (greater than 35 feet in length) vessels with the capacity to chill or freeze fish have entered the fleet.

The bottomfish fisheries in Guam include both a deep-water (80-120 fm) component dominated by commercial vessels (mostly greater than 25 feet in length) equipped with electric-powered reels, and a shallow-water (15-80 fm) component that includes smaller boats (mostly less than 25 feet in length) using rod-and-reel that occurs mainly in waters under the jurisdiction of the Territory of Guam. The majority of the catch is made in the latter component, in which much of the fishing is done for recreational and subsistence purposes (WPRFMC 2001b). Most bottomfish fishermen that sell their catch also hold jobs outside the fishery. Most participants in the bottomfish fishery also troll for pelagic species, often mixing methods during a given trip. Charter fishing has been a substantial component of the fishery since 1995, accounting for about 15-20% of all bottomfishing trips during that period (WPRFMC 2002b).

As in Guam, the bottomfish fisheries in the CNMI include both deep-water and shallow-water components.[14] The fleet is comprised primarily of vessels smaller than 25 feet in length that primarily target the shallow-water bottomfish complex fairly close to port and fish for both commercial and subsistence purposes. They tend to be equipped with handlines, hand reels, or electric reels, and tend not to have electronic navigation or fish-finding equipment. A few larger commercial vessels with the capacity to fish in the northernmost islands of the chain have periodically entered the fishery, targeting both the deep-water and shallow-water bottomfish complexes. These vessels are generally equipped with electric or hydraulic reels and electronic navigation and fish-finding equipment. Few fishermen depend on fishing for all of their income. Most participants in the bottomfish fishery also troll for pelagic species, often mixing methods during a given trip. A few charter vessels target shallow-water bottomfish, along with reef fish.

Bottomfish fishing occasionally occurs in the waters around the PRIAs, but the catches have been sporadic and generally small.[15] One such harvest, consisting of about 40,000 lb, was made by Hawaii-based at Kingman Reef in 1999, but part of the catch tested positive for ciguatera and the vessel stopped fishing there (WPRFMC 2001b). No further information on bottomfishing in the PRIAs is provided here.

5.1.1.2 Harvest and participation

Estimated landings of bottomfish from each of the island areas for the years 1989-2001 are indicated in Table 15. Recent historical participation in each of the island areas is described in Table 16.

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[14] Bottomfish fisheries occurring in the EEZ around the CNMI are not managed under the FMP.

[15] Bottomfish fisheries occurring in the EEZ around the PRIAs are not managed under the FMP.

Table 15. Bottomfish landings in the Western Pacific, 1989-2001

Year	Landings (1,000 lb)				
	NWHI	MHI	American Samoa	CNMI	Guam
1989	303	1,006	47	20	84
1990	421	646	14	11	77
1991	387	548	19	6	71
1992	424	587	13	8	87
1993	385	348	18	45	98
1994	443	458	45	20	109
1995	369	440	34	29	106
1996	311	440	39	53	153
1997	346	513	40	51	103
1998	332	479	16	46	98
1999	323	455	17	44	129
2000	262	478	28	36	146
2001	286	391	47	57	118

- Source: WPRFMC 2002b and NMFS Honolulu Laboratory.
- 2001 estimates are preliminary.
- Hawaii: includes BMUS only; includes commercial only.
- American Samoa: includes all “bottomfish” (not just BMUS); includes entire catch (not just commercial).
- CNMI: includes all “bottomfish” (not just BMUS); includes commercial only.
- Guam: includes BMUS only; includes entire catch (not just commercial).
- Relatively small catches of bottomfish are also made in the PRIAs.

Table 16. Participation in the bottomfish fisheries in the Western Pacific, 1989-2001

Year	Number of active vessels				
	NWHI	MHI	American Samoa	CNMI	Guam
1989	10	537	29	29	223
1990	19	501	19	29	226
1991	18	469	20	20	246
1992	13	407	14	38	236
1993	12	403	22	20	360
1994	17	423	19	32	298
1995	15	400	25	33	402
1996	16	466	26	69	408
1997	15	495	24	68	332
1998	14	493	16	50	354
1999	13	483	19	50	411
2000	11	495	17	64	312
2001	11	379	18	75	337

- Source: WPRFMC (2002b) and NMFS Honolulu Laboratory.
- Hawaii: accounts for BMUS only; accounts for commercial fishing only.
- American Samoa: accounts for all "bottomfish" (not just BMUS); accounts for all fishing (not just commercial).
- CNMI: accounts for all "bottomfish" (not just BMUS); accounts for commercial fishing only.
- Guam: accounts for BMUS only; accounts for all fishing (not just commercial).
- Relatively small levels of bottomfish fishing also occur in the PRIAs.

5.1.1.3 Markets

Hawaii bottomfish catches are mostly sold in the local Hawaii fresh fish market. Landings from the NWHI tend to consist of larger fish that are preferred by the restaurant market. Bottomfish imports currently supply about 40% of the Hawaii market (WPRFMC 2002b).

More than 90% of the catch of BMUS in American Samoa is sold; some has been exported to Hawaii (WPRFMC 2001b). Much of the year-to-year variation in landings and participation is related to the difference in prices of bottomfish and pelagic products, as most of the fleet is equipped for both types of fishing. Prices for local bottomfish product, for example, are influenced by prices of imported product from Samoa and Tonga. The hurricanes that occasionally reach American Samoa are also responsible for disrupting bottomfish fishing patterns.

Most of Guam's bottomfish catch is marketed locally. Prices for local product are affected by imports from elsewhere in Micronesia (WPRFMC 2001b).

In the CNMI most of the catch is consumed locally, although there have been some exports to Guam and Hawaii (WPRFMC 2001b).

5.1.1.4 Socio-economic importance

In the Hawaii-wide bottomfish fishery, BMUS landings and real (inflation-adjusted) ex-vessel revenue peaked in 1987 at about 1.8 million lb and $7.3 million (year-2000 $), respectively, after 20 years of growth (WPRFMC 2002b). In 2000 landings had declined by 50% from that peak and real revenue had declined by 60%, due primarily to decreases in participation and fishing effort (due in part to the NWHI limited access programs) and a generally weak market for fresh bottomfish in the 1990s. The trend was especially strong in the NWHI component of the fishery, where real revenue in 2000 was about 25% of that in 1987. Preliminary data for 2000 indicate gross revenue of $1.0 million for the NWHI fleet and $1.9 million for the MHI fleet (WPRFMC 2002b).

Analysis of operating costs and returns in 2000 indicated that, as in previous years, the average Hoomalu Zone vessel and the average Mau Zone vessel did not cover their total costs through bottomfishing operations (WPRFMC 2002b). This is not to say that all vessels in each of the two zones did not operate profitably. In addition, other fishing activities or other income sources bring additional revenue to some or all vessels. The Mau Zone vessels, for example, are known to engage in multiple types of fishing and are generally recognized to be less reliant on bottomfishing than Hoomalu Zone vessels. Furthermore, although economic performance – based on monetary returns – has, on average, been generally low in the NWHI fishery, there are additional, non-pecuniary, benefits that accrue to fishery participants and the larger fishing community. The PDEIS (WPRFMC 2001b) describes some of these difficult-to-quantify benefits, which include the enjoyment derived from fishing and the lifestyle it entails to providing an identifiable place in the community and allowing activities that strengthen social bonds.

From 1996 through 2000 the average annual inflation-adjusted ex-vessel value of commercial landings of bottomfish in American Samoa was about $60,000 (in year-2000 $) (WPRFMC 2002b). There has been little variation in inflation-adjusted gross revenues per fishing trip since 1989 (WPRFMC 2001b). No information on net revenues for the American Samoa bottomfish fleet is available.

From 1996 through 2000 the average annual inflation-adjusted ex-vessel value of commercial landings of bottomfish in Guam was about $57,000 (in year-2000 $) (WPRFMC 2002b). Inflation-adjusted gross revenues per fishing trip has varied substantially from year to year, apparently due in large part to the entry-exit patterns of highliners. No information on net revenues for the Guam bottomfish fleet is available.

From 1996 through 2000 the average annual inflation-adjusted ex-vessel value of commercial landings of bottomfish in the CNMI was about $157,000 (in year-2000 $) (WPRFMC 2002b). Inflation-adjusted gross revenues per fishing trip increased markedly through the 1990s as a result of increases in both prices and average per-trip catches. No information on net revenues for the CNMI bottomfish fleet is available.

5.1.2 Fish Stocks

The Bottomfish Management Unit Species (BMUS) are listed in Table 17.

Table 17. Bottomfish management unit species

English common name	Local common names	Scientific name
Snappers:		
silver jaw jobfish	lehi (H); palu-gustusilvia (S)	*Aphareus rutilans*
grey jobfish	uku (H); asoama (S)	*Aprion virescens*
squirrelfish snapper	ehu (H); palu-malau (S)	*Etelis carbunculus*
longtail snapper	onaga, ʻulaʻula (H); palu-loa (S)	*Etelis coruscans*
blue stripe snapper	taʻape (H); savane (S); funai (G)	*Lutjanus kasmira*
yellowtail snapper	palu-iʻ lusama (S); yellowtail, kalekale (H)	*Pristipomoides auricilla*
pink snapper	ʻōpakapaka (H); palu-ʻtlenaʻlena (S); gadao (G)	*Pristipomoides filamentosus*
yelloweye snapper	palusina (S); yelloweye ʻōpakapaka, kalekale (H)	*Pristipomoides flavipinnis*
snapper	kalekale (H)	*Pristipomoides sieboldii*
snapper	gindai (H,G): palu-sega (S)	*Pristipomoides zonatus*
Jacks:		
giant trevally	white ulua (H); tarakito (G); sapo-anae (S)	*Caranx ignoblis*
black jack	black ulua (H); tarakito (G); tafauli (S)	*Caranx lugubris*
thick lipped trevally	pig ulua, butaguchi (H)	*Pseudocaranx dentex*
amberjack	kāhala (H)	*Seriola dumerili*
Groupers:		
blacktip grouper	fausi (S); gadau (G)	*Epinephelus fasciatus*
sea bass	hāpuʻupuʻu (H)	*Epinephelus quernus*
lunartail grouper	papa (S)	*Variola louti*
Emperor fishes:		
ambon emperor	filoa-gutumumu (S)	*Lethrinus amboinensis*
redgill emperor	filoa-paʻloʻomumu (S); mafuti (G)	*Lethrinus rubrioperculatus*
Seamount groundfish:		
alfonsin		*Beryx splendens*
ratfish/butterfish		*Hyperoglyphe japonica*
armorhead		*Pseudopentaceros richardsoni*

Source: WPRFMC (2001b).
Notes: G = Guam; H = Hawaịi; S = American Samoa.

In addition to the landings of BMUS shown in Table 15, the bottomfish fisheries also result in bycatch of BMUS and landings and bycatch of non-BMUS, as well as unobserved fish mortality. These aspects of the fisheries are reviewed in detail in Section 4.1.1.

The status of stocks managed under the FMP is assessed using a measure called spawning potential ratio (SPR), which is defined as the ratio of the spawning stock biomass per recruit at the current level of fishing to the spawning stock biomass per recruit that would occur in the absence of fishing. Recruitment overfishing is defined to occur when the SPR is equal to or less than 20% (see FMP Amendment 3).[16] SPRs are estimated annually for those stocks for which adequate data are available. In Hawaii, SPR values are estimated for the entire Hawaiian archipelago, as evidence from larval drift simulations and preliminary genetic work has indicated that the primary target bottomfish species should be assessed as archipelagic-wide stocks. SPR values are also estimated for each of the three management zones in Hawaii.

In the most recent assessment, in 2000, SPR values were calculated for five bottomfish species in Hawaii. The latest SPR estimate for armorhead is based on 1997 data. Data have not been available to calculate SPR values for bottomfish stocks in American Samoa, Guam, or the CNMI.

The year-2000 point estimates of SPR for the five assessed bottomfish species in the Hawaiian archipelago were greater than 20%, ranging from a low of 27% for onaga to a high of 52% for uku and opakapaka. The values for ehu and hapuupuu were 40% and 49%, respectively (WPRFMC 2002b). The ranges that accompanied the point estimates (upper and lower bounds of the estimate) overlapped the 20% level for only onaga. SPRs for these five species have been estimated for each of the years 1986 through 2000 and none of the point estimates have reached as low as 20% (WPRFMC 2002b). The NWHI portions of the bottomfish stocks are recognized to be in better condition than those in the MHI. For example, localized SPR for onaga and ehu in the MHI were estimated to be 7% and 8%, respectively, in 2000 (WPRFMC 2002b). In the NWHI, in contrast, localized analyses of SPR in the NWHI indicated no localized depletion problems for any BMUS in either of the two NWHI management zones (WPRFMC 2002b).

The SPR estimates and other indicators of declining stock condition in the MHI, particularly for onaga and ehu, spurred the State of Hawaii to implement several management measures in state waters of the MHI (Hawaii Administrative Rule, Chapter 13-94). The new rules, which became effective June 1, 1998, apply to seven species of bottomfish, onaga, ehu, kalekale, opakapaka, gindai, hapu'upu'u, and lehi. The measures include gear restrictions, bag limits for non-commercial fishermen, areas closed to fishing and possession of fish, and a requirement that bottomfishing vessels be registered with the state. It is prohibited to use nets, traps, trawls, and bottom-set longline, with the intention of restricting the fishery to traditional handline gear. The bag limit for non-commercial fishermen is a total of five onaga and ehu combined. The system of restricted areas, which may be modified at the administration level, includes 20 areas that are broadly distributed through the MHI and include about 20% of all known fishing areas for onaga

[16] An amendment to this overfishing definition, following the new requirements of the Sustainable Fisheries Act of 1996, which requires thresholds to be specified for both stock biomass and fishing mortality, was prepared by the Council and submitted to NMFS in 1998 as Amendment 6, but it was disapproved. A supplement to Amendment 6, which would revise the overfishing criteria, is currently under development.

and ehu. The new rules also establish a control date of June 1, 1998 that may be used to qualify applicants for a limited entry program should one be established in the future.

Based on 1997 data, the SPR for armorhead, a seamount groundfish species targeted in a trans-EEZ-boundary trawl fishery that has been closed within the US EEZ since FMP implementation in 1986, was last estimated at about 1% (WPRFRC 2002b).

In American Samoa, the CNMI, and Guam, stock status indicators in recent years, such as catch-per-unit-effort, have not indicated any cause for concern over stock status.

The status of the bottomfish and seamount groundfish stocks managed under the FMP was reviewed in the Annual Report to Congress on the Status of U.S. Fisheries–2001 (NMFS 2002b). With the exception of armorhead, none of the stocks managed under the FMP was indicated as being in, or approaching, an overfished condition.

5.1.3 Ecosystem and Habitat

The Sustainable Fisheries Act of 1996 requires that fishery management plans identify and describe essential fish habitat (EFH) for managed fisheries, minimize to the extent practicable adverse effects on such habitat caused by fishing, and identify other actions to encourage the conservation and enhancement of such habitat.

Based upon the best available data, the Council designated the EFH for the adult life stage of the seamount groundfish complex as all waters and bottom habitat bounded by latitude 29° - 35° N and longitude 171°E - 179° W between 80 and 600 meters (m) depth. EFH for eggs, larvae and juveniles is the epipelagic zone (from 0 to about 200 m depth) of all waters bounded by latitude 29° - 35° N and longitude 171° E - 179° W. This EFH designation encompasses the Hancock Seamounts, part of the northern extent of the Hawaiian Ridge, located 1,500 nautical miles northwest of Honolulu. For the bottomfish species, EFH was designated to consist of the water column down to 400 m depth for eggs and larvae, and the water column and bottom down to 400 m depth for juveniles and adults. Based on the known distribution and habitat requirements of adult bottomfish, the Council designated all escarpments/slopes between 40 and 280 m depth as habitat of particular concern (HAPC). In addition, the Council designated the three known areas of juvenile opakapaka habitat in the MHI (two off Oahu and one off Molokai) as HAPC.

The line used while bottomfishing is continuously monitored by an individual fisherman. The weight and hooks are maintained near, but not on, the bottom because the target species occur from 1 to 20 m off the bottom. Because of the nature of this type of fishing, it is likely that the risk of direct impacts from fishing gear to EFH/HAPC and other benthic habitats is negligible. Anchors used by bottomfishing vessels can cause damage to benthic habitat. The presence of fishing vessels in the vicinity of shallow and intertidal habitats, including coral reefs, also brings some degree of risk of vessel groundings and pollutant spills that could degrade those habitats (the photic zone where coral reefs and reef building organisms are normally found ranges roughly between 0 and 18 fm). Although shallow-water bottomfish fishing generally puts vessels in closer proximity to shallow-water habitats than does deep-water bottomfishing, the vessels used in the latter tend to be larger than in the former, bringing greater risks of damage due to vessel groundings or pollutant spills.

5.1.4 Protected Species

Five species of sea turtles, all of which are listed as either threatened or endangered under the Endangered Species Act (ESA), occur in fishing areas that are subject to the FMP: the leatherback (*Dermochelys coriacea*), the olive ridley (*Lepidochelys olivacea*), the hawksbill (*Eretmochelys imbricata*), the loggerhead (*Caretta caretta*), and the green turtle (*Chelonia mydas*). Information on bottomfish fishery interactions with these species is provided in Section 4.1.1.3.

Marine mammals listed under the ESA that are present in bottomfishing areas subject to the FMP include the blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), northern right whale (*Eubalaena glacialis*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephelus*), and the Hawaiian monk seal (*Monachus schauinslandi*). Information on bottomfish fishery interactions with these and other marine mammal species is provided in Section 4.1.1.3. Additional information on the status of the Hawaiian monk seal is provided below.

Critical habitat for the Hawaiian monk seal, which is endemic to the Hawaiian archipelago and listed as endangered under the ESA, extends from the shore to a depth of 20 fathoms in ten areas of the NWHI. Hawaiian monk seals breed primarily at six major colonies, all of which are in the western portion of the NWHI. In addition, a unknown number of seals occasionally breed at Necker and Nihoa islands in the Mau Zone and further east in the MHI. Although little is known of the seal's population status prior to 1950, its range probably declined since humans first settled the islands. Between 1958 and 1993 the population of non-pups is estimated to have declined about 60 percent (NMFS 2002b). Counts from 1993 to 2000 remained fairly stable, with no statistically identifiable trend. The population was most recently estimated at between 1,300 and 1,400 individuals (Laurs 2000). Some sub-populations within the NWHI have decreased in size during the last two decades while others have increased or remained stable. At the same time, monk seals have apparently expanded their range and are now found in the MHI.

Poor pup survival in the last two decades in the largest sub-population – that at French Frigate Shoals – has resulted in an unstable age distribution, indicative of a future decline in sub-population size. That decrease will have to be offset by gains in other sub-populations for the population to remain stable. Although stable in size during the last two decades, the population is considered to be too small for the species to be protected from extinction in the foreseeable future (NMFS 2002b).

The causes of the recent poor survival at French Frigate Shoals have been attributed to poor condition from starvation, shark predation, male aggression towards pups, habitat loss, and entanglement in marine debris (NMFS 2002b). Further, monk seals frequenting Tern Island at French Frigate Shoals may have been exposed to harmful contaminants, including PCBs and lead. The reasons for the possible lack of prey availability are not known but may be related to decadal-scale fluctuations in productivity or other changes in local carrying capacity (NMFS 2002b).

Of the 18 species of seabirds known to be present in the Hawaiian Islands, only the short-tailed albatross (*Phoebastria albatrus*) is listed under the Endangered Species Act. Others are protected under the Migratory Bird Treaty Act.[17] Information on bottomfish fishery interactions with seabird species is provided in Section 4.1.1.3.

5.2 Pelagics FMP Fisheries

The information in this document incorporates by reference details provided in the Final Environmental Impact Statement (FEIS) for the Fishery Management Plan for the Pelagic Fisheries of the Western Pacific Region, which is available from the NMFS Southwest Regional Office (501 West Ocean Boulevard, Suite 4200, Long Beach, CA 90802-4213; http://www.nmfs.noaa.gov/). For further details, please see the FEIS.

A summary of the information in the FEIS (NMFS 2001b) (in most cases extracted directly from the FEIS), along with information from NMFS' March 2001 Biological Opinion on the Pelagic FMP (a product of Section-7 consultations under the ESA) (NMFS 2001a), are provided in this Sections 5.2.1 through 5.2.5. The FEIS is generally based on fishery data through 1998 or 1999. That information is updated in Section 5.2.6 with information that became available since completion of the FEIS.

5.2.1 Description of the Fisheries

The Pelagics FMP manages unique and diverse fisheries. Longline vessels are capable of traveling long distances to high-seas fishing grounds, with trips typically ranging from 14 to 44 days, while the smaller handline, troll, charter, and pole-and-line fisheries, which may be commercial, recreational, or subsistence, generally occur within 25 miles of land, with trips generally lasting only one day. These fisheries are first briefly described by sector and gear type, then described in more detail by geographical area.

Commercial fisheries

The Hawaii-based longline fleet has historically operated in two distinct modes based on gear deployment: deep-set longlines by vessels that target primarily tuna and shallow-set longlines by those that target swordfish or have mixed target trips including swordfish, albacore and yellowfin tuna. Swordfish and mixed target sets are buoyed to the surface, have few hooks between floats, and are relatively shallow. These sets use a large number of lightsticks since swordfish are primarily targeted at night. Tuna sets use a different type of float placed much further apart, have more hooks per foot between the floats, and the hooks are set much deeper in the water column. These sets must be placed by use of a line-shooter to provide slack in the line which allows it to sink. The fleet includes a few wood and fiberglass vessels, and many newer steel longliners that were previously engaged in fisheries off the U.S. mainland. There is a maximum vessel length of 101 feet for this fleet.

Apart from a few larger (> 40 ft) inboards, longlining out of American Samoa generally takes place on *alia*, twin-hulled (wood with fiberglass or aluminum) boats about 30 feet long, and powered by small gasoline outboard engines. Navigation on the *alia* is visual, using landmarks.

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[17] The Department of Interior has interpreted the Migratory Bird Treaty Act as applying seaward of the US territorial sea, but has not enforced this interpretation with respect to fishing vessels.

The gear is stored on deck attached to a hand crank reel which can hold as much as 10 miles of monofilament mainline. Participants set between 100 and 300 hooks on a typical eight-hour trip. The gear is set by spooling the mainline off the reel and retrieved by hand cranking back onto the reel. Currently most fishing is done within 25 miles of shore, but with better equipped vessels, fishing activity may extend further. Generally, gear setting begins in early morning; with retrieval in the mid-morning to afternoon. The fish are stored in containers secured to the decks or in the hulls. Albacore tuna is the primary species landed followed by skipjack tuna and yellowfin tuna.

The Hawaii-based skipjack tuna or aku fishery is also known as the pole-and-line fishery, or the bait boat fishery because of its use of live bait to target aku (skipjack tuna). The aku fishery is a labor-intensive, and highly selective operation. Live bait is broadcast to entice the primary targets of skipjack and juvenile yellowfin tuna to bite on lures made from barbless hooks with feather skirts. During the fast and furious catching activity, tuna are hooked on lines and in one motion swung onto the boat deck by crew members.

Handline fishing is an ancient technique used to catch yellowfin and bigeye tunas with simple gear and small boats. Handline gear is set below the surface to catch relatively small quantities of large, deep-swimming tuna that are suitable for *sashimi* markets. This fishery continues in isolated areas of the Pacific, and is the basis of an important commercial fishery in Hawaii. Three methods of pelagic handline fishing are practiced in Hawaii, the *ika-shibi* (nighttime) method, the *palu-ahi* (daytime) method, and seamount fishing (which combines both handline and troll methods).

Troll fishing is conducted by towing lures or baited hooks from a moving vessel, using big-game-type rods and reels as well as hydraulic haulers, outriggers, and other gear. Up to six lines rigged with artificial lures or live bait may be trolled when outrigger poles are used to keep gear from tangling. When using live bait, trollers move at slower speeds to permit the bait to swim "naturally."

Charter and recreational fisheries

The region's charter fisheries primarily troll for billfish. Big game sportfishing rods and reels are used, with four to six lines trolled at any time with outriggers. Both artificial and natural baits are used. In addition to lures, trollers occasionally use freshly caught skipjack tuna and small yellowfin tuna as live bait to attract marlin, the favored landings for charter vessels, as well as yellowfin tuna.

The recreational fleet primarily employs troll gear to target pelagic species. Although their motivation for fishing is recreational, some of these vessel operators sell a portion of their landings to cover fishing expenses and have been termed "expense" fishermen (Hamilton 1999). While some of the fishing methods and other characteristics of this fleet are similar to those described for the commercial troll fleet, a survey of recreational and expense fishermen showed substantial differences in equipment, avidity, and catch rates compared to commercial operations. Vessel operators engaged in subsistence fishing are included in this recreational category.

5.2.1.1 Hawaii pelagic fisheries

Hawaii's pelagic fisheries are small in comparison with other Pacific pelagic fisheries such as distant-water purse seine fisheries and other foreign pelagic longline fisheries (NMFS 1991), but they comprise the largest fishery sector in the state of Hawaii (Pooley 1993). Tuna, billfish and other tropical pelagic species supply most of the fresh pelagic fish consumed by Hawaii residents and support popular recreational fisheries (Boggs and Kikawa 1993).

Of all Pelagics FMP fisheries, the Hawaii-based limited access longline fishery is the largest. This fishery accounted for 85% of Hawaii's commercial pelagic landings (28.6 million lb) in 1998 (Ito and Machado 1999). The fleet operates under a limited entry regime with a total of 164 transferable permits (119 of which were active in 1999, the last full year prior to Court-required restrictions) and a maximum allowable vessel length overall of 101 feet. Based on federal logbook data, this fleet's 1999 landings were 28.3 million pounds (238,000, pounds per vessel) and gross ex-vessel revenue was $47.4 million ($398,000 per vessel). This fleet took 1,137 trips in 1999 (1,103 in 2000), an average of 9.5 trips per vessel. Thirty-one (6%) of these trips targeted swordfish, 296 (26%) had mixed swordfish/tuna targets, and 776 (68%) targeted tunas. Landings consisted of 6,830,000 pounds ($13 million) of swordfish, 10,300,000 pounds ($27 million) of tunas, and 10,620,000 pounds ($7.3 million) of other billfish (marlins), mahimahi, wahoo, moonfish and sharks. In 1999, 48% of fleet effort was expended on the high seas, 34% within the EEZ surrounding the Main Hawaiian Islands, 12% within the EEZ surrounding the Northwestern Hawaiian Islands, and 6% within the EEZ surrounding the US Pacific Remote Island Areas.

The longline fishery provides approximately 85% of fresh commercial seafood landings in Hawaii. As such it supports a substantial fishery supply sector (fuel, oil, bait, gear etc.) as well as an auction house, and numerous fish wholesaling and retailing operations. The Hawaii longline fishery, valued at $46.7 million in a 1998 baseline economic analysis, has been estimated to have a total impact on Hawaii business sales of $113 million using an input-output model of the Hawaii commercial fishery (Sharma et al. 1999). This model calculates the inter-relationship of industries producing inputs to the longline fishery – what are termed "backward" linkages. The total sales figure includes the direct effect of the ex-vessel sales and the indirect and induced income effects on other industries – what we term associated businesses. Using this model, the personal and corporate income effect of the longline fishery is $50 million with upwards to 1,500 jobs directly associated with the Hawaii longline fishery. State and local taxes are approximately $8 million. In addition there are "forward" linkages which refer to the supply effect of Hawaii longline-caught fish on the seafood auction, wholesalers and retailers, etc. These measures are more difficult to measure but have been estimated to represent an additional $8-16 million in value-added.

Landings by Hawaii-based fisheries in 1998 ranged from to 28.6 million pounds by the longline fleet to 696,000 pounds by the aku boats and are summarized in Table 18. Tunas (*Thunnus* spp.) and broadbill swordfish (*Xiphias gladius*) are the dominant target species, but a variety of other pelagic species are also landed incidentally, including blue sharks *(Prionace glauca*), opah (*Lampris guttatus*), marlin (Families *Tetrapturidae* and *Makairadae*), and mahimahi (*Coryphaena* spp.).

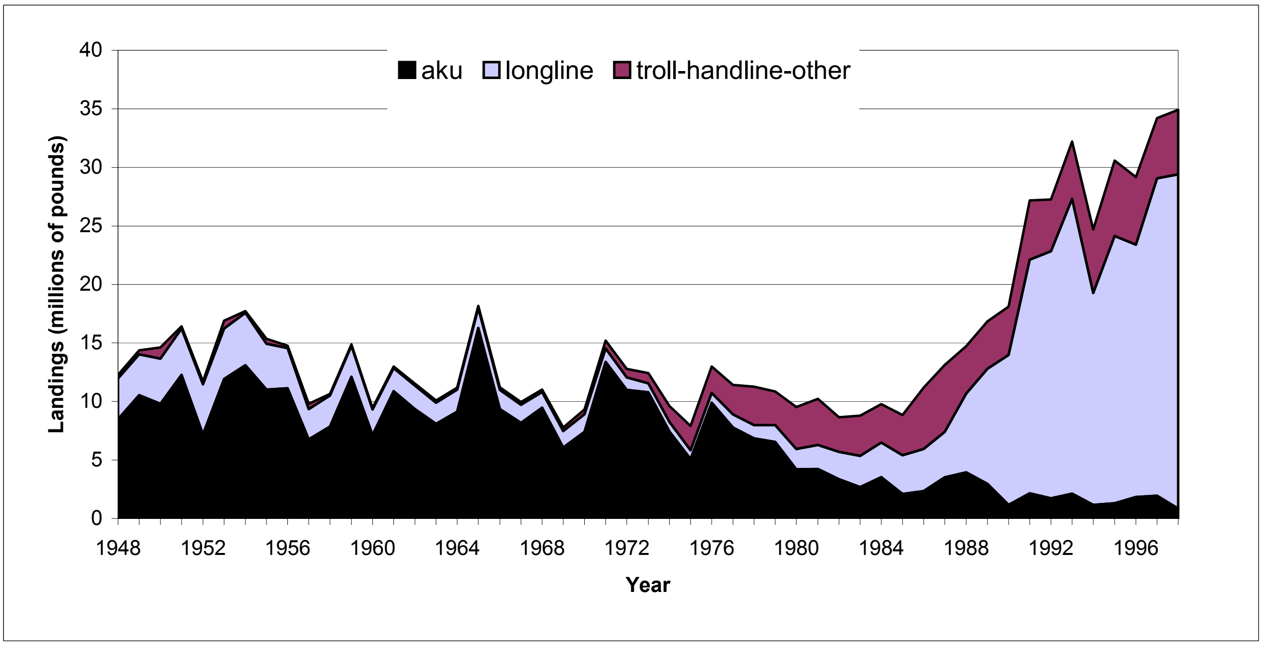
Table 18. Summaries of the pelagic fisheries of Hawaii, 1998

Gear/Vessel Type	Longline	Charter Fishery	Troll/Handline Fisheries	Pole-and-line Fishery (Aku Fishery)
Area Fished	EEZ around Hawaii (25-200 nm) and high seas	Inshore and EEZ	Inshore and EEZ	Inshore and EEZ
Total Landings	28.6 million pounds	1.8 million pounds	4.6 million pounds	0.7 million pounds
Catch Composition	24% bigeye tuna 24% pelagic sharks 12% albacore tuna 11% swordfish 6% yellowfin tuna	billfish wahoo yellowfin tuna skipjack tuna (catch percentages are unknown)	yellowfin tuna skipjack tuna mahimahi wahoo striped marlin bigeye tuna (catch percentages are unknown)	99.6% skipjack tuna
Season	All year	All year	All year	All year
Active Vessels	114	199	1,824	6
Total Permits	164 (transferable) (limited entry)	NA	NA	NA
Total Trips	1,140	16,700	26,203	223
Total Ex-vessel Value	$46.7 million	$15.3 million	$7.2 million	$0.9 million

Source: Adapted from WPRFMC 1999b and NMFS 1999.
Note: Data do not include all landings for recreational fishers. For the charter fishery, gross revenue estimates include charter fees, fish sales, and mount sales commissions for a 12-month period in 1996-1997.

Total pelagic landings experienced a slow decline from the early 1950s through the mid-1980s, as shown in Figure 12. The decline was primarily due to reduced landings by the aku fleet although decreases in longline landings are also apparent. Landings by the troll fleet began to increase in the early 1970s but the overall decline in pelagic landings continued. The pelagic landings of the longline fleet began to slowly increase in the late 1970s but it was not until the mid-1980s when longline landings began to increase substantially that the decline of more than three decades was overcome. Total pelagic landings increased dramatically through the mid-1990s with substantial variability since that time.

Figure 12. Pelagic landings in Hawaii, 1948-1998



Markets for the pelagic fisheries of Hawaii

The marketing and distribution system for fresh pelagic fish landed in Hawaii is part of a larger network of interconnected local and worldwide components that supplies a variety of fresh and frozen products to consumers in Hawaii and elsewhere (Pooley 1986). Hawaii's fishers supply a variety of pelagic fish in a range of qualities and quantities.

Local fishers using a variety of fishing methods are the dominant source of fresh pelagic fish for the Hawaii market. Hawaii's large pelagic longline fleet targets bigeye, yellowfin, and albacore tunas as well as swordfish. Longliners also supply marlin to the market, primarily as incidental catch. The handline fishing fleet targets yellowfin, bigeye, and skipjack tunas. Commercial trollers provide a variety of pelagic fish, especially mahimahi, wahoo, marlin, and yellowfin tuna, depending on the season (DBEDT 2000; Bartram 1997). Table 19 shows 1999 reported landings and sales of the major pelagic species in Hawaii.

Table 19. Hawaii reported landings and sales of pelagic species, 1999

	Landings (lb)	Sales (lb)
Bigeye tuna	5,139,432	5,105,270
Yellowfin tuna	3,930,995	3,785,305
Albacore tuna	3,348,820	3,326,670
Skipjack tuna	1,839,834	1,728,767
Blue marlin	1,090,920	985,385
Striped marlin	849,041	830,386
Swordfish	3,834,710	3,833,810
Mahimahi	1,179,583	1,103,132
Ono	899,880	819,144
Moonfish	1,000,844	1,000,665
Pomfret	288,435	287,449
Sharks	256,794	166,316
Total	**23,659,288**	**22,972,299**

Source: NMFS Honolulu Laboratory; Western Pacific Fishery Information Network.
The figures for sharks do not include data on sharks whose fins were retained and carcasses discarded.

Export markets are important for tuna and swordfish, which are produced and traded extensively on an international scale. However, much of the highest-quality tuna never finds it way out of the Hawaii market, where consumers are among the most discriminating in the world.

Historically, swordfish did not have a strong demand in Hawaii, and the bulk of landed swordfish is exported to larger, established markets on the U.S. mainland and in Japan. Subsequently, a market niche developed. Other pelagic species harvested in Hawaiian waters, such as blue marlin, striped marlin, mahimahi (also known as dolphinfish) and ono (also known as wahoo), are consumed largely in the local market. Marlin, prized in some markets, is considered an affordable alternative to the more expensive tuna. Mahimahi and ono have an established niche in the local market, which consumes the entire local supply, supplemented by imports of these species from other fisheries (Bartram 1997).

Per capita seafood consumption by residents and visitors to Hawaii is twice the U.S. average. Therefore, it is not surprising that the local supply falls short of local demand. For certain grades and species of fish, such as aku (skipjack tuna), demand is greater than landings in Hawaii's waters. To meet the excess demand, much fresh and frozen fish is imported to Hawaii. Although the imported volume may be as high as two-thirds of local production, substantial portions of the imports are re-exported to other markets. Hawaii's central Pacific location is convenient for consolidating fish shipments from other Pacific islands for shipping on to the U.S. mainland (Bartram 1997).

Markets for pelagic species fluctuate throughout the year. Prices for a given species may vary seasonally with fluctuations in quality, quantity, demand, and quantities of substitutes. Quality is a function of several factors. Gear and fishing method affect the condition of the fish and the quality of the meat. Fish quality is also thought to change seasonally with water temperature fluctuations.

Tuna forms the largest segment of Hawaii's fish production and is an expanding market. Variation in uses of different species is apparent, as Hawaii has both significant imports and exports of tuna (Bartram 1997). The high-quality tuna that is exported from Hawaii is sold mostly to Japanese buyers. Hawaii exporters and fishers target the Japanese tuna market because of its renowned high prices for fish. Tuna is also sold to mainland U.S. markets. These markets rely on sources other than Hawaii for high-quality fish. However, they import some lesser grades of tuna from Hawaii to serve the demand for lower-quality fish (Bartram et al. 1996).

Although significant exports are made, annual local consumption of fresh tuna alone is approximately 6,349,000 pounds. Several niches within Hawaii's tuna market have developed, each with its own quality standards. The market for tuna served raw as *sashimi* is generally known as the most demanding. Other markets include cooking (highly variable in quality demanded), *poke* (raw cubes served with spices and condiments), and smoking or drying (with the lowest quality requirements) (Bartram 1997).

As much as 40 percent of local tuna consumption is raw, in the form of *sashimi* and *poke*, a local favorite. Bigeye and yellowfin tunas are commonly used for *sashimi*, but bigeye is the species of choice because of its brighter muscle color, higher fat content, and longer shelf life (Bartram 1997).

Hawaii's consumers have traditionally placed a high demand on the Hawaii market for high-quality tuna. The Hawaii market has historically supplemented its local supply by importing substantial quantities of bigeye and yellowfin tunas, mostly from the Indo-Pacific region. Imports have declined in recent years as consumers have sought to satisfy more of their demand from the local supply. The reasons for the decline in imports are somewhat unclear. One contributing cause is the decline of the tuna fleet in the Marshall Islands in the mid-1990s and changes in fleet operations in the Pacific. In addition, the Hawaii market has seemed more willing to substitute local, high-quality albacore at times when top-quality bigeye and yellow fin tunas are in short supply (Bartram 1997).

Swordfish is the second largest fishery in Hawaii after bigeye tuna. The majority of swordfish is exported to the continental United States. Although swordfish is used locally for *sashimi* at times, grilling is the most popular method of preparation.

Most swordfish are caught by the longline fleet using nighttime shallow fishing techniques with luminescent attractants. Swordfish are also occasionally caught by tuna longline fishers as incidental catch. Trollers and handliners also participate in this fishery, but to a minor degree.

The peak season for swordfish is the early summer months from April to July. Most of the fish are sold at the Honolulu fish auction. A portion, however, is sold directly to wholesalers and exporters. Most of the fish are shipped to the US East coast, where Hawaii swordfish brings a premium price. East coast purchasers commonly purchase swordfish in airline container quantities to realize economies of scale in shipping.

Harvest levels grew substantially during the early 1990s due to the adoption of the nighttime surface fishing techniques. In 1987 and 1988, swordfish landings averaged 50,000 pounds. By 1991, landings had grown to more than ten million pounds. Swordfish landings peaked in 1993 at slightly more than 13 million pounds and have since ranged between 5.5 million and slightly more than seven million pounds a year (WPRFMC 1999b).

Hawaii generally is one of many suppliers of swordfish to a major US market served by a worldwide supply. In 1998 (when Hawaii landings were slightly more than seven million pounds), approximately 34.6 million pounds of swordfish were imported into the continental US market. Imports of fresh swordfish in excess of two million pounds were received in the United States from Brazil, Chile, and Australia. Singapore alone exported more than eight million pounds of swordfish to the U.S. market (WPRFMC 1999b; Seafood Market Analyst 2000). In addition, other areas of the continental United States recorded significant harvests. In 1998, the U.S. Pacific fleet (excluding Hawaii) caught three million pounds of swordfish, and the Atlantic and Gulf fleets caught an additional 4.8 million pounds (Hamm et al. 1999). Assuming that most of these domestic landings are used in the U.S. East coast market, Hawaii's landings comprise less than 15 percent of the U.S. East Coast swordfish market.

Neither marlin species, blue marlin or black marlin, is targeted by commercial fishers in Hawaii. The majority of the landings are caught incidentally by the longline tuna fleet. Trollers also contribute to Hawaii marlin harvests. Sport fishers, however, target blue marlin and often sell their landings in the commercial market, with proceeds going to the boat and crew. Most commercial marlin landings are sold in the Honolulu auction. Sport fishers and trollers, however, may sell their landings directly to wholesalers, retailers, or restaurants (DBEDT 2000).

Marlin is used as *sashimi* and *poke* in Hawaii. Large group caterers often prefer marlin because it discolors more slowly than tuna. Premium *sashimi*-quality striped marlin, which has orange-red meat and higher fat content, is thought to be of higher quality than blue marlin, although blue marlin with acceptable fat content is used as *sashimi*. Both are cooked by Hawaii restaurants. Blue marlin is popular with lower-income and fixed-income groups and often is smoked (Bartram 1997; DBEDT 2000).

The blue marlin and striped marlin harvests are a significant but secondary part of the Hawaii market. The combined annual landings of both species in the past ten years typically have been about two million tons. Historically, striped marlin harvests have exceeded blue marlin harvests, but in two of the last four years, blue marlin exceeded striped marlin by more than 100,000 lb (WPRFMC 1999b.).

Seasonal variability in price is greater for both blue marlin and striped marlin than for tuna. The Hawaii blue marlin season peaks between June and October. The peak of the striped marlin season is opposite, beginning in November and continuing until June. The seasonal price changes are similar for the two fish, suggesting that the prices are driven by changes in tuna supply and total demand for fish rather than by the volume of marlin harvests. Marlin prices reach annual highs from February to April and again in September and December. The high prices early in the year coincide with a period of low tuna supplies. The transition from summer yellowfin to winter bigeye is the likely explanation for the high price for marlin in September. Marlin is also likely substituted for tuna in December when demand is high. The low prices in

June and July occur during the period when tuna supply is at its highest and overall demand is at a low. Low prices occur in October, when marlin and bigeye are in high supply (DBEDT 2000).

The markets for billfish in particular have been affected by limits on mercury in imported fish. The U.S. Food and Drug Administration has a limit of 1.0 parts per million for methyl mercury in fish imports. Every lot imported is tested before release for sale. The procedures allow an importer to obtain a "green card" limiting testing requirements if the importer's first five shipments all test below the limit. The procedure is costly for minor importers and is believed to limit the inflow of swordfish into the United States. The sampling procedure is also costly and can damage fish, further deterring imports of swordfish into U.S. markets (Bartram 1997).

Other important PMUS are mahimahi, ono, moonfish, and pomfret. Most Hawaii restaurants have diversified menus that include mahimahi and several other species, such as marlin, ono (wahoo), opah (moonfish), and large-scale black pomfret. Demand for these pelagic species has led to substantial landings by Hawaii fishers, who sell to the Hawaii market. Harvests of mahimahi and ono, the most commonly targeted species, fluctuate seasonally. Significant quantities of opah and pomfret are caught incidentally. Quantities of these two species fluctuate significantly, but follow no seasonal trend. All of these species are sold fresh, because almost no market exists for frozen local landings (Bartram 1997; DBEDT 2000).

Most mahimahi and ono are caught by trollers, although portions of the harvest are taken by longline and pole-and-line fishers. These species are sold through the Honolulu and Hilo fish auctions and directly to wholesalers and restaurants. Mahimahi is a favorite in many local restaurants. Ono is generally substituted when mahimahi is in short supply. The limited local supply of mahimahi has led to import of substantial quantities to Hawaii from Taiwan, Japan, and Latin America. Since imported fish tend to be slightly cheaper than fresh local fish, imported fish tend to be directed toward less expensive restaurants. Little of either of these species is exported, because local consumers consume most of the local supply.

Pomfret and moonfish are also frequently sold in local restaurants. These species complement the supply of mahimahi and ono in the local fresh market. Both species are primarily incidental catch of the longline fleet and are sold almost exclusively through auctions (Bartram 1997, DBEDT 2000).

Prior to its prohibition of by the State of Hawaii and the U.S. in 2000, shark finning had been a source of significant revenue for crew members in the Hawaii-based longline fishery. Most of these revenues are generated by sales of blue shark fins sold to satisfy the demand for fins in the Asian market. A small market has also developed recently for thresher and mako sharks. The landings of these two species is small and does not contribute substantially to the overall revenue in the fleet.

The prohibitions on finning of sharks are likely to substantially limit the activity of Hawaii-based longline vessels in the Asian market for shark fins. No market exists for the carcass of blue sharks, which is the dominant incidental catch species in Hawaii longline fisheries (WPRFMC 2001c), and until such a market develops, the landing of these sharks is unlikely.

5.2.1.2 American Samoa pelagic fisheries

American Samoa-based pelagic fisheries consist of a small fleet of *alia* longliners, a few mid-size and larger longliners, and a small fleet of trolling vessels. These fleets target albacore, skipjack tuna, yellowfin tuna, and other pelagic species. Landings and other attributes of these fisheries for 1998, along with those of Guam and the CNMI, are summarized in Table 20.

Table 20. Summaries of the pelagic fisheries of American Samoa, Guam, and CNMI, 1998

Islands	American Samoa		Guam	CNMI
Gear	**Longline**	**Troll/Charter**	**Troll/Charter**	**Troll/Charter**
Area Fished	Inshore and EEZ	Inshore and EEZ	Inshore and EEZ	Inshore and EEZ
Total Landings	884,154 lb	25,271 lb	817,087 lb	192,568 lb*
Catch Composition	72% albacore tuna 8% yellowfin tuna < 5% all others	74% skipjack tuna 6% barracuda 4% yellowfin tuna < 4% all others	31% mahimahi 23% skipjack tuna 19% yellowfin tuna	70% skipjack tuna 11% mahimahi 8% dogtooth tuna 6% yellowfin tuna
Season	All year	All year	All year	All year
Active Vessels	25	24	438	89
Total Permits	50 (open access)	NA	NA	NA
Total Trips	2,359	123	14,324	2,230
Total Ex-vessel Value	$968,361	$29,949	$711,066**	$398,086

Source: adapted from WPRFMC 1999b; NMFS 1999.
* Landings for CNMI are recorded commercial landings, but not all commercial landings are recorded (D. Hamm, NMFS Honolulu Laboratory, pers. comm., November 3, 2000).
** Total ex-vessel value of landings in Guam are estimated from commercial landings, which are less than 50 percent of total landings.

Despite a 40-year history of tuna canning in American Samoa by two large processors, commercial fishing for tuna by domestic (local) vessels in the EEZ around American Samoa is a relatively recent endeavor. The importance of pelagic fish as a source of income and employment in American Samoa’s small-scale fishery has increased rapidly since 1996, following the adoption of longline fishing methods patterned after those in the neighboring country of Samoa. American Samoa’s small-scale fishery is presently evolving from the realm of traditional subsistence activities to more commercial activities.

The small-scale pelagic fishery in American Samoa employs relatively simple troll and longline fishing technology. More than 90 percent of the respondents in a survey of 20 longline fishermen planned to increase their efforts at longlining (Severance et al. 1999). Until very recently, most of the small-scale fleet was comprised of boats under 30 feet in overall length. New and safer types of small-scale vessels have begun to enter the pelagic fishery and they are capable of extending the safe range of fishing farther offshore.

Vessels in the American Samoa longline fishery fish under a western Pacific general longline permit. This permit allows the vessel to fish for PMUS using longline gear in the EEZ around American Samoa, Guam, the Commonwealth of the Northern Mariana Islands (CNMI) or other U.S. island possessions, excluding the Hawaiian Islands. Unlike Hawaii longline permits the number of Western Pacific general longline permits is not restricted. As of 1998, there were 48 general longline permitted vessels in American Samoa, three in Guam and one in the CNMI, however, however only those based in American Samoa were active during 1998.

Prior to 1995, the pelagic fishery in American Samoa was largely a troll-based fishery. In mid-1995, four vessels began longlining and by 1997, 33 vessels had permits to longline. Approximately 17 of these were actively fishing on a monthly basis. In 1998, only 26 of the 50 federally permitted longliners actually fished. These 26 vessels reported total landings of 884,000 pounds in 1998.

Apart from a few larger (> 40 ft) inboards, longlining out of American Samoa generally takes place on *alia*, twin-hulled (wood with fiberglass or aluminum) boats about 30 feet long, and powered by small gasoline outboard engines. Navigation on the *alia* is visual, using landmarks. The gear is stored on deck attached to a hand crank reel that can hold as much as 10 miles of monofilament mainline. Participants set between 100 and 300 hooks on a typical eight-hour trip. The gear is set by spooling the mainline off the reel and retrieved by hand cranking back onto the reel. Currently most fishing is done within 25 miles of shore, but with better-equipped vessels, fishing activity may extend further. Generally, gear setting begins in early morning with retrieval in the mid-morning to afternoon. The fish are stored in containers secured to the decks or in the hulls. Albacore tuna is the primary species landed followed by skipjack tuna and yellowfin tuna. Most fish are sold to large-scale canneries, but some are sold to restaurants, and donated for family functions.

As stated above, this fishery is presently open access, with no limits on the number of longline vessels, individual or total vessel capacity, catch or effort, but a control date has been established for the purpose of providing notice that vessels entering the fishery after the control date would not be assured of being allowed to use longline gear to fish for pelagic management unit species in the EEZ around American Samoa should a limited access program be established (WPRFMC 2000a) (see Section 2.2 for details).

The length distribution of vessels owned by longline permit holders, as of October 2000, is summarized in Table 21.

Table 21. Longline permit holders based in American Samoa as of October 2000

No. of Vessels, by Length Overall					
< 30 ft	31-35 ft	35-40 ft [a]	41-45 ft [b]	46-50 ft [c]	50+ ft
34	14	9	2	0	5

Source: NMFS in WPRFMC 2000a.
[a] A newer and safer version of *alia* (a catamaran-style vessel that is the most common type of fishing boat in American Samoa and Samoa) is being assembled in Samoa from pre-cut aluminum plates manufactured in New Zealand. Mostly 38 to 42 ft in length, this version is equipped with a larger fuel tank, navigational aids, higher freeboard, and more safety equipment to extend fishing range to well over 100 nm from shore. Several new fishing enterprises in American Samoa have plans to acquire vessels of this type.
[b] In addition to planned acquisitions in this length class, FAO is designing a 45 ft catamaran-style vessel for the next phase of longline fishery expansion in neighboring Samoa. This design will also be available for boat-building in American Samoa.
[c] A design for a monohull vessel assembled from precut steel plates in the 46 to 50 ft class has been prepared in American Samoa.

5.2.1.3 Guam pelagic fisheries

Pelagic fishing vessels based on Guam fall into two broad categories: (1) distant-water purse seiners and longliners that fish primarily outside the EEZ around Guam and transship through Guam; and (2) small, primarily recreational trolling boats that are either towed to boat launch sites or berthed in marinas and fish only local waters (within the EEZ around Guam or in the adjacent EEZ waters of the CNMI. This discussion covers primarily the local small boat pelagic fishery (WPRFMC 1999b). As of 1998, there were three vessels with general longline permits in Guam, but none were active (NMFS 2000a).

Aggregate landings of all pelagics, tuna, and non-tuna PMUS by the small boat fleet fluctuate greatly, but appear to be increasing. In the early 1980s, the pelagic landings consisted primarily of tunas. Then beginning in 1985, non-tuna PMUS, primarily mahimahi, began making up the bulk of the landings. The commercial landings of all pelagics also show a similar trend (WPRFMC 1999b).

The total landings data are extrapolated from the Guam Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and other available commercial fishing data. Unfortunately, the information necessary to reconcile the difference between commercial and all landings is not available. Therefore, this analysis assumes that the balance of the total landings is associated with fishing for personal and recreational purposes.

Most fishing boats are less than ten meters (33 ft) in length and are typically owner-operated by persons who earn a living outside of fishing (WPRFMC 1999b). Most fishers sell a portion of their landings at one time or another, and it is difficult to distinguish among recreational, subsistence, and commercial fishers. A small, but significant, segment of the pelagic fleet consists of marina-berthed charter vessels that are operated primarily by full-time captains and crews (WPRFMC 1999b).

In Guam, trolling with lures and (occasionally) baited hooks conducted from catamarans and other small commercial, recreational, and charter vessels in coastal waters, near seamounts, or around FADs. Charter boat activity decreased between 1997 and 1999, primarily because of a significant drop in the number of tourists as a result of the Asian economic crisis.

In 1981 and 1984, the bulk of pelagic landings consisted of tunas. However, after 1984 non-tuna PMUS began making up the bulk of pelagic landings due to an interest in targeting blue marlin, an increase in mahimahi landings, and a lack of interest in skipjack tuna. In 1998, total pelagic landings increased ten percent, tuna landings increased nine percent, and non-tuna PMUS increased nine percent. Charter trolling trips accounted for 15 percent of overall pelagic landings (WPRFMC 1999b).

In 1998, skipjack tuna landings decreased by nine percent from 1997 landings, while yellowfin tuna landings increased 52 percent. For most years, skipjack landings exceeded yellowfin landings by a two-to-one ratio. Given the near-zero value of skipjack tuna in the local market and the desirability of yellowfin tuna, the availability of skipjack tuna probably exceeds yellowfin availability by a wider margin.

Reliable estimates of the total economic contribution of the domestic fishing fleets in Guam are currently unavailable.

5.2.1.4 CNMI pelagic fisheries

The CNMI is a string of islands in the western Pacific Ocean (longitude 145° E, and latitude 14° N to 21° N). Inhabitants live on three primary islands: Saipan, Rota, and Tinian. The pelagic fishery activities occur primarily from the island of Farallon de Medinilla south to the island of Rota (NMFS 2000a). Commercial, subsistence, and recreational fishing are practiced.

Trolling is the most common fishery in the CNMI, with bottomfishing and reef fishing also conducted (Glazier 1999). The product is primarily skipjack tuna. This fishery is on the increase, most likely due to increasing population in CNMI (WPRFMC 1999b). All domestic commercial fishery product is consumed locally. Yellowfin tuna and mahimahi are targeted to a lesser degree, and are easier targets for the local fishermen during seasonal runs. (Yellowfin are preferred to skipjack, but are rarely encountered. These species are accepted by all ethnic groups in the CNMI and have maintained their market demand with the ongoing in-migrating population growth on Saipan (more than half of the population on Saipan is non-native) (WPRFMC 1999b).

No large-scale longline or purse seine activity occurs around the CNMI at this time. However, fishery development consultants for the CNMI have suggested providing incentives for the longline fleet to move into CNMI waters (University of Hawaii 2000). If longline fleets move into the CNMI, the domestic commercial fisheries will be affected. Currently only one vessel in CNMI has a General Longline Permit, which allows the vessel to fish with longline gear in the EEZ around CNMI, Guam, and American Samoa. This vessel was not active as a longliner in 1998 (WPRFMC 1999b).

Because skipjack are common in nearshore waters off the CNMI, these fish are caught with minimal travel time and fuel costs. Trolling is the primary gear. Most trips are less than a full day. Trolling for skipjack tuna takes place throughout the year. The mahimahi season is February through April, and the yellowfin tuna season is April to September (WPRFMC 1999b).

The pelagic fishing fleet, other than charter boats, consists primarily of vessels less than 7.32 m (24 ft) in length, which usually travel in a limited 20-mile radius from Saipan (WPRFMC

1999b). Most are 3.66-7.32 m (12-24 ft), outboard-powered, runabout-type vessels (NMFS 2000a).

According to WPRFMC (1999b), about 82 percent of all boats registered with the DPS participated in some form of fishing activity in the CNMI in 1998 (75 full-time commercial, 65 part-time commercial, and 143 subsistence/recreational). Of the registered vessels, 24 were charter vessels, which generally retain their landings and sell to local markets (WPRFMC 1999b). The amount of charter boat sales is not known. However, it constitutes a small portion of the local fish market, and most fish are typically consumed by the charter crew (Hamm et al. 1999).

Official estimates of the number of crewmembers involved in the commercial fishery in CNMI are not available. However, since the primary gear is trolling, it is reasonable to assume that there is one crew person in addition to the skipper, as is typical on troll boats in Hawaii (Hamilton and Huffman 1997).

Most vessels in the CNMI pelagic fishery are based on Saipan. Although available data do not indicate actual residence of vessel owners, it is reasonable to assume that most landings in Saipan are made by residents of Saipan.

Cost studies of the pelagic fisheries in CNMI similar to studies for Hawaii in Hamilton and Huffman (1997) have been conducted by Miller. Nor does it appear that an input-output study, similar to work in Sharma et al. (1999), is available.

5.2.1.5 PRIA pelagic fisheries

Knowledge of fishing activity and effort in the PRIA is limited to logbook reports of Hawaii-based longline vessels, and the US purse seine fleet. Purse seine fishing activity in the US EEZs around Howland and Baker Islands, Jarvis Island, and Palmyra Atoll and Kingman Reef increases in El Niňo years as purse seine fishing shifts eastwards from the western to the central Pacific. Longline vessels that fish in EEZ waters around the PRIA must be registered under a longline general permit or the Hawaii-based longline limited access permit. These vessels have federal reporting requirements. Until recently there were no federal reporting requirements for commercial troll and handline vessels targeting pelagic species in these areas. However, a regulatory amendment to the Pelagics FMP requires a federal permit and logbook troll and handline fish in the US EEZ around the PRIA (67 FR 56500). The only existing reporting requirement for recreational and charter vessels in this area is a U.S. Fish and Wildlife Service requirement for maintaining a “Midway Sports Fishing Boat Trip Log.” This requirement applies to fishing within the Midway Atoll National Wildlife Refuge.

Two Hawaii-based troll and handline vessels are known to have fished recently in EEZ waters around Palmyra and Kingman Reef targeting pelagic (including yellowfin and bigeye tunas, wahoo, mahimahi, and sharks) and bottomfish species. Catch and effort data on these vessels are unavailable.

Five charter vessels are known to be based on Midway, two of which troll for pelagic species. The other three are used for nearshore and lagoon fishing. Approximately seven vessels are maintained and used for recreational fishing by Midway residents. Three of these are known to troll for pelagic species including yellowfin tuna, ono, and blue and striped marlin.

5.2.1.6 Foreign pelagic fisheries

Fisheries managed under the Pelagics FMP compete with a variety of foreign fleets operating on the high seas and within the EEZs of many Pacific nations in the Central and Western Pacific. Large-scale, distant-water foreign fisheries include three gear types: longline, pole-and-line and purse seine.

The pole-and-line fleet in the western and central Pacific Ocean (WCPO) was composed of approximately 1,400 vessels in 1999. Most of the vessels are small to medium-sized and operate in the domestic fisheries in Indonesia and Japan. There are few environmental issues concerning pole-and-line fishing because the technique is very selective in catching tuna species, primarily skipjack tuna.

Purse seine vessels from Japan and the United States have fished in the WCPO since the mid-1970s and new vessels from Korea and Taiwan entered the fishery in the early 1980s. In 1999 the WCPO purse seine fleet was comprised of 223 vessels including 159 distant-water vessels, 31 domestic Pacific Island vessels, and 33 domestic non-Pacific Island vessels (e.g., Australia, Indonesia, Japan and New Zealand). The 1999 catch of 1,033,000 mt was comprised of: skipjack tuna – 781,000 mt (76% of the total), yellowfin tuna – 218,000 mt (21%) and bigeye – 35,000 mt (3%) (Coan et al. 2000).

The diverse longline fleet in the WCPO was composed of roughly 4,700 vessels in 1999. These vessels can be divided into four components largely based on the area of fishing operations: (1) over 400 vessels are domestically based in the Pacific Islands with the Samoa (formerly Western Samoa) *alia* fleet representing half of these vessels; (2) approximately 3,000 vessels are domestically based in non-Pacific Island countries, largely in Japan and Taiwan; (3) about 750 large distant-water freezer vessels from Japan, Korea and Taiwan that operate over large areas in the region; and (4) about 450 offshore vessels based in Pacific Island countries and composed of roughly equal numbers of vessels from mainland China, Japan and Taiwan. Pacific-wide longline effort increased from 300 to 500 million hooks from 1962 to 1980. Since 1980, annual pelagic longline effort has been roughly 560 million hooks. Effort in the longline fishery is the most widespread of any industrial fishery in the Pacific.

Longline fisheries usually target tuna or swordfish. Tuna longlining is characterized by day fishing at moderate depths (100-250 m) to target albacore and yellowfin tunas, or deeper depths (250-400 m) to effectively target bigeye tuna (Hanamoto 1976; Boggs 1992). The Japanese longline fleet had mainly targeted albacore for canning until the early 1970s. These longliners deployed "conventional" longline gear of four to six hooks between floats (HBF) fishing a depth of approximately 90-150 meters. In the early 1970s longliners changed to 'deep' sets by placing more hooks between longline floats. The deeper longline gear was more effective in catching bigeye tuna and the fleet shifted activities in waters near the equator where the thermocline is shallower.

In addition to the Hawaii-based longline fishery, which targets swordfish, there are several foreign fleets (e.g., longline, gillnet, and harpoon) that target swordfish in the Pacific. While most of the foreign longline effort targets tuna species, the shallower swordfish longlining has a higher incidence of encountering protected species. Foreign longline fisheries specifically targeting swordfish occur in Japan, Chile and Australia. Fishing methods by the Japanese swordfish fleets are similar to the Hawaii fleet: night fishing with three or four branch lines between each float which results in a shallow gear configuration.

5.2.2 Socioeconomic Importance of the Pelagic Fisheries

5.2.2.1 The regional context

Fishing industry sectors related to the harvest, processing and transshipment of tuna and other highly-migratory pelagic species have made U.S. ports in the Western Pacific Region among the nation's leaders in terms of value of catch landed. However, fisheries occurring inside the U.S. EEZ of the Western Pacific – that is, the area covered by the FMP – account for only a small fraction of the volume of pelagic species caught in the Pacific basin. This small percentage reflects the fact that Pacific pelagic stocks are capable of extensive movement and are the targets of intense competition among a multitude of distant-water U.S. and foreign fishing fleets that operate on the high-seas and within the EEZs of many nations.

Hawaii is unique in the Western Pacific Region in that a relatively high proportion of the pelagic fish landed in this sub-region are harvested within the U.S. EEZ. Even then, about half of the catch of the pelagic fishery of greatest economic importance to Hawaii - the longline fishery - occurs outside the EEZ. The sub-region with the next highest landings of pelagic species harvested within the U.S. EEZ is American Samoa. Yet, the quantity of fish landed by boats operating in federal waters around the territory are far eclipsed by the landings of domestic and foreign distant-water fishing vessels that deliver tuna to American Samoa's fish canneries. Similarly, in Guam catches of pelagic species in the EEZ are much smaller than the landings by the international fleet of distant-water tuna vessels that utilize the territory as a reprovisioning and transshipment center. Even in the CNMI, which benefits the least from distant-water fishing fleets in the Pacific, the quantity of tuna that enters local air transshipment operations from island areas outside the commonwealth exceeds catches of pelagic species within the EEZ around the CNMI. In considering the baseline or existing conditions of the pelagic fisheries of the Western Pacific Region (and the subsequent analysis of alternatives) it is fundamentally important to understand the relative role of that portion of the fishery subject to direct management under the FMP.

5.2.2.2 Community setting

The community setting of the pelagic fisheries of the Western Pacific Region is a complex one. While the region shares some features with domestic fishing community settings elsewhere, it is unlike any other area of the United States or its territories and affiliates in terms of its geographic span, the relative role of U.S. EEZ versus foreign EEZ versus high seas area dependency, as well as its general social and cultural history. Further, the identification of specific, geographically identical and bounded communities in these small insular areas is often problematic, at least for the purpose of social impact analysis. Participants in some pelagic fisheries may reside in one area on an island, moor or launch their vessels in another area, fish offshore of a different area, and land their fish in yet another area. In these cases, an island or group of islands is the most logical unit of analysis for describing the community setting and assessing community-level impacts. On the other hand, in cases such as the Hawaii-based longline fishery the influence of and dependency upon the fishery appears to be concentrated in certain areas of a particular island. Unfortunately, in most instances there is a paucity of socioeconomic data on fishery participants at a sub-island level with which to illustrate these points.

5.2.2.3 Economic importance

The management of pelagic fisheries is of particular importance to the sub-regions and communities of the Western Pacific, as the harvest of pelagic species is the major component of fishing industry or activity in the region. The Pacific basin contains immense pelagic fisheries resources and provides more than 40 percent of the world tuna catch. The annual landings of various tuna species harvested from the entire Pacific islands region total over one million metric tons (mt), with a dockside value of $1.5 billion (Lawson 1995).

When the WPRFMC was created in 1977, foreign fleets were fishing heavily for tuna as close as twelve miles to American-flag Pacific islands. The Council's initial priority was to restrict foreign fishing and allow domestic fishers more opportunities to catch fish. Hawaii, being the most industrialized and populated island area, was in the best position to support an expansion of the domestic commercial fishery. At that time it was the policy of the United States that highly migratory fish could be effectively managed only through international arrangements. This policy led to a provision in the Magnuson Act of 1976 that effectively precluded the authority of coastal nations to establish exclusive fishing rights over tuna within their EEZs.[18] Despite the inability of the WPRFMC to manage tuna fishing by foreign vessels in the U.S. EEZ, the number of domestic longline vessels based in Hawaii grew from 14 in 1979 to 141 in 1991. Landings by longline vessels increased from 1,900 mt to 11,500 mt between 1987 and 1993. The inflation-adjusted ex-vessel value of the catch more than tripled during this period to $56 million. Swordfish catches accounted for most of this revenue and represented about 60 percent of the total domestic landings for this species. More recently, the longline fleet has returned to targeted tuna species, and the harvest of albacore, bigeye and yellowfin reached a record high of 7,651 mt in 1997. In 1998, the port of Honolulu ranked 30th in the nation in terms of the quantity of fish landed, but it ranked 7th in terms of the value landings (Table 22).

Table 22. Ex-vessel value of fish landings by commercial domestic and foreign vessels at major U.S. ports, 1996-1998

[18] In 1992, the Magnuson Act was amended to include all tunas as management unit species so that the United States recognized coastal state jurisdiction over highly migratory species within EEZ boundaries.

Port	Value of Landings ($ millions)		
	1996	1997	1998
Pago Pago, American Samoa	211.8	192.7	~232.0
Dutch Harbor-Unalaska, Alaska	118.7	122.6	110.0
New Bedford, Massachusetts	100.5	103.2	93.5
Agana, Guam	94.2	NA	NA
Kodiak, Alaska	82.3	88.6	78.7
Brownsville-Port Isabel, Texas	60.0	46.1	64.2
Honolulu, Hawaii	50.1	53.7	49.0
Key West, Florida	62.8	54.9	NA
Reedville, Virginia	NA	29.5	42.6
Point Judith, Rhode Island	46.0	47.6	41.8

Source: WPRFMC 1999b.

The expansion of the longline fishery in Hawaii during the past two decades has been accompanied by a general trend away from bulk fisheries for pelagic species (e.g., fish cake and canned tuna) and development of quality, high-price products (e.g., *sashimi* tuna) that have enhanced the market value of Hawaii's pelagic fisheries (Boehlert 1993). Local and export markets for Hawaii's seafood products have expanded enormously in recent years, and fresh fish from Hawaii's waters now appears on restaurant menus throughout the United States, from Honolulu to Des Moines to Boston (Pooley 1993).

Hawaii's smaller-scale troll and handline fisheries have also benefited in recent years from this expanding local and export markets for high-quality seafood products. Annual revenues within these fisheries total around $10 million.

Related to the troll fishery is the charter boat industry that targets billfish, tuna and other pelagic species mainly for a tourism-based clientele. With direct revenues of $17 million from patrons' fees and fish sales and indirect revenues of up to $30 million, and some 77,000 anglers participating annually, charter fishing is a notable component of tourism in Hawaii (Glazier 2000). Selling the catch is a priority for many charter vessel operators, with the revenues from fish sales generally being split evenly among the captain, crew and vessel owner (Hamilton 1998). One component of recreational fishing that has gained in popularity is tournament fishing. Most notable is the Hawaiian International Billfish Tournament conducted annually on the Island of Hawaii. Since its inception in 1958, this tournament has consistently attracted the most serious big game anglers in the world. In 1995, 72 boats with fishers from 15 countries participated. An indication of the economic significance of these tournaments is that the winner of a 1998 fishing tournament in Kona won $111,000 after landing a 500 lb blue marlin. Recreational fishing is also of economic importance in Hawaii. The U.S. Fish and Wildlife Service (USFWS 1998) estimates that in 1996, 260,000 anglers in the state spent $130 million on fishing trip-related items.

Other areas within the Western Pacific Region have not experienced the same increase in domestic industrial-scale fisheries, apart from American Samoa, where the longline fishery expanded markedly in 2001. The local fishing fleets that operate in the EEZs around American Samoa, Guam, and the CNMI consist mainly of small boats operated by part-time commercial or recreational fishers. However, these islands have discovered alternative ways to take economic advantage of expanding Pacific pelagic fisheries. Tuna processing, transshipment and home port industries has developed in American Samoa because it possesses a comparative economic advantage over other locations in the Pacific basin. These advantages include proximity to fishing grounds, shipping routes and markets; the availability and relatively low cost of fuel and other goods and services that support tuna fishing operations; tariff-free market access to the United States; and significant tax incentives.

American Samoa has seen a level of fish processing related activity unequaled elsewhere in the United States, with the capital of Pago Pago easily being the leading port in the United States in terms of the value of fish landings. For many years Pago Pago has been the site of a major tuna canning industry, and the StarKist cannery in Pago Pago is the current world's largest tuna processing facility. In 1998, American Samoa received 208,300 short tons of fish worth approximately $232 million. Since the tuna processing industry began in American Samoa four decades ago, it has been the largest private sector employer in the territory and leading exporter.

The link between local waters and processors in American Samoa, however, is not a straightforward one. The principal suppliers of tuna to the canneries are island-based U.S. purse seiners that fish primarily between five and ten degrees north or south of the Equator for skipjack and yellowfin tuna. From 1990 to 1998, about 95 percent of the domestic purse seine harvest in the central and western Pacific occurred outside the U.S. EEZ, with most of the fishing taking place between Papua New Guinea, the Federated States of Micronesia and Kiribati. However, during some years, particularly during an El Niño-Southern Oscillation event, a substantial portion of the U.S. purse seine harvest comes from the U.S. EEZs around Palmyra Atoll, Jarvis Island, Howland Island and Baker Island. For example, 36,970 mt of skipjack and yellowfin tuna (26% of the total harvest) were caught around these islands in 1997. Other major suppliers of tuna to the canneries in American Samoa include U.S. albacore trollers operating in the North and South Pacific and foreign longline vessels that fish for large albacore, yellowfin and bigeye tuna. In addition, freezer vessels deliver tuna to American Samoa from various transshipment centers around the Pacific.

Guam has also benefited from the development of an industrial scale pelagic fishery that is not focused exclusively either on a locally based harvest fleet, or on fish from its portion of the U.S. EEZ. During the past decade Guam has been one of the largest tuna transshipment centers in the Pacific, and the value of the fish transshipped in Guam in 1996 was estimated to be more than $94 million. Frozen fish is delivered by domestic and foreign purse seiners and fresh fish is landed by foreign longliners or air-freighted from the Marshall Islands, Federated States of Micronesia and other neighboring Pacific islands. The fish is then shipped from Guam to markets in Japan and elsewhere.

Some Western Pacific Region communities have also found ways to benefit from the regional pelagic fisheries beyond involvement in just the harvesting and processing sectors. A particularly lucrative activity related to the tuna canning and transshipment industry is the resupplying of the fishing boats that deliver the fish. Pago Pago Harbor in American Samoa and Apra Harbor in Guam are home ports to several hundred foreign and domestic longline and purse seine vessels. Expenditures by these fleets on fuel, provisions and repairs make an important contribution to the economies of these islands. Fleet expenditures in American Samoa were estimated in 1994 to be between $45 million and $92 million (Hamnett and Pintz 1996). Fleet expenditures in Guam were about $68 million in 1998 (Guam Department of Commerce 1999). This home port industry in the islands has both created primary jobs and enhanced investment opportunities for local entrepreneurs.

It should be specifically noted that with the exception of the U.S. Pacific remote island areas, all of the sub-regions in the Western Pacific benefit from foreign as well as domestic fishing operations. While the importance of foreign longline vessels as suppliers of fish to the tuna canneries in American Samoa has steadily decreased in recent years, Pago Pago remains an important re-provisioning base for foreign distant-water '*sashimi*' vessels that transship their catch to carrier vessels in the harbor. Foreign longline and purse seine vessels are the principal customers in Guam's home port and transshipment industry. This type of support activity is not limited to surface transportation, as Guam is also the center of a large air transshipment operation that flies fresh fish caught by foreign vessels to overseas markets. A similar air transshipment operation is based in the CNMI. Finally, a substantial number of foreign fishing vessels find Hawaii an attractive and convenient location for port calls.

5.2.2.4 Sociocultural importance

The sociocultural setting of the Western Pacific Region pelagic fisheries reflects the particular cultural and social history of the area, with different aspects of the fisheries encompassing, by varying degrees, aspects of lifeways of a divergent mix of groups, from the traditions of the descendants of the earliest inhabitants of the islands to those of some of the most recently arrived groups. In general, the sociocultural setting or aspects of a fishery include the shared technology, customs, terminology, attitudes and values related to fishing of a wide variety of these groups. While it is the fishers that benefit directly from the fishing lifestyle, individuals who participate in the marketing or consumption of fish or in the provision of fishing supplies often share in the fishing culture. An integral part of this framework is the broad network of inter-personal social and economic relations through which the cultural attributes of a fishery are transmitted and perpetuated. The relations that originate from a shared dependence on fishing and fishing-related activities to meet economic and social needs can have far-reaching effects in the daily lives of those involved. For example, they may constitute important forms of social capital, i.e., social resources that individuals and families can draw on to help them achieve desired goals.

The products of fishing supplied to the community may also have sociocultural significance. For instance, beyond their dietary importance fish may be important items of exchange and gift-giving that also help develop and maintain social relationships within the community. Alternatively, at certain celebratory meals various types of seafood may become imbued with specific symbolic meanings.

The sociocultural context of fishing may include the contribution fishing makes to the cultural identity and continuity of the broader community or region as well. As a result of this contribution, the activity of fishing may have existence value for some members of the general public. Individuals that do not fish themselves and are never likely to may derive satisfaction and enjoyment from knowing that this activity continues to exist. They may value the knowledge that the traditions, customs and lifestyles of fishing are being preserved.

It is also important to note that fishing is a traditional economic activity in the islands of the Western Pacific Region, and that fishing, in many cases, represents a continuity with the past that may or may not have parallels in other aspects of life and making a living in the modern context. The degree of 'traditional-ness' can and does vary by vessel and gear type, with some types of fishing more closely associated with particular social, cultural, and ethnic groups than others. This is important for the analysis of fishery management measures for pelagic species to the extent that specific measures may differentially impact specific regions and communities, and social, cultural, or ethnic groups.

Culturally distinct ideas and values of relevance to the management of the pelagic fisheries are not restricted to the domain of the target species and activities associated with the use of those species. For example, issues of primary concern to the contemporary management of the longline fishery relate to the incidental mortality of sea turtles and seabirds and the controversy associated with shark finning. In these cases there are concerns that could be categorized as 'existence' or 'ethically motivated' values. For example, value may emanate from the satisfaction of just knowing that a leatherback turtle or Laysan albatross exists in a natural state. Alternatively, the public, or some portions of the public, may place an intrinsic value on sea turtles and seabirds for religious or philosophical reasons. These animals may have symbolic value as a unique life form similar to the way some marine mammals have become 'charismatic megafauna.' However, perceptions of the value of sea turtles and appropriate protection strategies vary considerably from culture to culture and between social and ethnic groups in the Western Pacific Region. In the CNMI, for example, Saipan Carolinians have strongly argued that they should be allowed to capture green sea turtles for cultural purposes if it is determined that the stock could support a limited harvest (McCoy 1998). Some Native Hawaiians have also requested a limited harvest of green sea turtles for traditional and customary uses (Charles Ka'ai'ai, pers. comm., WPRFMC, 20 November 2000).

5.2.3 Fish Stocks

5.2.3.1 Pelagic management unit species

The Pelagics FMP focuses its management efforts on a group of Pelagic Management Unit Species (PMUS), listed in Table 23.

Table 23. Pelagic management unit species

English common name	Scientific name	Samoan or AS	Hawaiian or HI	Chamorroan or Guam	S. Carolinian or NMI	N. Carolinian or NMI
mahimahi	*Coryphaena* spp.	masimasi	mahimahi	botague	sopor	habwur
wahoo	*Acanthocybium solandri*	paala	ono	toson	ngaal	ngaal
Indo-Pacific blue marlin	*Makaira mazara*	sa'ula	a'u, kajiki	batto'	taghalaar	taghalaar
black marlin	*Makaira indica*					
striped marlin	*Tetrapturus audax*		nairagi			
shortbill spearfish	*Tetrapturus angustirostris*	sa'ula	hebi	spearfish		
swordfish	*Xiphias gladius*	sa'ula malie	a'u kū, broadbill, shutome	swordfish	taghalaar	taghalaar
sailfish	*Istiophorus platypterus*	sa'ula	a'u lepe	guihan layak	taghalaar	taghalaar
pelagic thresher shark	*Alopias pelagicus*	malie	mano	halu'u	paaw	paaw
bigeye thresher shark	*Alopias superciliosus*					
common thresher shark	*Alopias vulpinus*					
silky shark	*Carcharhinus falciformis*					
oceanic whitetip shark	*Carcharhinus longimanus*					
blue shark	*Prionace glauca*					
shortfin mako shark	*Isurus oxyrinchus*					
longfish mako shark	*Isurus paucus*					
salmon shark	*Lamna ditropis*					
albacore	*Thunnus alalunga*	apakoa	'ahi palaha, tombo	albacore	angaraap	hangaraap
bigeye tuna	*Thunnus obesus*	asiasi, to'uo	'ahi po'onui, mabachi	bigeye tuna	toghu, sangir	toghu, sangir
yellowfin tuna	*Thunnus albacares*	asiasi, to'uo	'ahi shibi	'ahi, shibi	yellowfin tuna	toghu

English common name	Scientific name	Samoan or AS	Hawaiian or HI	Chamorroan or Guam	S. Carolinian or NMI	N. Carolinian or NMI
northern bluefin tuna	*Thunnus thynnus*		maguro			
skipjack tuna	*Katsuwonus pelamis*	atu, faolua, ga'oga	aku	bunita	angaraap	hangaraap
kawakawa	*Euthynnus affinis*	atualo, kavalau	kawakawa	kawakawa	asilay	hailuway
moonfish	*Lampris* spp.	koko	opah		ligehrigher	ligehrigher
oilfish family	Gempylidae	palu talatala	walu, escolar		tekiniipek	tekiniipek
pomfret	family Bramidae	manifi moana	monchong			
other tuna relatives	*Auxis* spp., *Scomber* spp., *Allothunus* spp.	(various)	ke'o ke'o, saba (various)	(various)	(various)	(various)

Source: WPRFMC (2002a).
This list includes changes that would be made through FMP Amendment 10. It would remove from the PMUS list dogtooth tuna (*Gymnosarda unicolor*) and all species of shark except the nine pelagic species listed here. NMFS issued a Record of Decision on June 14, 2002 that approves this aspect of Amendment 10 but it has not yet implemented it through a final rule.

Species of oceanic pelagic fish live in tropical and temperate waters throughout the world's oceans, and they are capable of long migrations that reflect complex relationships to oceanic environmental conditions. These relationships are different for larval, juvenile and adult stages of life. The larvae and juveniles of most species are more abundant in tropical waters, whereas the adults are more widely distributed. Geographic distribution varies with seasonal changes in ocean temperature. Migration patterns of pelagic fish stocks in the Pacific Ocean are not easily understood or categorized, despite extensive tag-and-release projects for many of the species. This is particularly evident for the more tropical tuna species (e.g., yellowfin, skipjack, bigeye) which appear to roam extensively within a broad expanse of the Pacific centered on the equator. Likewise, the oceanic migrations of billfish are poorly understood, but the results of limited tagging work conclude that most billfish species are capable of transoceanic movement, and some seasonal regularity has been noted.

Movements of pelagic species are not restricted to the horizontal dimension. In the ocean, light and temperature diminish rapidly with increasing depth, especially in the region of the thermocline. Many pelagic fish make vertical migrations through the water column, often moving toward the surface at night to feed on prey species that exhibit similar diurnal vertical migrations. Certain species, such as swordfish, are more vulnerable to fishing when they are concentrated near the surface at night. Bigeye tuna may visit the surface during the night, but generally, longline catches of this fish are highest when hooks are set in deeper, cooler waters. Adult swordfish are opportunistic feeders, preying on squid and various fish species. Oceanographic features such as frontal boundaries that tend to concentrate forage species (especially cephalopods) apparently have a significant influence on adult swordfish distributions in the North Pacific.

The status of the pelagic stocks managed under the FMP was reviewed in the Annual Report to Congress on the Status of U.S. Fisheries–2001 (NMFS 2002c). None of the stocks were indicated as being in, or approaching, an overfished condition.

The results of stock assessments for pelagic stocks are increasingly being expressed in terms of MSY-based reference points, which are now required under the MSA. Summarized below are the results of recent stock assessments that provide estimates of: 1) adult stock biomass at a given time relative to the adult stock biomass associated with maximum sustainable yield (B_t / B_{MSY}), and 2) the fishing mortality rate at a given time relative to the fishing mortality rate associated with maximum sustainable yield (F_t / F_{MSY}). Using the terminology of the MSA, the smaller the ratio B_t / B_{MSY}, the closer the stock is to being "overfished." The greater the ratio F_t / F_{MSY}, the closer the stock is to having "overfishing" take place.[19]

Boggs et al. (2000) tabulated then-recent estimates of F_t / F_{MSY} and B_t / B_{MSY} for the pelagic stocks managed under the FMP. These estimates, along with the year for which they were made, are shown in Table 24. Also shown are estimates of natural mortality rates (M) presented in Boggs et al. (2000) for the purpose of specifying reference points. It can be seen that for two stocks, bigeye tuna and eastern Pacific yellowfin tuna, the fishing mortality ratio was estimated to

[19] The Council is in the process of preparing amendments to its bottomfish, pelagics, and crustaceans FMPs that would specify MSY-based reference points against which these ratios could be compared in order to determine whether overfishing is taking place or the stock is overfished.

exceed 1.0 and the stock biomass ratio was estimated to be less than 1.0 (but see Hampton 2002a, below, for contrary results for bigeye tuna).

Table 24. Estimates of status indicators for Pacific pelagic stocks

Stock	Year	F_t / F_{MSY}	B_t / B_{MSY}	M
Bigeye tuna	1994	1.09	0.99	0.4
Northern Pacific albacore	1995	0.9	1.1	0.3
Southern Pacific albacore	1993	0.62	2.5	0.3
Eastern Pacific yellowfin tuna	1997	1.08	0.95	0.8
Western Pacific yellowfin tuna	1998	0.11 – 0.22	1.65	0.8 – 1.6
Eastern Pacific skipjack tuna	1997	unknown	2.5	> 0.5
Western Pacific skipjack tuna	--	0.25	2.5	> 0.5
Other tunas		unknown	unknown	
Northern Pacific swordfish	1997	0.3	2.47	0.3
Blue marlin	1997	0.46 – 0.88	1.1 – 1.7	0.2
Other billfishes		unknown	unknown	
Pelagic sharks		unknown	unknown	
Other MUS		unknown	unknown	

Source: Boggs et al. (2000).

In a recent assessment of the northern Pacific blue shark stock (using 1992-1998 catch data), it was concluded that MSY was probably between 1.8 and 4 times the level of catch during that period and that fishing mortality during the period was between one fifteenth and one half of F_{MSY} (Kleiber et al. 2001).

The Secretariat for the Pacific Community recently published stock assessments for western and central Pacific bigeye tuna (Hampton 2002a), western and central Pacific yellowfin tuna (Hampton 2002b), western and central Pacific skipjack tuna (Hampton 2002c), and south Pacific albacore (Hampton 2002d). The results are summarized below. The assessments covered the period from the early 1960s through 2001 for all stocks except skipjack, for which the study period started in the early 1970s.[20]

Western and central Pacific bigeye tuna: Estimated values of F_t / F_{MSY} generally increased from the early 1960s through the mid-1990s, followed by an apparent decrease through 2001. F_t / F_{MSY} remained below 1.0 during the entire period, peaking at about 0.7 to 0.8 in the mid-1990s. Estimated values for the period since 2000 were between 0.3 and 0.7. Estimated values of ${}_aB_t$

[20] Please see these publications for further details, including the methods used, the confidence intervals associated with the estimates, and a brief discussion of the possible shortcomings of using MSY-based indicators of stock status – particularly about the questionable assumptions that have to be made about the equilibrium behavior of populations.

$/_aB_{MSY}$ (adult biomass over adult biomass-at-MSY) for bigeye tuna generally decreased from the early 1960s through the mid-1990s, followed by an apparent increase through 2001. Estimated $_aB_t / _aB_{MSY}$ remained above 1.0 during the entire period, with a low of about 1.5 to 2.0 in the mid-1990s. Estimated values for the period since 2000 were between 2 and 4.

Western and central Pacific yellowfin tuna: Estimated values of F_t / F_{MSY} generally increased from the early 1960s through 2001. F_t / F_{MSY} remained well below 1.0 during the entire period, peaking at about 0.3 to 0.6 in the last year or two. Estimated values of $_aB_t / _aB_{MSY}$ for yellowfin tuna remained above 1.0 during the entire period, with a low of about 2 in the mid-1970s. Estimated values for the period since 2000 were between 2.0 and 3.5.

Western and central Pacific skipjack tuna: Estimated values of F_t / F_{MSY} were well below 1.0 since the early 1970s, peaking at less than 0.2 in the mid-1990s. Estimated values of $_aB_t / _aB_{MSY}$ for skipjack tuna remained well above 1.0 during the entire period, with a low of about 2 in the mid-1970s. Estimated values for the period since 2000 were between 3 and 9.

Southern Pacific albacore tuna: Estimated values of F_t / F_{MSY} were well below 1.0 for the entire period, peaking at about 0.2 to 0.3 in the late 1980s. Estimated values of $_aB_t / _aB_{MSY}$ for albacore tuna remained above 1.0 during the entire period. The 1990s had the lowest values, estimated to be between 1.5 and 5.

Stock assessment results for other pelagic stocks, including the other tunas, other billfishes, and other management unit species, are not available.

5.2.3.2 Non-target finfish species

In addition to the landings of PMUS described in previous sections, the pelagic fisheries also result in bycatch of PMUS and landings and bycatch of non-PMUS, as well as unobserved fish mortality. These aspects of the fisheries are reviewed in detail in Section 4.2.1.

5.2.4 Ecosystem and Habitat

It is important to recognize that the pelagic ecosystem responds to ambient climatological and oceanographic conditions on a variety of spatial and temporal scales, and that even in the complete absence of any fishing stock sizes would fluctuate, sometimes quite dramatically. It is also clear from the species accounts that initiation of very marked declines in some groups such as sea turtles, seabirds and possibly sharks coincided with prosecution of the high seas drift-gillnet fishery in the 1980s and early 1990s. Added to the serious impacts to protected species resulting from that fishery was a regime shift that markedly lowered the carrying capacity and productivity of the ecosystem at that time. Because of the long life spans and limited reproductive potential of sea turtles, seabirds and sharks, these populations are likely only beginning to recover from these circumstances.

Essential Fish Habitat (EFH) for the adult and juvenile life stages of the PMUS was designated through FMP Amendment 8 as the water column to a depth of 1,000 m. Although most PMUS are epipelagic (the surface layer to about 200 m depth), bigeye tuna are abundant at depths greater than 400 m and swordfish have been tracked to a depth of 800 m. The vertically migrating mesopelagic fishes and squids associated with the deep scattering layer are important prey organisms for PMUS and they are seldom abundant deeper than 1,000 m.

EFH for the eggs and larvae of PMUS is the epilelagic zone, including the water column from the surface to a depth of 200 m, from the shoreline to the outer limit of the EEZ. The eggs and larvae of all teleost PMUS are pelagic, and are slightly buoyant when first spawned, spreading throughout the mixed surface layer and subject to advection by ocean currents. Eggs and larvae of PMUS are found throughout the tropical (and in summer, subtropical) epipelagic zone.

Habitat Areas of Particular Concern (HAPC) have been designated as the water column from the surface to a depth of 1,000 m that lies above all seamounts and banks with the EEZ that rise to within 2,000 m of the surface. The rationale for the HAPC designation included the ecological function provided by those waters, the rarity of the habitat type, and the susceptibility of the areas to human-induced environmental degradation.

5.2.5 Protected Species

In addition to PMUS and non-PMUS finfish species, pelagic fisheries interact, or have the potential to interact, with protected species, including sea turtles, marine mammals, and seabirds. These aspects of the fisheries are reviewed in Section 4.2.1.3.

5.2.6 New Information on Affected Environment

The information described in the previous subsections came from the March 2001 FEIS for the pelagic fisheries, which generally included fishery data only through 1998. Updates to that information are provided here.

Several important regulatory changes have recently taken place in the fishery (see Section 2.2 for details), with consequent impacts on fishing activity. They include a ban on the practice of shark finning (retaining the fins without the carcass), an effective closure of the swordfish-directed longline fishery, a large area closure south of Hawaii during April and May for the longline fishery, requirements to use certain gear-related measures to reduce the incidental catch of sea turtles and seabirds, and an area closure out to 50 nm for large longline vessels (greater than 50 feet in length) in American Samoa.

Table 25 shows the estimated catch and revenues from pelagic fishing in the Western Pacific Region in 2001.

Table 25. Summary of US federally managed pelagic fishing activity in the Western Pacific Region, 2001

<table>
<tr><th>Fishery</th><th>Landings (1,000 lb)</th><th>Ex-vessel revenue (1,000 $)</th><th>Number of active vessels</th><th>Number of trips</th></tr>
<tr><td>Hawaii pole-and-line</td><td>1,200</td><td>1,600</td><td>5</td><td>246</td></tr>
<tr><td>Hawaii longline</td><td>15,400</td><td>32,700</td><td>101</td><td>1,075</td></tr>
<tr><td>Hawaii troll</td><td>2,600</td><td>3,800</td><td>1572</td><td>20,281</td></tr>
<tr><td>Hawaii handline</td><td>1,320</td><td>2,300</td><td>190</td><td>3,967</td></tr>
<tr><td>Hawaii other</td><td>600</td><td>500</td><td>NA</td><td></td></tr>
<tr><td>American Samoa longline</td><td>8,131</td><td rowspan="2">7,817</td><td>65</td><td>(# sets:) 4,700</td></tr>
<tr><td>American Samoa troll</td><td>23</td><td>18</td><td>335</td></tr>
<tr><td>Guam commercial troll</td><td>686</td><td rowspan="2">680</td><td rowspan="2">375</td><td>9,563</td></tr>
<tr><td>Guam charter troll</td><td>74</td><td>2,453</td></tr>
<tr><td>CNMI commercial troll</td><td>143</td><td>286</td><td>111</td><td>2,176</td></tr>
<tr><td>Total</td><td>30,000</td><td>50,000</td><td></td><td></td></tr>
</table>

Source: WPRFMC 2002d and NMFS Honolulu Laboratory.
Most estimates are preliminary.
Revenues account only for sales of fish, not for charter fees or other income from fishing.

During the year 2001, 101 Hawaii-based longline vessels were active, landing 15.4 million pounds of fish worth $32.7 million ex-vessel, a decrease in landings of about 35% compared to 2000. As a result, 2001 total commercial pelagic landings (21.1 million lb; $41.3 million) for all pelagic gear types combined fell by 30% from 2000. Swordfish landings decreased by more than 90% from 2000 because of the closure of the swordfish-directed fishery, and bigeye tuna landings declined by about 10% despite a considerable shift in fishing effort from the swordfish and mixed-target sector into the tuna target sector (WPRFMC 2002d). According to logbook data compiled by the NMFS Honolulu Laboratory, the number of sharks caught in the Hawaii-based longline fishery decreased substantially (from an annual average of 102,000 during 1992-2000 to 47,000 in 2001), largely as a result of the closure of the swordfish-directed longline fishery. The percentage shark bycatch rate increased substantially (from an average of 63% in 1997-2001 to 96% in 2001) as a result of the ban on shark finning. The absolute number of sharks discarded was 45,000 in 2001, compared to an annual average of 67,000 during the 1992-2001 period.

The regulatory changes in Hawaii's longline fishery have had substantial effects on rates of interaction with sea turtles and seabirds. Interaction and mortality rates have not yet been estimated for 2001, but differences in estimated interaction rates between two periods of 2000 indicate the magnitude of the regulatory impacts. During the first eight months of 2000 there was an area closure in place, but during the last four months of the year the restrictions on the fleet were expanded to include a limit of 154 sets within a certain area and swordfish-directed fishing was prohibited in waters bounded by the equator and 28° N and by 173° E and 137° W. There were an estimated 372 sea turtle interactions in the first period of 2000, compared to 52 in the second period, and there was a statistically significant difference between the two periods in the number of interactions per set for all species but the green (WPRFMC 2002a). The estimated number of interactions with albatrosses decreased from 2,343 in the first period to 90 in the second period, and there was a statistically significant difference between the two periods in the number of interactions per set for both species (WPRFMC 2002a). (Note that there is a substantial degree of uncertainty – not described here – in these estimates of interaction rates.)

Landings, revenues, and catch rates in 2001 in Hawaii's small-boat commercial fisheries were within the ranges of recent years.

Like the Hawaii fishery, pelagic fishing in American Samoa is experiencing a period of rapid change. In 1994, five vessels were engaged in longlining, all *alia*. In 2001, 65 vessels were in the fishery, including a number of vessels larger than 50 feet in length (WPRFMC 2002d). Longline landings have consequently skyrocketed, increasing from less than a quarter of a million pounds in 1994 to 8.1 million pounds in 2001.

Eighteen vessels participated in the American Samoa troll fishery in 2001, substantially less than the average for the last 20 years of 35 vessels (WPRFMC 2002d). Landings in 2001 were 23,000 pounds.

Guam's pelagic landings of about 750,000 pounds in 2001 were about equal to the annual average of the last five years. The estimated number of boats in the troll fleet, about 375, is not significantly different from the numbers estimated for the previous ten years or so.

The estimated 2001 commercial landings in the CNMI's pelagic fisheries, about 143,000 pounds, were about the same as the previous two years, but substantially less than estimated landings during 1996-1998, which had an estimated peak of 225,000 pounds in 1996. The number of vessels engaged in the fishery has been fairly steady during the last six years, with 111 boats making commercial landings in 2001.

6. Proposed Management Measures – Alternatives

Described in this section are four alternative sets of management measures related to bycatch reporting, minimizing bycatch, and minimizing the mortality of unavoidable bycatch.

6.1 Alternative 1: No Action

Under the no-action alternative, no new measures would be implemented. However, the descriptions in Section 4 of recent levels of bycatch, bycatch assessment and reporting systems, and existing and in-progress bycatch reduction measures for the Bottomfish and Pelagics FMPs would be incorporated into the FMPs. This information would also be incorporated under Alternatives 2-4, along with the new measures described for each of those alternatives.

6.2 Alternative 2: Outreach, Gear and Market Research, and Reporting Systems (Preferred Alternative)

This alternative would implement several measures to achieve further reductions in bycatch and bycatch mortality and to better assess the amounts and types of bycatch occurring in the bottomfish and pelagic fisheries. The measures are represent improvements to existing programs and activities that already serve to minimize and measure bycatch. The measures are consistent with the advice of NMFS (Morehead 2001) regarding the improvement of bycatch reporting and reduction in the Western Pacific Region. The measures fall in four categories: 1) outreach to fishermen, engagement of fishermen in management processes, and consideration of incentive programs to reduce bycatch, 2) research on fishing gear and method modifications, 3) research into the development of markets for discarded fish species, and 4) improvement of data collection and analysis systems to better measure bycatch.

Outreach to fishermen

The outreach component of this alternative would aim to increase fishermen's awareness of the adverse effects of bycatch and of options they can employ to reduce bycatch and improve bycatch reporting. Information on fishing strategies, gear modifications, fish handling methods, and market opportunities that could lead to bycatch reduction would be made available to fishermen through various media and activities. The value of accurate bycatch reporting would also be emphasized.

The outreach would be conducted in several ways. First, printed materials, such as flyers and newsletters, would be sent to all permit holders and registered owners of fishing vessels. There is an industry organization that represents participants in the Hawaii-based longline fishery, the Hawaii Longline Association, which would serve as an important means of communication. Second, consideration would be given to adding a finfish bycatch module to the protected species workshops that vessel operators in the Hawaii-based longline fishery must attend annually. Consideration would also be given to requiring that NWHI bottomfish vessel operators annually attend a protected species workshop (currently, workshop attendance by NWHI bottomfish permit holders is required only once, prior to being issued a permit). Finally, the various public fora provided through the Council's management process and those of local fisheries agencies would continue to be used to exchange bycatch-related information with fishermen and to encourage fishermen to exchange concerns and ideas among themselves, including best practices they have developed to reduce bycatch and avoid protected species interactions. Examples of such opportunities are the deliberations of the Council's advisory panels and committees, public meetings facilitated by the Council and by local fisheries agencies in each of the island groups, international fisheries meetings hosted by the Council, and occasional fisheries workshops organized by the Council. For instance, in November 2002 the Council will host the Second International Fishers' Forum, which will convene fishermen, gear technologists, researchers, and fishery managers to address the incidental catch of sea turtles and seabirds in longline fisheries.

Involving fishermen in research and monitoring activities is an effective way to increase their interest in reporting and reducing bycatch. In Australia the Fisheries Research and Development Corporation and the Bureau of Rural Sciences initiated a sea turtle tagging program in the northern prawn fishery that used volunteer fishermen to do the tagging (Roberts 2001). Participants included vessel masters, deck hands, and cooks. The project sponsors found that participants developed an interest in sea turtle conservation issues, and their interest continued after they had finished participating in the program. The feasibility of establishing a similar program would be explored under this alternative. In the Hawaii-based longline fishery selected participants could be trained to tag protected species such as sea turtles and seabirds, as well as finfish such as sharks and billfish. Such a program would likely have several beneficial effects. First, valuable data on post-hooking mortality would be collected. Second, as in the Australian case, after participating in such studies and learning the results and their implications, participants would likely become more interested in bycatch-related issues and voluntarily improve their reporting and reduction of bycatch and bycatch mortality. For example, fishermen would be likely to improve their handling of discarded animals such that survival rates improve.

Another incentive program that would be explored is one that offers recognition and rewards for fishermen that consistently reduce bycatch or bycatch mortality. One difficulty with such a program is that data confidentiality rules would limit the program to voluntary participation. The Hawaii Longline Association might be enlisted to encourage participation and to manage the program, at least for the longline fishery. Another problem with such a program would be that it could provide a perverse incentive – to under-report discards in order to claim a bycatch reduction.

Research on fishing methods and gear

NMFS is undertaking a research program to evaluate the efficacy of various longline gear and method modifications to reduce interactions with sea turtles. The research is being carried out using Hawaii-based commercial longline vessels and crew. The Council and NMFS will ensure that the fishing community has ample opportunity to participate in, and learn from, the program. Participation by fishermen will increase their appreciation of problems related to bycatch and protected species. It will also take advantage of the considerable knowledge of fishermen and help identify solutions that resolve bycatch problems cost-effectively and with minimal adverse impacts to fisheries. Under this alternative, consideration would be given by the Council and NMFS to initiate a corollary research program dedicated to the reduction of finfish bycatch in longline fisheries. The reduction of shark catch and shark bycatch mortality would be potentially valuable outcomes of such a program. Potential areas of such research include those reviewed by Erickson and Berkeley (2000) and McCoy and Ishihara (1999) as having potentially positive effects, such as soak time, the use of artificial bait, the use of monofilament versus steel leaders, hook types, the type and placement of lightsticks when targeting swordfish, and the use of environmental sensing equipment to avoid areas with tendencies to congregate sharks. Additional goals that would be considered for such a program are the development of methods to measure and reduce unobserved fish mortality from predation, such as by marine mammals.

The vessel observer program for the NWHI bottomfish fishery is in the process of being reinitiated. Under this alternative, consideration would be given to the possibility of collecting detailed information on fishing gears and strategies used in the fishery in order to better assess the relationships between these factors and bycatch rates, bycatch mortality rates, and protected species interaction rates.

Research on market development

Under this alternative, the Council and NMFS would consider opportunities to conduct research towards the development of new markets for low-value species that tend to be discarded. Developing markets for currently discarded species presents a considerable challenge. The prospects for increased utilization are probably greatest for the various carangids caught in the bottomfish fishery. These species are marketable but they fetch relatively low prices and do not keep well. Consequently, bottomfish vessels probably engage in a certain amount of high-grading – that is, discarding relatively low-value species in order to save iced storage space for higher value species. The prevalence of ciguatoxin in kahala presents an almost insurmountable barrier to utilization. Field tests for the poison are cost-prohibitive, although efforts are being made to improve them. Even if fish could be confirmed toxin-free, there would likely be continued resistance among purchasers given the potentially severe consequences of false negative test results.

In the case of blue sharks, although longline bycatch rates are quite high in both absolute and percentage terms, bycatch mortality rates appear to be relatively low. Any measure that successfully increases the retention rate would therefore increase the fishing mortality rate. Consequently, although there may be opportunities to increase blue shark utilization through improved on-vessel processing technologies and the development of markets, there is no bycatch-related rationale for Council intervention in these areas. The focus with regard to blue shark would therefore be the reduction of catchability and bycatch mortality, as described above.[21]

Bycatch measurement

The standardized reporting methodologies to assess the amount and type of bycatch in the bottomfish and pelagics fisheries and the data collection and analysis systems used to implement those methodologies have recently been substantially improved since the passage of the SFA. Under this alternative, the Council would continue to work with NMFS, USFWS, and the local-

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[21] Having said this, it is worth mentioning some of the issues related to marketing blue shark. Internationally, markets exist for blue shark flesh. However, because of the high concentration of nitrogen compounds in the flesh, intensive and immediate on-board processing and freezing must be carried out in order to make the flesh saleable. The current configuration of Hawaii-based longline vessels makes this impossible, and the cost of refitting vessels to provide processing facilities and freezer space would be substantial. In any case, unless the value of blue shark meat were to increase substantially, converting storage space that is currently used to chill target tuna species to freezer space for sharks would not be cost-effective (see McCoy and Ishihara (1999) for a fuller discussion of constraints to marketing blue shark). Developing new markets in Hawaii poses several challenges. First, consumers prefer fresh rather than frozen fish, at least for locally caught fish. Second, there is considerable resistance to consuming shark flesh among the local population. For example, local producers of *kamaboku* (a type of processed fish of Japanese origin) used shark meat for a time, but demand fell off when consumers discovered this (P. Bartrum, Hawaii Seafood Distributors, pers. comm.). It should be noted, however, that before the swordfish-directed fishery was closed interest in overcoming the barriers to shark utilization was growing among some participants in the fishery. If the swordfish fishery is ever re-opened baseline research and testing would be useful to reduce bycatch. Chefs in Hawaii have experimented with species that were typically discarded, including opah (moonfish) and pomfrets, and successfully spurred demand for these species. Although it is unlikely that blue shark could ever become a staple of restaurant cuisine, other shark species, such as mako and thresher, might be promoted in this fashion.

level fisheries agencies to periodically assess the reliability of collected data, assess the cost-effectiveness of the data collection and analysis systems, and improve the systems as needed.

As identified in Sections 4.1.2.6 and 4.2.2.6, weak areas in the ability to assess the amount and type of bycatch in the two fisheries include: 1) assessment of the amount and type of bycatch in the small-boat bottomfish and pelagic fisheries in all the island groups, 2) assessment of the mortality of discarded finfish in the pelagic fisheries, 3) assessment of post-interaction mortality and morbidity of sea turtles and marine mammals, 4) assessment of unobserved mortality in the longline fisheries, 5) assessment of bycatch in the American Samoa longline fishery, and 6) routine analysis, synthesis, and interpretation of bycatch data.

These weaknesses would be addressed as follows: 1) The Council and NMFS would continue to work with the local-level fisheries agencies to improve, where practicable, the detail and reliability of bycatch data collected in the creel surveys, including the Hawaii Marine Recreational Fishery Survey. NMFS should also re-deploy observers on the NWHI bottomfish vessels to obtain up-to-date data on bycatch and protected species interactions. 2) The Council and NMFS would continue to assess bycatch mortality of pelagic finfish to the extent practicable using observer data and the results of tagging and other relevant studies done elsewhere. 3) The Council and NMFS would continue to assess post-interaction mortality and morbidity of sea turtles and marine mammals using observer data and the results of tagging studies and other relevant studies conducted by the USFWS and other parties elsewhere. 4) The Council and NMFS would consider the value of more fully assessing unobserved mortality in the longline fisheries, and to the extent determined to be appropriate, they would utilize the results of assessments conducted elsewhere and consider research to more fully assess unobserved mortality. 5) The Council and NMFS would continue to develop the vessel observer program for the American Samoa longline fishery, including consideration of methods for observing fishing activities on small vessels such as the *alia*. 6) The Council and NMFS would continue to develop and apply methods for adjusting "extensively collected" bycatch data (e.g., logbook data) with "intensively collected" bycatch data (e.g., observer data) in order to obtain accurate bycatch information in the most cost-effective manner (e.g., as being undertaken by the Pelagic Fisheries Research Program for the Hawaii-based longline fishery; see Walsh 2002). The Council and NMFS would also continue to expand the scope of the SAFE reports such that bycatch information is more fully presented and interpreted.

It is emphasized that these efforts to improve the measurement of bycatch would address both the technical aspects of the information systems and the motivations and incentives for fishermen to cooperate in data reporting, as described above.

As indicated in Sections 4.1.2 and 4.2.2, the design details of each of the data collection components (e.g., the frequency and coverage of observer programs) vary by area and gear type and would be occasionally adjusted in order to meet information targets in the most cost-effective manner. Those targets, such as the scope, accuracy, precision, and resolution of collected data, would also be occasionally adjusted as needed.

6.3 Alternative 3: Limit on Shark Discards

Sharks make up large components of the bycatch in the bottomfish and pelagics fisheries. Most sharks are caught in the Hawaii-based longline fishery (that fishery makes about 80% of all pelagic landings in the Western Pacific Region, excluding the purse seine catch in the US EEZ of the region). Blue sharks accounted for 94% of all sharks caught from 1992 through 2000. Most blue sharks are caught north of 30° N.

This alternative would implement a fleet-wide annual limit on blue shark discards in the Hawaii-based longline fishery in the area north of 30° N latitude. Once this fleet-wide limit is reached, longline vessels fishing in this area would have to stop discarding blue sharks, either by retaining all additional blue sharks or by stopping fishing in the area until the end of the calendar year. The limit would be specified through a framework measure and could be periodically re-specified through framework measures. For example, the limit could be gradually reduced over time in order to give the industry time to adopt new processing technologies or to develop new markets for blue shark.

6.4 Alternative 4: Require Full Retention

Under this alternative Hawaii-based longline vessels and vessels holding a NWHI bottomfish permit would be required to retain all captured finfish.

7. Environmental Consequences of the Management Alternatives

This section describes the likely environmental impacts of each of the alternatives, including the no-action alternative, based on criteria outlined in NOAA Administrative Order 216-6 (Section 6.02). The impacts of the alternatives are considered in seven categories. These are: 1) impacts on the fishery, including bycatch, economic performance, and markets and consumers, 2) target and non-target fish stocks, 3) ocean and coastal habitat and Essential Fish Habitat, 4) public health and safety, 5) protected species, 6) biodiversity and ecosystem function, and 7) cumulative impacts. In Section 7.9 is a discussion of the reasons for selecting the preferred alternative as the proposed measure.

Descriptions of the effects of the no-action alternative describe the conditions against which the effects of the other alternatives are compared. It is important to note that these no-action conditions are not necessarily static in time, as lack of management action can lead to future changes just as action can.

7.1 Impacts on the Fishery

7.1.1 Bycatch

Bycatch can be described in “percentage” and “absolute” terms. The former refers to the percentage of the catch of a given species that is bycatch. The latter refers to the absolute amount (number or weight) of fish that is bycatch.

Bycatch rates can be altered in several basic ways. The composition of the catch could change, altering the absolute catch rate of particular species and the absolute bycatch rate of those species for which the percentage bycatch rate is greater than zero. The percentage of a given species that is retained could change, altering the percentage and absolute bycatch rates of that species. The overall catch rate of all species combined could change, altering the absolute bycatch rate of all species for which the percentage bycatch rate is greater than zero. Finally, unobserved mortality rates, such as due to escape or predation, could change.

Under Alternative 1, the no-action alternative, it is likely that absolute bycatch and bycatch mortality rates – at least in the well-established fisheries – would either remain unchanged or decrease in the future, and bycatch assessment would likely improve in the future (albeit probably only modestly and slowly). This is because even lacking any new management action, the Council and NMFS have the scope within existing management measures to achieve reductions in bycatch and improve the assessment of bycatch. For example, outreach to fishermen can be, and is likely to be, accomplished without any formal management action. Improvements to bycatch reporting forms can be, and are likely to be, undertaken without any formal management action. Furthermore, fishermen have, in many cases, economic incentives to reduce bycatch (e.g., to the extent that it contributes to lost gear, lost fishing time, or lost catch), and they may achieve reductions through innovations in fishing gears, methods, and strategies that improve catch selectivity. Similarly, fish dealers have incentives to develop new markets for less-utilized species. In other words, reductions in bycatch and bycatch mortality may occur in the future without any government intervention. In some fisheries – particularly the less established and regulated ones, there would be the possibility of bycatch rates increasing in the future. In the American Samoa longline fishery, for example, the rapid increase in fleet size and shift in vessel types resulted in an increase not only in absolute bycatch rates (because of the increase in effort and catch), but probably in percentage bycatch rates, as well (stemming from the shift in the fishery's composition of vessel types and trip types).

Under Alternative 2, as in the no-action alternative, bycatch and bycatch rates are likely to either remain unchanged or be reduced, and the assessment of bycatch is likely to improve in the future. Although the measures in this alternative could be implemented in large part by the Council and NMFS without any formal management action, incorporation of these non-regulatory measures in the FMPs would provide more explicit mandates for fishery managers to pursue opportunities for bycatch reduction. Therefore, the likelihood, magnitude, and pace of any such beneficial changes on bycatch and bycatch mortality rates would be somewhat greater than under Alternative 1. For the same reason, the likelihood of bycatch rates increasing in any of the fisheries would be lower than under the no-action scenario.

Alternative 3 would be likely to result in a substantially lower absolute bycatch rate of blue sharks than under the no-action scenario, with the difference dependent on the level at which the discard limit is set. The percentage discard rate of blue sharks might not be substantially different than under the no-action scenario, because being a fleet-wide rather than a vessel-specific discard limit, there would be little incentive for individual vessels to retain unwanted sharks. Instead, individual vessels would be motivated to fish hard north of 30° N early in the season, before being effectively penalized when the limit is reached. The catch of all species in the Hawaii-based longline fishery is likely to be less than under the no-action scenario (because fishing effort would be constrained by the discard limit, which would probably effectively serve as a seasonal area closure; and in general terms, fishing costs in the fishery would be greater, dampening fishing effort and catch). In addition, due to a lack of markets for blue shark, meat the major portion of the carcasses would likely be discarded once on shore. Therefore, the absolute (but not percentage) bycatch rates of all other species caught in the fishery are likely to be less than under the no-action scenario. This alternative would be unlikely to have a sizable impact on bycatch rates or assessment in the bottomfish or other pelagic fisheries, although participation, effort, and catch could shift from the Hawaii-based longline fishery to other fisheries, thereby resulting in greater absolute (but not percentage) bycatch rates in those fisheries than under the no-action scenario.

Alternative 4, which would prohibit at-sea discards in the Hawaii-based longline fishery and the Hoomalu Zone bottomfish fishery, would be likely to result in substantially lower absolute bycatch rates of all species in those fisheries than under the no-action scenario. One reason is that because it would become more costly to fish in those fisheries, fishing effort and catch rates would be lower than under the no-action alternative. A second reason is that, to the extent that the "otherwise-not-retained" fish would have value upon landing and not be dumped ashore (i.e., become bycatch), the percentage bycatch rates (and consequently the absolute bycatch rates) would be lower than under the no-action scenario. The alternative is likely to result in greater percentage – and in some cases, absolute – bycatch mortality rates than under the no-action scenario for many species. This is because in the case of low-value species that have high post-hooking survival rates, such as most of the shark species, much of the forcibly-retained catch is likely to be dumped ashore (i.e., as dead bycatch). The effect on the absolute bycatch mortality rate for a given species would depend on the proportion of the catch not used, its post-hooking survival rate (i.e., if discarded at sea), and the effect on overall fishing effort and catch. For species with low post-hooking survival rates, such as some of the deep bottomfish species, this adverse bycatch mortality effect would be small. There would be a strong incentive to develop and employ gears and methods to avoid bycatch, which would have the tendency to stem any decreases in fishing effort while decreasing percentage bycatch rates. There would also be a strong incentive for the industry to develop new markets for less-utilized species and sizes, again, with the effect of stemming any decrease in fishing effort and fishing mortality while decreasing percentage bycatch rates. The outcome of these enhanced incentives is difficult to predict.

7.1.2 Economic Performance

Alternative 1, no-action, is not likely to result in any substantial future adverse changes in economic performance of the bottomfish and pelagics fisheries. In other words, there do not appear to be any bycatch-related problems that, if left unresolved, would have the potential to adversely impact the future economic performance of the fisheries. Because innovations in fishing gears, methods, and strategies that would result in reduced bycatch rates may occur in the future (because there are private incentives and because the government may invest in such innovations even without any formal management action), individual vessel performance may – ignoring other, non-bycatch-related factors – also improve in the future. Gains in performance would come from such innovations through reductions in lost fishing time and lost gear, as long as the catch rates of target species are not unduly compromised. Markets for less-utilized species may also develop in the future under the no-action scenario, and to the extent that such market development entails product expansion rather than market substitution, individual and fleet-wide economic performance would be likely to improve. The prospects for these developments to occur depend on many factors having to do with both market prices and production costs. In the case of blue shark, neither the market side or production side appears promising. The market value of blue shark flesh is unlikely to increase substantially in the near future. And marketability at all would require substantial investments by vessel owners in on-board processing and storage (freezer) facilities. The Hawaii-based longline fishery is probably the only fishery with blue shark catch rates high enough to possibly justify such investments. Since the swordfish-directed sector of that fishery, which has much greater blue shark catch rates than the tuna-directed sector, is now closed, there is less incentive for fishermen to consider making such investments. The prospects for improving marketability for the carangids that make up much of the bycatch in the bottomfish fishery are perhaps a little better.

The impacts of Alternative 2 on fishery economic performance are likely to be similar to those of Alternative 1, but the likelihood, magnitude, and pace of any such bycatch-reducing effects and consequent impacts are likely to be greater than under Alternative 1.

Alternative 3 could have moderate to serious adverse impacts on economic performance in the short term and possibly in the long term, depending on the level at which the blue shark discard limit is set. If and when the fleet-wide limit is reached in a given year, fishermen would have the choice of stopping fishing, shifting to areas south of 30º N, or retaining and landing all blue shark (and marketing it to the extent possible but dumping the rest ashore, as bycatch). Fishermen would choose the least costly of these options, and it appears that the option of shifting to areas south of 30° N would not be excessively costly, especially given that the swordfish-directed fishery is closed anyway. In any case, all three options are likely to result in adverse impacts to average vessel net returns – again, the magnitude would depend on the discard limit. There is a possibility that the swordfish-directed longline fishery will be re-opened in the future if measures can be taken to reduce interactions with protected species. If re-opened, any adverse economic effects of this alternative would be especially strongly felt in that sector of fishery, since catch rates of blue shark are higher there than in tuna-directed longlining.

Alternative 4 would be likely to have serious adverse effects on economic performance in the bottomfish and pelagics fisheries. This is because on-board storage space is limited, storage costs are a function of the amount of fish stored, the duration of a trip is limited by storage space, and the economic performance of a given trip is a function of the gross value of landed fish. The retain-all-finfish requirement would result in a substantial decrease in the gross value of fish landed per trip. This adverse effect would be countered by a strong incentive for fishermen to adopt gears and methods that would cost-effectively avoid bycatch and for the industry to develop markets for less-utilized species. However, it appears unlikely that bycatch reduction resulting from those incentives would fully offset the substantial losses in economic performance. Further, any such positive effects would probably take considerable time to develop, while the adverse impacts would be immediate.

7.1.3 Markets and Consumers

Under Alternative 1, no-action, gear and method innovations may lead to reductions in bycatch rates and markets for less-utilized, commonly discarded species may develop in the future (because there are private economic incentives and because the government may invest in such developments even without this proposed management action). The general effects of supply-side bycatch reduction would be an improvement in vessel economic performance and a possible consequent decrease in prices to consumers. The general effects of market-side developments would be an increase in the variety of products available on the market, an increase in prices of the new products, and ignoring other factors, possibly a decrease in prices of well-established products for which the new products would substitute (to the extent that such substitution occurs).

As with the likely effects on bycatch and economic performance of the fisheries, the impacts of Alternative 2 on markets and consumers are likely to be similar to those of Alternative 1, but the likelihood, magnitude, and pace of any such bycatch-reducing effects and consequent impacts are likely to be greater than under Alternative 1.

Alternatives 3 and 4 would potentially have moderate to severe impacts on markets, depending in the case of Alternative 3 on the level at which the blue shark limit is set, and in both cases, on the degree to which vessel economic performance is adversely effected, the volume of landings is reduced, and prices of fish products increase. These adverse impacts would be countered to the extent that either alternative leads to the development of new markets for less-utilized species. Depending on the level of the blue shark discard limit, Alternative 3 could result in seasonal shifts in fishing effort – both by area and magnitude – as a result of the longline fleet having the incentive to fish hard north of 30° N early in the season and then either move south or stop fishing after the fleet-wide limit is reached. Any such seasonal shifts in fishing effort would be likely to result in seasonal shifts in the composition of products available on the market, as well as in their prices (other factors being equal, prices of pelagic fish products would be relatively low early in the calendar year and relatively high late in the year).

7.2 Impacts on Target and Non-target Fish Stocks

Under Alternative 1, no-action, it is likely that innovations in fishing gears, methods, and strategies would lead to reductions in bycatch rates and that markets for currently discarded species would continue to develop in the future (because there are private economic incentives and because the government may invest in such developments even without this proposed management action). Any effects stemming from these developments would be felt primarily by non-target species. Target species are discarded generally only if damaged or if undesirable sizes. The only innovations that would affect percentage bycatch rates of target species would be those that reduce predation on target species (reducing unobserved mortality and damaged catch) or improve size selectivity. Absolute bycatch rates of target species are a function of both the percentage bycatch rates and overall catch rates, but the no-action alternative is unlikely to effect any substantial changes in the latter. The bycatch-related innovations and developments described above would result in reductions in percentage bycatch rates of non-target species (market developments would give value to undesired species, effectively changing their status to target species, or at least make them less undesirable). In cases (species/area/gear) where the bycatch mortality rate is less than 100%, and assuming constant overall catch rates, this would result in an increase in fishing mortality of those species, thereby increasing the risk of overfishing the stock. None of the stocks subject to capture in the bottomfish and pelagic fisheries have been determined to be overfished or approaching an overfished condition, so the risk of overfishing from any such effect appears to be small. Blue shark is a good example. The state and federal finning bans resulted in dramatic increases in the percentage and absolute bycatch rates of blue shark, as it became much less cost-effective to retain them. Although the bycatch rate increased, the mortality rate decreased, since some (or most) blue sharks are likely to survive after being discarded. Any fishing innovation or market development that serves to reduce blue shark bycatch would reverse the finning ban's effect on fishing mortality. With regard to the risk of overfishing, a recent stock assessment indicates that the blue shark stock was not at risk of being overfished under the pre-finning-ban level of fishing mortality (Kleiber et al. 2001), so even with positive bycatch-related developments in the future, the risk to the blue shark stock would be small (ignoring any changes in the non-US fisheries that also exert fishing effort on the stock). Because the assessment of bycatch would be likely to improve in the future under the no-action alternative (because the Council and NMFS are likely to continue to improve the bycatch reporting methodology even in the absence of formal management action), the ability of fishery managers to identify bycatch-related threats to target and non-target fish stocks is likely to improve in the future.

The impacts of Alternative 2 on target and non-target fish stocks are likely to be similar to those of Alternative 1, but the likelihood, magnitude, and pace of bycatch-reducing effects and consequent impacts are likely to be greater than under Alternative 1.

Alternative 3, which would establish a limit on the number of blue sharks that could be discarded annually north of 30º N by the Hawaii-based longline fleet, would be likely to result in lower catch rates, absolute bycatch rates, and fishing mortality rates on blue sharks than under the no-action scenario, with the magnitude of the differences dependent on the level at which the limit is set. Given that the Hawaii-based longline fleet is a small component of total fishing effort on the North Pacific blue shark stock, its impact on the population as a whole would be relatively small. To the extent that the limit causes a reduction in fleet-wide fishing effort, this alternative would result in smaller catches of all species caught in the fishery than under the no-action alternative (assuming that yield is on the "safe" side of the yield-on-effort curve) and smaller risks of overfishing on all species captured in the fishery.

Alternative 4 would be likely to result in substantially lower absolute bycatch rates of all species captured in the Hawaii-based longline fishery and the Hoomalu Zone bottomfish fishery than under the no-action alternative. However, as described in Section 7.1.1, it would also be likely to result in greater percentage – and in some cases, absolute – bycatch mortality rates for many species than under the no-action scenario, because of the requirement for fishermen to land their fish ashore rather than discard them at sea, where they could survive. The effect on the fishing mortality rate for a given species would depend on the proportion of the catch not used, its post-hooking survival rate (i.e., if discarded at sea), and the effect of the alternative on overall fishing effort. For species with low post-hooking survival rates, such as some of the deep bottomfish species, the adverse effect on fishing mortality would be small. There would be strong incentives to develop ways to avoid bycatch in the two fisheries and to develop new markets, which would counter any decreases in fishing effort while decreasing percentage bycatch rates. The likely net outcome of these countervailing effects is difficult to predict.

7.3 Impacts on Ocean and Coastal Habitat and Essential Fish Habitat

None of the alternatives would likely have adverse impacts on essential fish habitat (EFH) or habitat areas of particular concern (HAPC) for species managed under the Pelagics, Bottomfish and Seamount Groundfish, Precious Corals, or Crustaceans Western Pacific Fishery Management Plans. EFH and HAPC for these species groups have been designated as presented in Table 26. None of the alternatives would likely lead to substantial physical, chemical, or biological alterations of these habitats. For the same reason, none of the alternatives is expected to cause substantial damage to ocean or coastal habitats.

Table 26. Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) for species managed under the FMPs for the Pelagics, Bottomfish and Seamount Groundfish, Precious Corals, and Crustaceans Fisheries of the Western Pacific Region

SPECIES GROUP (FMP)	EFH (juveniles and adults)	EFH (eggs and larvae)	HAPC
Pelagics	water column down to 1,000m	water column down to 200m	water column down to 1,000m that lies above seamounts and banks
Bottomfish	water column and bottom down to 400m	water column down to 400m	all escarpments and slopes between 40-280 m, and three known areas of juvenile opakapaka habitat (2 off Oahu and 1 off Molokai)
Seamount Groundfish	(adults only:) water column and bottom from 80 to 600 m, bounded by 29° - 35° N and 171° E - 179° W	(including juveniles:) epipelagic zone (0 to ~200m), bounded by 29° - 35° N and 171° E – 179° W	
Precious Corals	Keahole, Makapu'u, Kaena, Wespac, Brooks, and 180 Fathom gold/red coral beds, and Miloli'i, S. Kauai and Au'au Channel black coral beds	not applicable	Makapu'u, Wespac, and Brooks Bank beds, and the Au'au Channel
Crustaceans	bottom habitat from shoreline to a depth of 100m	water column down to 150m	all banks within the Northwestern Hawaiian Islands with summits less than 30m

All areas are bounded by the shoreline and the outer boundary of the EEZ unless indicated otherwise.

7.4 Impacts on Public Health and Safety

Alternatives 1 and 2 are unlikely to have any impact on public health and safety.

Alternatives 3 and 4 could have a negative impact on public health for two reasons. First, fishermen would be encouraged to dispose of unmarketable fish ashore, increasing demand on landfills. Fish that are destined for dumping on might be kept on vessels without being chilled or frozen, creating unsanitary conditions. Fishermen would have the incentive to sell or use fish that present a health hazard, such as kahala, which are known to sometimes be ciguatoxic. Some low-value species might be stored for long periods of time (using the lowest-cost methods available) in the hopes that they can eventually be sold. The longer they are stored, the greater the likelihood of spoilage and detrimental health effects if consumed.

7.5 Impacts on Protected Species

The extent of interactions on protected species, including sea turtles, marine mammals, and seabirds, with bottomfish and pelagics fisheries – as currently managed – are reviewed in Sections 4.1.1.3 and 4.2.1.3 for the bottomfish and pelagics fisheries, respectively.

Alternative 1 (no action) is likely to result in either unchanged or lower interaction rates (per unit of fishing effort) with protected species in the future, as fishermen have an economic incentive to develop methods and gears that will avoid such interactions and fishery managers have some scope to achieve reductions in bycatch without formal management measures. Future absolute interaction rates (per unit of time) would be a function of both interaction rates per unit of fishing effort and overall fishing effort. Changes in overall fishing effort are difficult to predict. For the same reasons cited above, percentage survival rates of protected species involved in interactions would remain constant or decrease in the future, the latter with the effect of decreasing absolute mortality rates of those species.

Alternative 2 (preferred), which would implement a number of non-regulatory measures aimed at reducing bycatch and protected species interactions, is likely to have effects similar to those of Alternative 1, but the likelihood, magnitude, and pace of any such beneficial changes on interaction and mortality rates would be somewhat greater than under Alternative 1, since the FMPs would provide more explicit mandates for fishery managers to pursue opportunities for bycatch reduction.

Alternative 3, which would establish a fleet-wide limit on blue shark discards north of 30° N in the Hawaii-based longline fishery, would likely result in somewhat smaller absolute protected species interaction rates in that fishery than under the no-action alternative, as the restriction would probably serve to somewhat constrain overall fishing effort.

Alternative 4, which would require that all finfish be retained in the Hawaii-based longline fishery and the Hoomalu Zone bottomfish fishery, would likely result in substantially smaller absolute protected species interaction rates in those fisheries than under the no-action alternative, as the restriction would probably serve to substantially constrain overall fishing effort.

7.6 Impacts on Biodiversity and Ecosystem Function

To the extent that the pelagic and bottomfish fisheries have any impact on biodiversity and ecosystem function, such impacts are a function of both the total fishing mortality on various components of the ecosystem and the distribution of the mortality among those components (the more disproportional the distribution among components, the more likely the ecosystem will be altered in form and function).

At the recent levels of fishing mortality, there do not appear to be any serious concerns about ecosystem function or about the continued existence of any species subject to capture in the bottomfish and pelagic fisheries. The impacts of the action alternatives on fishing mortality are difficult to predict, as they depend on whether improvements in utilization would outweigh improvements in fishing selectivity and bycatch mortality. Whichever way they go, the impacts of Alternatives 1 and 2 on fishing mortality would likely be small and similar. Alternative 3 would – depending on the level of the discard limit – possibly result in substantially lower fishing mortality rates for some species than under the no-action alternative – and thus greater abundance and lower likelihood of being extirpated. Alternative 4 would likely result in substantially lower fishing mortality rates for some species, but for commonly discarded species with substantial post-hooking survival rates, it could result in greater mortality rates than the no-action alternative.

Any measure that succeeds at reducing bycatch or bycatch mortality would likely result in even greater unevenness in the distribution of fishing mortality among components of the ecosystem – that is, the fishery would become more selective among species, sexes, or sizes. While the direct effect on the species experiencing less fishing mortality would be positive, it is conceivable that there would be an adverse impact on the structure and function of the ecosystem as a whole (e.g., by changing predator-prey dynamics). All the action alternatives, which share the objective of increasing fishery selectivity, have the possibility of causing such adverse impacts. However, given the healthy status of fished stocks and the relatively small changes in selectivity that would result from any of the alternatives, the likelihood of any such adverse impact is small.

7.7 Cumulative Impacts

Council-managed bottomfish fisheries comprise a significant source of fishing mortality for both target and non-target stocks. By contrast, the Council-managed pelagic fisheries contribute only a small proportion of total stock-wide fishing effort and mortality for both target and non-target stocks. Foreign vessels fishing on the high seas and in the EEZs of other Pacific Island nations contribute the bulk of total pelagic fishing effort and mortality. Council-managed pelagic and bottomfish fisheries are a relatively small source of mortality for protected species. Any adverse impacts stemming from bycatch and protected species interactions in the Council-managed bottomfish and pelagic fisheries are therefore in most cases relatively minor, but together with adverse impacts from other sources, cumulative effects occur.

All the action alternatives have the aim of reducing bycatch and bycatch mortality, even if such reductions comprise small portions of total mortality on a given species. Therefore, to the extent that Council-managed fisheries and their management regimes act as models for other fleets and jurisdictions sharing the same stocks, any beneficial effects on bycatch of each of these alternatives could lead to similar effects elsewhere and cumulative positive impacts. By the same token, any failure on the part of the Council and NMFS to implement available and cost-effective bycatch reduction and reporting measures could result in cumulative adverse effects. Because the Council and NMFS are engaged in trans-national management initiatives, any lessons regarding bycatch that are shared through the region – whether from successes or failures – are more likely to result in positive than adverse cumulative effects.

7.8 Areas of Controversy

The objectives of this management action and the measures contained in the alternatives do not appear to have generated any public concern, controversy, or opposition.

7.9 Reasons for Selecting the Preferred Alternative

Except for a few species, such as kahala and butaguchi in the bottomfish fishery and blue sharks in the pelagic longline fishery, bycatch and bycatch mortality rates appear to be relatively low in the fisheries managed under the two FMPs. Percentage and absolute bycatch rates of many finfish species and interaction rates with a number of protected species have decreased over time as a result of a number of management measures. None of the finfish stocks that have substantial bycatch rates appear to be overfished or at risk of being overfished. Section-7 consultations under the ESA and litigation have recently resulted in the implementation of management measures that appear to be dramatically reducing interaction rates with sea turtles and seabirds.

Although no serious bycatch-related problems in the bottomfish or pelagics fisheries have been identified, there appear to be areas, gears, and/or species for which percentage or absolute bycatch or bycatch mortality rates could be cost-effectively further reduced. There also appear to be areas, gears, and/or species for which bycatch and bycatch mortality rates could be cost-effectively better measured. In some fisheries, such as the American Samoa longline fishery, there has been, or there is the potential for, rapid growth, and it would be prudent to pro-actively improve the reduction and measurement of bycatch in those fisheries before bycatch-related problems arise. For these reasons, Alternative 1, the no-action alternative, is rejected.

Alternative 3 would impose a substantial new regulatory burden on the Hawaii-based longline fishery, the largest source of shark bycatch in the Western Pacific Region. The likely result would be decreased earnings to individual vessels and decreased net benefits to the industry and the nation. The measure would require substantial new management costs, both in setting and administering the blue shark discard limit and in ensuring compliance. Given that fishermen would have a strong incentive to underreport blue shark catch, a high level of observer coverage would be required to ensure a reasonable level of compliance. Given that the bycatch mortality rate of blue sharks in the longline fishery is low and the blue shark stock appears not to be at risk of overfishing even under the level of fishing mortality exerted before the finning ban and the swordfish fishery closure, it appears unlikely that that the benefits of Alternative 3 would outweigh the costs. For these reasons, Alternative 3 is rejected.

Alternative 4 would require that all captured finfish in the Hawaii-based longline fishery and the Hoomalu Zone bottomfish fishery be retained. Because there is no market for many of the currently discarded species, much of the catch would probably be thrown away ashore, and that portion of the catch is, by definition, bycatch. For species that have high post-hooking survival rates, such as most of the shark species, the likely result would be an increase in the percentage bycatch mortality rate, and depending on the proportion of the catch thrown away and the post-hooking mortality rate, possibly an increase in the absolute bycatch mortality rate. For species with low post-hooking survival rates, such as some of the deep bottomfish species, the result is likely to be a decrease in the absolute bycatch mortality rate. There would be a substantial incentive for fishermen to violate the no-discard requirement (and therefore to underreport their catch), and a high level of observer coverage would consequently be needed to ensure a reasonable level of compliance. Net returns to fishermen would almost certainly decline as fishermen are forced to fill cold storage space or deck space with fish of low or zero value. Consumers might be provided with a greater variety of products, and possibly relatively low-cost products, but since fishermen would be effectively forced to reduce their landings of high-value species, prices for those products would probably increase, and because the cost of fishing would increase, prices in general would tend to increase. The primary benefits of this alternative would be that it would markedly increase the incentive for fishermen to avoid catching undesirable species or sizes (e.g., through modified gears or methods) and for the industry to develop new markets for the less-utilized species. It is not possible to forecast the degree to which, and pace at which, these positive impacts are likely to occur. It appears unlikely that these possible benefits would outweigh the substantial adverse effects of the measure in the foreseeable future. Furthermore, both these benefits – decreases in the catchability of undesired species and the development of markets for low-value species – could be pursued through non-regulatory means, as proposed in Alternative 1. For these reasons, Alternative 4 is rejected.

Alternative 2 proposes a set of non-regulatory measures that would likely result in a reduction in percentage and/or absolute bycatch or bycatch mortality rates. It would do so by raising fishermen's awareness of bycatch-related issues and of action they can take to minimize bycatch. The Council and NMFS would also consider implementing non-regulatory incentives to reduce bycatch, explore and develop new gear and method variants, and develop markets for discarded species. The bycatch reporting methodology would also continue to be improved.

It is important to note that the reliability of data reported by fishermen is a function of the costs and benefits to them of reporting accurately. Once a rule is imposed as to whether a given species or size may be retained or discarded, the reliability of logbook and creel survey data regarding those species or sizes is compromised. For example, logbook data cannot, in general, be relied on alone to measure interactions with protected species. To the extent that bycatch can be minimized through non-regulatory means, there is the considerable advantage of having fishermen provide high quality data with a minimum of rules and attendant enforcement.

Given the apparent lack of serious bycatch-related problems in these fisheries, the non-regulatory measures of Alternative 2 appear to be appropriate at this time. The existing bycatch reporting methodology, with its ongoing and planned improvements, would continue to serve to identify specific gears, methods, areas, and seasons where bycatch or bycatch mortality is excessive and can potentially be cost-effectively reduced. For these reasons, Alternative 2 is selected as the preferred alternative.

8. Consistency With National Standards for Fishery Conservation and Management

Section 301 of the MSA establishes ten national standards for fishery conservation and management. FMPs and their associated regulations must be consistent with the National Standards. The degree of consistency of the measures proposed in the preferred alternative (Alternative 2) is discussed below.

(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.

The proposed measures are not directly aimed at preventing overfishing or achieving optimum yield. But to the extent that the measures are successful in reducing bycatch and bycatch mortality and consequently fishing mortality—particularly on species that are typically discarded—they would reduce the risk of overfishing those stocks.

(2) Conservation and management measures shall be based on the best scientific information available.

The proposed measures have been developed based on the best available bycatch data from Council-managed fisheries and other fisheries in the region. Information sources include vessel observer programs, logbook programs, creel surveys, and fishery-independent surveys and research.

(3) To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

The proposed measures have been developed with recognition of the stock characteristics of the MUS and non-MUS affected by the fisheries. Bottomfish stocks in the Hawaiian Islands are recognized as a single archipelago-wide stock. Pelagics stocks are trans-boundary, occurring in the EEZs of other nations and in the waters of the high seas. These characteristics have been taken into account.

(4) Conservation and management measures shall not discriminate between residents of different States. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges. The proposed measures will not discriminate between residents of different States.

The proposed measures would not discriminate between residents of different states or assign fishing privileges.

(5) Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.

The proposed measures would have the overarching goals of reducing bycatch and bycatch mortality. One objective would be to improve the efficient utilization of the portions of the catch that are typically discarded. Further, the proposed measures would allow fishermen to choose the least-cost solutions to improving bycatch reduction, thereby encouraging efficiency in fishing operations.

(6) Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources and catches.

The proposed measures have accounted for the differing characteristics of the various fishing sectors, including their relative contributions to bycatch, as well as the uncertainties associated with the measurement of bycatch and bycatch mortality and with the assessment of the adverse effects of bycatch and bycatch mortality. The measures are conservative with respect to the contingencies associated with the viability of fish stocks and protected species in that they seek to further reduce bycatch and bycatch mortality even where bycatch is believed not to be a serious problem. At the same time, the measures are conservative with respect to the contingencies associated with economic performance, participation by fishermen, and seafood markets in that they seek bycatch reduction through non-regulatory means.

(7) Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

The proposed measures would not impose new regulations. Many of the outreach, research, and information system components of the measures would be incorporated into ongoing programs and activities of the Council, NMFS, and the local fisheries agencies, with minimal additional costs. Consideration of possible new activities would take costs into account. The measures would compliment and not duplicate any existing measures.

(8) Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

The proposed measures have taken into account the importance of fishery resources to fishing communities, for example by placing preference on bycatch reduction solutions that would have minimal adverse impact on participation in the affected fisheries.

(9) Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

The proposed measures would have the overarching goals of reducing bycatch and bycatch mortality. The amendments would include documentation of current bycatch and bycatch reporting, recent improvements in bycatch and bycatch reporting, and non-regulatory measures for further reducing bycatch and improving bycatch reporting.

(10) Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

The proposed measures would have no effect on the health and safety of human life at sea.

9. Relationship to Other Applicable Laws and Provisions of the Magnuson-Stevens Act

9.1 National Environmental Policy Act (NEPA)

This document has been prepared in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969 to assess the impacts on the human environment that may result from the proposed action. It contains the elements consistent with an Environmental Assessment (EA), including an assessment of the likely impacts of a range of alternatives. This serves as a determination of the need for an Environmental Impact Statement. NEPA requires preparation of an Environmental Impact Statement if the EA does not support a finding of no significant impact.

The purpose and need for action is described in Section 3 of this document. A description of the affected environment is provided in Section 5. A description of the alternatives considered is in Section 6. A discussion of the likely impacts of the alternatives is in Section 7.

9.1.1 Conclusions and Determination (Finding of No Significant Impact)

a. The preferred alternative is not expected to adversely impact the bottomfish or pelagic fisheries in terms of bycatch, economic performance, or markets and consumers, as it will encourage the reduction and assessment of bycatch through means that are cost-effective to fishery participants (Section 7.1).

b. The preferred alternative is not expected to jeopardize the sustainability of any target or non-target fish stocks, since for many stocks it will likely result in lower fishing mortality rates, and for those stocks where it results in greater fishing mortality, the impact will likely be minor relative to the productivity of the stocks (Section 7.2).

c. The preferred alternative is not expected to cause substantial damage to ocean and coastal habitats or essential fish habitat as defined under the Magnuson-Stevens Act and identified in FMPs, as it is not likely to lead to substantial physical, chemical, or biological alterations of these habitats (Section 7.3).

d. The preferred alternative is not expected to have a substantial adverse impact on public health or safety, as it would not affect any public health or safety aspect of the fishery or associated economic sectors (Section 7.4).

e. The preferred alternative is not expected to adversely affect any species protected under the Endangered Species Act or their critical habitat or any species protected under the Marine Mammal Protection Act or the Migratory Bird Treat Act. If the preferred alternative has any effects at all on protected species, they are likely to be lower relative interaction rates and higher post-interaction survival rates, and thus lower mortality rates (Section 7.5).

f. The preferred alternative is not expected to have a substantial impact on biodiversity or ecosystem function within the affected area, as it is not likely to result in a substantial increase in fishing effort or catch or change in catch composition or impact on habitat (Section 7.6).

g. The preferred alternative is not expected to result in any cumulative adverse effects. To the extent that the preferred alternative succeeds at reducing and assessing bycatch, any cumulative effects are likely to be positive, as the measures would serve as a model for other countries with jurisdiction over the stocks managed under the FMPs (Section 7.7).

h. The preferred alternative is not controversial, as it does not appear to have generated any public concern or opposition (Section 7.8).

Based on the information contained in the Environmental Assessment and other sections of this document, I have determined that the preferred alternative, which would seek to reduce bycatch and bycatch mortality and improve the assessment of bycatch in the Bottomfish and Seamount Groundfish Fisheries and Pelagics Fisheries of the Western Pacific Region by amending the Fishery Management Plans for those fisheries to include a number of non-regulatory measures, including outreach to fishermen, consideration of incentive programs, fishing gear and method research, market research, and improvement of data collection and analysis systems, is consistent with existing national environmental policies and objectives set forth in sections 101(a) and 101(b) of the National Environmental Policy Act and will not have a significant impact on the quality of the human environment. As described in section 5.03.c of NOAA Administrative Order 216-6, a Finding of No Significant Impact is supported and appropriate for the preferred alternative. Therefore, preparation of an Environmental Impact Statement for the preferred alternative is not required by Section 102(c) of the National Environmental Policy Act or its implementing regulations.

__________________________________ ____________

William T. Hogarth — Date
NOAA Assistant Administrator for Fisheries

9.2 Regulatory Impact Review (RIR)

Executive Order 12866 requires that long-term national net costs and benefits of significant regulatory actions be assessed through the preparation of a Regulatory Impact Review (RIR). The preferred alternative in these amendments does not propose any regulatory changes, so an RIR is not required. Alternatives 3 and 4 do propose regulatory changes, so if either of those alternatives is selected, or if in the future regulatory action related to the reduction and measurement of bycatch is proposed, the necessary RIR will be completed.

9.3 Regulatory Flexibility Act (RFA)

The Regulatory Flexibility Act (RFA), 5 U.S.C. 601 *et seq*., requires government agencies to assess the impact of their proposed regulations on small entities, including small businesses, small non-profit organizations, and small governments. The preferred alternative in these amendments does not propose any regulatory changes, so an RFA analysis is not required. Alternatives 3 and 4 do propose regulatory changes, so if either of those alternatives is selected, or if in the future regulatory action related to the reduction and measurement of bycatch is proposed, the necessary RFA analyses will be completed.

9.4 Coastal Zone Management Act (CZMA)

The CZMA requires a determination that a FMP or amendment has no effect on the land or water uses or natural resources of the coastal zone, or is consistent to the maximum extent practicable with an affected state's approved coastal zone management program. A copy of the proposed amendments will be submitted to the appropriate agencies in American Samoa, Commonwealth of the Northern Mariana Islands, Guam, and Hawaii for review and concurrence with a determination made by the Council that the amendments are consistent, to the maximum extent practicable, with the coastal zone management programs of those jurisdictions.

9.5 Endangered Species Act (ESA)

Several species listed as endangered or threatened under the Endangered Species Act (ESA) occur in the areas fished by the bottomfish and pelagics fisheries. These include marine mammals, sea turtles and seabirds. The species of concern are:

Marine Mammals	**Status**
Hawaiian monk seal (*Monachus schauinslandi*)	Endangered
Humpback whale (*Megaptera novaeangliae*)	Endangered
Sperm whale (*Physeter macrocephalus*)	Endangered
Northern Pacific right whale (*Eubalaena japonica*)	Endangered
Blue whale (*Balaenoptera musculus*)	Endangered
Fin whale (*Balaenoptera physalus*)	Endangered
Sei whale (*Balaenoptera borealis*)	Endangered
Sea Turtles	
Green turtle (*Chelonia mydas*)	Threatened/Endangered
Hawksbill turtle (*Eretmochelys imbricata*)	Endangered
Leatherback turtle (*Dermochelys coriacea*)	Endangered
Loggerhead turtle (*Caretta caretta*)	Threatened
Olive Ridley turtle (*Lepidochelys olivacea*)	Threatened/Endangered
Seabirds	
Short-tailed albatross (*Phoebastria albatrus*)	Endangered
Newell's shearwater (*Puffinus auricularis newelli*)	Endangered

Interactions between ESA-listed species and the bottomfish and pelagics fisheries are reviewed in Sections 4.1.1.3 and 4.2.1.3, respectively. The effects of the bottomfish and pelagics fisheries on the marine mammals and sea turtles listed above are reviewed in recent Biological Opinions issued by NMFS (2002b and 2001a). The relationship between ESA-listed species and the bottomfish and pelagics fisheries are also discussed in NEPA documents, including the FEIS for the pelagics fishery (NMFS 2001b) and a Preliminary DEIS for the bottomfish fishery (WPRFMC 2001b). The likely impacts of each of the four management alternatives on ESA-listed species are discussed below.

Alternative 1 (no action) is likely to result in either unchanged or lower interaction rates (per unit of fishing effort) with protected species in the future, as fishermen have an economic incentive to develop methods and gears that will avoid such interactions and fishery managers have some scope to achieve reductions in bycatch without formal management measures. Future absolute interaction rates (per unit of time) would be a function of both interaction rates per unit of fishing effort and overall fishing effort. Changes in overall fishing effort are difficult to predict. For the same reasons cited above, percentage survival rates of protected species involved in interactions would remain constant or decrease in the future, the latter with the effect of decreasing absolute mortality rates of those species.

Alternative 2 (preferred), which would implement a number of non-regulatory measures aimed at reducing bycatch and protected species interactions, is likely to have effects similar to those of Alternative 1, but the likelihood, magnitude, and pace of any such beneficial changes on interaction and mortality rates would be somewhat greater than under Alternative 1, since the FMPs would provide more explicit mandates for fishery managers to pursue opportunities for bycatch reduction.

Alternative 3, which would establish a fleet-wide limit on blue shark discards north of 30° N in the Hawaii-based longline fishery, would likely result in somewhat smaller absolute protected species interaction rates in that fishery than under the no-action alternative, as the restriction would probably serve to somewhat constrain overall fishing effort.

Alternative 4, which would require that all finfish be retained in the Hawaii-based longline fishery and the Hoomalu Zone bottomfish fishery, would likely result in substantially smaller absolute protected species interaction rates in those fisheries than under the no-action alternative, as the restriction would probably serve to substantially constrain overall fishing effort.

9.6 Marine Mammal Protection Act (MMPA)

The Bottomfish and Pelagic Fisheries of the Western Pacific Region are classified as Category III under Section 118 of the Marine Mammal Protection Action of 1992 (MMPA) (62 FR 28657 and 66 FR 42780), meaning that the fisheries were determined by NMFS “to have a remote likelihood of, or no known incidental mortality and serious injury of marine mammals” (50 CFR 229.2). Vessel owners and crew that are engaged only in Category III fisheries may incidentally take marine mammals without registering or receiving an Authorization Certificate under the MMPA, but they are required to: 1) report all incidental mortality and injury of marine mammals to NMFS, 2) immediately return to the sea with minimum of further injury any incidentally taken marine mammal, 3) allow vessel observers if requested by NMFS, and 4) comply with guidelines and prohibitions under the MMPA when deterring marine mammals from gear, catch, and private property (50 CFR 229.5, 229.6, 229.7).

Any species listed as endangered or threatened under the ESA is considered to be depleted under the MMPA, and any incidental take of that species must be authorized under Section 101(a)(5) of the MMPA, subject to a determination by the Secretary of Commerce that any incidental mortality or serious injury will have a negligible impact on the affected species or stock and that a recovery plan has been developed or is being developed under the ESA for the species or stock. Such incidental take for the Hawaiian monk seal has not yet been authorized for the bottomfish fisheries, and there is no need for such authorization in either fishery for any other ESA-listed marine mammals.

Species of marine mammals that are protected under the MMPA but not listed as threatened or endangered and that occur in the areas where the bottomfish and pelagic fisheries operate include the following:

Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)
Rough-toothed dolphin (*Steno bredanensis*)
Risso's dolphin *(Grampus griseus*)
Bottlenose dolphin (*Tursiops truncatus)*
Spotted dolphin (*Stenella attenuata*)
Spinner dolphin (*Stenella longirostris*)
Striped dolphin (*Stenella coeruleoalba*)
Melon-headed whale (*Peponocephala electra*)
Pygmy killer whale (*Feresa attenuata*)
False killer whale (*Pseudorca crassidens*)
Killer whale (*Orcinus orca*)
Pilot whale *(Globicephala melas*)
Blainsville's beaked whale *(Mesoplodon densirostris*)
Cuvier's beaked whale (*Ziphius cavirostris*)
Pygmy sperm whale (*Kogia breviceps*)
Dwarf sperm whale (*Kogia simus*)
Bryde's whale (*Balaenoptera edeni*)

Of the above, only the bottlenose dolphin has been documented interacting with the bottomfish fishery, often taking fish from hooks, as recorded during the 1990-1993 NWHI vessel observer program (Nitta 1999). Several sightings of spinner dolphin were made during the observer program but no interactions were observed (Nitta 1999) (see Section 4.1.1.3).

Interactions between marine mammals and the longline fisheries are relatively are events. NMFS observers in the Hawaii-based longline fishery reported about 20 dolphin and whale interactions in 3,813 longline sets observed between 1994 and 2000. This represents one interaction for every 190 longline sets. This rate is probably higher than the actual fleet-wide rate because vessels engaged in swordfish fishing received more observer coverage than tuna-fishing vessels, and the former is known to have higher interaction rates with marine mammals than the latter. The observed interaction rate for tuna-targeting sets was one whale/dolphin interaction per 521 sets, compared with one whale/dolphin interaction per 116 swordfish or mixed sets. When expanded to the Hawaii-based longline fleet as a whole, the observer data suggest that there were probably at most 60 interactions per year with whales and dolphins (Kleiber, 1998). With the recent closure of the swordfish-directed fishery, the rate has probably decreased.

Alternatives 1 (no action) is likely to result in either unchanged or lower interaction rates (per unit of fishing effort) with marine mammals in the future, as fishermen have an economic incentive to develop methods and gears that will avoid such interactions and fishery managers have some scope to achieve reductions in bycatch without formal management measures. Future absolute interaction rates (per unit of time) would be a function of both interaction rates per unit of fishing effort and overall fishing effort. Future changes in overall fishing effort are difficult to predict. For the same reasons cited above, percentage survival rates of marine mammals involved in interactions can also be expected to remain constant or decrease in the future, the latter with the effect of decreasing absolute mortality rates of marine mammals.

Alternative 2 (preferred), which would implement a number of non-regulatory measures aimed at reducing bycatch and marine mammal interactions, is likely to have effects similar to those of Alternative 1, but the likelihood, magnitude, and pace of any such beneficial changes on interaction and mortality rates would be somewhat greater than under Alternative 1, since the FMPs would provide more explicit mandates for fishery managers to pursue opportunities for bycatch reduction.

Alternative 3, which would establish a fleet-wide limit on blue shark discards north of 30° N in the Hawaii-based longline fishery, would likely result in a somewhat smaller absolute marine mammal interaction rate in that fishery than under the no-action alternative, as the restriction would probably serve to somewhat constrain overall fishing effort.

Alternative 4, which would require that all finfish be retained in the Hawaii-based longline fishery and the Hoomalu Zone bottomfish fishery, would likely result in substantially smaller absolute marine mammal interaction rates in those fisheries than under the no-action alternative, as the restriction would probably serve to substantially constrain overall fishing effort.

9.7 Executive Order 13089

Executive Order 13089 on Coral Reef Protection directs federal agencies to use their authorities to protect coral reef ecosystems and, to the extent permitted by law, prohibits them from authorizing, funding or carrying out any action that will degrade these ecosystems. All four alternatives considered in these amendments are consistent with the objectives and recommendations of this Executive Order. The bottomfish and pelagics fisheries mostly operate outside of coral reef ecosystems, although the bottomfish fisheries operate in close proximity and both have the potential to affect coral reef ecosystems through ecosystem links. None of the alternatives considered are likely to result in an increase in fishing operations in or near coral reef ecosystems, and none are likely to result in fishing gear or method modifications that would increase fishing-related impacts on coral reef ecosystems. All the considered alternatives have the aim of reducing the catch and mortality of unwanted species. Coral reef-associated species are generally unwanted in the bottomfish and pelagics fisheries, so to the extent that the measures are successful, the catch and mortality of coral reef-associated species is likely to be reduced. For these reasons, none of the alternatives is likely to have the effect of degrading coral reef ecosystems.

9.8 Paperwork Reduction Act (PRA)

The purpose of the Paperwork Reduction Act of 1995 is to minimize the paperwork burden on the public. The Act requires federal agencies to ensure that information collected from the public is needed and is collected in an efficient manner (44 U.S.C. 3501 (1)).

None of the alternatives considered in these amendments would impose new record keeping or reporting requirements on the public. Alternative 1 would take no action. Alternative 2 (preferred) would seek bycatch reduction through non-regulatory means and would not impose any additional record keeping or reporting requirements. Alternative 3, which would impose an area-based limit on blue shark discards, would rely on fishery participants in the Hawaii-based longline fishery to keep track of their discards, but such reporting is already required under federal law. Alternative 4, which would impose a retain-all-finfish requirement, would rely primarily on at-sea enforcement to ensure compliance and would not impose any new reporting requirements.

9.9 Traditional Indigenous Fishing Practices

The Magnuson-Stevens Act requires the Council to take into account traditional fishing practices in preparing any FMP or amendment.

None of the alternatives considered in these amendments would adversely affect traditional indigenous fishing practices in the Western Pacific Region. Section 305(i) of the MSA provides for the establishment of a Western Pacific Community Development Program for any fishery under the authority of the Council. This provision results from concern that communities consisting of descendants of indigenous peoples in the Western Pacific Region have not been appropriately sharing in the benefits from the area's fisheries. The Council and the Secretary have the discretion to develop and approve programs for eligible communities for the purpose of enhancing access to the fisheries under the authority of the Council.

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Appendix 1. Bycatch Data Collection Forms

Included in the appendix are the forms used in the data collection programs for bycatch measurement in the bottomfish and pelagics fisheries. Some of the programs may use additional forms; only those related to the measurement of bycatch are included here. The forms included here are the versions currently in use, with the exception of those marked (*), which are versions with proposed revisions that are likely to start being used in late 2002. All the forms are subject to change.[22]

A1.1 Bottomfish and Seamount Groundfish Fisheries

Observer programs
(none currently active)

Logbook programs

Creel surveys

[22] Indicated in the list below for each data collection program is the primary agency responsible for its implementation; see Sections 4.1.2 and 4.2.2 for the bottomfish and pelagic fisheries, respectively, for the roles of other agencies (ASDMWR = American Samoa Department. of Marine and Wildlife Resources; CNMIDFW = CNMI Division of Fish and Wildlife; GDAWR = Guam Division of Aquatic and Wildlife Resources; HDAR = Hawaii Division of Aquatic Resources; NMFS = National Marine Fisheries Service; SPC = Secretariat of the Pacific Community; USFWS = US Fish and Wildlife Service).

A1.2 Pelagic Fisheries

[23] This form, included in the Multilateral Treaty on Fisheries between Pacific island States and the United States, specifies the information that US purse seiners are obliged to report under the terms of the treaty.

[24] This form, produced by the Secretariat of the Pacific Community's Oceanic Fisheries Program, is completed by all purse seiners operating in the Central and Western Pacific, including the US purse seiners.