CHAPTER 2

ALTERNATIVES INCLUDING PROPOSED FEDERAL ACTION

CHAPTER 2 ALTERNATIVES

Chapter 2 presents the alternatives for management of the U.S. pelagic fisheries in the Western Pacific Region that are evaluated in this Environmental Impact Statement (EIS). The National Environmental Policy Act (NEPA) requires that a wide range of alternative actions to meet management objectives (see section 2.3) be explored and rigorously evaluated. If alternatives have been eliminated from detailed analysis, the EIS must discuss the reasons for elimination. Alternatives must include the "no action" alternative, meaning continuation of the current course of action without a change in management. The environmental consequences of each alternative are then evaluated in the EIS and a preferred alternative is identified.

The alternatives were developed to reflect the purpose and need for the action presented in Chapter 1 of this EIS. Also considered were the objectives of the Fishery Management Plan for the Pelagic Fisheries of the Western Pacific Region (Pelagics FMP) and the requirements for monitoring and updating the plan; issues and direction identified in recent litigation; issues identified in pending Pelagics FMP regulatory adjustments; and issues identified through the scoping process. In order to systematically develop reasonable alternatives, this chapter presents a summary of the fisheries managed under the Pelagics FMP, the management objectives of the FMP, and measures with potential for furthering the objectives. Ten alternatives, plus an option for fishing experiments, are then presented and discussed for evaluation in Chapter 4 of this EIS. Figure 2-2 at the end of this chapter compares the alternatives based on their estimated direct effects on sea turtle and albatross takes in the Hawai'i-based longline fishery. Table 2-21 at the end of this chapter summarizes the predicted direct, indirect and cumulative impacts on the human environment of management alternatives for the pelagic fisheries of the Western Pacific Region.

Alternative 1 is the no additional action baseline against which the other alternatives are compared in Chapter 4. It represents the management regime of the Pelagics FMP that existed prior to December 27, 1999, the date of implementation of emergency rules ordered by the Court. The Court-ordered modifications of the FMP management regime are represented in Alternative 3, which is essentially the current status quo. Independent of Court-ordered actions, Alternative 1 is also being modified by management actions taken by the Western Pacific Regional Fishery Management Council (Council), National Marine Fisheries Service (NMFS) and the U.S. Congress. This dynamic situation is represented by Alternative 2. Many of the control measures included in Alternative 2 have been analyzed in environmental documents separate from this EIS and some of the proposed measures may continue to be modified after EIS preparation, thereby requiring additional

environmental assessments. The purpose for including Alternative 2 in the present EIS is twofold: (1) to avoid the piecemeal approach that has characterized previous environmental analyses of Pelagics FMP amendments and present a comprehensive examination of the FMP, even as it continues to evolve; and (2) to address possible effects of the individual control measures in Alternative 2 on each other. Table 2-1 summarizes the measures included in Alternative 2, their status (as of EIS preparation) and related source documents.

Table 2-1: Federal management measures included in Alternative 2.

Management Issue	Control Measure	Status of Proposed Action	Related Source Documents
Pelagic shark conservation	Shark fins cannot be possessed onboard fishing vessels or landed in U.S. ports by fishing vessels without a corresponding weight of shark carcasses.	Shark Finning Prohibition Act (P.L. 106-557) became law in Jan. 2001. NMFS regulations pending.	
	Quota of one pelagic shark (other than blue shark) landed per fishing trip by Hawai'i-based longline vessels. Must be landed whole or dressed. Bottom-set longline fishing prohibited in existing longline prohibited areas around the Northwestern Hawaiian Islands (NWHI) and the Main Hawaiian Islands (MHI).	FMP Amendment 9 revised by Council February 2001.	WPRFMC, 2000b WPRFMC, 2001b
Protected species education	Hawai'i-based longline vessel owners/captains must annually complete protected species education and training workshops conducted by NMFS.	Pelagics FMP regulatory adjustment proposed by Council	WPRFMC, 1999c WPRFMC, 2001a
		Part of Reasonable and Prudent Alternative (RPA) in NMFS' Biological Opinion (BO) for western Pacific pelagic fishePries. NMFS regulations pending.	NMFS, 2001a
		Part of RPA in U.S. Fish and Wildlife Service's (FWS) BO for short-tailed albatross.	FWS, 2000
Reduce fishery interactions with seabirds	Hawai'i-based longline skippers use at least two deterrents from a menu of measures when longline fishing north of 25° N. latitude.	Pelagics FMP regulatory adjustment proposed by Council. NMFS interim final rule pending.	WPRFMC, 1999c WPRFMC, 2001a
	Terms and conditions of FWS' BO for short-tailed albatross require skippers to employ three deterrent measures when longline fishing north of 23° N. latitude.	Part of RPA in FWS' BO for short-tailed albatross. NMFS final rule pending.	FWS, 2000
Avoid gear conflicts	Nearshore areas of Exclusive Economic Zone (EEZ) around American Samoa islands closed to pelagic fishing by large vessels (> 50 ft).	Pelagics FMP regulatory adjustment proposed by Council. Transmitted for NMFS review.	WPRFMC, 2000f
Improve pelagic	Permits and logbook reporting (including	Pelagics FMP amendment	WPRFMC, 2000g

The alternatives are intended to bracket a wide range of potential fishery and management impacts, including the specific concern raised by CMC v NMFS about Hawai'i-based longline fishery interactions with sea turtles listed as threatened or endangered species under the Endangered Species Act. They are comprehensive in nature in that they consider a range of protected species incidental catch, of pelagic fish species bycatch, of potential conflicts with gear and catch interactions, and of associated economic effects on the fishing industry and fishing communities. Chapter 4 compares the potential effects of each of the alternatives with the no-action baseline represented by the FMP management regime (Alternative 1) prior to the Court-ordered actions. The results of Chapter 4 analyses are summarized in Table 2-21 at the end of this chapter. Alternatives that were considered but not analyzed in detail are also addressed.

The alternatives were formulated based on the following sequence of analysis:

(1) Identify all Pelagics FMP-managed fisheries (Section 2.1) and assess their status in relation to the FMP objectives and other relevant objectives and issues, and identify needs not adequately addressed by the existing management regime (Section 2.3).

(2) Consider the potential of various possible control measures to meet the identified needs and further management objectives (Section 2.4).

(3) Define a range of alternatives that incorporate control measures likely to be effective (Section 2.2) and eliminate other alternatives that will be not considered in detail (Section 2.5).

Table 2-2 provides an overview of the alternatives and highlights their most significant direct effects.

Table 2-2: Overview of Alternatives. HI = Hawai'i; LL = Longline.

Alt 1: Existing FMP (No Additional Action)	Alt 2: Existing FMP Plus Pending Council, NMFS Actions	Alt 3: Court Ordered Action (Status Quo)	Alt 4: Seasonal Area Longline Fishery Closures	Alt 5: Increase Fishing Gear Deployment Depth	Alt 6: Permanent and Seasonal Closure of All Longline Fishery Areas	Alt 7: Increase Gear Deployment Depth, Seasonal Closure of All LL Fishery Areas	Alt 8: Regional Longline Closure	Alt 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries	Alt 10: *(Preferred)* Increase Gear Deployment Depth, Seasonal Area Closure, Restricting HI LL Permit De-registering and Re-registering	Option A: Fishing Experiment
No reg's for domestic troll, handline, pole-and-line, or purse seine "General LL Permit" req'd for LL fishing or landings outside HI Daily logbooks req'd Gear markings req'd Observers req'd if requested LL limited access permit and VMS req'd for Hawai'i-based vessels NWHI 50 nm closure MHI seasonal 25-75 nm closures State of HI law to land shark carcasses with fins intact Total sets = 11,879 Total Revenues = $40.7M Total turtle takes/kills = 716/150 Total albatross mortality = 2235	All reg's, permits, logbooks, gear markings, observers, and area closures as per Alt 1 PLUS: Protected species workshops for HI LL skippers Use of three seabird deterrents in Hawai'i longline fishing north of 23° N. latitude Shark Finning Prohibition Act Large vessel area closure plus limited entry control date for American Samoa Permit/reporting requirements for handline and troll fisheries in PRIAs Total sets = 11,879 Total Revenues = $40.9M Total turtle takes/kills = 716/150 Total albatross mortality = 291	All reg's, permits, logbooks, gear markings, observers, and area closures as per Alt 1 PLUS: Current court ordered time/area HI LL closures Area A: closed Area B: max 154 sets 8/10-12/31, 2000; max 77 sets 1/1-3/14, 2001; 100% observer coverage; closed 3/15-5/31, 2001 or until FEIS completed Area C: no lightsticks; deep sets only; 30% swordfish revenues to charity; 10% observer coverage by 9/21/00; 20% observer coverage by 11/7/00; closed 3/15-5/31, 2001 or until FEIS completed HI LL vessels to carry line clippers, hook cutters and dip nets and use specific methods for handling, resuscitating and releasing sea turtles. Total sets = 6644-9508 Total Revenues = $20.0-28.2M Total turtle takes/kills = 238-311/ 56-75 Total albatross mortality = 379-433	All reg's, permits, logbooks, gear markings, observers, and area closures as per Alt 1, and modified by pending Council / NMFS actions in Alt 2 PLUS: July-Jan closure of areas north of 29° N. latitude to HI LL fishing HI LL vessels to carry line clippers, hook cutters and dip nets and use specific methods for handling, resuscitating and releasing sea turtles Total sets = 11,879 Total Revenues = $39.6M Total turtle takes/kills = 502/110 Total albatross mortality = 221	All reg's, permits, logbooks, gear markings, observers, and area closures as per Alt 1, and modified by pending Council / NMFS actions in Alt 2 PLUS: Require methods to increase water depth of HI LL fishing gear deployment HI LL vessels to carry line clippers, hook cutters and dip nets and use specific methods for handling, resuscitating and releasing sea turtles Total sets = 7640-11,879 Total Revenues = $23.8-37.4M Total turtle takes/kills = 97-168/ 22-37 Total albatross mortality = 14-22	All reg's, permits, logbooks, gear markings, observers, and area closures as per Alt 1, and modified by pending Council / NMFS actions in Alt 2 PLUS: Permanent closure of areas north of 29° N. latitude, April-July closure of all other areas to HI LL fishing HI LL vessels to carry line clippers, hook cutters and dip nets and use specific methods for handling, resuscitating and releasing sea turtles Total sets = 8682 Total Revenues = $29.1M Total turtle takes/kills = 323/77 Total albatross mortality = 221	All reg's, permits, logbooks, gear markings, observers, and area closures as per Alt 1, and modified by pending Council / NMFS actions in Alt 2 PLUS: Require methods to increase water depth of HI LL fishing gear deployment April-May closure of all areas to HI longline fishing HI LL vessels to carry line clippers, hook cutters and dip nets and use specific methods for handling, resuscitating and releasing sea turtles Total sets = 7015-10,692 Total Revenues = $21.5-32.1M Total turtle takes/kills = 78-117/ 19-31 Total albatross mortality = 12-20	The EEZ of all areas covered by the FMP will be closed to Western Pacific General Permit holders and Hawai'i Limited Access Permit Holders. (No landings at ports in the EEZs covered by the pelagics FMP.) Shark Finning Prohibition Act State of HI law to land shark carcasses with fins intact Total sets = 0 Total Revenues = $0.0 Total turtle takes/kills = 0/0 Total albatross mortality = 0	All reg's, permits, logbooks, gear markings, observers, and area closures as per Alt 1 PLUS: Large vessel area closure plus control date for possible limited entry in American Samoa Permit/reporting requirements for handline and troll fisheries in PRIAs Implement a comprehensive research plan that will enable catch interactions among Pelagics FMP-managed fisheries to be more thoroughly evaluated and appropriate management action to be taken Total sets = 11,879 Total Revenues = $40.7M Total turtle takes/kills = 716/150 Total albatross mortality = 2235	All reg's, permits, logbooks, gear markings, observers, and area closures as per Alt 1, and modified by pending Council / NMFS actions in Alt 2 PLUS: Prohibit U.S. longline vessels managed under the Pelagics FMP from: (a) using swordfish-style longline fishing methods north of the equator; (b) using any LL fishing methods during months of April and May in areas south of 15° N. lat. to equator, bounded by 145° W. and 180° long.; (c) de-registering and re-registering vessels from HI LL limited access permits more than once a year. HI LL vessels to carry line clippers, hook cutters and dip nets & use specific methods for handling, resuscitating and releasing turtles; req'mts extended to all U.S. LL vessels managed under Pelagics FMP Specific guidelines for handling/ releasing live sea turtles after capture for all boats fishing with hooks (LL, handline, troll) managed under Pelagics FMP NMFS to continue observer coverage aboard HI LL limited access permit vessels at min. ave. 20% of total annual fishing trips; coverage to expand to LL general permit vessels where feasible Total sets = 7640-11,879 Total Revenues = $23.1-36.0M Total turtle takes/kills = 45-71/11-18 Total albatross mortality = 16-28	Under section 10 Endangered Species Act permit, conduct fishing experiments within a NMFS experimental design and protocol in areas and times or with deployments of longline gear otherwise prohibited by any of Alternatives 4-7, or 10

The next section identifies the fisheries managed under the Pelagics FMP (more detailed descriptions are included in Chapter 3); that is followed by an examination of each of the individual alternatives. A specific discussion of the management objectives and control measures which led to the formulation of the alternatives, and the alternatives considered but not analyzed in detail, conclude the chapter.

2.1 FISHERIES MANAGED UNDER THE PELAGICS FMP

Pelagic fish are harvested by several methods in the Exclusive Economic Zones (EEZs) around the U.S. Pacific islands: purse seine, longline, pole-and-line, troll and handline. The shoreward boundary of the EEZ is measured from the seaward-boundaries of the territorial seas around American Samoa and Guam and the State of Hawai'i, and from the shorelines of other U.S. Pacific islands having no territorial seas. U.S. purse seine vessels fish in the EEZs around American Samoa, and Howland and Baker Islands (two of the U.S. Pacific remote island areas) during *El Niño* episodes but, at other times, they fish outside the EEZ. U.S. longline vessels based in Hawai'i regularly fish for tuna in the EEZs and high seas around Hawai'i, with some longline fishing effort as far south as the EEZ around Palmyra Atoll and Kingman Reef. Other Hawai'i-based longline vessels target swordfish in the high seas north of Hawai'i and seasonally in the high seas offshore of California. A domestic small-scale longline fishery is developing in the EEZ around American Samoa and three domestic vessels based in Guam are preparing to begin longline fishing. In American Samoa (and predicted for Guam), longline gear is deployed so that the maximum depth of the mainline between floats is shallower than 100 m. Domestic handline and troll fisheries for tuna and other pelagic fish species are active in parts of the EEZs around American Samoa, Hawai'i, Guam and the Northern Mariana Islands. Charter and non-charter recreational fishing comprise a large share of the troll fisheries in Hawai'i, Guam and the Northern Mariana Islands (WPRFMC, 1998, 2000a). A limited amount of troll and handline fishing is also conducted in the EEZs around Midway Islands and Johnston and Palmyra Atolls which are managed by the U.S. Department of the Interior Fish and Wildlife Service as national wildlife refuges and off Wake Island, which has been proposed as a new national wildlife refuge. Regulations have been implemented under the Pelagics FMP primarily for the Hawai'i-based longline fishery.

2.2 DESCRIPTION OF ALTERNATIVES

2.2.1 Alternative 1: Existing Pelagics FMP Management Regime (No further action)

Under this alternative, fisheries managed under the Pelagics FMP would return to the management regime that existed prior to December 27, 1999, (the date of implementation of emergency rules ordered by the Court). The management measures then in place for western Pacific pelagic fisheries under the Pelagics FMP, together with regulations currently in place for state and territorial waters, constitute the no action alternative. The Pelagics FMP does not specifically regulate non-longline pelagic fisheries in the western Pacific, including domestic troll, handline, pole-and-line or purse seine fishing activities. If problems

and issues arise in the future in the latter fisheries, the Pelagics FMP could be adjusted as necessary through a regulatory framework procedure. The estimated direct effects on incidental takes of sea turtles and albatross in the Hawai'i-based longline fishery are compared in Figure 2-2 at the end of this chapter. A summary of the direct, indirect and cumulative effects predicted for the alternatives is included in Table 2-21 at the end of this chapter.

The FMP for the Pelagic Fisheries of the Western Pacific Region was published in 1987 (52 FR 5987, March 23, 1987). The FMP includes initial estimates of maximum sustainable yields (MSY) for the stocks and sets optimum yields for these fisheries in the EEZs. The management unit species at the time the FMP was published were billfish, wahoo, *mahimahi*, and oceanic sharks[1]. Tuna species were later designated as fish under U.S. management authority and included in the FMP Management Unit (57 FR 48564, November 1992). Current regulatory measures in place provide that:

- Fishing for pelagic species in the western Pacific EEZs with drift gillnets is prohibited (52 FR 5987, March 23, 1987).
- Each vessel using longline gear to fish for pelagic species in the EEZs around American Samoa, Guam, the Commonwealth of Northern Mariana Islands (CNMI), or other U.S. islands of the western Pacific, and vessels used to transport or land longline-harvested pelagic species shoreward of the outer boundary of these same EEZs, must be registered for use with a general longline permit (CFR 660.16) and must keep daily logbooks (CFR 660.14) detailing species harvested, area of harvest, time of sets, and other information. Also, longline gear used in the western Pacific EEZs must be marked with the official number of the permitted vessel (CFR 660.16) that deploys the gear (56 FR 24731, May 1991).
- Longline vessels must carry a NMFS observer if requested to do so (55 FR 49285, November 1990[2]; 58 FR 67699, December 1993[3]).
- Each vessel that uses longline gear to fish for pelagic species in the EEZ around Hawai'i, or is used to transport or land longline-harvested pelagic species shoreward of the outer boundary of the EEZ around Hawai'i, must

[1] Amendment 1 was drafted in response to the Secretary of Commerce's Guidelines for the Magnuson-Stevens Act National Standards requiring a measurable definition of recruitment overfishing for each species or species complex in a FMP (56 FR 9686, March 1991).

[2] At the request of the Council, NMFS published in November 1990 (55 FR 49285) an emergency interim rule that placed regulatory conditions on the longline vessels that included permitting and logbook requirements, and required the placement of observers if a vessel intended to fish within 50 nm of certain islands of the NWHI and was requested to do so by the NMFS Regional Director.

[3] NMFS was required to establish the observer program due to Terms and Conditions in the Incidental Take Statement from the Biological Opinion issued in June 1993.

be registered for use with one of 164 Hawai'i-based longline limited entry permits[4] (59 FR 26979, June 1994).

- As requested by NMFS, all vessels registered for use with a Hawai'i-based longline limited access permit must carry a NMFS-owned "vessel monitoring system" (VMS) transmitter (59 FR 58789, November 1994).
- Longline fishing for pelagic species is prohibited in circular areas (known as "protected species zones") 50 nm around the center points of each of the Northwestern Hawaiian Islands (NWHI), plus a 100 nm wide corridor connecting those circular closed areas that are non-contiguous (56 FR 52214, October 1991). To avoid gear conflicts with troll and handline fisheries near the Main Hawaiian Islands (MHI), longline fishing is prohibited in areas approximately 75 nm around the islands of Kaua'i, Ni'ihau, Ka'ula, and O'ahu, and approximately 50 nm off the islands of Hawai'i, Maui, Kaho'olawe, Lana'i, and Moloka'i. This prohibition is lessened from October 1 through January 30, when the longline closed areas decrease on the windward sides to approximately 25 nm off Hawai'i, Maui, Kaho'olawe, Lana'i, Moloka'i, Kaua'i, Ni'ihau, and Ka'ula, and approximately 50 nm off O'ahu (56 FR 28116, June 1991)[5]. Longline fishing is also prohibited in an area approximately 50 nm off Guam (57 FR 7661, March 1992).

2.2.1.1 Pelagic Fishery Management in State and Territories

The FMP does not contain any management measures specifically applicable to vessels that use pole-and-line, troll or handline gear to harvest pelagic species in the Western Pacific Region. The territories of American Samoa and Guam and the CNMI have no regulations that affect pelagic fishing activities in territorial waters, although fishing vessel registration is required. In American Samoa, some villages impose fishing curfews on Sundays (R. Tulafono, Director DMWR, pers. comm.). The State of Hawai'i prohibits the sale of yellowfin and bigeye tuna (both known in Hawai'i as *ahi*) smaller than three pounds landed by all domestic fisheries. The State also requires fishers who sell any portion of their catch to hold a commercial marine license and file catch reports.

An act adopted by the Hawai'i State Legislature (SB 2712, Hawai'i State Legislature 2000 session) to require sharks to be landed whole in Hawai'i with the fins still attached became law in August 2000. The new State law applies only to vessels actually landing fish in the State of Hawai'i and does not penalize foreign vessels re-provisioning in Hawai'i with shark fins onboard. Nor does the State law halt the transshipment of shark fins through the State as bonded cargo that does not enter U.S. commerce and is exported to foreign destinations

[4]A Hawai'i longline limited access permit will not be registered for use with a vessel larger than 101 ft (length overall).

[5]A few longline vessel owners qualify for exemptions to fish in portions of longline closed areas around the MHI where they can document historical longline fishing activity prior to 1970.

(WPRFMC, 2001b). The new State law does not limit the entry (as cargo) into Hawai'i of shark fins or cartilage shipped from foreign sources.

2.2.1.2 Pelagic Fishery Management in the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve.

The Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve was established by Presidential Executive Orders 13178 (December 4, 2000) and 13196 (January 18, 2001) in late 2000 and early 2001. The executive orders prohibit commercial pelagic fishing within the boundaries of the reserve (extending as much as 12 nm offshore of some NWHI), except for pelagic trolling by fishers who had Federal NWHI bottomfish permits on December 4, 2000. Recreational fishing for pelagic fish in the reserve is capped at historical levels to be determined by the National Ocean Service.

2.2.1.3 Pelagic Fishery Management in the EEZs Around U.S. Pacific Remote Island Areas

Longline vessels registered for Hawai'i-based longline limited access permits are subject to the management requirements of the FMP throughout the Western Pacific Region, including the EEZs around remote U.S. Pacific island possessions (Jarvis, Howland, Baker, Wake and Midway Islands, Kingman Reef, Johnston and Palmyra Atolls). There are no other NMFS regulations specifically applicable to domestic pelagic fishing activities in those areas, however, the National Wildlife Refuge Administration Act of 1966, as amended, prohibits fishing activities without a special use permit within the seaward boundaries of National Wildlife Refuges (NWRs) in the Northwestern Hawaiian Islands, at Midway Atoll, Baker Island, Howland Island, Jarvis Island, Johnston Atoll and Rose Atoll and in new NWRs established at Kingman Reef and Palmyra Atoll in January 2001.

2.2.1.4 Measures to Reduce Pelagics FMP-managed Fisheries' Interactions with Sea Turtles

Alternative 1 includes no specific measures relating to western Pacific pelagic fishery interactions with protected sea turtles, although the Pelagics FMP was amended by the Council in the early 1990s to limit the size of the Hawai'i-based longline fleet, thereby reducing its potential for sea turtle takes. The ranges of sea turtle takes in Table 2-3 are based on observed longline fishing trips during the 1994-1999 period. These ranges provide a rough estimate of the numbers of sea turtles that may be taken by the Hawai'i-based longline fishery during any given year depending on fishing effort and natural variation in ocean conditions and sea turtle abundance and movement in the areas fished by the fleet. Sea turtle takes and mortalities in line with these ranges would be expected to continue under the no-action baseline.

Point estimates for annual average sea turtle takes and mortalities in the Hawai'i-based longline fishery are provided in a later section (2.4) and the information is used in Chapter

4 to compare the potential effects of the alternatives on sea turtle incidental take. The prediction intervals associated with the point estimates derived for sea turtle incidental catch are quite broad because sea turtle takes are rare events in the fishery and, prior to 2000, there was a low level (less than five percent) of coverage by NMFS shipboard observers (McCracken, 2000).

Table 2-3: Estimated Annual Range of Sea Turtle Takes and Mortalities in the Hawai'i-based Longline Fishery Based on 1994-1999 Observer Information[1] Source: NMFS, 2001a, excerpted in Appendix Q.

Species	Annual Estimated Range of Incidental Take[2]	Annual Estimated Range of Incidental Mortality[3]
Green	17 - 73	7 - 28
Leatherback	68 - 162	27 - 61
Loggerhead	263 - 547	98 - 203
Olive Ridley	97 - 207	49 - 101

[1] Where numbers represented fractions of turtles, the number was rounded up to represent a whole turtle.
[2] Calculated as the average of the upper and lower bounds of the 95 percent prediction intervals for the 1994 through 1999 fishery (McCracken, 2000).
[3] Estimated mortality based on methodology of Morehead (2001). Where condition of a turtle was marked as "unknown" NMFS assumed that the turtle had died. "Entangled" turtles, because they were not recorded as "alive and uninjured" were assigned a mortality rate of 27 percent (Morehead, 2001).

2.2.1.5 Measures to Reduce Pelagics FMP-managed Fisheries' Interactions with Seabirds

Alternative 1 includes no specific measures relating to pelagic fishery interactions with seabirds, although Pelagics FMP amendments by the Council in the early 1990s to limit the size of the Hawai'i-based longline fleet and to prohibit longline fishing within a 50 nautical mile protected species zone around the Northwestern Hawaiian Islands had the effect of reducing the incidental catch and mortality of seabirds by the Hawai'i-based longline fishery.

The NMFS Southwest Fisheries Science Center - Honolulu Lab (SWFSC-HL) used data from NMFS observer reports and the NMFS Western Pacific Daily Longline Fishing Log to estimate the annual incidental catch of seabirds in the Hawai'i-based longline fishery between 1994 and 1999 (McCracken, 2000). It is estimated that between 1994 and 1999, an average of 1,175 Laysan albatross and 1,388 black-footed albatross per year were incidentally hooked/entangled in the Hawai'i-based longline fishery (Table 2-4). An estimated 90 percent of the albatross takes result in mortality (NMFS, unpub. observer data). This information is used in Chapter 4 to compare the potential effects of the alternatives on seabird incidental take. Virtually all of the interactions with seabirds occur in the northern portion of the Hawai'i-based longline fishery when gear is set shallow (see Table 2-9).

Table 2-4: Estimated Annual Takes of Albatross in the Hawai'i-based Longline Fishery Based on Catches Recorded by NMFS Observers on Monitored Fishing Trips, 1994-1999. Values in parentheses are approximate 95 percent prediction bounds. Source: McCracken, 2000.

Year	Black-footed Albatross			Laysan Albatross		
	Recorded Catch	Estimated Total Take		Recorded Catch	Estimated Total Take	
1994	126	1830	(1457-2239)	73	2067	(1422-2948)
1995	105	1134	(899-1376)	107	844	(617-1131)
1996	59	1472	(1199-1811)	31	1154	(835-1600)
1997	107	1305	(1077-1592)	66	985	(715-1364)
1998	46	1283	(1028-1601)	56	981	(679-1360)
1999	51	1301	(1021-1600)	28	1019	(688-1435)

2.2.1.6 Measures to Reduce Pelagics FMP-managed Fisheries' Incidental Catches of Sharks

An act adopted by the Hawai'i State Legislature (SB 2712, Hawai'i State Legislature 2000 session) to require sharks to be landed whole in Hawai'i with the fins still attached became law in August 2000. The new State law applies only to vessels actually landing fish in the State of Hawai'i and does not penalize foreign vessels re-provisioning in Hawai'i with shark fins onboard. Nor does the law halt the transshipment of shark fins through the State as bonded cargo that does not enter U.S. commerce and is exported to foreign destinations. (WPRFMC, 2001b). The new law does not limit the entry (as cargo) into Hawai'i of shark fins or cartilage shipped from foreign sources.

2.2.2 Alternative 2: Pelagics FMP Management Regime Modified by Proposed Regulatory Adjustments and Other Federal Measures Being Implemented at the Time of EIS Preparation

Alternative 2 would modify Alternative 1 through several regulatory adjustments to the Pelagics FMP and other Federal measures that are being implemented at the time of FEIS preparation. Court-ordered modifications of Alternative 1 are not included in Alternative 2. The pending actions would (1) restrict the retention and landing of pelagic sharks and shark products by U.S. vessels; (2) require annual completion by Hawai'i-based longline vessel owners/captains of protected species training at workshops conducted by NMFS; (3) require the Hawai'i-based longline fishery to employ albatross deterrent measures when fishing north of a specified latitude; (4) establish nearshore area closures around the islands of American Samoa to pelagic fishing by large vessels to avoid the potential for gear conflicts with the expanding small-scale longline fishery; and (5) provide for more comprehensive pelagic fisheries monitoring through permit and logbook requirements for troll and handline fisheries in the EEZs around the U.S. Pacific remote island areas. All of the measures in

Alternative 2 are also included in Alternatives 4-7 and 10, which differ in the control measures proposed to reduce sea turtle interactions in the Hawai'i-based longline fishery.

The estimated direct effects of the alternatives on incidental takes of sea turtles and albatross in the Hawai'i-based longline fishery are compared in Figure 2-2 at the end of this chapter. A summary of the direct, indirect and cumulative effects predicted for the alternatives is provided in Table 2-21 at the end of this chapter.

2.2.2.1 Restrict the Retention and Landing by Western Pacific Pelagic Fisheries of Sharks and Shark Products

The "Shark Finning Prohibition Act" enacted by the U.S. Congress in December 2000 became Public Law No. 106-557 in January 2001. Section 307(1) of the MSA was amended to prohibit fishing vessels from removing any of the fins of a shark and discarding the carcass at sea and to possess any shark fins onboard without the corresponding carcass. Fishers may process shark carcasses at sea but they must be able to prove that the weight of fins possessed and landed by the vessel is not more than five percent of the total weight of shark carcasses onboard or landed (WPRFMC, 2001b). The Shark Finning Prohibition Act applies to all fishing vessels subject to U.S. jurisdiction and applies to all fishing vessels that unload shark fins without the corresponding carcass in a port of the United States, including the U.S. Pacific territories and possessions.

Prior to the enactment of the Shark Finning Prohibition Act, the Council had proposed a precautionary harvest guideline for blue sharks as one of the measures in Amendment 9 (WPRFMC, 2000b). The Shark Finning Prohibition Act rendered this guideline moot (WPRFMC, 2001b). Further, a stock assessment of North Pacific blue sharks concluded that the current harvest level was 50 percent of the most conservative MSY estimate for the stock (Kleiber, 2000). However, there are still concerns about sustainable use of pelagic shark species other than blue shark, so the Council has proposed to limit the landing of non-blue shark species by Hawai'i-based longline vessels. One non-blue shark per fishing trip per vessel could be landed whole or dressed. The Council has also proposed to prohibit bottom-set longline fishing in the existing longline prohibited areas around the Northwestern Hawaiian Islands and main Hawaiian Islands (WPRFMC, 2001b). Alternative 2 also incorporates the new State of Hawai'i law requiring sharks to be landed in the State with fins still attached.

2.2.2.2 Mandatory Training of Hawai'i-based Longline Vessel Skippers in Protected Species Identification, Handling and Release

Hawai'i-based longline vessel owners and captains would be required annually to attend protected species workshops conducted by NMFS. Longline fishers would be updated on the status of protected sea turtle and albatross populations, informed as to current regulations, and trained in identification of sea turtle and albatross species, methods to reduce interactions, and methods to improve the survival of sea turtles and seabirds that

may be entangled or hooked during fishing operations. They will be taught specific handling procedures to save and release live captured sea turtles and seabirds, to resuscitate comatose and lethargic turtles and to care for injured seabirds before release so that their chances of survival are improved.

In addition, the workshops may be used to train fishers to participate in collaborative research projects directed at finding ways to reduce the number of interactions between sea turtles and longline fishing gear.

Nearly 100 longline owners/captains from 78 Hawai'i-based longline vessels voluntarily attended the first four scheduled workshops conducted by NMFS in 2000. Protected species workshop certificates were issued to the fishers who attended.

2.2.2.3 Require Hawai'i-based Longline Vessels to Employ Seabird Avoidance Measures when Fishing North of a Specified Latitude

If some simple mitigation methods were implemented in the Hawai'i-based longline fishery, the incidental catch of albatross could be reduced by an order of magnitude and eventually to a negligible level of take (Cousins *et al.*, 2000). In October 1999, the Council proposed a regulatory adjustment to the Pelagics FMP that would require Hawai'i-based longline vessel operators to use at least two seabird deterrents that they choose from a list of options (see Table 2-5) when longline fishing north of 25° N. latitude (WPRFMC, 2000b). Publication of a NMFS interim final rule is pending.

Consultation under Section 7 of the ESA was initiated between NMFS and the U.S. Fish and Wildlife Service (FWS) in 1999 after an endangered short-tailed albatross was sighted at sea by a research vessel off Laysan. The consultation resulted in the issuance of a Biological Opinion for the Effects of the Hawai'i-Based Domestic Longline Fleet on the Short-Tailed Albatross (STAL BO) by FWS on November 28, 2000 (FWS, 2000, excerpted in Appendix P).

Although there have been no reported takes of this species in the fishery, the STAL BO concluded that the fishery may adversely affect the short-tailed albatross and several terms and conditions must be implemented by NMFS no later than April 15, 2001, to allow the fishery to continue. Unlike the Council's proposed regulatory adjustment of the Pelagics FMP, the Terms and Conditions of the STAL BO would not allow longline vessel operators to exercise discretion in selecting combinations of seabird mitigation measures. Specific deterrents are prescribed in the STAL BO when Hawai'i-based longline fishing is conducted north of a lower latitude (23° N.) than the one referenced in the Council's proposed action (north of 25° N.).

The Terms and Conditions of the STAL also call for implementation of gradual coverage of Hawai'i-based longline fishing trips north of 23° N. latitude by NMFS observers whose primary duty is to observe for short-tailed albatross and other endangered species during

sets and haulbacks. The observers would have to be qualified biologists trained or experienced with seabirds. Observer coverage targeting short-tailed albatross would have to increase from at least one percent of all longline trips above 23° N. in 2001 to at least three percent coverage in 2002 and reach at least five percent coverage in 2003 and later years (FWS, 2000).

The Council's proposed action will be implemented as an interim final rule until replaced by the STAL BO Terms and Conditions. The differences between the STAL BO Terms and Conditions and the Council's proposal are presented in Table 2-5.

Table 2-5: Comparison of Seabird Deterrent Measures between the Council's Proposal and FWS' Terms and Conditions of the Short-tailed Albatross Biological Opinion (STAL BO). Source: WPRFMC, 2000b; FWS, 2000, excerpted in Appendix P.

Control Measure	Council's Proposal	Terms and Conditions of the STAL BO	
Area where deterrents must be employed	Above 25° N. latitude	Above 23° N. latitude	
Affected longline operations	All longliners pick two from list	Tuna (deep) set	Swordfish/Mixed (shallow set)
Thawed, blue-dyed bait	Optional	Required[1]	Required
Strategic offal discharge	Optional	Hook-free offal required	Hook-free offal required
Night setting	Optional	Optional	Required (based on local sunset and sunrise times)
Line-setting machine and weighted branch lines (min wt = 45 gm)	Optional	Required	Optional
Weighted branch lines alone (min wt = 45 g)	Optional	Optional	Optional
Towed deterrent (buoy/ tori line)	Optional	Optional	Optional
SUMMARY:	Required = 2	Required = 3	Required = 3
Careful handling of hooked seabirds	Required for all seabirds	Injured short-tailed albatross must be retained unless it exhibits all of the following: 1. head erect and responds to stimuli; 2. breathes without noise; 3. wings can flap and retract to normal folding position; 4. stands on both feet and toes point forward.	
Annual completion of protected species training at educational workshops conducted by NMFS	All Hawai'i-based longline vessel owners/captains	All Hawai'i-based longline vessel owners/captains. Albatross identification cards to be provided.	

[1]The preferred bait used by Hawai'i-based longline vessels to make deep sets for tuna is *sanma* (saury mackeral, *Cololabris saira*), which has a naturally blue color.

2.2.2.4 Close Nearshore Areas to Pelagic Fishing by Large Vessels in American Samoa's Pelagic Fishery and Set a Control Date for Possible Future Actions Limiting Fishing Effort in the American Samoan Longline Fishery

The potential for gear conflicts between large (> 50 ft overall length) and small (50 ft or smaller) pelagic fishing vessels is increasing in American Samoa because (1) the fishing range of the small-scale fishery is expanding offshore with the addition of new and safer types of boats; and (2) up to 40 large vessels previously based in Hawai'i may be displaced from the central North Pacific longline fishery for swordfish after a U.S. court order (in Center for Marine Conservation, *et al.* v NMFS) issued August 4, 2000, closed a large portion of the swordfish grounds to vessels with Hawai'i-based longline limited entry permits. Although most of the swordfish vessels are temporarily relocating to the Pacific coast for the near future, at least five vessel owners have contacted the Department of Marine and Wildlife Resources (DMWR) (Tulafono, 2000) to express interest in relocating to American Samoa sometime in the future.

In anticipation of an influx of large longliners (> 50 ft) into American Samoa's pelagic fishery and the potential for conflict between the large vessels and small-scale vessels, the Council established November 13, 1997, as a control date to restrict further participation of large vessels in the fishery if the Council decides to limit entry or effort by establishing areas closed to large fishing vessels (63 FR 3592, January 23, 1998).

At its meeting in June 2000, the Council voted to (1) establish 50 nm areas around the islands of American Samoa closed to commercial fishing vessels larger than 50 ft in length targeting pelagic management unit species (PMUS); (2) allow vessels registered for use with a federal general longline permit and a documented landing of PMUS prior to the control date of November 13, 1997, to use longline gear within a 50 nm closed area around American Samoa; and (3) establish a new control date of July 15, 2000, to be used if the Council decides to develop a limited entry program for the American Samoa longline fishery.

The Council believes that there is a risk of speculative entry into the longline fishery while the Council further evaluates the potential benefits and costs of limited entry alternatives (65 FR 203, October 19, 2000). Persons who enter the longline fishery in the EEZ around American Samoa after the July 15, 2000, control date are not guaranteed future participation if the Council prepares and NMFS approves a program limiting entry or effort. Establishing a control date does not commit the Council or NMFS to limit effort or to prevent any other date from being selected for eligibility to participate in the American Samoa pelagic longline fishery. The Council or NMFS also may use other criteria to limit fishing effort or participation in a limited entry program if one is developed in the future (65 FR 203, October 19, 2000).

2.2.2.5 Establish Permit and Reporting Requirements for Pelagic Troll and Handline Fisheries in the U.S. Pacific Remote Island Areas (PRIAs) of the Western Pacific Region

An amendment to the Pelagics FMP has been proposed (submitted to NMFS by the Council on September 1, 2000). The proposed measure would require any fishing vessel using troll or handline gear to harvest pelagic management unit species in the EEZs of the PRIAs to register for use under a pelagic fishing permit from NMFS and submit a federal logbook (including reports of any interactions with protected species). Existing levels of troll and handline fishing in these areas are very low but the proposed measure is intended to correct a deficiency in pelagic fishery monitoring and provide for more comprehensive fisheries statistics.

Table 2-6 summarizes the measures comprising Alternative 2 and included in Alternatives 4-7 and 10.

Table 2-6: Summary and Status of Federal Control Measures Included in Alternative 2.

Management Issue	Control Measure	Status of Proposed Action	Related NEPA Documents
Pelagic shark conservation	Shark fins cannot be possessed onboard fishing vessels or landed in U.S. ports by fishing vessels without a corresponding weight of shark carcasses.[1]	Shark Finning Prohibition Act (P.L. 106-557) became law in January 2001. NMFS regulations pending.	
	Quota of one pelagic shark (other than blue shark) landed per fishing trip by Hawai'i-based longline vessels. Must be landed whole or dressed. Bottom-set longline fishing prohibited in existing longline prohibited areas around NWHI and MHI.[1]	FMP Amendment 9 revised by Council February 2001.	WPRFMC, 2000b WPRFMC, 2001b
Protected species education	Hawai'i longline vessel owners/captains must annually complete protected species education and training workshops conducted by NMFS.[2]	Pelagics FMP regulatory adjustment proposed by Council	WPRFMC, 1999c WPRFMC, 2001a
		Part of Reasonable and Prudent Alternative (RPA) in NMFS' Biological Opinion (BO) for western Pacific pelagic fisheries. NMFS regulations pending.	NMFS, 2001a
		Part of RPA in FWS' BO for short-tailed albatross.	FWS, 2000
Reduce fishery interactions with seabirds	Hawai'i longline skippers use at least two deterrents from a menu of measures when longline fishing north of 25° N. latitude.[3]	Pelagics FMP regulatory adjustment proposed by Council. NMFS interim final rule pending.	WPRFMC, 1999c WPRFMC, 2001a
	Terms and conditions of FWS' BO for short-tailed albatross require skippers to employ three deterrent measures when longline fishing north of 23° N. latitude.[3]	Part of RPA in FWS' BO for short-tailed albatross. NMFS final rule pending.	FWS, 2000
Avoid gear conflicts	Nearshore areas of EEZ around American Samoa islands closed to pelagic fishing by large vessels (> 50 ft).[4]	Pelagics FMP regulatory adjustment proposed by Council. Transmitted for NMFS review.	WPRFMC, 2000f
Improve pelagic fishery monitoring	Permits and logbook reporting (including any interactions with protected species) required for troll and handline fishing in EEZs around U.S. PRIAs.	Pelagics FMP amendment proposed by Council. Transmitted for NMFS review.	WPRFMC, 2000g

[1] The effects of this proposal on sea turtle interactions cannot be estimated because of possible food web effects that could result from reduced fishing mortality of sharks, which are known to prey on sea turtles (Kitchel *et al.*, 2000). The magnitude of such effects remains poorly documented, however.

[2] Training may help to achieve further reductions in sea turtle mortalities below the level of reduction that might result from time/area closures or gear modifications such as those included in Alternatives 4-7 and 10. Such effects are presently uncertain, however.

[3] Some of the same deterrents (e.g., blue-dyed bait, use of a line-shooter) might achieve further reductions in sea turtle takes below the level of reduction that would be expected to result from time/area closures or gear modifications included in Alternatives 4-7 and 10. Such effects are presently uncertain, however.

[4] This proposal would avoid takes of sea turtles in nearshore areas of the EEZ as a result of increasing longline fishing effort by large vessels.

2.2.3 Alternative 3: Pelagics FMP Management Regime Modified by Court-ordered Actions (Current Status Quo).

Alternative 3 is a modification of Alternative 1 exclusive of the management measures in Alternative 2. Alternative 3 modifies Alternative 1 by the emergency rule implemented by NMFS (65 FR 51992, August 25, 2000) in response to Court orders in Center for Marine Conservation, *et al.* v NMFS (CMC v NMFS). The evolution of court-ordered actions resulting from the case is described in Chapter 1 of the EIS. The emergency rule currently in place divides a large area of the central Pacific into three zones: Area A (between 28° and 44° N. latitude, and 168° and 150° W. longitude), essentially the area closed by the Court's November 2, 1999, Order; Area B (between 28° and 44° N. latitude, divided into two parts east and west of Area A from 173° E. to 168° W. and 150° to 137° W.); and Area C (south of the preceding two areas from 28° N. to the equator). Figure 1-2 shows the extent of these three areas. The following provisions apply to the activities of vessels registered for use with Hawai'i-based longline limited access permits.

> Area A: closed to fishing and transshipping operations all year.
>
> Area B: (1) permit holders in aggregate cannot make more than 154 sets during the period August 10 to December 31, 2000; (2) they cannot make more than 77 sets from January 1 to March 14, 2001; (3) all vessels must carry fishery observers when fishing in this area (i.e., 100 percent observer coverage); and (4) the area is closed from March 15 to May 31, 2001 (or until the final EIS is complete).
>
> Area C: (1) lightsticks may not be possessed onboard longline vessels; (2) vessels are required to set mainline so that the deepest point between any two floats is greater than 100 m; and (3) as a disincentive to targeting of swordfish, 30 percent of gross revenues derived from the sale of swordfish caught in the area must be donated to charity; (4) the percentage of vessels carrying fishery observers must increase to 10 percent by September 21, 2000, and to 20 percent by November 7, 2000; (5) each operator must have onboard the longline vessel an observer waiver form issued by NMFS if the vessel fishes without an observer; and (6) like Area B, Area C is closed from March 15 to May 31, 2001 (or until the final EIS is complete).

This alternative includes several other general provisions ordered by the Court: submission of observer reports to the Court; continuance of the previously Court-ordered regulation (65 FR 67511, April 27, 2000) that Hawai'i-based longline vessels carry line clippers, hook cutters and dip nets and fishers follow specific guidelines in the handling and release of hooked or entangled sea turtles; and continuation of NMFS research on the effectiveness of various gear modifications in reducing sea turtle interactions.

The estimated direct effects of the alternatives on incidental takes of sea turtles and albatross in the Hawai'i-based longline fishery are compared in Figure 2-2 at the end of this

chapter. A summary of the direct, indirect and cumulative effects predicted for the alternatives is provided in Table 2-21 at the end of this chapter.

2.2.4 Alternative 4: Close Areas North of 29° N. Latitude from July Through January of Every Year to Longline Fishing by the Hawai'i-based Fishery.

Alternative 4 modifies Alternative 1 by implementing a time/area closure different from the Court-ordered regime (Alternative 3). Areas north of 29° N. latitude would be closed to longline fishing by the Hawai'i-based fleet from July through January of every year. Hawai'i-based longline vessels would also be required to carry line clippers, hook cutters and dip nets and fishers would follow specific guidelines in the handling and release of hooked or entangled sea turtles. Alternative 4 also includes the components of Alternative 2, as summarized in Table 2-6.

NMFS observer coverage aboard Hawai'i-based longline vessels would be continued at a minimum average of 20 percent of the annual total longline trips. Under the Terms and Conditions of the STAL BO (FWS, 2000), observer coverage primarily dedicated to short-tailed albatross would increase from a minimum of one percent of all Hawai'i-based longline trips north of 23° N. latitude in 2001 to at least five percent of such trips in 2003 and later years.

The estimated direct effects of the alternatives on incidental takes of sea turtles and albatross in the Hawai'i-based longline fishery are compared in Figure 2-2 at the end of this chapter. A summary of the direct, indirect and cumulative effects predicted for the alternatives is provided in Table 2-21 at the end of this chapter.

2.2.5 Alternative 5: Require Hawai'i-based Vessels to use Line-shooters and/or Weighted Branch Lines When Setting Longline Gear

Longline fishing that deploys gear at shallow depths, such as when targeting swordfish or mixed targets, may increase the potential for sea turtle interactions in the Hawai'i-based longline fishery (NMFS, 2001a). Alternative 5 modifies Alternative 1 by requiring Hawai'i-based longline vessels to use a line-setting machine (i.e., "line-shooter") to set the mainline so that the deepest point between any two floats is deeper than 100 m. Hawai'i-based longline vessels would also be required to carry line clippers and dip nets and fishers would follow specific guidelines in the handling and release of hooked or entangled sea turtles. The gear changes required under this alternative would apply only to Hawai'i longline permit holders, not general longline permit holders in American Samoa or other U.S. Pacific islands. Alternative 5 also includes the components of Alternative 2, as summarized in Table 2-6.

NMFS observer coverage aboard Hawai'i-based longline vessels would be continued at a minimum average of 20 percent of the annual total longline trips. Under the Terms and Conditions of the STAL BO (FWS, 2000), observer coverage primarily dedicated to short-tailed albatross would increase from a minimum of one percent of all Hawai'i-based longline

trips north of 23° N. latitude in 2001 to at least five percent of such trips in 2003 and later years.

The estimated direct effects of the alternatives on incidental takes of sea turtles and albatross in the Hawai'i-based longline fishery are compared in Figure 2-2 at the end of this chapter. A summary of the direct, indirect and cumulative effects predicted for the alternatives is provided in Table 2-21 at the end of this chapter.

2.2.6 Alternative 6: Close Areas North of 29° N. Latitude to Hawai'i-based Longline Fishing at all Times and Close all Areas to Longline Fishing by Hawai'i-based Vessels During the Months from April through July.

Alternative 6 would modify Alternative 1 by implementing a time/area closure different from the Court-ordered regime (Alternative 3). Areas north of 29° N. latitude would be closed to longline fishing by the Hawai'i-based fleet at all times and all areas would be closed to longline fishing by the Hawai'i-based fleet from April through May. Hawai'i-based longline vessels would also be required to carry line clippers, hook cutters and dip nets and fishers would follow specific guidelines in the handling and release of hooked or entangled sea turtles. Alternative 6 also includes the components of Alternative 2, as summarized in Table 2-6.

NMFS observer coverage aboard Hawai'i-based longline vessels would be continued at a minimum average of 20 percent of the annual total longline trips. Under the terms and conditions of the STAL BO (FWS, 2000), observer coverage primarily dedicated to short-tailed albatross would increase from a minimum of one percent of all Hawai'i-based longline trips north of 23° N. latitude in 2001 to at least five percent of such trips in 2003 and later years.

The estimated direct effects of the alternatives on incidental takes of sea turtles and albatross in the Hawai'i-based longline fishery are compared in Figure 2-2 at the end of this chapter. A summary of the direct, indirect and cumulative effects predicted for the alternatives is provided in Table 2-21 at the end of this chapter.

2.2.7 Alternative 7: *(Identified as preferred in Draft EIS)* (a) Require Hawai'i-based Vessels to Use Line-shooters and/or Weighted Branch Lines to Set Longline Gear; and (b) Close All Areas to Longline Fishing by the Hawai'i-based Vessels during April and May of Every Year.

Alternative 7 was identified as the preferred alternative in the Draft EIS, however NMFS issued a Biological Opinion on the Authorization of the Pelagic Fisheries Under the Fishery Management Plan for the Pelagic Fisheries of the Western Pacific Region (Pelagics BO) in March 2001 (NMFS, 2001a) containing a "Reasonable and Prudent Alternative" for continuation of the Hawai'i-based longline fishery. This alternative has been added to the EIS as Alternative 10, which is now the preferred alternative.

Alternative 7 would modify Alternative 1 by implementing a time/area closure different from the Court-ordered regime (Alternative 3). No longline fishing by the Hawai'i-based fleet would be allowed during the months of April and May. In addition, Hawai'i-based longline vessels would be required to use a line-setting machine (i.e., "line-shooter") to set mainline so that the deepest point between any two floats is deeper than 100 m. Hawai'i-based longline vessels would also be required to carry line clippers and dip nets and fishers would follow specific guidelines in the handling and release of hooked or entangled sea turtles. The gear changes required under this alternative would apply only to Hawai'i longline permit holders, not general longline permit holders in American Samoa or other U.S. Pacific islands. Alternative 7 also includes the components of Alternative 2, as summarized in Table 2-6.

NMFS observer coverage aboard Hawai'i-based longline vessels would be continued at a minimum average of 20 percent of the annual total longline trips. Under the terms and conditions of the STAL BO (FWS, 2000), observer coverage primarily dedicated to short-tailed albatross would increase from a minimum of one percent of all Hawai'i-based longline trips north of 23° N. latitude in 2001 to at least five percent of such trips in 2003 and later years.

The estimated direct effects of the alternatives on incidental takes of sea turtles and albatross in the Hawai'i-based longline fishery are compared in Figure 2-2 at the end of this chapter. A summary of the direct, indirect and cumulative effects predicted for the alternatives is provided in Table 2-21 at the end of this chapter.

2.2.8 Alternative 8: Prohibit All Pelagic Longline Fishing by U.S. Vessels in the Western Pacific EEZs and Prohibit the Landing of Pelagic Fish by U.S. Longline Vessels in all U.S. Ports in the Western Pacific Region.

Alternative 8 would modify Alternative 1 by eliminating Hawai'i longline limited access permits and longline general permits in the Western Pacific Region. All existing and potential domestic longline fishing effort in the EEZs would be prohibited. Landing of pelagic species by U.S. longline vessels would be prohibited in all U.S. ports in the Western Pacific Region, including American Samoa, Hawai'i, Guam, CNMI and U.S. Pacific remote island areas.

Alternative 8 is included in the EIS to represent a policy that would eliminate the incidental catch of sea turtles, seabirds and sharks in domestic longline fisheries throughout the Western Pacific Region.

The estimated direct effects of the alternatives on incidental takes of sea turtles and albatross in the Hawai'i-based longline fishery are compared in Figure 2-2 at the end of this chapter. A summary of the direct, indirect and cumulative effects predicted for the alternatives is provided in Table 2-21 at the end of this chapter.

2.2.9 Alternative 9: (a) Analyze Limited Effort Alternatives for American Samoa's Longline Fishery; and (b) Prepare and Implement a Comprehensive Research Plan to Evaluate the Potential for Catch Interactions Between Western Pacific Fisheries Managed Under the Pelagics FMP.

Alternative 9a could be combined with any of the other alternatives, except Alternative 8. Alternative 9b could be combined with any of the other alternatives. The estimated direct effects of the alternatives on incidental takes of sea turtles and albatross in the Hawai'i-based longline fishery are compared in Figure 2-2 at the end of this chapter. A summary of the direct, indirect and cumulative effects predicted for the alternatives is provided in Table 2-21 at the end of this chapter.

(a) American Samoa's longline fishery

Recent declines in albacore catch rates by longline fisheries in American Samoa and neighboring independent Samoa may reflect locally reduced fish densities related to the rapid development of regional longline fishing effort or environmental factors, such as an oceanic regime shift (WPRFMC, 2000c). Under Alternative 9, the Council would define and evaluate the costs and benefits of alternatives to limit entry or effort in American Samoa's longline fishery. After analysis and if warranted, a preferred alternative would be recommended by the Council for NMFS approval and implementation.

(b) All western Pacific fisheries managed under the Pelagics FMP

Fisheries managed under the Pelagics FMP may interact in ways that affect catch rates. Detecting or predicting fisheries interactions and their actual or potential effects on catch is difficult and presents a serious research challenge (Shomura *et al.*, 1994, 1996). Under Alternative 9, the Council, in collaboration with the federal, state and territorial fisheries agencies, the University of Hawai'i's Pelagic Fisheries Research Program and international and academic organizations, would prepare and implement a comprehensive research plan to thoroughly evaluate the effects that pelagic fisheries may have on each other and to determine the optimal way(s) to mitigate adverse effects of such interactions.

General types of research that have proven useful in evaluating pelagic fisheries' interactions are tag-recapture studies and time-trend analyses of catch/effort records for different

fisheries targeting the same fish sub-populations. The specific research activities that could allow managers to detect and mitigate the effects of adverse interactions between pelagic fisheries in Guam, Hawai'i and the Northern Mariana Islands will be identified through the five-year review that the Council is undertaking for the Pelagics FMP. The five-year review process will include input from appropriate scientific and research organizations.

2.2.10 Alternative 10: (*Preferred*) Prohibit U.S. Longline Vessels Managed Under the Pelagics FMP from (a) Using Swordfish-style Longline Fishing Methods North of the Equator; (b) Using any Longline Fishing Methods During the Months of April and May in Areas South of 15° N. Latitude to the Equator, Bounded by 145° W. and 180° Longitude.

NMFS issued the Pelagics BO in March 2001 (NMFS, 2001a) containing a "Reasonable and Prudent Alternative" (RPA) for continuation of the Hawai'i-based longline fishery. The RPA has been incorporated in the EIS as Alternative 10, which is now NMFS' preferred alternative. In addition to sea turtle conservation measures prescribed by the RPA, Alternative 10 also includes the components of Alternative 2, as summarized in Table 2-6.

(a) Prohibit swordfish-style longline fishing methods by U.S. vessels north of the equator

Based on observer data, most sea turtle takes by the Hawai'i-based longline fishery during the 1994-1999 period were by vessels using techniques to target swordfish or a mixture of swordfish and tuna. Prohibition of this style of fishing for vessels with Hawai'i longline limited access permits or general longline permits under the Pelagics FMP is expected to significantly reduce the incidental take of sea turtles, especially loggerheads, because the takes appear to be related to how and where the gear is being set. Control measures may include restrictions on the number of floats a vessel may deploy or have on board, type of hook and bait that may be used, require use of a line-shooter and speed of the line-shooter, use of lightsticks, length of float line and branch lines and number of hooks that may be deployed (NMFS, 2001a, excerpted in Appendix Q).

This measure is expected to nearly eliminate U.S. longline interactions with loggerhead turtles and to greatly reduce interactions with leatherback and green turtles (NMFS, 2001a).

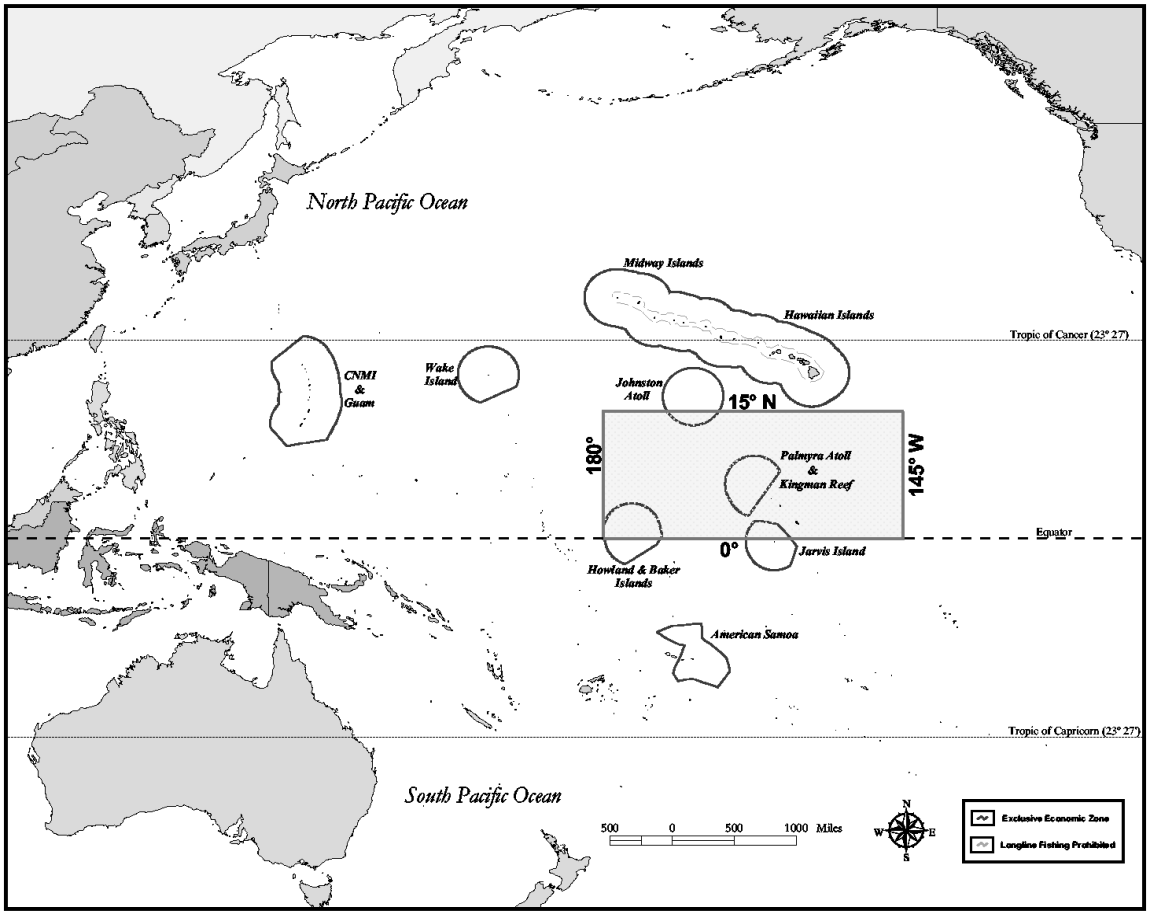
(b) Close areas south of 15° N. latitude to the equator, bounded by 145° W. and 180° longitude, to all U.S. longline vessels during the months of April and May of each year

When combined with measure (a), the time/area closure is expected to further reduce the likelihood that tuna longline fishing by U.S. vessels south of the Hawaiian Islands "...will jeopardize the continued existence of leatherback and green sea turtle species" (NMFS, 2001a). Immediate mortality of turtles captured in the tuna longline fishery appears, from

existing observer data, to occur disproportionately in this area. Therefore restrictions on tuna fishing effort are believed necessary by NMFS (NMFS, 2001a).

Measures (a) and (b) together are predicted to reduce sea turtle takes in the Hawai'i-based longline fishery by the following: 100 percent (loggerhead), 82-85 percent (leatherback), 52-69 percent (olive ridley) and 89-91 percent (green), depending on how much of the displaced shallow longline effort targeting swordfish and mixed species is redirected to deep-set fishing targeting tuna (D. Kobayashi, pers. comm. to G. Krasnick, URS, March 2001).

Figure 2-1: Proposed Time/Area Closure under Alternative 10. Source: URS.



Additional elements of the Preferred Alternative would: (c) prohibit permit holders from de-registering and re-registering vessels from Hawai'i longline limited access permits more than once a year. In addition (d) previous requirements for Hawai'i-based longline vessels to carry dip nets, line clippers and hook cutters would be extended to all U.S. longline vessels managed under the Pelagics FMP; (e) specific procedures for handling and releasing live sea turtles after capture would be required of all boats fishing with hooks (longline, handline, troll) and all skippers managed under the Pelagics FMP would be trained in sea turtle

resuscitation, hook removal and gear disentanglement; and (f) NMFS would continue observer coverage aboard Hawai'i-based longline limited access permit vessels at a mimimum average of 20 percent of the annual total longline trips and would expand coverage, where feasible, to longline vessels fishing under Pelagics FMP longline general permits.

(c) Prohibit permit holders from de-registering vessels from Hawai'i longline limited access permits unless the permits are surrendered for the duration of the calendar year; NMFS would process applications to re-register vessels to Hawai'i longline limited access permits only during the month of October of each calendar year.

Some vessels may try to avoid the prohibition on swordfish style longline fishing methods (as detailed in (a) above) by temporarily removing their Hawai'i longline limited access permits and continuing to use fishing techniques to target swordfish in some of the high seas areas that would be closed to swordfish-style longline fishing methods by vessels with Hawai'i longline limited access permits. To provide a disincentive for this possible indirect effect of Alternative 10 (a), permit holders would be allowed to surrender their Hawai'i limited access permits at any time of the year for the remaining duration of a calendar year but they would not be able to re-register their vessels to Hawai'i limited access permits until the following October. The month of October was selected based on past fishing activity of some Hawai'i-based swordfish vessels that target swordfish outside the EEZ off California from October through February. The lack of flexibility to transfer Hawai'i longline limited access permits upon request is expected to discourage vessels from trying to avoid the prohibitions on swordfish style longline fishing methods (NMFS, 2001a). Applications for transfers of Hawai'i limited access permits to new vessel owners would continue to be processed at any time (NMFS, 2001a).

In addition to the provisions of (a-c), NMFS would require completion of protected species training workshops by all U.S. longline skippers managed under the Pelagics FMP and would expand training on sea turtle resuscitation and on gear and hook removal and disentanglement to <u>all vessel operators</u> in fisheries under the Pelagics FMP. NMFS would also require all U.S. longline vessels managed under the Pelagics FMP to carry line clippers, dip nets and hook cutters and fishers to follow specific procedures in handling and releasing hooked or entangled live sea turtles to avoid injury or mortality and improve chances for survival. Unless otherwise requested by NMFS, dead sea turtles could not be consumed, landed, offloaded, transshipped or kept below deck (NMFS, 2001a).

The purpose of maintaining a minimum average of 20 percent observer coverage of the annual total fishing trips by vessels with Hawai'i longline limited access permits and, where feasible, extending observer coverage to vessels with longline general permits under the Pelagics FMP is to provide NMFS with information necessary to determine the levels of interaction of these fisheries with protected species. NMFS observers will collect data on the incidental capture, injury and mortality of sea turtles by species, gear and set information

in which each interaction occurred and life history information. The observers will also note whether sea turtles captured by longline fishing are tagged (NMFS, 2001a). Under the terms and conditions of the STAL BO (FWS, 2000), observer coverage primarily dedicated to short-tailed albatross would increase from a minimum of one percent of all Hawai'i-based longline trips north of 23° N. latitude in 2001 to at least five percent of such trips in 2003 and later years.

The estimated direct effects of the alternatives on incidental takes of sea turtles and albatross in the Hawai'i-based longline fishery are compared in Figure 2-2 at the end of this chapter. A summary of the direct, indirect and cumulative effects predicted for the alternatives is provided in Table 2-21 at the end of this chapter.

2.2.11 Option A: Allow Limited Research (including fishing experiments) in Areas and Times or with Deployment of Longline Gear Otherwise Prohibited by Alternatives 4-7 and 10.

The value of integrating scientific knowledge and the working knowledge of fishers to devise solutions to incidental catch problems has been demonstrated. Perhaps the most important scientific initiative to address the worldwide problem of cetacean incidental catch was the International Whaling Commission Symposium and Workshop on the Mortality of Cetaceans in Passive Fishing Gear and Traps held in 1990 (Hall, 1998). Its particular strength was that it brought together not just cetalogists but also experts in fisheries biology and management, gear technology and fishers themselves. In most cases where cetacean bycatch levels have been reduced in fisheries, this has been achieved with the direct cooperation of fishers, for example, in changing fishing gear or practices (Hall, 1998).

A Working Group on Reducing Turtle Bycatch in the Hawai'i Longline Fishery was convened and chaired by Dr. John Sibert, manager of the Joint Institute for Marine and Aquatic Research (JIMAR) Pelagic Fisheries Research Program. Participants in the first meeting of the working group included several leading sea turtle researchers, government fisheries scientists, Hawai'i-based longline vessel owners and a longline gear manufacturer. The report of the first meeting of the working group noted that rigid quantitative limits on sea turtle takes and mortalities would be difficult to implement because of the broad confidence intervals associated with estimated takes and mortalities. If effective mitigation measures to reduce sea turtle interactions in longline fishing could be tested and proven, they could be exported to longline fisheries internationally to reduce sea turtle interactions on a broad scale. This could have farther reaching positive effects on long-term sea turtle population viability and recovery than management actions limited to the Hawai'i-based longline fishery. An array of possible sea turtle deterrent measures was reviewed at the first meeting of the Working Group (Sibert, 2000).

One of the conservation recommendations of the Pelagics BO is for NMFS to research modifications to existing gear that (1) reduce the likelihood of gear interactions; and (2) dramatically reduce the immediate and/or delayed mortality rates of captured turtles. All

research funded and/or implemented by NMFS must be covered by a research and enhancement permit pursuant to section 10(a)(1)(a) of the Endangered Species Act (ESA). The goal of any research should be to develop a technology or method via a robust experimental assessment, which would achieve the two stated goals and remain economically and technically feasible for fishers to implement (NMFS, 2001a). Funds could be made available by NMFS to charter commercial vessels for fishing experiments unlikely to be profitable commercial operations (NMFS, 2001a).

The benefits of developing a new fishing strategy or modifying existing gear to significantly (50 to 75 percent) reduce sea turtle interactions throughout the Pacific Ocean far outweighs any potential harm that may occur during the short term while the experiment is underway because of the future savings that would occur when successful strategies and measures are instituted internationally over the long term. Conducting a fishing experiment may ultimately increase the likelihood of survival and recovery of the sea turtle populations by reducing takes and mortalities in international longline fisheries and by increasing sea turtle conservation awareness in the international community through the development of sea turtle saving technologies.

Option A could be added to any alternative from 4-7 or 10 to allow a fishing experiment. Through a structured experiment, the effectiveness of innovative gear and tactics for reducing sea turtle takes could be tested and demonstrated. Such an experiment could be conducted with access to specific closed areas or time frames granted only to participants in the fishing experiment. Hawai'i longline limited access permit holders have indicated their willingness to participate in a fishing experiment.

Longline fishers could undertake their own fishing experiments without Section 10(a)(1)(a) ESA permits by working within the rules imposed by the BO to test the feasibility of fishing deep for swordfish in the convergence zone north of Hawai'i. This possibility is discussed in more detail in the mitigation section of Chapter 5.

Several protective measures are necessary to minimize the impact of the NMFS experiment on sea turtle populations. The experiment will have 100 percent observer coverage. In addition, incidental takes of sea turtles will be reported to NMFS on a real-time basis using the satellite vessel monitoring system. If at any time, NMFS determines that the take levels established in the ESA section 10(a)(1)(a) permit for the experiment are being exceeded or are likely to be exceeded during the experiment (controls and experimental sets), NMFS will cease the experiment. The success of the experiment will be judged by the significance of the level of sea turtle reduction that can be demonstrated. If the results from the experiment demonstrate a greater than 50 percent reduction in the level of sea turtle interactions by vessels targeting swordfish, exporting this technology or fishing methodology could reduce the international sea turtle take rate by at least half. This level of reduction is far more valuable than the reduction that would be achieved if the swordfish component of the U.S. domestic longline fishery were just eliminated because the U.S. swordfish fleet represents a small portion of the international fishing effort (C. Boggs pers. comm., March 2001).

The NMFS SWFSC-HL has designed a fishing experiment premised on a staged reduction of loggerhead and leatherback turtle takes across the entire Hawai'i-based longline fishery, from 25 percent in the first year, to 50 percent in the second, to 75 percent in the third and final year of the experiment (C. Boggs, pers. comm., March 2001). The experimental design would utilize approximately 3,500 shallow type swordfish and mixed target sets per year. Alternatively, the experiment could be done more slowly with fewer experimental sets and sea turtle takes per year. The number of sets required for the experimental protocol is based on providing as much statistical validity as possible given the natural variability of longline-turtle interactions and using the type of fishing with the highest interaction rates. Half of the experimental sets would be allocated to testing mitigation techniques and half would serve as controls (C. Boggs, pers. comm., March 2001).

The proposed number of sets (3,500) would detect a significant mitigation method that is 28 percent effective for loggerheads (180 turtles in the control sets, 130 turtles in the treatment sets). However, with this number of sets, only a more effective mitigation measure for leatherback turtles (55 percent effectiveness) would be detected (39 control interactions and 18 treatment interactions) because of their lower level of interaction with the shallow-set swordfish and mixed-target component of the Hawai'i-based longline fishery. Based on the results of the first year, the experiment would either be refined or supplemented with other mitigation measures and would test them separately and/or test the combined effect of the effective measures in the subsequent years of the experiment (C. Boggs, pers. comm., March 2001).

The proposed experiment has the potential for interacting with 420 turtles (314 loggerhead, 57 leatherback, 25 olive ridley and 24 green) in the first 3,500 sets. The potential turtle take numbers are based on the estimated historical interaction rates in the shallow-set swordfish and mixed-target component of the longline fishery. The estimated total mortality from these takes is as many as 116 loggerhead, 18 leatherback, 18 olive ridley and six green turtles. These estimates are conservative in that they assume the same number of takes will occur in the control and experimental sets. However, if the experiments work to any degree, takes will actually be less than projected because only control sets would take the previous rate of turtles. Moreover, NMFS will evaluate the effects of the experiments on a real-time basis to determine preliminarily how effective the strategies are at reducing turtle takes. The sample size (number of interactions) required to detect a significant mitigation measure depends on the level of effectiveness. For example, if the mitigation measure were 90 percent effective, it would require only ten potential interactions (nine in the control group and one in the mitigation group). However, if the mitigation measure were only 50 percent effective, it would require 75 potential interactions (50 in the control group and 25 in the mitigation group). The number of sets required by the experimental protocol depends on the interaction rate between the individual species of sea turtle and the longline gear (C. Boggs, pers. comm., March 2001).

Despite the sea turtle mortality incurred by these take reduction experiments, the benefits that can be achieved for sea turtle conservation will be greater than the short term impacts

of the experiment. The benefit will far outweigh any potential harm because of the future savings that would occur when effective strategies and mitigation measures are instituted internationally (C. Boggs, pers. comm., March 2001). Turtle interactions are rare events in the Hawai'i-based longline fishery but this is no more of an argument against a fishing experiment than it is against management actions that restrict fishing based on their potential for interactions with sea turtles.

The experiment would initially test three basic mitigation techniques: (1) blue-dyed bait; (2) removing branch lines near floats; and (3) moving the fishing vessel following any turtle interaction (C. Boggs, pers. comm., March 2001). These measures are described as follows.

Blue-dyed bait. There is a much higher rate of longline interactions with squid-baited hooks (characteristic of shallow-set swordfish gear) than fish-baited hooks (characteristic of deep-set tuna gear). The causative factor has been assumed to be the depth that gear is set rather than the appearance of the bait. Sea turtles may bite on squid bait because of its resemblance to their normal prey. Blue-dyed squids have been shown to reduce the bycatch of seabirds and possibly increase the catch of swordfish. In field testing on seabirds, no turtles were taken on blue-dyed bait, although turtles were captured in the same tests with regular bait (Kleiber and Boggs, 2000).

Move branch lines away from floats. A higher proportion of loggerhead and leatherback turtles are taken on the branch line closest to floats than on other branch lines. Whether turtles are attracted to floats, either visually or aurally, is unknown (Sibert, 2000). The distance between branch lines on a set of longline gear targeting swordfish is 40 fm, so the suggestion is to require that the nearest branch lines be 80-100 fm from the float line. A supplementary measure could be to "counter-shade" floats to reduce their visibility from below (Sibert, 2000).

Move away from sea turtle interactions. Encounters with marine turtles are not entirely random. The probability of catching a turtle increases if one turtle has already been caught at that location (Sibert, 2000). A useful strategy might be to move and set the longline in another location. This strategy would be more effective for the species of sea turtles which have higher than expected probabilities of multiple takes (i.e., loggerheads, leatherbacks) than for others. The Working Group made several suggestions about the most effective distance and direction to move. The fishers in the group favored the suggestion of moving a short distance (i.e., 30 rather than 60 nm) in a direction perpendicular to the axis of the set (Sibert, 2000).

A take reduction experiment using blue dyed bait, removal of branch lines near floats, and moving after an interaction was initiated in January 2001 using the limited number of swordfish style fishing sets allowed by the court in area B of the Hawai'i-based fishery. It may be feasible to continue this experiment using uncompensated commercial fishing operations if the take reduction techniques have a low impact on target species. Alternatively, these and other take reduction techniques may also be investigated using chartered fishing vessels.

Turtle takes by chartered vessels would also count against the experimental take limits established by the ESA permit for the experiments. Research on other take reduction methods could be conducted in the first year if more sophisticated analyses indicated greater statistical power to detect effective techniques, or if more promising techniques are indicated. Additional research could include: (1) "stealth" fishing gear (counter-shaded floats, dark mainline, and dark-colored branch line snaps, etc); (2) deep daytime vs shallow nighttime fishing for swordfish; (3) altering the time and duration of soak; (4) monitoring the behavior of turtles around longline gear; (5) determining time of turtle capture using hook timers; (6) large (18/0) circle hooks; (7) stiffened leaders to reduce entanglement; or other research that indicates great promise in reducing sea turtle interactions with longline gear (C. Boggs, pers. comm., March 2001).

While the above fishing experiment will primarily focus on the three potential mitigation techniques thought to have the most significant potential for reducing interactions, other methods may also have promise and may be added to the experimental protocol after analysis of the first year's results. These measures were examined by Kleiber and Boggs (2000), as well as by the Working Group on Reducing Turtle Bycatch in the Hawai'i Longline Fishery, which includes scientists, longline vessel owners and a gear manufacturer (Sibert, 2000). These measures are described in the following paragraphs. Directed research studies on the sensory physiology of sea turtles and targeted pelagic fish species is needed concurrent with fishing experiments. The purpose of the studies is to investigate the olfactory, visual and auditory capabilities of both sea turtles and fish to develop mitigation techniques that exploit their sensory differences. Determination of sea turtle metabolic rates is another important subject for research efforts. Knowing how long a turtle can hold its breath could allow reconfiguration of gear to stay within the turtle's limits (Pelagic FMP Action Memo, WPRFMC 108th meeting, February 2001).

Replace "J" hooks with circle hooks. Circle hooks reduce the likelihood that a hook can embed in the esophagus if ingested by a sea turtle and the likelihood that an animal will become foul hooked (hook snagged on the flank of a flipper). In some fisheries, catch rates of tuna may actually increase when circle hooks are used. Early trials in Hawai'i indicated that circle hooks were not strong enough and often opened up or broke. Newer model circle hooks are currently used by about 75 percent of the longline fleet in eastern Canada, where they have proven effective in catching both tuna and swordfish. However, conflicting results from the Gulf of Mexico suggest that the use of circle hooks increases the take of leatherback turtles. Circle hooks may have the potential to increase the survivorship of sea turtles taken in longline fishing and further investigation is warranted (Sibert, 2000).

Branch lines longer than float lines. If a branch line is longer than the float line, a hooked turtle can reach the sea surface to breath. This is the current practice in longline sets targeting swordfish, where the float lines are 4-6 fm and the branch lines are 16 fm. This measure is impractical for tuna sets where the intended depth of the hooks is deeper than 100 fm. The Working Group agreed that this method should continue to be practiced when setting longline gear to catch swordfish (Sibert, 2000).

Guarded hooks. Hooks with "weed guards," automatically opening guards between the shank and the point of the hook, are commercially available. The Working Group discussed various modifications to these devices that could be adapted for use on a commercial longline hook to reduce foul and esophagus hooking of sea turtles. Suitable guarded hooks are not presently commercially available (Sibert, 2000).

Underwater set. Chutes for setting and retrieving hooks underwater are under development in Australia. This gear differs from the conventional line-shooter and will soon be tested in Hawai'i. They are intended to reduce seabird bycatch and their efficacy for reducing sea turtle bycatch depends on whether turtle takes occur during setting and retrieval or during "soak" of the gear (Sibert, 2000).

Corrosible hooks. Hooks that dissolve when embedded in turtle flesh or in the digestive tract are possible, in principle, to design. However, the relevant characteristics of turtle flesh are unknown (Sibert, 2000).

Release methods. The current number of sea turtle interactions is very low, so it may be difficult to evaluate changes to longline fishing gear and practices that substantially reduce the number of takes. The Working Group believes that release of turtles in good condition after being caught should be given a high priority as a practical method of mitigating the effects of interactions with longlines. Practical de-hooking systems should be developed that allow fishers to remove hooks from superficially-hooked turtles without bringing them onboard the vessel. Enhanced training in turtle handling and resuscitation should be required for fishers (Sibert, 2000).

Eliminate light sticks. Light sticks are widely used in longline sets targeting swordfish and they are thought to attract turtles. The relationship between light sticks and turtle bycatch in the 1994-1998 observer data was not statistically significant, however (Kleiber and Boggs, 2000).

2.3 MANAGEMENT OBJECTIVES FOR WESTERN PACIFIC PELAGIC FISHERIES

This section assesses the status of Pelagics FMP-managed fisheries in relation to the FMP objectives and other relevant objectives and issues, and identifies needs not adequately addressed by the existing management program. The alternatives defined in the previous section (2.2) incorporate control measures that could be effective (based on evaluation in 2.4) in meeting needs and furthering management objectives identified in the present section.

The objectives of the Pelagics FMP are stated in Amendment 1:

1. To manage fisheries for pelagic management unit species in the Western Pacific Region to achieve optimum yield (OY) (see 2.3.1 for definition).

2. To promote, within the limits of managing at OY, domestic harvest of the PMUS in the western Pacific EEZs and domestic fishery values associated with these species, for example, by enhancing the opportunities for the following (not listed by order of any particular priority):

    a. Satisfying recreational fishing experiences;
    b. Continuation of traditional fishing practices for non-market personal consumption and cultural benefits; and,
    c. Domestic commercial fishers, including charter boat operators, to engage in profitable fishing operations.

3. To diminish gear conflicts in the EEZs, particularly in areas of concentrated domestic fishing.

4. To improve the statistical base for conducting better stock assessments and fishery evaluations, thus supporting fishery management and resource conservation in the EEZs, and throughout the range of the PMUS.

5. To promote the formation of a regional or international arrangement for assessing and conserving the PMUS throughout their range.

6. To preclude waste of PMUS associated with longline, purse seine, pole-and-line or other fishing operations.

7. To promote, within the limits of managing at OY, domestic marketing of the PMUS in American Samoa, Guam, Hawai'i and Northern Mariana Islands.

The eighth management objective in the EIS is to encourage the recovery of depleted populations of protected species of sea turtles, seabirds and marine mammals by reducing interactions with fisheries managed under the Pelagics FMP. The FMP was amended in 1991 (Amendment 3) to designate a 50 nm protected species zone around the Northwestern Hawaiian Islands that has prevented interactions between longline gear and endangered Hawaiian monk seal populations. The Council has proposed Amendment 9 to reduce the take of albatross in the northern portion of the Hawai'i-based longline fishery.

The Pelagics FMP includes a procedure through which regulatory adjustments can be proposed by the Council for approval and implementation by NMFS. Eight amendments (and additional emergency rules) were made between 1987 and 1999 and, in the past year, three more adjustments have been submitted for action by NMFS. The adjustment process begins with identification of problems and issues that are in conflict with the FMP's objectives and, therefore, may need management attention and analysis of alternative solutions. The same general procedure is used in this chapter to define alternatives for evaluation in the EIS.

2.3.1 Objective 1 – Achieve Optimum Yield (OY)

The principal goal of fishery management under the MSA is "...to prevent overfishing while achieving, on a continuing basis, optimum yield." The Pelagics FMP defines optimum yield as the amount of each pelagic management unit species or species complex that can be harvested by domestic and foreign fishing vessels in the EEZs and adjacent waters to the extent regulated by the FMP without causing "local overfishing" or "economic overfishing" within the EEZ of each island area, and without causing or significantly contributing to "growth overfishing" or "recruitment overfishing" on a stock-wide basis.

Pelagic fish stocks are not confined to any particular EEZ or country but have a wide geographical distribution in the central and western Pacific. Domestic fisheries conducted in the EEZs of the Western Pacific Region have little or no stock-wide impact because they account for such a small percentage of the Pacific-wide fishing effort (less than five percent of total longline effort) and harvest of pelagic fish (less than eight percent of total longline harvest) (Sections 3.4, 3.14).

The stock structures of pelagic fish are by no means well defined. Long distance movements are evident for all species but mixing of various fractions of stocks between areas, at least over short and medium time periods, seems to be incomplete. Fluctuations in oceanic environmental conditions or prey availability can cause striking and unpredictable changes in the relative abundance and catch rates of pelagic fish, as a function of local movement patterns rather than of stock-wide overfishing. If these fluctuations reduce the availability of pelagic fish in a localized area, they have a much more severe impact on small-scale fleets with limited fishing range than on larger, more mobile vessels (Shomura *et al.*, 1994,1996).

Environmentally-induced reductions in pelagic fish densities can be amplified by catch interactions or catch competition between fisheries with different gear types or scales of harvesting. There are several ways that one fishery could affect the performance of other fisheries (Itano and Holland, 2000):

- Concurrent interactions between competing fisheries in the same time/area strata for the same sized pelagic fish, including surface and sub-surface populations.

- Sequential or progressive interactions which may occur as pelagic fish grow and recruit to different fisheries.

- Spatially segregated interactions where pelagic fish move between fishing grounds and enter new fisheries remote in time and space.

The ready availability of yellowfin and bigeye tuna off the Hawaiian Islands provides a resource base for a diversity of domestic tuna fisheries operating from Hawai'i ports, with resulting conflicts and perceptions of conflicts between user groups using troll, handline, pole-and-line and longline gears (Itano and Holland, 2000). Small boat fishers' concerns that

the four-fold expansion in longline fishing effort by the Hawai'i-based fleet between 1987 and 1991 might be intercepting pelagic fish moving towards nearshore areas was one of the reasons that the Council established a limited access permit program for Hawai'i-based longline vessels in 1994 (Pelagics FMP Amendment 7). Interactions between the longline and small-boat tuna fisheries affecting catch rates were not detectable (Boggs, 1991; He and Boggs, 1995).

Concerns continue to be expressed about potential catch interactions by all sectors of Pelagics FMP-managed fisheries. For example, the charter boat sector in Hawai'i is concerned about the possible impact of the Hawai'i-based longline fishery on marlin catch rates (Dalzell, in press) and some sports fishers favor catch-and-release over retention of marlin. Small-boat pelagic fishers in all island areas are concerned about potential long-distance effects of the purse seine fishery on catch rates of surface skipjack and yellowfin tuna, as well as the large amount of discards associated with purse seine sets around untethered fish aggregation devices (FADs) (Fishers' interviews conducted for Kaneko *et al.*, 2000, unpub.).

Tuna longline fishers in Hawai'i are concerned about potential effects of the Hawai'i seamount handline fishery and the distant-water purse seine fishery because the latter two fisheries harvest large quantities of juvenile bigeye tuna (HLA members, pers. comm.). Seamount handline fishers were so concerned about increasing handline fishing effort at the Cross Seamount that, in 1991, the Hawai'i Handliners Association (HHA) petitioned the Council for a moratorium on the handline fishery. A control date of July 2, 1992, was established for the offshore handline fishery, after which persons entering the fishery are not guaranteed participation if the Council acts in the future to limit entry (WPRFMC, 1994). A new control date of February 14, 2001, was established at the 108th Council meeting for the pelagic handline fishery that operates on the Cross Seamount and National Oceanic and Atmospheric Administration (NOAA) buoys.

In general, pelagic fisheries interactions are difficult to detect or predict because of inadequate data, insufficient knowledge of the biology and population dynamics of the resource and poor understanding of environmental influences (Shomura *et al.*, 1994; Shomura *et al.*, 1996). There is some evidence that "core areas" off the Pacific coast of Mexico frequented by marlin (Muhlia-Melo, 1996) and seamounts, inshore ledges and man-made fish aggregation devices that aggregate skipjack, juvenile yellowfin and bigeye tuna in Hawai'i (Itano and Holland, 2000) can experience reduced pelagic fish densities as a result of heavy fishing pressure.

A recent study of the possibility of marlin catch competition between the Hawai'i-based longline fishery and the Kona, Hawai'i-based pelagic charter fishery made a preliminary finding that the level of longline fishing inside the EEZ around Hawai'i does not appear to have a significant influence on charter vessel catch-per-unit-effort (CPUE) of blue marlin and striped marlin. The primary influence on charter vessel CPUE may be the annual amount of charter vessel fishing activity but this is not yet documented (Dalzell, in press). The potential

for intra-fishery interactions to affect catch rates for blue marlin in the charter fishery is yet another of the many possibilities for catch interactions.

Pelagic fisheries interactions over greater distances have been more difficult to document. A study in the Republic of Kiribati suggests that, at a scale of separation of 300-600 nm, purse seine catches of yellowfin are not negatively correlated with troll fishery catches. When purse seiners fished within 60 nm of Kiribati shorelines, however, some negative impacts on troll catch rates were observed (Hampton *et al.*, 1996). There is some indication from preliminary modeling of theoretical skipjack tuna movement that a purse seine fishery has the potential to produce detectable effects on a troll fishery as far away as 600 nm (P. Kleiber, pers. comm. *in* WPRFMC, 2000f).

Most island nations neighboring American Samoa have, or are developing, domestic longline fisheries that compete for pelagic fish resources within the region. It is not understood whether the sub-surface albacore tuna taken in American Samoa's small-scale longline fishery are primarily a local sub-population or are part of a more widely distributed regional mass (Stanley and Toloa, 1998). The albacore catch by small-scale longline fisheries in American Samoa and neighboring independent Samoa totaled 6,800 mt in 1998, representing 19 percent of the South Pacific regional albacore harvest by longline fisheries (Lawson, 1999). The effect of rapid expansion and high catches by the small-scale longline fishery in independent Samoa on the regional "throughput" of albacore cannot be estimated but may be a contributing factor in a recent decline in CPUE experienced by the American Samoa small-scale fishery. It is also not known whether catches obtained in the recent expansion of the independent Samoa fishery are representative of the long-term average (WPRFMC, 2000c).

Uncertainty does not diminish the concerns by some fishers about potential catch interactions that have been expressed in the troll, handline and longline fisheries managed under the Pelagics FMP. Alternatives to address this issue, therefore, are considered in the EIS.

2.3.2 Objective 2 – Promote Domestic Fishery Values Within the Limits of OY

The Pelagics FMP defines domestic fishery values associated with pelagic management unit species as opportunities for:

a. Satisfying recreational fishing experiences;
b. Continuation of traditional fishing practices for non-market personal consumption and cultural benefits; and,
c. Domestic commercial fishers, including charter boat operations, to engage in profitable fishing operations.

Increasing regulation of domestic fisheries by various government agencies for fisheries management, vessel safety and seafood safety purposes is perceived by many participants

in Pelagics FMP-managed fisheries as the greatest impediment to this objective. These regulations are included in the no-action baseline, Alternative 1.

In 1996, the small-scale domestic longline fishery in American Samoa consisted of six vessels holding federal general longline permits. In 1998, the number of permitted vessels increased to 40 and, currently, there are 68 small-scale longline vessels (and about ten additional large vessels with length overall greater than 50 ft) registered with federal general longline permits. Continued uncontrolled expansion of longline fishing effort could possibly lead to locally reduced pelagic fish densities and catch rates in the EEZ around American Samoa. Limitation of longline fishing effort is believed necessary because a significant reduction in pelagic fish catch rates and the supply of fish would be potentially ruinous to the Samoan culture. Local overfishing could jeopardize sustained community participation in the small-scale pelagic fishery, that not only produces food, income and employment but also contributes to the perpetuation of Samoan culture (WPRFMC, 2000c). This issue is considered in the EIS alternatives that address optimum yield (Objective 1).

Dependence on FMP-managed fishery resources and sustained participation by indigenous populations are also of general concern in Guam, Hawai'i and the Northern Mariana Islands. The Council plans to address this issue through an indigenous fisheries demonstration program in all four island areas (C. Ka'ai'ai, WPRFMC Indigenous Programs Coordinator, pers. comm. at 75th mtg. of WPRFMC SSC, October 12, 2000).

2.3.3 Objective 3 – Diminish Gear Conflicts

During a period of rapid growth between 1987 and 1991, there were escalating gear conflicts between the Hawai'i-based longline fishery and small-scale troll and handline fleets in nearshore waters around the main Hawaiian Islands. Several of the domestic longline vessels relocated to Guam, and gear conflicts were anticipated to occur there as well. To eliminate the conflicts in the EEZ around Hawai'i and to avoid such conflicts in the EEZ around Guam, the Pelagics FMP was amended (Amendment 5) to prohibit domestic longline fishing within 50 nm of the MHI and Guam. In the mid-1990s, gear conflicts arose at Cross Seamount between tuna handline fishers and a small number of Hawai'i-based longline vessels. The problem that arose in the mid-1990s was resolved through mediation (WPRFMC, 1997) but tuna handline fishers are concerned about a reoccurrence.

The potential for gear conflicts between large (> 50 ft overall length) and small (50 ft or smaller) pelagic fishing vessels is increasing in American Samoa because (1) the fishing range of the small-scale fishery is expanding offshore with the addition of new and safer types of boats; and (2) up to 40 large vessels previously based in Hawai'i may be displaced from the central North Pacific longline fishery for swordfish after a U.S. court order (in CMC v NMFS) issued August 4, 2000, closed a large portion of the swordfish grounds to vessels with Hawai'i-based longline limited entry permits. Although most of the swordfish vessels are temporarily relocating to the Pacific coast for the near future, at least five vessel owners

have contacted the DMWR (Tulafono, 2000) to express interest in relocating to American Samoa sometime in the future.

Three large vessels entered American Samoa's longline fishery during late 1999 and 2000 and others were reported to be gearing up to enter but had not secured general longline permits as of late 2000 (Verbal reports on large vessel entry into American Samoa's longline fishery, October 11, 2000, 75th mtg. of WPRFMC SSC). The large vessels (> 50 ft overall length) that comprise U.S. longline fishing fleets are highly mobile and they have demonstrated a willingness in the past to seek new fishing opportunities in the central and western Pacific as fisheries in other areas of the U.S. EEZs become increasingly restricted (Travis, 1999). If large vessels set gear in the same nearshore areas where small-scale longline fishing effort is concentrated, there would be a high probability of gear conflicts (WPRFMC, 2000c). The EIS, therefore, includes an alternative that addresses potential gear conflicts in American Samoa's pelagic fishery.

2.3.4 Objective 4 – Improve the Statistical Base for Conducting Better Stock Assessments and Fishery Evaluations

The technical data available to monitor and adjust the Pelagics FMP are incomplete and uncertain. The most serious deficiency is catch and effort data for the recreational sector in most of the U.S. Pacific island areas (Dalzell, 2000). Poorly-documented issues, such as potential catch interactions between different gear types and scales of fishing, could be more thoroughly evaluated with improved fisheries statistics. In the EIS, this objective is linked to Alternative 9, which addresses the need for additional research and information to better document and manage catch interaction issues.

2.3.5 Objective 5 – Promote Regional or International Arrangements for Assessing and Conserving Pelagic Fish Stocks Throughout Their Range

A series of Multi-Lateral High Level Conferences among representatives of Pacific island states and Pacific rim fishing nations, including the United States, culminated in September, 2000 in the adoption of the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Central and Western Pacific Region. The Convention was signed by 14 Pacific island states, nine Pacific rim countries and one European country with Pacific island possessions. A preparatory conference, scheduled for 2001, will develop rules, regulations and procedures governing the operations of the commission. Preparatory activities will be voluntary and until at least ten countries ratify the commission, there is no binding agreement. Upon entry into force, the commission may eventually assume responsibility for implementing the central and western Pacific pelagic fishery management regime described in the Convention. No additional alternatives are considered in the EIS.

2.3.6 Objective 6 – Preclude Waste of PMUS Associated with Fishing Operations

Most of the pelagic fishing methods managed under the Pelagics FMP are relatively selective and produce minimal bycatch or waste. There is concern about waste, however, in the Hawai'i-based swordfish longline fishery and in FAD-associated purse seine sets. The Hawai'i-based longline fishery does not target sharks, but blue sharks are a large incidental component of the harvest, accounting for about 25 percent of the total number of pelagic fish in catch reports. Only about 14 percent of all sharks hooked incidentally in Hawai'i-based longline fishing are brought to the side of the vessel dead. A majority of the incidental shark catch was released in the early 1990s (Ito and Machado, 1999). A rapid increase in the number of blue sharks finned, with carcasses disposed of at sea, has generated considerable controversy in Hawai'i.

Approximately 60,000 sharks landed by the Hawai'i-based longline fishery were finned in 1998 (Ito and Machado, 1999). Shark fin products are highly esteemed in Chinese culture but shark conservationists view finning as wasteful. Release of dead sharks is economically wasteful and finning reduces the waste by recovering some economic value from the catch (WPRFMC, 2000a). There is no evidence to suggest that the North Pacific blue shark population is presently overfished (Kleiber, 2000).

The "Shark Finning Prohibition Act" enacted by the U.S. Congress in December 2000 became Public Law No. 106-557 in January 2001. Section 307(1) of the Magnuson-Stevens Act was amended to prohibit fishing vessels from removing any of the fins of a shark and discarding the carcass at sea and to possess any shark fins onboard without the corresponding carcass. Fishers may process shark carcasses at sea but they must be able to prove that the weight of fins possessed and landed by the vessel is not more than five percent of the total weight of shark carcasses onboard or landed (WPRFMC, 2001b). The Shark Finning Prohibition Act applies to all fishing vessels subject to U.S. jurisdiction and applies to all fishing vessels that unload shark fins without the corresponding carcass in a port of the United States, including the U.S. Pacific territories and possessions.

A new State of Hawai'i law enacted in 2000 prohibits all domestic fisheries licensed or landing fish catches in Hawai'i from landing shark fins in the State "...unless the fins were taken from a shark landed whole in the State." The new law does not limit the entry (as cargo) into Hawai'i of shark fins or cartilage shipped from foreign sources.

The shift towards purse seine fishing around untethered FADs (*payao*) has affected the U.S. purse seine fleet's catch in two ways that have significantly increased fish discards. First, the average size of tuna caught in floating object sets tend to be smaller than in free-swimming school sets. A higher percentage of tuna that is caught in floating object sets is undersized for U.S. canning and, hence, is discarded. Second, because floating objects tend to aggregate a large number of pelagic species other than tuna, they produce more bycatch than free-swimming school sets (Coan *et al.*, 1999). Small-scale fishers based on the island of Hawai'i (Kaneko *et al.*, 2000) and Hawai'i-based longline fishers (WPRFMC, 1997) have expressed

concern about increasing handline catches of small yellowfin tuna at inshore *koa* (localized areas of tuna aggregation) and of small bigeye offshore at the Cross Seamount and anchored weather buoys, which function as FADs.

The Forum Fishery Agency (FFA) administers an observer program covering a minimum of 20 percent of the fishing trips by U.S. purse seiners for sampling per year, higher observer coverage than in any other central and western Pacific fishery. FFA observers collected bycatch and discard information from 616 sets made in 1998. The data indicate that the bycatch rate associated with floating object sets (1.59 mt of bycatch per set) is substantially higher than for free-swimming school sets (0.06 mt of bycatch per set) (Coan *et al.*, 1999).

2.3.7 Objective 7 – Promote, Within the Limits of Managing at OY, Domestic Marketing of the PMUS

Increasing regulation of Pelagics FMP managed fisheries is perceived by many in the domestic seafood industry as the greatest impediment to this objective. Displacement of domestic fisheries could increase reliance on imported pelagic fish products. This position is considered in the EIS by inclusion of a no-action baseline without new regulations for Pelagics FMP-managed fisheries.

2.3.8 Objective 8 – Reduce Total Interactions with Protected Species in Pelagics FMP-managed Fisheries to Encourage Recovery of Their Populations

Species protected under the Marine Mammal Protection Act (MMPA), the Migratory Bird Treaty Act and the Endangered Species Act are present in some areas where western Pacific pelagic fisheries are conducted and there are interactions with fishing gear. The Pelagics FMP was amended in 1991 (Amendment 3) to designate a 50 nm protected species zone around the Northwestern Hawaiian Islands that has prevented interactions between longline gear and endangered Hawaiian monk seal populations.

The focus of current concerns is on the incidental take and mortality of sea turtles and seabirds in the Hawai'i-based longline fishery. "Take" is the number of a particular species caught accidentally by the fishing gear and mortality is the number of animals that are actually killed or estimated to be killed as a result of being taken. The Council has proposed Amendment 9 to reduce the incidental take of albatross in the northern portion of the Hawai'i-based longline fishery.

The common general objectives in managing protected species are to not increase their probability of extinction or jeopardize their prospects for population recovery (Hall, 2000). Unless "zero mortality" is specified, these objectives imply that some level of incidental catch of protected species is acceptable (Hall, 1998). Choosing appropriate target levels for protected species' populations is not a trivial exercise (Hall, 1998). Without basic data to compare the level of fishing mortality with population size and its net recruitment, mortality estimates have only limited value because "...the assessment is left to the 'gut feelings' of

those interested" (Hall, 1999), which in itself is problematic from both a scientific perspective and in terms of obtaining the confidence of fishers and managers (Hall, 1998).

2.3.8.1 Reduce Interactions of Western Pacific Pelagic Fisheries with Sea Turtles to Encourage Recovery of Depleted Populations

Western Pacific Troll and Handline Fisheries

There have been no reported interactions with sea turtles in the fisheries of the Pelagics FMP other than the Hawai'i-based longline fishery, the American Samoa-based longline fishery, and the central and western Pacific U.S. purse seine fishery. There is a chance, based on fishing methods including bait used and gear-type, that these other fisheries do interact with sea turtles although the information is not reported. Due to low effort and target-species selectivity of the gear, incidental take and mortality in these fisheries is likely minimal and has an insignificant effect on the survival and recovery of sea turtle populations (NMFS, 2001a).

Western Pacific Purse Seine Fishery

From 1988 to the present, observers have recorded the incidental take of only six loggerheads by the central and western Pacific U.S. purse seine fishery; all were released alive (A. Coan, NMFS, pers. comm., February 2001, *in* NMFS, 2001a). In addition, logbook data during this period show that there were no reported sea turtle takes. This suggests under-reporting. Although the U.S. fleet is required to have 20 percent observer coverage and to maintain catch and bycatch logbooks, a straight extrapolation of the known observed takes is probably not an accurate representation of the effect this fishery has on sea turtles. Collecting data on sea turtles is a lower priority for observers, and since vessels are likely to release turtles immediately after pursing the net, it is likely that very little information on the bycatch of turtles is recorded (NMFS, 2001a).

Based on information collected in the eastern tropical Pacific tuna purse seine fishery (100 percent coverage), the mortality of sea turtles taken by purse seine is low (around ten percent). 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 do tend to take more turtles because of the close association that exists between floating objects and sea turtles in the open ocean. Since 1997, U.S. purse seiners fishing in the central and western Pacific Ocean have begun shifting their strategy to setting more often on drifting FADs. This may increase the likelihood of sea turtle interactions with the fishery. However, NMFS cannot speculate as to what effect this change in fishing strategy may have on sea turtles in the central and western Pacific (NMFS, 2001a).

Based on observer data, logbooks, and information from the Forum Fisheries Agency (K. Staisch, pers. comm., February 2001, *in* NMFS, 2001a), NMFS cannot quantitatively estimate

the amount or extent of sea turtle take by the central and western Pacific purse seine fishery; however, it is believed to be low (NMFS, 2001a).

American Samoa-based Longline Fishery

For the American Samoa-based longline fishery, the federal logbooks from 1992 to 1999 indicate a range of interactions with sea turtles (i.e., hooking/entanglement). There is no observer coverage of this fishery, so none of the species' identifications were validated by NMFS. In addition, logbook data may not be a reliable method to measure sea turtle interactions in this fishery. From 1992-1999, the take of 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).

Hawai'i-based Longline Fishery

A previous NMFS Biological Opinion on the effects of the Hawai'i-based longline fishery on sea turtle populations (NMFS, 1998a) concluded that the operation of the fishery was not likely to jeopardize the continued existence and recovery of any sea turtle populations. Incidental take levels were derived by calculating the average of the upper 95 percent confidence limits of the fishery's estimated annual takes and mortalities for each species over a four year period, based on data collected by the NMFS Southwest Region (NMFS SWR) Observer and Vessel Logbook Programs from 1994-1997. These anticipated incidental take levels were updated in 1998, as a part of that BO.

On May 18, 2000, NMFS finalized its annual assessment of the impact of the Hawai'i-based longline fishery on sea turtles during 1999. This evaluation produced estimates of interactions in 1999, as well as updated previous years' estimates through the inclusion of NMFS observer and logbook data in a refined statistical model. The results indicate that, in 1999, the fishery exceeded its anticipated incidental take for olive ridley mortalities. A Section 7 consultation under the Endangered Species Act on the fishery and especially its impacts on olive ridley turtles was therefore re-initiated on June 7, 2000. This resulted in a new Biological Opinion on sea turtle interactions with western Pacific pelagic fisheries issued by NMFS in March 2001 (NMFS, 2001a).

Because sampling probabilities are unknown and less than five percent of Hawai'i-based longline fishing trips were observed during the 1994-1999 period, a model-based predictor was used to estimate the total take of sea turtles by the fishery. Because the abundance and distribution, migration and foraging patterns, and physiology vary so significantly between the four species of sea turtles that may be encountered by domestic longliners fishing in the central and western Pacific Ocean, their vulnerability to Hawai'i-based longline fishing operations also varies. In developing the prediction model, explanatory variables were considered in order to estimate takes accurately and precisely. Such variables included: latitude, longitude, distance to the 17° C isotherm, distance to the 19° C isotherm, year (1994-1999), month, day, hooks, hooks/float, temperature, catch of other species (e.g., tuna

species, marlin, albatross, etc.), vessel length, and trip type (i.e., swordfish, tuna, mixed). Some of the variables considered and found to be associated with take were poorly represented in the logbooks during the time period of data gathering and were therefore not considered for prediction purposes (McCracken, 2000).

(1) Level of fishery interactions with green turtles: The incidental take of green turtles by the Hawai'i-based longline fishery is rare. Observers have recorded the incidental take of ten green turtles by the fishery from 1994-1999. All of these turtles were hooked either externally (nine), or internally (one), and only one was observed dead, the rest were injured. In addition, all green turtles were taken from different trips; therefore, there was no evidence within the data that a green turtle take in one set implies a higher probability of a green turtle take in another set from the same trip (McCracken, 2000).

Green turtles have been observed taken in the Hawai'i-based longline fishery during the months of February through July only. The turtles were caught in the area bounded by 155° W. and approximately 180° longitude and between 5° N. and 30° N. latitude. Six out of the ten turtles were caught in an area around the Hawaiian island chain between 155° W. and 160° W. longitude and between 15° N. and 30° N. latitude. The remaining four were caught either far south of the Hawaiian islands (n=1), or to the northwest of the MHI (n=3). In addition, more green turtles were observed taken in a swordfish-style set compared to a tuna-style set. Eight out of the ten turtles caught were taken in sets with less than ten hooks per float, indicative of swordfish-style, shallow-set gear (NMFS, 2001a).

From observer data, and using a model-based predictor, McCracken (2000) estimated that between 37 and 45 green turtles (average 40) were taken each year by the Hawai'i-based longline fishery, and of these, an average of five were killed (given a 13 percent mortality rate) (Table 2-7).

Table 2-7: Green Sea Turtle Take and Kill Estimates with 95 Percent Prediction Intervals (PI). Source: McCracken, 2000.

Year		1994	1995	1996	1997	1998	1999	Annual Average
Takes	Estimate	37	38	40	38	42	45	40
	95% PI	[15-65]	[15-70]	[19-70]	[14-73]	[18-76]	[18-76]	
Kills	Estimate	5	5	5	5	5	6	5
	95% PI	[0-16]	[0-17]	[1-17]	[0-17]	[1-19]	[1-19]	

Green turtles encountered during longline fishing may originate from a number of known proximal, or even distant, breeding colonies in the region. However the most likely candidates would include those from Hawai'i (French Frigate Shoals) and the Pacific coast of Mexico population. This is based on limited genetic sampling conducted within the NMFS observer program for the Hawai'i-based longline fishery. Of eight greens caught by the Hawai'i-based longline fishery and genetically tested, four were of eastern Pacific (Mexico)

origin, while three were either of Hawaiian origin or eastern Pacific origin, and one was of Hawaiian origin (P. Dutton, NMFS, pers. comm., January 2001, *in* NMFS, 2001a).

(2) Level of fishery interactions with leatherback turtles: From 1994-1999, observers recorded the incidental take of 40 leatherback turtles by the Hawai'i-based longline fishery. Of these, three were entangled, released alive and uninjured (7.5 percent), 31 were injured (77.5 percent – comprised of 3 entanglements, 23 hooked externally, one hooked internally, and four hooked in an unknown location), three died as a result of the interaction (7.5 percent - comprised of two that were entangled and one that was hooked externally), and for three leatherbacks taken, there were no records (i.e., the observer was unable to identify the fate or condition of the turtle) (NMFS, 2001a).

Leatherback turtles have been observed taken in all months of the year, except August. The leatherbacks were caught in the area bounded by 170° E. and 133° W. longitude and between 5° N. and 41° N. latitude. Leatherbacks caught in sets above 20° N. latitude (34 out of 40 leatherbacks observed, or 85 percent) were caught in sets with less than ten hooks per float, indicative of swordfish-style, shallow-set gear and also indicative of the general area in which swordfish-style fishing methods are used. Leatherback takes in these sets occurred primarily between 165° W. and 130° W. longitude and 20° N. and 40° N. latitude. The remaining leatherbacks observed taken (six out of 40), were taken in sets with more than ten hooks per float, indicative of tuna-style, deep-set gear. Leatherback takes in these sets occurred between 157° W. and 167° W. longitude and 5° N. and 15° N. latitude (NMFS, 2001a).

Sea surface temperatures, latitude, and the distance to the approximate 17° C and 19° C isotherms were associated with the takes, but there was a high degree of collinearity between these variables (McCracken, 2000). When examining four latitude predictor categories for leatherbacks,[2] McCracken (2000) found that the proportion of sets with positive leatherback takes was higher in the northernmost and southernmost breakdown of latitudes she used. These areas had fewer observed sets than the middle two categories, which had more observed sets but fewer observed takes.

Based on observations of all sea turtles taken by the Hawai'i-based longline fishery, it appears that leatherbacks in particular tend to get hooked externally or entangled rather than ingesting the hook. This is most likely due to their foraging strategy as well as their physiology. Whereas some hard-shelled turtle species (e.g., loggerheads) are piscivores and will forage on the bait (e.g., squid) used on longlines and therefore become hooked internally, leatherbacks tend to target cnidarians (e.g., medusae and siphonophores), so they may also be attracted to the lightsticks used on the longlines at night to attract squid and subsequently are hooked externally or entangled (NMFS, 2001a).

[2]These four categories were: less than 14.95° N., between 14.95° N. and 24.84° N., between 24.84° N. and 33.82° N., and greater than 33.82° N. (McCracken, 2000).

From observer data, and using a model-based predictor, McCracken (2000) estimated that between 88 and 132 leatherback turtles (average 112) were taken each year by the Hawai'i-based longline fishery, and of these, an average of nine were killed (giving an eight percent mortality rate) (Table 2-8).

Table 2-8: Leatherback Turtle Take and Kill Estimates with 95 Prediction Intervals (PI). Source: McCracken, 2000.

Year		1994	1995	1996	1997	1998	1999	Annual Average
Takes	Estimate	109	99	106	88	139	132	112
	95% PI	[68-153]	[62-141]	[69-148]	[55-124]	[79-209]	[76-193]	
Kills	Estimate	9	8	9	7	12	11	9
	95% PI	[0-22]	[0-21]	[1-21]	[0-18]	[1-28]	[1-27]	

Based on genetic analysis of mitochondrial DNA (mtDNA), leatherback stocks encountered in the Hawai'i-based longline fishery are derived from two Pacific stocks: (1) the eastern Pacific region (Mexico and Costa Rica); and (2) the Western Pacific Region (Malaysia, Indonesia and Solomon Islands). To date mtDNA analyses indicated that 12 of 14 leatherbacks captured in the Hawai'i-based longline fishery originated from nesting populations in the southwestern Pacific; the other two specimens, taken in the southern range of the Hawai'i-based fishery, were from nesting beaches in the eastern Pacific (Dutton *et al*., in press; P. Dutton, NMFS, pers. comm., May 2000, *in* NMFS, 2001a).

(3) Loggerhead impacts: Of all marine turtles, loggerheads are the species most often taken by the Hawai'i-based longline fishery. From 1994-1999, observers recorded the incidental take of 147 loggerheads. Of these, three were released alive and uninjured (two percent), 139 were injured by hooking (94.5 percent) (56 hooked externally, 83 hooked internally), and four died as a result of the interaction (three percent) (one hooked internally and three hooked in an unknown location). There was no record of its condition for one loggerhead interaction. From life history data collected by observers, it appears that the Hawai'i-based longline fishery primarily interacts with juvenile loggerheads (NMFS, 2001a).

When loggerhead takes were analyzed statistically with several different variables (described earlier), sea surface temperature, latitude, and the distance to the approximate 17° C and 19° C isotherms were associated with the take of loggerheads, but there was a high degree of collinearity between these variables. Where both latitude and sea surface temperature were used in the prediction model, there was a cluster of positive observations at the higher latitudes, and at these latitudes, the cluster was located in the colder temperatures. When comparing loggerhead take with latitude versus the three classifications for month (see Table IV-3 for classifications used for loggerheads), there were fewer observed trips at the higher latitudes in May and June (months five and six). In fact, there were no observed takes of loggerheads during the months of May and June, and most interactions occurred during the fall and winter months, especially in January and February. Degrees of latitude appeared to

be associated with the probability of loggerhead take; for example, there were no observed loggerhead takes south of 22° N. (1,263 sets observed below this latitude had zero takes) (McCracken, 2000). Kleiber (1998) also found latitude to be the primary explanatory variable. In addition, of 55 trips with positive takes of loggerheads, 29 had positive takes of loggerheads in more than one set. Therefore, it is likely that (1) loggerheads forage or migrate in groups, which is evidenced by the witnessed reports of thousands of loggerheads feeding on pelagic crabs off Baja California; and/or (2) longliners target swordfish and tuna in areas of high loggerhead concentration (NMFS, 2001a).

All of the 147 loggerheads observed taken by the Hawai'i-based longline fishery from 1994-1999 were captured by longliners targeting swordfish (i.e., target depth less than 100 meters, using less than ten hooks per float, fishing at night, using lightsticks). The mean dive depth for loggerheads (post-nesting female and subadult) is between 9 and 22 meters; therefore, loggerheads are more likely to interact with a shallow swordfish set than a tuna set, which generally has a target depth greater than 100 meters. In addition, as described below, loggerheads tend to congregate in areas typically fished by longliners targeting swordfish, taking advantage of high productivity associated with particular oceanographic features (NMFS, 2001a).

Recent satellite tracking by Polovina *et al*. (2000) indicates that loggerheads of all life stages are active migrators, swimming against weak geostrophic currents along two convergent fronts as they travel from east to west across the Pacific. Of nine juvenile loggerheads tracked in the central North Pacific, six were associated with a front characterized by 17° C sea surface temperature (SST) (termed "cool group") and the other three were associated with a front with a sea surface temperature of 20°C ("warm group"). Seasonally, these 17° C and 20° C isotherms move north and south over ten degrees of latitude, and as the turtles moved westward, they also appeared to move north and south coincident with these isotherms. During the first quarter, the distribution of surface longline sets (targeting swordfish) is largely between the 17° C and 20° C SST fronts used by loggerheads. Swordfish are believed to move south through the fronts, perhaps following squid, so during the second quarter, the fishery is well to the south of the 17° C SST front but overlapping the 20° C SST front. Sea turtles tracked during the first quarter of the years (1997 and 1998) occupied waters with a mean of 17° C SST, with considerable overlap with the SST occupied by the fishery in the northern portion of the fishing grounds. As the fishery moves south in the second quarter, those "warm group" turtles following the 20° C front may be well within the fishing grounds, while the "cool group" will likely be well north of the fishing grounds (Polovina *et al*., 2000). Observer data show that the interaction rate (turtles per longline set) is substantially greater at 17° C SST than at 20° C SST (P. Kleiber, NMFS, pers. comm. *in* Polovina *et al*., 2000; NMFS, 2001a).

Loggerheads in North Pacific pelagic habitats are opportunistic feeders that generally forage on items floating near or at the surface, although they will actively feed at depth if there are high densities of prey available. Loggerheads captured and killed by the international high-seas driftnet fishery in the Pacific Ocean were opportunistically necropsied to determine

stomach contents. Based on the results from 52 turtles, it appears that loggerheads are omnivorous predators of the surface layer, feeding both by swallowing floating prey whole and/or biting off prey items from larger floating objects. In samples that contained *pyrosomas*, the prey items often comprised a high percent of the total gut content, indicating that the turtles were encountering dense patches of this prey item. In addition, prey items normally found in the upper photic zone (within 100 meters of the surface) but not the surface layer were also found in the gut, indicating that the loggerheads actively hunted for these species (Parker *et al*., in press). With 57 percent of loggerheads observed hooked internally, it is likely that they are foraging at depth and may have been confusing lightsticks for prey items or were attracted to the baited hooks. In addition, the presence of a float in the water may have caused the initial interest and attraction to the gear (NMFS, 2001a).

Using mortality and take estimates described above, McCracken (2000) estimated the take and kill of loggerheads per year, as shown in Table 2-9. An estimated 418 were taken and 73 were killed per year from 1994-1999 (giving a 17.5 percent mortality rate).

Table 2-9: Loggerhead Take and Kill Estimates with 95 Percent Prediction Intervals (PI). Source: McCracken, 2000.

Year		1994	1995	1996	1997	1998	1999	Annual Average
Takes	Estimate	501	412	445	371	407	369	418
	95% PI	[315-669]	[244-543]	[290-594]	[236-482]	[259-527]	[234-466]	
Kills	Estimate	88	72	78	65	71	64	73
	95% PI	[36-141]	[31-115]	[34-127]	[28-102]	[32-112]	[28-102]	

Genetic analyses of 124 loggerheads caught in the Hawai'i-based longline fishery indicated that the majority (nearly 100 percent) originated from Japanese nesting stock (Dutton *et al*., 1998) and the rest derived from Australia (P. Dutton, NMFS, pers. comm., January 2001, *in* NMFS, 2001a).

(4) Level of fishery interactions with olive ridley turtles: From 1994-1999, observers recorded the incidental take of 32 olive ridleys by the Hawai'i-based longline fishery. Of these, 26 were injured (81 percent – all hooking incidents, ten hooked externally and 16 hooked internally) and six died as a result of the interaction (19 percent - comprised of four that were hooked externally, and two that were hooked internally). In addition, of the 32 olive ridleys observed taken, 26 were captured in swordfish-style sets, and six were caught in tuna-style sets. Based on life history data collected by observers, it appears that the fishery is interacting with both subadult and adult life stages of olive ridleys (NMFS, 2001a).

None of the olive ridleys observed taken by the fishery were entangled - all were hooked, 14 externally, and 16 internally; therefore, it is likely that the olive ridleys may be attracted to the baited hook or to the lightsticks, which may be confused for *pyrosomas* by the turtle.

From 1994 to 1999, olive ridleys were observed taken by the Hawai'i-based longline fishery during all months of the year except February, with most of the take occurring during the warmer months (May-August). In addition, the fishery interacted with olive ridleys throughout the fishing grounds, with observed takes ranging from as far north as 33° N. to as far south as 7° N. latitude, and from longitudes 143° W., west to 175° W. Sea surface temperatures, latitude, and the distance to the approximate 17° C and 19° C isotherms were associated with the takes, but there was a high degree of collinearity between these variables. There was a clear distinction between the proportion of takes between the two categories of sea surface temperature, but over latitude, the pattern was less clear (McCracken, 2000).

Based on observer data, olive ridleys had the highest mortality rate of all sea turtles taken by the Hawai'i-based longline fishery, most likely because more olive ridleys were captured and killed in tuna-style sets than any other species of sea turtle. As shown in Table 2-10, an estimated 146 were taken and an estimated 49 were killed per year from 1994-1999 (giving a 33.25 percent mortality rate). Although pathological lesions were noted in five olive ridleys necropsied after being taken and killed by the fishery, these were considered mild and incidental (i.e., the turtles were probably not predisposed to being taken as a result of the lesions) (Work, 2000). Therefore, the turtles that died as a result of the interaction most likely drowned, suffocated, or succumbed to injuries suffered as a result of their being hooked. Of the six taken by tuna-style sets, five died. This high mortality rate is most likely a result of the turtles' inability to reach the surface, due to the deep sets (NMFS, 2001a).

Table 2-10: Olive Ridley Take and Kill Estimates with 95 Percent Prediction Intervals (PI). Source: McCracken, 2000.

Year		1994	1995	1996	1997	1998	1999	Annual Average
Takes	Estimate	107	143	153	154	157	164	146
	95% PI	[70-156]	[90-205]	[103-210]	[103-216]	[102-221]	[111-231]	
Kills	Estimate	36	47	51	51	52	55	49
	95% PI	[8-64]	[7-84]	[11-90]	[8-92]	[11-92]	[11-96]	

Results from genetic analyses suggest that olive ridley stocks interacting with the Hawai'i-based longline fishery may originate from nesting beaches in both the western and Indian Pacific, and in the eastern Pacific. Although haplotypes for olive ridley rookeries have not been identified due to small sampling sizes, there is a current effort underway to expand the rookery database. Thus far, genetic analyses suggest that of the 20 sampled olive ridleys taken by the Hawai'i-based longline fishery, 40 percent (n=8) originate from the Indian/western Pacific and 60 percent (n=12) originate from the eastern Pacific (P. Dutton, NMFS, pers. comm., January 2001). Some areas of large relative take of olive ridleys indicated representation from both eastern and western Pacific beaches, signifying that ridleys from both sides of the Pacific converge in the North Pacific pelagic environment (NMFS, 2001a).

Estimates of sea turtle mortalities in Hawai'i-based longline fishery

Until the new Pelagics BO was issued in March 2001 (NMFS, 2001a), mortality estimates for turtles taken by the Hawai'i-based longline fishery had been based on limited data from Aguilar *et al*. (1992) and from information recorded by observers on the condition of the turtles when released (Kleiber, 1998). Aguilar *et al*. (1992) estimated a 29 percent mortality rate for loggerheads ingesting a longline hook; therefore all turtles (hard-shelled and leatherback) that had been hooked internally were assigned a mortality rate of 29 percent by NMFS. Turtles recorded as dead had a 100 percent mortality rate, and turtles recorded as okay (released uninjured) were assigned a zero percent mortality rate. All species of turtles hooked externally were also assigned a zero percent mortality rate (McCracken, 2000).

The methodology for estimating annual mortality of sea turtles was changed in the BO (NMFS, 2001a). The estimated mortality rates described in Morehead (2001) and summarized in Table 2-11 were applied to the proportion of a species externally hooked, deeply hooked, or retrieved dead based on past observations. A 27 percent mortality rate is assigned to externally hooked turtles with minor or moderate injuries and a 42 percent mortality rate is assigned to turtles with more serious injuries, including deep hooks, For example, of the ten green turtles observed in the Hawai'i-based longline fishery (tuna-style and swordfish-style gear combined) ten percent experienced immediate mortality (100 percent mortality rate), 80 percent were externally hooked (broadly estimated as 27 percent mortality rate), and ten percent were deeply hooked (42 percent mortality rate). Applying these percentages and their associated mortality rate to the annual estimated range of incidental take of green turtles, NMFS calculated that 7-28 green turtles could be killed each year (NMFS, 2001a).

Table 2-11: Sea Turtle Mortality Estimates Used by NMFS Based on Level and Type of Interaction with Longline Fishing Gear. Source: Morehead, 2001.

Interaction	Response	Injury	Mortality Rate
Entangled / no hook	Disentangled	No injury	0%
Entangled / external hook	Disentangled, no gear	Minor	27%
	Disentangled, trailing gear	Moderate	27%
	Dehooked, no gear	Minor	27%
Hooked in beak or mouth	Hook left, no gear	Moderate	27%
	Hook left, trailing gear	Serious	42%
	Dehooked, no gear	Moderate	27%
Hook swallowed	Hook left, no gear	Serious	42%
	Hook left, trailing gear	Serious	42%
Turtle retrieved dead	—	Lethal	100%

Using the mortality rates assigned above for the condition of a turtle taken by the Hawai'i-based longline fishery, the total number of turtles killed per year was estimated by averaging the mortality rates assigned to each condition class for the species, based on observed takes from 1994-1999. For example, of 147 loggerheads observed taken from 1994-1999, 83 were deeply hooked (29 percent mortality rate), 56 were externally hooked (zero percent mortality rate), three were hooked in an unknown location (17 percent mortality rate[3]), 1 was dead (100 percent mortality rate), three were entangled and released alive and uninjured (zero percent mortality rate), and one was of unknown condition (17 percent mortality rate). Averaging these, the resultant mortality rate for the 147 loggerheads observed taken by the Hawai'i-based longline fishery was 17.5 percent (McCracken, 2000).

What information is available to predict the fate of released sea turtles?

The best available information to estimate sea turtle mortality after incidental take and release of hooked sea turtles is limited and relatively weak. Studies are of two types: (1) satellite telemetry tracking of sea turtles after longline capture and release (Riewald *et al.*, 2000; Polovina *et al.*, 2000); and (2) onshore observations of hooked turtles in tanks (Aguilar *et al.*, 1992). The limitations of these studies should be kept in mind as the research results are applied to sea turtle mortality estimates in the Hawai'i-based longline fishery.

Review of telemetry studies

Satellite telemetry tracking has been conducted in both the Atlantic and the Pacific to estimate post-hooking survival and behavior of sea turtles captured by longline gear. The data are inconclusive because of problems with interpreting available results. It is not possible to distinguish sea turtle mortalities from equipment-related cessation of transmissions. Battery failure, transmitter failure, detachment of transmitter and turtle death are all potential causes of cessation of transmissions. Equipment-related cessations are relatively common events, adding considerable uncertainty to interpreting currently available telemetry data to make estimates of post-release mortality. Whether or not turtles are assumed to have died, or whether or not the transmitters stopped transmitting in these studies is a matter of speculation.

In the Azores study (Riewald *et al.*, 2000) that tracked a total of ten loggerhead turtles (four controls and six hooked in the esophagus), transmitters failed in two out of four controls (dipnetted) and only one out of six hooked turtles. This cannot be interpreted as dipnettiing causing 50 percent mortality and hooking only 16.6 percent mortality. The authors of the Azores study stress that transmitter failure should not be interpreted as an indication of mortality. Overall, dive behavior appeared similar between hooked and non-hooked turtles Even when the transmitters work, the authors were reluctant to conclude mortalities to turtles, in light of recorded diving and swimming behavior or location after release.

[3]Turtles with an unknown condition were assigned the average within species of turtles with a known condition (Kleiber, 1998).

In the Pacific, from 1997 to late 2000, a total of 49 pelagic turtles hooked by the Hawai'i-based longline fishery have had satellite transmitters attached to them in order to track their location and distance traveled following the interaction. Of these 49 turtles, 15 produced no transmissions, or their transmissions lasted less than a month - eleven had deeply ingested hooks (turtles had swallowed the hook, and it was not removed) and four were lightly hooked (turtles had the hook lodged externally (beak or flipper), permitting easy removal) (D. Parker and G. Balazs, NMFS, pers. comm., November 2000, *in* NMFS, 2001).
For the 34 turtles that did produce successful tracks for periods lasting more than a month, there were no significant differences ($P>0.05$) found for the duration of tracking (days) and the distance traveled between lightly hooked turtles ($n=15$) and turtles with deeply ingested hooks ($n=19$). Even when the 15 turtles that did not produce successful tracks were taken into account, no significant differences were found in terms of distance traveled and duration between the two groups (19 total lightly hooked, and 30 total deeply ingested). Furthermore, when individual species were analyzed for the two categories, no significant differences were found (NMFS, 2001).

Polovina *et al.* (2000) reported the results of satellite telemetry tracking of nine loggerhead turtles released after interactions with the Hawai'i-based longline fishery. Four of the sea turtles were entangled or lightly hooked without ingestion, whereas five had swallowed the hooks. Transmitter signals were received from 2.2 to 6.9 months after hooking and turtles traveled from 1,311 to 5,199 km after being released. All nine animals moved in the same westerly direction against a largely eastward "geostrophic flow" and there did not appear to be any difference in the duration of the transmitter signals or the total distance traveled by sea turtles that had been lightly hooked versus those that had deeply ingested hooks.

Review of Aguilar *et al.* (1992) Study

The available information from on-shore observation indicates that hooked sea turtles can and do survive for long periods and even pass hooks after nine months. Prior to the issuance of the BO (NMFS, 2001a), estimates of post-hooking mortality by NMFS were derived from a study of loggerhead turtles caught by Spanish swordfish longliners in the Mediterranean (Aguilar *et al.*, 1992). This study monitored the fate of deeply hooked loggerhead turtles by observing them in shore-side holding facilities. After observing 38 loggerhead turtles between 1986 and 1992, eleven turtles died, leading to the calculated mortality rate estimate associated with deep hooking of 28.9 percent. This study is the basis of the mortality estimate of 29 percent being applied to deeply hooked loggerhead turtles. This same mortality estimate is being applied to all species of sea turtles in the absence of species-specific post-hooking mortality data.

Although the Aguilar *et al.* (1992) study may be the best available information on post-hooking mortality, it has serious limitations. The report lacks a detailed description of the condition of the turtles on-board the fishing vessel. It is important to have an indication of the initial condition of the turtles, if they were active and alert, or lethargic or comatose and whether they had other signs of disease or injury. The report does not describe the on-

board handling of the turtles at sea during transport to shore facilities. It is important to know if the turtles were held in a tank of water, kept under a wet canvas or merely left on deck during transport. There is also no description of how soon after capture the turtles were delivered to the shore facilities. The stress associated with transport may have had an effect on survival of the turtles.

The described husbandry conditions and associated stress of captivity may have contributed to the observed mortalities, although there is a possibility that survival could have been enhanced by conditions of captivity. The reported salinity appears high (43-48 ppt) and the water temperature range may be extreme (9.6° C to 27.6° C). There is no mention of whether the turtles were fed, what they were fed, if they ate, and whether they were given any other treatments (chemotherapeutics, nutritional supplements, etc.).

The study did not include a control group of non-hooked turtles that would be needed to better assess the potential contributing factors leading to the observed mortalities. Sea turtles and other wildlife are susceptible to morbidity and mortality as a result of captivity alone, without hooking interactions. The study does not report necropsy findings of those turtles that died in captivity nor does it note how long after being captured the turtles died. Although it may be assumed that deeply ingested hooks have the potential for causing serious pathology, thorough necropsies would have been extremely valuable in determining the cause of death. The lack of a control group, uncertainties about the effects of the stress induced by capture, transport at sea and captivity, and the lack of necropsy results raise questions about the post-hooking mortality estimates based on Aguilar *et al.* (1992).

Population Effects of Hawai'i-based Longline Fishery Interactions with Sea Turtles

In addition to uncertainty about the actual level of sea turtle mortalities associated with Hawai'i-based longline fishery interactions, there is insufficient information about the size and age structure and movement patterns of sea turtle populations to evaluate the effects of these interactions on long-term population viability and recovery. The survival of the affected sea turtle species will largely depend on their ability to retain sufficient abundances that enable populations to persist in the face of chance events operating at several levels (demographic variation, environmental variation, genetic variation) that affect the likelihood of extinction. The same traits that make long-lived species with delayed sexual maturity, such as sea turtles, so vulnerable to reduced survival rates also make their populations slow to recover once depleted (NMFS, 2000j). A population remains viable when it maintains sufficient genetic variation for evolutionary adaptation to a changing environment. It has been recommended that effective population sizes of at least hundreds of individuals be maintained to preserve evolutionarily important amounts of genetic variation (Lande and Barrowclough, 1987).

Population maintenance and recovery is highly sensitive to changes in the survival rates of the age classes that have a higher reproductive value (i.e., large juveniles and adults) than early life stages (i.e., eggs and hatchlings). Juvenile and adult survival rates should be

sufficiently high to ensure enough juveniles survive to and through their reproductive years to maintain stable populations. Even seemingly small numbers of takes, especially of certain life stages, may have negative effects on population viability and the prospects for recovery (NMFS, 2000b).

Expert testimony given to the Court in CMC v NMFS indicated that reduction of sea turtle take and mortalities in the Hawai'i-based longline fishery alone would have only a minimal effect on the prospects for population viability and recovery of protected sea turtle species. Alternatives intended to reduce sea turtle interactions in the latter fishery are considered in the EIS.

Recognizing that the Hawai'i-based longline fishery is a small proportion of the total amount of longline fishing that occurs in the Pacific Ocean, NMFS believes that the establishment of a research program is critical to developing gear technologies and fishing strategies for reducing sea turtle capture rates throughout the Pacific Ocean. Furthermore, a research program is necessary if the U.S. is going to cultivate an open dialogue within the international community to formulate collaborative efforts to address the incidental sea turtle interaction problem.

2.3.8.2 Reduce Interactions of Western Pacific Pelagic Fisheries with Seabirds to Encourage Recovery of Depleted Populations

Seabirds feed at the ocean surface by seizing, dipping or scavenging. They locate food using well-developed eyesight and sense of smell. They may be attracted to the baited hooks deployed in longline fishing operations. In the process of scavenging on this "free" food, some birds may become hooked or entangled with fishing gear at the surface. Seabirds are more often killed during longline-setting because if they become hooked or entangled they sink with the fishing gear and are drowned, whereas, if the seabirds are hooked during gear retrieval, they can be unhooked and released. The probability of a bird being hooked or entangled by longline gear is a function of multiple factors, including: how the gear is deployed, how long it is at or near the surface, feeding and foraging behavior of different bird species, sea condition, size of the bird, availability of other food and physical condition of the bird. Large pelagic seabirds occur in high density in the North Pacific Ocean but the level of interaction with longline fishing varies considerably, depending on location and season (NMFS National Plan to Reduce the Incidental Take of Seabirds in Longline Fisheries, 2000).

The Hawai'i-based longline fishery has occasional interactions with black-footed (*Phoebastria nigripes*) and Laysan albatross (*P. immutabilis*) that nest on the Northwestern Hawaiian Islands (NWHI). Neither albatross species is listed as endangered, but both are protected under the U.S. Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703 *et. seq.*). It is estimated that between 1994 and 1999, an average of 1,175 Laysan albatross and 1,388 black-footed albatross were incidentally hooked or entangled in the Hawai'i-based longline fishery each year (McCracken, 2000). These average annual incidental catches represent about 0.46 percent and 0.05 percent of the estimated black-footed and Laysan albatross populations,

respectively (Cousins and Cooper, 2000). At least 70 percent of the incidental longline catch of Laysan albatross and an estimated 80 percent of the incidental longline catch of black-footed albatross are estimated as mortalities (Kobayashi and Polovina, 2000, unpub. data). Albatross incidental catch rates increased when longline gear was deployed at shallow depths with slow sink rates of baited hooks deployed at the same time birds are feeding most actively and coinciding with the nesting season (between mid-October and mid-July in the NWHI). Besides the direct mortality of juvenile or adult birds, fishing-related deaths may also have a negative influence on chick survival if one or both parent birds are killed (Cousins *et al.*, 2000).

A few individuals of the short-tailed albatross (*P. albatrus*) also visit the NWHI, especially Midway Atoll, each year. No takes of short-tailed albatross have been reported in the Hawai'i-based longline fishery but between 1993 and 1999 a total of five birds were observed incidentally hooked, with three mortalities, in Alaska bottom longline fisheries (FWS, 2000, excerpted in Appendix P), which are not pelagic longline fisheries. The Pacific population of this species numbers just under 1,400 birds and is listed under the U.S. Endangered Species Act of 1973 (16 U.S.C. 1536) as endangered (FWS, 2000) . Consultation under Section 7 of the ESA was initiated between NMFS and FWS in 1999, after a short-tailed albatross was seen flying over a research vessel engaged in longlining operations in 1997 near Laysan Island. A Biological Opinion was issued by FWS in November 2000 (FWS, 2000). The level of incidental take of short-tailed albatross "not likely to jeopardize the species" was defined by the BO as 2.2 birds per year.

Population Effects of Hawai'i-based Longline Fishery Interactions with Albatross

The issue of fishery interactions with seabirds is not limited to the Hawai'i-based longline fishery. The short-tailed, black-footed and Laysan albatross, all native to the North Pacific, are vulnerable to incidental hooking in the North Pacific demersal longline fishery off the coast of Alaska and the Bering Sea and in pelagic longline fisheries farther south, especially between 25° and 40° N. latitude. Nevertheless, large populations of black-footed and Laysan albatross nest seasonally on the NWHI and the proximity of the northern-latitude portion of the Hawai'i-based longline fishing effort to these colonies during the nesting season increases the probability of interactions with these species. Thus, unilateral management to reduce this incidental catch of seabirds through amendment of the Pelagics FMP and other actions by the U.S. government could contribute to an international plan of action encouraging the population recovery of albatross species.

2.3.9 Relationships of Pelagics FMP-managed Fisheries, Objectives and Alternatives Considered in the EIS

The preceding examination of management objectives and issues for all Pelagics FMP-managed fisheries indicated which fisheries are adequately managed to further the objectives and which may require further management attention. EIS alternatives were formulated to

address the management needs identified. These relationships are summarized in Table 2-12.

Table 2-12: Management Objectives/issues in Pelagics FMP-managed Fisheries and Related Alternatives Considered in the EIS.

Pelagics FMP-managed fishery	Objectives that may need management attention	EIS alternatives that address potential management needs
Pelagic troll/handline fisheries, including charter fishing		
American Samoa	Obj. 1, 2, 3, 4, 8	Alt. 2, 4-7, 9
CNMI	Obj. 1, 2, 4, 8	Alt. 9
Guam	Obj. 1, 2, 4, 8	Alt. 1, 9
Hawai'i	Obj. 1, 2, 4, 8	Alt. 1, 9
Remote U.S. Pacific islands	Obj. 4, 8	Alt. 2, 4-7
Longline fisheries		
American Samoa	Obj. 1, 2, 3, 4, 6, 8	Alt. 2, 4-10
Guam	Obj. 1, 2, 4, 6, 8	Alt. 2, 4-10, Option A
Hawai'i	Obj. 1, 2, 4, 6, 8	Alt. 1, 2-10, Option A
Remote U.S. Pacific islands	Obj. 1, 2, 4, 6, 8	Alt. 2, 4-10, Option A
Purse seine fishery		
American Samoa	Obj. 1, 2, 6, 8	Alt. 2, 4-7, 9
Pacific remote island areas	Obj. 1, 2, 6, 8	Alt. 9

Objectives: 1 – achieve optimum yield; 2 – promote domestic fishery values; 3 – diminish gear conflicts; 4 – improve data; 5 – promote international stock-wide management; 6 – preclude waste; 7 – promote domestic marketing; 8 – population recovery of protected species

2.4 CONTROL MEASURES WITH POTENTIAL FOR FURTHERING MANAGEMENT OBJECTIVES

The following information was used in defining the alternatives described in Section 2.2. This section (2.4) considers an array of control measures that may have potential for resolving or mitigating the management problems identified in Section 2.3.

2.4.1 Time/Area and Gear Control Measures That Could Reduce Sea Turtle Interactions in the Hawai'i-based Longline Fishery

In response to the Court orders in CMC v NMFS, NMFS SWFSC-HL completed a study of the temporal and spatial distribution of interactions between Hawai'i-based longline vessels and sea turtles. It examined the predicted effects on sea turtles of various closures of Hawai'i-based longline fishing grounds using the fleet's logbook and observer data. A total of 361,194 scenarios were evaluated, using a number of criteria such as percent change in sea turtle take and mortality, both by species and in the aggregate, percent of fishing effort (sets) disrupted, fishing effort lost and change in ex-vessel revenue. The study allowed for sensitivity analysis of various time/area closures to compare possible reductions in longline interactions with sea turtles and costs to the Hawai'i-based longline fishery.

NMFS summarized the results in the Time/Area Analysis report to the Court (Kobayashi and Polovina, 2000 in Appendix C). An expert panel process directed by the Court in CMC v NMFS led to formulation of a number of additional measures that could be implemented to conserve endangered and threatened sea turtles. The NMFS BO (NMFS, 2001a) further investigated possible relationships between environmental conditions, longline fishing gear and techniques and sea turtle interactions in the Hawai'i-based longline fishery.

Table 2-13 compares the two basic types of longline fishing that occur within the Hawai'i-based longline fishery (NMFS, 2001a).

Table 2-13: Differences Between the Gear and Fishing Methods for Vessels Targeting Swordfish Compared to Vessels Targeting Bigeye Tuna Using Averages Derived from Observer Data (February 1994 - December 1999). Source: NMFS, 2001a, excerpted in Appendix Q.

Gear/Trip Type	Swordfish Fishing	Tuna Fishing
Area Fished	North of Hawaiian Islands	South of Hawaiian Islands
Main line Length	42 miles	34 miles
Shooter Used	No	Yes
Vessel Speed	7.8 knots	6.8 knots
Lightsticks Used	Yes	No
Branch Line Length	17 meters	13 meters
Float Line Length	8 meters	22 meters
Number of Hooks	820 hooks	1,690 hooks
Number of Hooks per Float	4 hooks	27 hooks
Number of Floats	189 floats	66 floats
Type of Hook	J-shaped	Japanese tuna
Type of Bait	Squid	Saury
Target Depth	28 meters	167 meters
Gear Soaks	Night	Day
Soak Time	20 hours	19 hours

Routine dives for sea turtles range from 9-22 meters (loggerhead) to 50-84 meters (leatherback) (Lutcavage and Lutz, 1997), and foraging often takes place at night in order to target vertically migrating zooplankton (e.g., Eckert *et al*., 1989). In addition, there is speculation that sea turtles are able to target some species due to their bioluminescence (e.g., *pyrosomas*). Therefore, a longline set at more shallow depths, at night, using lightsticks appears to be more likely to take turtles than one set deeper during the day (NMFS, 2001a).

Comparison of fishing method with turtle interaction rates and condition

Swordfish-style fishing effort rarely occurs below 20° N. throughout the year, although there has been some effort between 18° N. and 20° N. in the third quarter. Tuna-style gear fishing effort rarely occurs north of 25° N. Examination of observer data from 1994 to 1999 indicates that turtle takes on swordfish-style gear occurred throughout the area observed for this segment of the fishery. The observer data set shows that the incidental take of sea turtles is much rarer in tuna-style sets compared to swordfish-style sets (NMFS, 2001a).

From February 1994 through December 1999, 239 turtles have been observed taken by the Hawai'i-based longline fishery. Of these 239, only 14 (5.9 percent) have been observed caught by tuna-style, deep-set fishing gear out of 1,440 observed tuna-style sets (0.0097 turtles per set). Conversely, 225 turtles (94.1 percent) were observed taken in 1,811 swordfish-style sets (0.1242 turtles per set), a markedly higher interaction rate. This higher interaction rate in swordfish-style sets occurs within species as well.

The condition of these 239 observed turtles is displayed in Table 2-14 below. It appears, based on observer data, that sea turtles caught in the two different gear types experience different rates of "immediate" mortality, or death of a turtle while still on the gear. Eight of the 14 turtles (57 percent), or 0.0056 turtles per set, caught by tuna-style gear were dead upon retrieval of the gear compared to three turtles (1.33 percent, or up to 4.9 percent if all unknown condition turtles are treated as dead) dead out of 225 turtles, or 0.0017 turtles per set, caught in swordfish-style gear. Differences in species-specific "immediate" mortality between gear types are also apparent. Based on past observer data for 1,440 tuna-style sets, 50 percent of the green turtles, 33 percent of the leatherback turtles, and 83 percent of the olive ridley turtles died per set. Loggerhead turtles were not observed captured in this segment of the fishery. In 1,811 swordfish-style gear sets, 11.8 perecnt of the leatherback turtles, 1.36 percent of the loggerhead turtles, 3.85 percent of the olive ridley turtles, and 40 percent of the unidentified sea turtles died per set (assuming that the four out of ten turtles captured in "unknown" condition were mortalities). This difference between "immediate" death rates could have several explanations, although one possible explanation is that the turtles captured in tuna-style sets could not reach the surface to breathe or rest, but turtles caught in swordfish-style gear may be able to reach the surface. For example, on a swordfish set, the length of the branch line is 17 meters. This length is more than half the distance between the hook and the surface (average target depth is 28 meters). With a float line length of eight meters, the main line sag between floats would be about three meters or about eleven meters below the water surface. This means that a hooked turtle could swim to the surface and breathe because the branch line length is greater than the depth of the main line from the surface (NMFS, 2001a).

Overall mortality rates, or combined immediate and delayed mortality rates, are also notably different between the two fishing styles. In tuna-style sets, five turtles were lightly hooked and one was entangled. These injuries were assigned a zero percent post-interaction mortality rate (McCracken, 2000). In swordfish-style sets 108 turtles were lightly hooked,

103 were deeply hooked, and two were entangled. Deeply hooked turtles were assigned a post-interaction mortality rate of 29 percent (McCracken, 2000). Given the assigned mortality rates for dead and deeply hooked sea turtles, the tuna-style gear had a sea turtle mortality rate per take of 57 percent and the swordfish-style gear had an overall sea turtle mortality rate per take of 14.7 percent (30 turtles killed by deep hook injuries [29 percent of 103 deep hooked turtles] and three turtles dead upon gear retrieval [100 mortality] = 33 turtles/225 turtles = 14.7 percent). This appears to be a considerable difference in overall mortality rates between the two types of fishing, however when overall mortality rates are calculated per set, it becomes apparent that swordfish-style gear kills more turtles per set (0.0182 turtles per set versus 0.0056 turtles per set in tuna-style sets) due to the higher interaction rates and higher incidence of deep hooking swordfish sets have with turtles compared to tuna sets. Thus, swordfish-style gear sets kill more turtles per set with 0.042 turtles killed per set compared to tuna-style gear sets which kill 0.0081 turtles per set (NMFS, 2001a).

Table 2-14: Disposition of Turtles Released, Stratified by Less than Ten Hooks per Float (Swordfish-style Fishing) and Greater than or Equal to Ten Hooks per Float (Tuna-style Fishing), Based on Observer Data from February 1994 through December 31, 1999. Source: NMFS, 2001a.

(a) < 10 hooks per float (Swordfish)

Species	Uninjured	Injured			Dead	Unknown	Total
		Light	Deep	Entangled			
Green Turtle	0	7	1	0	0	0	8
Leatherback Turtle	3	24[1]	1	2	1	3	34
Loggerhead Turtle	3	64	83	0	1	1	152
Olive Ridley Turtle	0	9	16	0	1	0	26
Unidentified Turtle	0	4[2]	2	0	0	4	10

[1] Exact hooking location of four turtles is unknown and is assumed to be lightly hooked.
[2] Exact hooking location of three turtles is unknown and is assumed to be lightly hooked.

(b) > 10 hooks per float (Tuna)

Species	Uninjured	Injured			Dead	Unknown	Total
		Light	Deep	Entangled			
Green Turtle	0	1	0	0	1	0	2
Leatherback Turtle	0	3	0	1	2	0	6
Loggerhead Turtle	0	0	0	0	0	0	0
Olive Ridley Turtle	0	1	0	0	5	0	6
Unidentified Turtle	0	0	0	0	0	0	0

A variety of mitigation measures could be employed in the Hawai'i-based longline fishery to reduce interactions with sea turtles or improve their survival after releases, however research demonstrating their effectiveness has been limited (Kleiber and Boggs, 2000). Tables 2-15 and 2-16 summarize the prospects for effectiveness and potential fishery impacts of an array of possible deterrents that were assessed at a 1999 workshop (Kleiber and Boggs, 2000). The possible effects of mitigation measures on fishers's safety, operating cost and catch rates were not the focus of the workshops.

Table 2-15: Variety of Measures to Reduce Sea Turtle Takes in Longline Fisheries, Their Prospective Effectiveness and the Expected Impact on Fisheries. Source: Kleiber and Boggs, 2000.

Measure	Prospects for Reducing Sea Turtle Takes	Expected Fishery Impact
Reduce total fishing effort	Very effective	High negative impact - proportional to reduction
Season/area closures	Probably effective but issue of fixed versus adjustable space or time boundaries	Depends on degree of segregation between sea turtles and target species – modeling and tracking research needed
Gear modifications:		
Remove light sticks	Evidence to date not promising – more analysis of Atlantic data needed	Pacific: high impact on swordfish-directed fishery
Deeper hooks: longer float and branch lines more hooks per float hooks set farther apart from floats line shooter	Probably effective – needs research to distinguish between depth and attraction to floats	Moderate – depending on depth of hook, could have high impact on targeting swordfish
Guarded hooks	Could be very effective	Depends on degree of depth segregation between turtles and target species
Modify operations:		
Time of set and haul vs. daylight	Some effectiveness – needs research	Depends on scenario – needs research
Deterrents:		
Colored bait	Tentative evidence of promise – needs research	Some evidence of improved catch
Bait type	Unknown (some promise)	Unknown – could be low impact or even an improvement
Odors	Unknown (probably low)	Unknown
Sounds	Low	Unknown
Change float color	Unknown	Unknown
Remove strobe lights	Unknown	High

Table 2-16: Variety of Measures to Improve Survival of Sea Turtles that are Taken in Longline Fisheries, Their Prospects for Effectiveness and the Expected Impacts on Fisheries. Source: Kleiber and Boggs, 2000.

Measure	Prospects for Improved Sea Turtle Survival	Expected Fishery Impact
Gear modification:		
Circle hooks	Unknown, some	Tuna: could be low Swordfish: could be high
Corrodible (dissolving) hooks and/or crimps	Unknown but makes some sense	Low
Branch lines longer than float lines	Unknown but makes some sense	Swordfish: low Hawai'i tuna: impractical
Operational modifications:		
Shorten soak time	Unknown but potentially high	Tuna: high Swordfish: moderate
Turtle handling guidelines:		
Guidelines in Balazs *et al.* (1995)	High – depending on compliance	Low to moderate
Make guidelines into regulations	High – depending on compliance	Low to moderate
Tool to cut line short	High – depending on compliance	Low

2.4.2 Modifications of Longline Fishing Gear or Tactics That Could Reduce Seabird Interactions in the Hawai'i-based Longline Fishery

Unlike possible mitigation measures to reduce sea turtle interactions, simple and specific measures to reduce longline interactions with seabirds have been identified and extensively tested in pelagic longline fisheries, including the Hawai'i-based longline fishery. Table 2-17 discusses the seabird deterrents that have been tested in the Hawai'i-based longline fishery. The possible effects of mitigation measures on fishers's safety, operating cost and catch rates were not the focus of the workshops.

Table 2-17: Discussion of Seabird Mitigation Measures Evaluated for the Hawai'i-based Longline Fishery. Source: McNamara *et al.*, 1999; Boggs, in press; and WPRFMC, 1999c.

Mitigation Measure	Discussion
A. Discharge offal strategically:	While gear is being set or hauled, fish, fish parts or bait should be strategically discharged on the opposite side of the vessel from which the longline is being set or hauled. This mitigation method requires the preparation and storage of hook-free offal for strategic use during the longline set. The intent of this measure is to **divert seabirds from baited hooks to other food sources** when necessary to reduce interactions.
B. Night setting:	The longline set should begin at least one hour after sunset and be completed at least one hour before sunrise. The purpose of setting fishing gear during hours of darkness is to **reduce the visibility to seabirds of baited hooks at the water's surface**. If branch lines are weighted, light sticks should not significantly reduce the sink rate. The effectiveness of this deterrent may be reduced by deck lighting which is necessary for crew and vessel safety.
C. Blue-dyed and thawed bait:	An adequate quantity of blue dye should be maintained on board, and only bait dyed a color that conforms to Council/NMFS standards may be used. All bait should be completely thawed before it can be dyed. The objective of dyeing bait blue is to **reduce the visibility to seabirds of baited hooks at the water's surface**. In addition, completely thawed bait tends to sink faster than frozen bait during the longline set, thereby reducing the time that baited hooks are accessible to seabirds.
D. Towed deterrent:	A line with suspended streamers (tori line) or a buoy that conforms to Council/NMFS standards must be deployed when the longline is being set and hauled. These devices **scare seabirds from baited hooks at the water's surface as well as provide a physical barrier that reduces the ability of seabirds to approach the hooks.** This deterrent presents a risk of fouling with longline gear as it is being set and it increases the danger to crews and vessels during setting and hauling of gear.
E. Weighted branch lines:	At least 45 g of weight should be attached to branch lines within one meter of each baited hook. The purpose of attaching weights to branch lines is to **increase the sink rate of baited hooks, thereby reducing the availability of baited hooks to seabirds**.
F. Line-setting machine with weighted branch lines:	The longline should be set with a line-setting machine (line-shooter) so that the longline is set faster than the vessel's speed. In addition, weights of at least 45 g must be attached to branch lines within one meter of each baited hook. Using wire leader enhances the weight of the branch line. The purpose of this measure is to **remove line tension during the set, thereby increasing the mainline sink rate and reducing the time that baited hooks are at the surface and accessible to seabirds.**

Overall estimates of the effectiveness of mitigation measures in reducing the incidental catch of seabirds in the Hawai'i-based longline fishery (Table 2-18) were computed by averaging the impacts on seabird interactions determined by research and NMFS longline observer estimates.

Table 2-18: Summary of Estimated Effectiveness of Various Mitigation Measures in Reducing the Incidental Catch of Black-footed Albatross (BF) and Laysan Albatross (LA) in the Hawai'i-based Longline Fishery. Source: McNamara *et al*. (1999)[1]; Boggs, in press[2]; WPRFMC, 1999c[3].

Mitigation Measure	Species	Percent Reduction in Incidental Catch
Discharge offal strategically [1]	BF	83
	LA	91
Night setting [1]	BF	95
	LA	40
Blue-dyed squid [1,2]	BF	95
	LA	90
Towed deterrent [1]	BF	86
	LA	71
Weighted branch lines [2]	BF	93
	LA	91
Line-setting machine with weighted branch lines [3]	BF	98
	LA	97

The studies suggest that various deterrents individually have the potential to significantly reduce the incidental catch of albatross in the Hawai'i-based longline fishery but that no one measure is likely to be totally effective by itself. Combining two or more measures is expected to improve overall mitigation effectiveness, although it is uncertain by how much. Moreover, combining mitigation measures may be necessary if any single measure significantly loses its effectiveness under certain circumstances (e.g., night setting during a full moon or use of a towed deterrent during rough seas) or gradually loses its effectiveness (e.g., if seabirds become habituated to a particular towed deterrent, or blue-dyed bait) (WPRFMC, 2000b).

Albatross are most vulnerable to incidental hooking and entanglement when longline gear is set at shallow depths, with slow sink rates of baited hooks deployed at the same time birds are feeding most actively. This combination of factors is more characteristic of swordfish-directed fishing than longline fishing for tuna. Longline fishing interactions with seabirds are minimal when the gear is set deep to target tuna (Table 2-19).

Table 2-19: Incidental Catch of Albatross in the Hawai'i-based Longline Fishery by Set Type Based on NMFS Observer Records from 1994-1998. Source: WPRFMC, 1999c.

Targeted Fish During Set	Observed Bird Catch	Number of Observed Sets	Bird Catch/Set
Swordfish	370	488	0.758
Mixed (swordfish and tuna)	472	946	0.499
Tuna	16	1,250	0.013

In December 1999, the Council proposed a regulatory adjustment to the Pelagics FMP that would require Hawai'i-based longline vessel operators to use at least two seabird deterrents that they choose from a list of options (see Table 2-17) when longline fishing north of 25° N. latitude (WPRFMC, 2000b). NMFS published the proposed rule in 2000 but did not implement it.

Consultation under Section 7 of the ESA was initiated between NMFS and the U.S. Fish and Wildlife Service (FWS) in 1999, after a short-tailed albatross was seen flying over a research vessel engaged in longlining operations in 1997 near Laysan Island. A Biological Opinion was issued by the FWS in November 2000 (FWS, 2000). Unlike the Council's proposed regulatory adjustment of the Pelagics FMP, the Terms and Conditions of the BO under which the Hawai'i-based longline fishery could be allowed to continue would not allow longline vessel operators to exercise discretion in selecting combinations of seabird mitigation measures. Specific deterrents are prescribed in the BO when Hawai'i-based longline fishing is conducted north of a lower latitude (23° N. latitude) than the one referenced in the Council's proposed action (north of 25° N. latitude). The BO calls for NMFS to promulgate regulations that comply with all seabird deterrent-related measures in the Terms and Conditions no later than April 15, 2001. The Council's proposed action could be implemented in the interim.

Implementation of the more effective and feasible deterrents, either in combinations chosen by Hawai'i-based longline vessel skippers (Council) or as prescribed by Terms and Conditions of the BO (FWS/NMFS) is anticipated to provide significant levels of protection to seabirds in a more focused and cost-effective manner than time/area closures or fishing effort reductions.

2.4.3 Modifications of Longline Fishing Gear or Tactics That Could Reduce Shark Interactions in the Hawai'i-based Longline Fishery

Modifications in longline gear or fishing tactics could reduce the incidental catch of sharks in the Hawai'i-based longline fishery or improve their survivability after hooking and release. Some research of this type has been conducted in Hawai'i (Boggs, 1992). Deployment of longline gear so that the maximum depth between floats is deeper than 100 m might reduce

the incidental catch of blue sharks and mako sharks but increase the catch rates of thresher sharks (Kobayashi and Polovina, 2000 in Appendix C).

2.4.4 Measures That Could Avert Gear Conflicts

Rapid development of the longline fishery in the independent country of Samoa (neighbor to American Samoa) led to gear conflict between fishing vessels in nearshore areas around Samoa. To minimize further conflicts, the Samoa government implemented new regulations in 1998 that allowed vessels over 15 m into the pelagic fishery but prohibited them from fishing within 50 nm of the coast (Chapman, 1998). In Hawai'i, gear conflict was evident between the small-boat (handline/troll) and longline fleets during the rapid expansion of the Hawai'i-based longline fleet in the early 1990s. This problem was resolved by establishing a longline exclusion zone around the main Hawaiian Islands (Pelagics FMP Amendment 5). Area closures separating different gears or scales of fishing have proven their effectiveness in avoiding and mitigating gear conflicts between pelagic fisheries in the Western Pacific Region, especially when they are enforced by vessel monitoring systems (VMS).

2.4.5 Measures That Could Address Concerns about Potential Catch Interactions

Catch rates of pelagic fish species fluctuate in a given time and space in relation to cumulative factors. The most important of these are: (1) environmental influences on the distribution and movement patterns of fish, both in vertical and horizontal dimensions (e.g., depth of the thermocline or the seasonal latitudinal or *El Niño*-Southern Oscillation (ENSO)-related longitudinal extension of warm ocean waters); (2) changes in abundance of the stock, with low or high levels of recruitment, in relation to either an environmental change or to the size of the spawning stock biomass (e.g., stock-recruitment relationship); and (3) changes in fishing techniques that cause changes in the catchability of particular species (e.g., changing the depth at which hooks are deployed or the distance from port where gear is set).

Numerous types of fishery management techniques provide for direct or indirect control over fishing effort (Anderson, 1986) but how to apply such controls to mitigate catch interactions or the potential for such interactions is unclear. In some non-pelagic fisheries in the United States, managers allocate resources based on gear type or vessel size and fishing power. If catch interactions between pelagic fisheries occur over long distances, however, resource allocations in a particular area may not effectively mitigate competition of different fisheries for the same resource.

Previous studies of catch interactions between pelagic fisheries have not provided sufficient guidelines for effectively managing this issue (Shomura *et al.*, 1994, 1996). A considerable investment in research may be necessary to document the existence of such interactions before any attempt can be made to develop alternatives for effective mitigation.

2.5 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

Alternatives 3-8 and 10 have the conservation and management of protected species as their primary objective. Many scientists argue that such species cannot be separated from the management of other components of the ecosystem (Hall, 1998) and a national panel has recommended that U.S. fishery management policy become more ecosystem-based (EPAP, 1999). It is very difficult to conceive an ecosystem approach to Western Pacific pelagic fisheries management that provides ecosystem-wide protection of some components of the pelagic ecosystem (e.g., threatened or endangered sea turtles) across the maritime boundaries of many Pacific basin nations.

Alternatives focused solely on managing non-U.S. components of pelagic fisheries and on non-fishing activities (e.g., conservation of protected species' nesting habitats) were excluded from detailed study although their effects on the environment are considered as part of the cumulative impacts analysis.

There are "two levers" available (Hall, 2000) to achieve the objective of reducing incidental catches of protected species: a) reducing the total level of fishing effort; or b) reducing the average take of protected species caused by each unit of fishing effort. Table 2-20 identifies various ways to reduce both terms of the two-lever equation. The alternatives analyzed in detail in the EIS represent some but not all of the possibilities. Alternatives that would phase in reductions in sea turtle takes in the Hawai'i-based longline fishery were not considered. Nor was an adaptive approach considered that would manage the fishery based on real-time reporting of interactions with sea turtles by the Hawai'i-based longline fishery using the existing vessel monitoring system. Trade sanctions, consumer boycotts, vessel buyouts and performance standards for imports are discussed in Chapter 5 but no specific alternatives were defined or analyzed in the EIS.

Table 2-20: Basic incidental catch equation ("two lever system") and ways to reduce both terms. Total incidental catch = "effort" x Incidental take per unit of effort. Source: after Hall, 2000.

Method	Examples Worldwide	and in this EIS	Method	Examples Worldwide	and in this EIS
Regulatory bans	U.N. high seas drift net ban	Longline fishing ban in EIS Alt. 8	Technological changes	Dolphin release backdown procedure in eastern Pacific tuna purse seine fishery	Seabird deterrents in EIS Alt. 2, 4-7, 10
Trade sanctions	US threatened embargo on countries until they adopted turtle excluder devices in shrimp trawl fisheries	None analyzed in this EIS	Training	Procedures for handling protected species after incidental capture	Protected species workshops in EIS Alt. 2-7, 10
Consumer boycotts	Eastern Pacific "dolphin safe" tuna policy	None analyzed in this EIS	Gear restrictions	Hook size, bait type, depth of gear	Time/area closures; depth of longline sets in EIS Alt. 2-7, 10
Gear change/buyout	Subsidized drift net vessel conversion in Japan, Korea, Taiwan	None analyzed in this EIS	Performance standards	Selective licensing rewarding best performance; acknowledging fishers with good records and publishing list of worst offenders; labels to identify responsible fishers that meet required standards	None analyzed in this EIS
Quotas for incidentally-caught protected species	Incidental take limits in NMFS BO issued for Western Pacific pelagic fisheries and FWS BO for short-tailed albatross	Other alternatives also include these measures. EIS Alt. 10 reflects NMFS BO incidental take limits for sea turtles. No alternatives to phase in limits or use adaptive management based on real-time reporting of sea turtle were analyzed			

With the exception of Alternative 9, which focuses on addressing current potential gear conflicts and catch competition in the longline fishery around American Samoa, there are no alternatives that specifically address management alternatives for fisheries targeting PMUS in other western Pacific areas. There are currently no issues ripe for decisionmaking in these fisheries. Should such issues arise in the future, the subsequent NEPA analyses may tier off this EIS. According to NOAA Administrative Order 216-6, tiering "is appropriate when the sequence of environmental review is...from a program, plan, or policy EIS to a program,

plan, or policy statement or analysis of lesser scope or to a site-specific environmental review...Tiering in such cases is appropriate and encouraged because it helps the lead agency focus on the issues that are ripe for decision and exclude from consideration issues...that are premature for review."

Control measures not evaluated in detail in this EIS are not necessarily "rejected" from future consideration. Regulations promulgated under the Pelagics FMP include a framework procedure for regulatory adjustment. Framework adjustments can be "established measures" that, at some time, have been included in regulations implementing the FMP and for which the impacts have been evaluated in Council/NMFS documents, or "new measures" that have not previously been included in the regulations or evaluations. New NEPA analyses could occur at any time if there is new information (e.g., results from a fishing experiment) prompting new action. Re-consultation under Section 7 of the ESA could also occur if conditions change or the incidental take limits are exceeded.

Return of western Pacific pelagic fisheries to unregulated, pre-FMP status would remove all existing federal management controls except the Court-ordered actions on the Hawai'i-based longline fishery. This alternative was rejected, however, because gear conflicts, uncontrolled fishing effort and other problems that have been resolved could return if the longline fishery were no longer regulated under the FMP. Few of the management objectives would likely be furthered by this course of action and it is not evaluated in detail.

Figure 2-2: Estimated Turtle and Albatross Mortality Under the Alternatives (direct effects only, not considering possible cumulative effects)

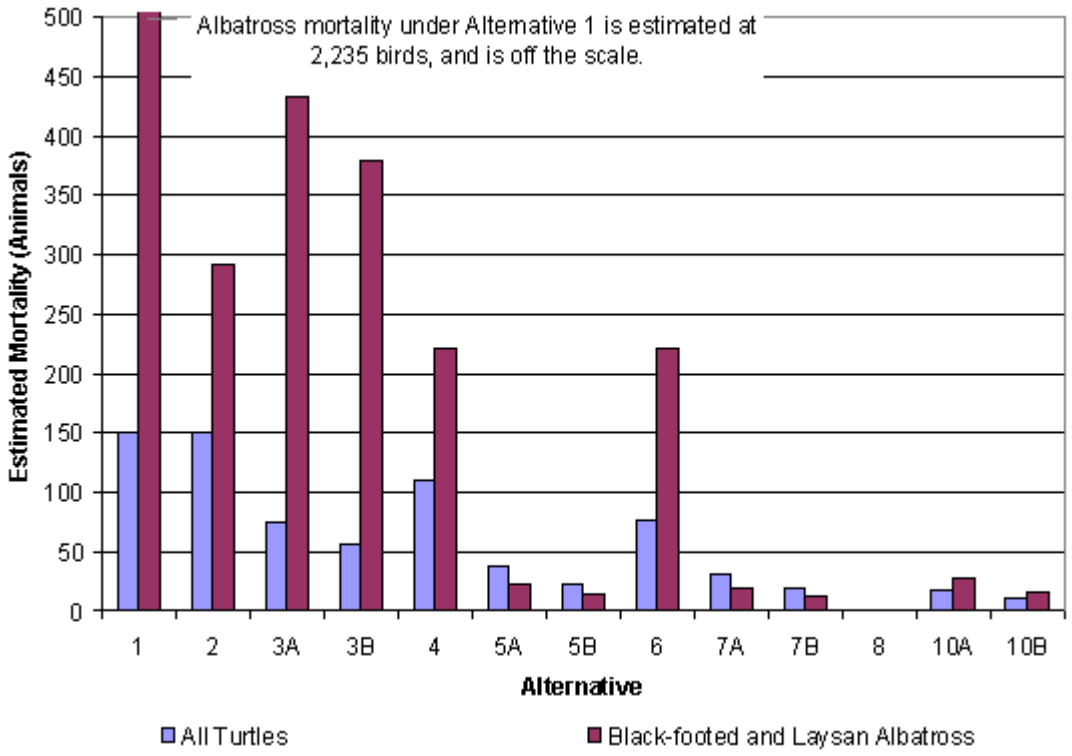


Table 2-21: Summary of Impacts. Note: The impacts of each management alternative are described in comparison to the baseline No Action alternative, Alternative 1.

Essential Fish Habitat and the Marine Environment

EFFECTS: Essential Fish Habitat and Marine Environment		**Alternative 1: Existing FMP (No Action)** **Baseline for Comparison**	**Alternative 2: Pending Council Actions**	**Alternative 3: Court Ordered Action (Status Quo)**	**Alternative 4: Seasonal Area Longline Fishery Closures**	**Alternative 5: Increase Fishing Gear Deployment Depth**	**Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas**	**Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas**	**Alternative 8: Regional Longline Closure**	**Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries**	**Alternative 10 (*Preferred*): Increase Fishing Gear Deployment Depth, April-May Closure of Southern Fishing Areas**	**Option A: Swordfish Research Fishery (If implemented will be used in combination with other Alternatives)**
Essential fish habitat	Direct/Indirect		No significant difference from no action	No significant difference from no action	No significant difference from no action	No significant difference from no action	No significant difference from no action	No significant difference from no action	No significant difference from no action	No significant difference from no action	No significant difference from no action	No significant difference from no action
	Cumulative		No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects
Marine environment	Direct/Indirect		No significant difference from no action	No significant difference from no action	No significant difference from no action	No significant difference from no action	No significant difference from no action	No significant difference from no action	No significant difference from no action	No significant difference from no action	No significant difference from no action	No significant difference from no action
	Cumulative		No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects

Table 2-21: Summary of Impacts (continued). Note: The impacts of each management alternative are described in comparison to the baseline No Action alternative, Alternative 1.

Pelagic Management Unit Species (PMUS)

EFFECTS: Catches and Populations of PMUS		**Alternative 1: Existing FMP (No Action)** **Baseline for Comparison**	**Alternative 2: Pending Council Actions**	**Alternative 3: Court Ordered Action (Status Quo)**	**Alternative 4: Seasonal Area Longline Fishery Closures**	**Alternative 5: Increase Fishing Gear Deployment Depth**	**Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas**	**Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas**	**Alternative 8: Regional Longline Closure**	**Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries**	**Alternative 10 (*Preferred*): Increase Fishing Gear Deployment Depth, April-May Closure of Southern Fishing Areas**	**Option A: Swordfish Research Fishery (If implemented will be used in combination with other Alternatives)**
Catches and Populations of PMUS	Direct/Indirect		No significant difference from no action on status of most stocks; possible minimal increase in N. Pacific blue shark populations	No significant difference from no action	No significant difference from no action on status of most stocks; possible minimal increase in N. Pacific blue shark populations - same as Alternative 2	No significant difference from no action on status of most stocks; possible minimal increase in N. Pacific swordfish and blue shark populations	No significant difference from no action on status of most stocks; possible minimal increase in N. Pacific blue shark populations - same as Alternative 2	No significant difference from no action on status of most stocks; possible minimal increase in N. Pacific swordfish and blue shark populations - same as Alternative 5	No significant difference from no action on status of most stocks; possible minimal increase in N. Pacific swordfish and blue shark populations - same as Alternative 5	No significant difference from no action	No significant difference from no action on status of most stocks; possible minimal increase in N. Pacific swordfish and blue shark populations - same as Alternative 5	No significant difference from no action
	Cumulative		No detectable change in cumulative effects on most stocks; possible minimal increase in N. Pacific blue shark populations	No detectable change in cumulative effects	No detectable change in cumulative effects on most stocks; possible minimal increase in N. Pacific blue shark populations - same as Alternative 2	No detectable change in cumulative effects on most stocks; possible minimal increase in N. Pacific swordfish and blue shark populations	No detectable change in cumulative effects on most stocks; possible minimal increase in N. Pacific blue shark populations - same as Alternative 2	No detectable change in cumulative effects on most stocks; possible minimal increase in N. Pacific swordfish and blue shark populations - same as Alternative 5	No detectable change in cumulative effects on most stocks; possible minimal increase in N. Pacific swordfish and blue shark populations - same as Alternative 5	No detectable change in cumulative effects	No detectable change in cumulative effects on most stocks; possible minimal increase in N. Pacific swordfish and blue shark populations - same as Alternative 5	No detectable change in cumulative effects
Local Catches and Populations of PMUS	Direct/Indirect		No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	Some possible catch competition for local sub-adult tuna resources	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects
	Cumulative		No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects	Some possible catch competition for local sub-adult tuna resources	No detectable change in cumulative effects	No detectable change in cumulative effects	No detectable change in cumulative effects

Table 2-21: Summary of Impacts (continued). Note: The impacts of each management alternative are described in comparison to the baseline No Action alternative, Alternative 1.

Sea Turtles

EFFECTS: Sea Turtle Take		**Alternative 1: Existing FMP (No Action)** **Baseline for Comparison**	**Alternative 2: Pending Council Actions**	**Alternative 3: Court Ordered Action (Status Quo)**	**Alternative 4: Seasonal Area Longline Fishery Closures**	**Alternative 5: Increase Fishing Gear Deployment Depth**	**Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas**	**Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas**	**Alternative 8: Regional Longline Closure**	**Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries**	**Alternative 10 (*Preferred*): Increase Fishing Gear Deployment Depth, April-May Closure of Southern Fishing Areas**	**Option A: Swordfish Research Fishery (If implemented will be used in combination with other Alternatives**
Leatherback	Direct/Indirect		No change in take levels, though possible very slight reduction in post-release mortality	Moderate (est. 64%[4]) reduction in take, though possible very slight reduction in post-release mortality	Low (est. 19 %) reduction in take, though possible very slight reduction in post-release mortality	Moderate (est. 61%) reduction in take, though possible very slight reduction in post-release mortality	High (est. 78%) reduction in take, though possible very slight reduction in post-release mortality	High (est. 78%) reduction in take, though possible very slight reduction in post-release mortality	High (est. 100%) reduction in take	No change in take levels	High (est. 84%) reduction in take, though possible very slight reduction in post-release mortality	Unknown, possible temporary take near current level
	Cumulative		No significant change in cumulative effect	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect	No significant change in cumulative effect with all fishing effort relocated	Conditionally significant, could have significant positive impact if experiment successful
Loggerhead	Direct/Indirect		no change in take levels, though possible slight reduction in post-release mortality	High (est. 79%) reduction in take, though possible slight reduction in post-release mortality	Moderate (est. 48%) reduction in take, though possible slight reduction in post-release mortality	High (est. 100%) reduction in take, though possible slight reduction in post-release mortality	Moderate (est. 63%) reduction in take, though possible slight reduction in post-release mortality	High (est. 100%) reduction in take, though possible slight reduction in post-release mortality	High (est. 100%) reduction in take	No change in take levels	High (est. 100%) reduction in take, though possible slight reduction in post-release mortality	Unknown, possible temporary take near current level
	Cumulative		No significant change in cumulative effect	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect	No significant change in cumulative effect with all fishing effort relocated	Conditionally significant, could have significant positive impact if experiment successful

[4] For alternatives with both switching and non-switching scenarios, the estimated take reductions shown are means of the projected reductions for both scenarios.

Table 2-21: Summary of Impacts (continued). Note: The impacts of each management alternative are described in comparison to the baseline No Action alternative, Alternative 1.

EFFECTS: Sea Turtle Take		**Alternative 1: Existing FMP (No Action)** **Baseline for Comparison**	**Alternative 2: Pending Council Actions**	**Alternative 3: Court Ordered Action (Status Quo)**	**Alternative 4: Seasonal Area Longline Fishery Closures**	**Alternative 5: Increase Fishing Gear Deployment Depth**	**Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas**	**Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas**	**Alternative 8: Regional Longline Closure**	**Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries**	**Alternative 10 (*Preferred*): Increase Fishing Gear Deployment Depth, April-May Closure of Southern Fishing Areas**	**Option A: Swordfish Research Fishery (If implemented will be used in combination with other Alternatives**
Olive Ridley	Direct/Indirect		No change in take levels, though possible slight reduction in post-release mortality	Low (est. 18%) reduction in take, though possible slight reduction in post-release mortality	Low (est. 7%) increase in take, though possible slight reduction in post-release mortality	Moderate (est. 51%) reduction in take, though possible slight reduction in post-release mortality	Low (est. 20%) reduction in take, though possible slight reduction in post-release mortality	Moderate (est. 55%) reduction in take, though possible slight reduction in post-release mortality	High (est. 100%) reduction in take	No change in take levels	High (est. 61%) reduction in take, though possible slight reduction in post-release mortality	Unknown, possible temporary take near current level
	Cumulative		No significant change in cumulative effect	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect	No significant change in cumulative effect with all fishing effort relocated	Conditionally significant, could have significant positive impact if experiment successful
Green Turtle	Direct/Indirect		No change in take levels	Low (est. 41%) reduction in take	Low (est. 6%) reduction in take	Moderate (est. 56%) reduction in take	Moderate (est. 36%) reduction in take	High (est. 83%) reduction in take	High (est. 100%) reduction in take	No change in take levels	High (est. 88%) reduction in take	Unknown, possible temporary take near current level
	Cumulative		No significant change in cumulative effect	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect with all fishing effort relocated	No significant change in cumulative effect	No significant change in cumulative effect with all fishing effort relocated	Conditionally significant, could have significant positive impact if experiment successful

Table 2-21: Summary of Impacts (continued). Note: The impacts of each management alternative are described in comparison to the baseline No Action alternative, Alternative 1.

Seabirds

EFFECTS: Seabird Take and Populations		**Alternative 1: Existing FMP (No Action)** **Baseline for Comparison**	**Alternative 2: Pending Council Actions**	**Alternative 3: Court Ordered Action (Status Quo)**	**Alternative 4: Seasonal Area Longline Fishery Closures**	**Alternative 5: Increase Fishing Gear Deployment Depth**	**Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas**	**Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas**	**Alternative 8: Regional Longline Closure**	**Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries**	**Alternative 10 (*Preferred*): Increase Fishing Gear Deployment Depth, April-May Closure of Southern Fishing Areas**	**Option A: Swordfish Research Fishery (If implemented will be used in combination with other Alternatives)**
Seabird Take and Populations	Direct/Indirect		Significant reduction of seabird take in Hawai'i-based longline fishery	Potentially significant reduction of seabird take in Hawai'i-based longline fishery as indirect effect	Significant reduction of seabird take in Hawai'i-based longline fishery - same as Alternative 2	Significant reduction of seabird take in Hawai'i-based longline fishery - same as Alternative 2	Significant reduction of seabird take in Hawai'i-based longline fishery - same as Alternative 2	Significant reduction of seabird take in Hawai'i-based longline fishery - same as Alternative 2	Elimination of seabird take in Hawai'i-based longline fishery	No impact on seabird take	Significant reduction of seabird take in Hawai'i-based longline fishery - same as Alternative 2	Significant reduction of seabird take in Hawai'i-based longline fishery - same as Alternative 2
	Cumulative		Possible positive change in cumulative effects adversely affecting recovery of seabird populations; actual significance on population levels unknown	No significant change in cumulative effects adversely affecting recovery of seabird populations; actual significance on population levels unknown	Possible positive change in cumulative effects adversely affecting recovery of seabird populations; actual significance on population levels unknown - same as Alternative 2	Possible positive change in cumulative effects adversely affecting recovery of seabird populations; actual significance on population levels unknown - same as Alternative 2	Possible positive change in cumulative effects adversely affecting recovery of seabird populations; actual significance on population levels unknown - same as Alternative 2	Possible positive change in cumulative effects adversely affecting recovery of seabird populations; actual significance on population levels unknown - same as Alternative 2	Potential positive change in cumulative effects adversely affecting recovery of seabird populations; actual significance on population levels unknown		Possible positive change in cumulative effects adversely affecting recovery of seabird populations; actual significance on population levels unknown - same as Alternative 2	Possible positive change in cumulative effects adversely affecting recovery of seabird populations; actual significance on population levels unknown - same as Alternative 2

Table 2-21: Summary of Impacts (continued). Note: The impacts of each management alternative are described in comparison to the baseline No Action alternative, Alternative 1.

Marine Mammals

EFFECTS: Marine Mammal Take and Populations		**Alternative 1: Existing FMP (No Action)** **Baseline for Comparison**	**Alternative 2: Pending Council Actions**	**Alternative 3: Court Ordered Action (Status Quo)**	**Alternative 4: Seasonal Area Longline Fishery Closures**	**Alternative 5: Increase Fishing Gear Deployment Depth**	**Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas**	**Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas**	**Alternative 8: Regional Longline Closure**	**Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries**	**Alternative 10 (*Preferred*): Increase Fishing Gear Deployment Depth, April-May Closure of Southern Fishing Areas**	**Option A: Swordfish Research Fishery (If implemented will be used in combination with other Alternatives)**
Marine Mammal Take and Populations	Direct/Indirect		Protected species workshop would have a positive effect	Effects uncertain because displaced vessels may shift into fisheries for which interaction rates have not yet been estimated	Protected species workshop would have a positive effect, but overall effect is uncertain because displaced vessels may shift into fisheries for which interaction rates have not yet been estimated	Protected species workshop would have a positive effect, but overall effect is uncertain because displaced vessels may shift into fisheries for which interaction rates have not yet been estimated	Protected species workshop would have a positive effect, but overall effect is uncertain because displaced vessels may shift into fisheries for which interaction rates have not yet been estimated	Protected species workshop would have a positive effect, but overall effect is uncertain because displaced vessels may shift into fisheries for which interaction rates have not yet been estimated	Effects uncertain because displaced vessels may shift into fisheries for which interaction rates have not yet been estimated	No significant effects	Protected species workshop would have a positive effect, but overall effect is uncertain because displaced vessels may shift into fisheries for which interaction rates have not yet been estimated	Temporary increase in take could result in methods for long-term reduction of take
	Cumulative		No significant change in cumulative effect	No significant change in cumulative effect	No significant change in cumulative effect	No significant change in cumulative effect	No significant change in cumulative effect	No significant change in cumulative effect	No significant change in cumulative effect	No significant change in cumulative effect	No significant change in cumulative effect	No significant change in cumulative effect uncertain

Table 2-21: Summary of Impacts (continued). Note: The impacts of each management alternative are described in comparison to the baseline No Action alternative, Alternative 1.

Economic Impacts Note: The analysis of Alternatives 3, 5, 7, and 10 includes two scenarios (A and B) that reflect different analytical assumptions regarding the ability of swordfish fishers to switch targets. In each case Scenario A assumes that switching swordfish vessels will have the same catch per unit effort as the existing tuna fishers, while Scenario B assumes that swordfish fishers are unable to switch targets. The actual outcome under the alternatives will most likely fall between the two scenarios, as some fishers will be able to switch and some will not. For the purposes of this table, the significance of the impact is determined based on such an intermediate outcome. Also note that Alternative 9 and Option A can be applied in combination with other Alternatives. Both are likely to have an additive effect when combined the other alternatives.

EFFECTS: Economic Impacts		**Alternative 1: Existing FMP (No Action)** **Baseline for Comparison**	**Alternative 2: Pending Council Actions**	**Alternative 3: Court Ordered Action (Status Quo)**	**Alternative 4: Seasonal Area Longline Fishery Closures**	**Alternative 5: Increase Fishing Gear Deployment Depth**	**Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas**	**Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas**	**Alternative 8: Regional Longline Closure**	**Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries**	**Alternative 10 (*Preferred*): Increase Fishing Gear Deployment Depth, April-May Closure of Southern Fishing Areas**	**Option A: Swordfish Research Fishery (If implemented will be used in combination with other Alternatives)**
Gross Revenues from Tuna Longline Sales	Direct/Indirect		**Not Significant** Little change in fishing effort or harvests	**Significant Negative** Extensive time and area closures	**Not Significant** Little change in tuna targeting effort	**Conditionally Significant** If swordfish vessels are able to switch to tuna, then a significant positive effect is expected; if not then a significant negative effect is expected.	**Not Significant** Little change in tuna targeting effort	**Conditionally Significant** If swordfish vessels are able to switch to tuna, then a significant positive effect is expected; if not then a significant negative effect is expected. Some change in the timing of tuna effort is expected as a result of the closure. Fishers have traditionally fished at the time of the closure but will be forced to shift efforts to other times.	**Significant & Very Negative** Closure eliminates all revenues	**Not Significant**	**Conditionally Significant** If swordfish vessels are able to switch to tuna, then a significant positive effect is expected. If not then significant negative effect is expected. Also some change is expected in the location of tuna effort from south to north during the closed period.	**Conditionally Significant** Partially offsets any positive effects or any negative effects of the alternative with which it is combined.
	Cumulative		**Not Significant** No effect outside Hawai‘i	**Significant Negative** Increase in imports reduces price increase	**Not Significant** No effect outside Hawai‘i	**Not Significant** No effect outside of Hawai‘i	**Not Significant** No effect outside of Hawai‘i	**Not Significant** No effect outside of Hawai‘i	**Significant & Very Negative**	**Not Significant**	**Not Significant** No effect outside of Hawai‘i	**Not Significant** No effect outside of Hawai‘i

Table 2-21: Summary of Impacts (continued). Note: The impacts of each management alternative are described in comparison to the baseline No Action alternative, Alternative 1.

EFFECTS: Economic Impacts		**Alternative 1: Existing FMP (No Action)** **Baseline for Comparison**	**Alternative 2: Pending Council Actions**	**Alternative 3: Court Ordered Action (Status Quo)**	**Alternative 4: Seasonal Area Longline Fishery Closures**	**Alternative 5: Increase Fishing Gear Deployment Depth**	**Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas**	**Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas**	**Alternative 8: Regional Longline Closure**	**Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries**	**Alternative 10 (*Preferred*): Increase Fishing Gear Deployment Depth, April-May Closure of Southern Fishing Areas**	**Option A: Swordfish Research Fishery (If implemented will be used in combination with other Alternatives)**
Gross Revenues from Swordfish Longline Sales	Direct/Indirect		**Not Significant** Little impact on fishing effort or harvests	**Significant and Very Negative** Extensive time and area closures	**Significant Negative** Seasonal closures	**Significant & Very Negative** Elimination of swordfish targeting effort	**Significant Negative** Permanent and seasonal closures	**Significant & Very Negative** Elimination of swordfish targeting effort	**Significant & Very Negative** Closure eliminates all revenues	**Not Significant**	**Significant & Very Negative** Elimination of swordfish targeting effort	**Conditionally Significant** Partially offsets any negative effects of alternative with which it is combined
	Cumulative		**Not Significant** No effect outside Hawai'i	**Significant Negative** No price increase because of global supply	**Significant Negative** No price increase because of global supply	**Significant & Very Negative**	**Significant Negative** No price increase because of global supply	**Significant & Very Negative**	**Significant & Very Negative**	**Not Significant**	**Significant & Very Negative**	**Conditionally Significant** Partially offsets any negative effects of alternative with which it is combined
Gross Revenues of Non-Longline Hawai'i Fishing Vessels under the FMP	Direct/Indirect		**Not Significant** No change in harvest of locally consumed fish	**Not Significant** Slight price increase in tuna	**Not Significant** Little change in harvest of locally consumed fish	**Not Significant** Little change in harvest of locally consumed fish	**Not Significant** Little change in harvest of locally consumed fish	**Not Significant** Little change in harvest of locally consumed fish	**Significant Positive** Price increase in tuna and other pelagic species	**Not Significant**	**Not Significant** Little change in harvest of locally consumed fish	**Not Significant**
	Cumulative		**Not Significant** No change in harvest of locally consumed fish	**Not Significant** Increase in imports reduces price increase	**Not Significant** No effect outside Hawai'i	**Not Significant** No effect outside Hawai'i	**Not Significant** No effect outside Hawai'i	**Not Significant** No effect outside Hawai'i	**Significant Positive** Increase in imports reduces price increase	**Not Significant**	**Not Significant** No effect outside Hawai'i	**Not Significant** No effect outside Hawai'i

Table 2-21: Summary of Impacts (continued). Note: The impacts of each management alternative are described in comparison to the baseline No Action alternative, Alternative 1.

EFFECTS: Economic Impacts		**Alternative 1: Existing FMP (No Action)** **Baseline for Comparison**	**Alternative 2: Pending Council Actions**	**Alternative 3: Court Ordered Action (Status Quo)**	**Alternative 4: Seasonal Area Longline Fishery Closures**	**Alternative 5: Increase Fishing Gear Deployment Depth**	**Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas**	**Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas**	**Alternative 8: Regional Longline Closure**	**Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries**	**Alternative 10 (*Preferred*): Increase Fishing Gear Deployment Depth, April-May Closure of Southern Fishing Areas**	**Option A: Swordfish Research Fishery (If implemented will be used in combination with other Alternatives)**
Displaced Vessels from the Hawai'i-based Longline Fleet	Direct/Indirect		**Not Significant** Little change in fishing effort or harvests	**Significant Negative** High potential for swordfish vessels to relocate	**Not Significant** Possible temporary relocation (seasonal closure)	**Significant Negative** High potential for swordfish vessels to relocate, particularly to California	**Significant Negative** High potential for swordfish vessels to relocate	**Significant Negative** High potential for swordfish vessels to relocate, particularly to California	**Significant & Very Negative** High potential for all vessels to relocate	**Not Significant**	**Significant Negative** High potential for swordfish vessels to relocate outside the U.S. and its territories.	**Conditionally Significant** Partially offsets any negative effects of alternative with which it is combined.
	Cumulative		**Not Significant**	**Significant Negative**	**Not Significant**	**Significant Negative**	**Significant Negative**	**Significant Negative**	**Significant & Very Negative**	**Not Significant**	**Significant Negative**	**Conditionally Significant** Partially offsets any negative effects of alternative with which it is combined
Number of Turtle Interactions	Direct/Indirect		**Not Significant** Little impact on fishing effort or harvests	**Significant Positive** Effective closures	**Significant Positive** Effective closures	**Significant & Very Positive** Effective prohibitions on shallow sets	**Significant Positive** Effective closures	**Significant & Very Positive** Effective prohibitions on shallow sets	**Significant & Very Positive** Closure eliminates all interactions with Hawai'i fishers	**Not Significant**	**Significant & Very Positive** Effective prohibitions on shallow sets and permit restrictions	**Conditionally Significant** Partially offsets positive effects of alternative with which it is combined, but if the research is successful then it could have a significantly positive effect.
	Cumulative		**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Conditionally Positive** If the research is successful then it could have a significantly positive effect on global swordfish fishery interactions.

Table 2-21: Summary of Impacts (continued). Note: The impacts of each management alternative are described in comparison to the baseline No Action alternative, Alternative 1.

EFFECTS: Economic Impacts		**Alternative 1: Existing FMP (No Action)** **Baseline for Comparison**	**Alternative 2: Pending Council Actions**	**Alternative 3: Court Ordered Action (Status Quo)**	**Alternative 4: Seasonal Area Longline Fishery Closures**	**Alternative 5: Increase Fishing Gear Deployment Depth**	**Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas**	**Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas**	**Alternative 8: Regional Longline Closure**	**Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries**	**Alternative 10 (*Preferred*): Increase Fishing Gear Deployment Depth, April-May Closure of Southern Fishing Areas**	**Option A: Swordfish Research Fishery (If implemented will be used in combination with other Alternatives)**
Number of Albatross Interactions	Direct/Indirect		**Significant & Very Positive** Effective Deterrents	**Significant & Very Positive** Effective Closures	**Significant & Very Positive** Effective Closures and Deterrents	**Significant & Very Positive** Effective prohibitions on shallow sets and requirements for use of deterrents	**Significant & Very Positive** Effective Closures and Deterrents	**Significant & Very Positive** Effective prohibitions on shallow sets and requirements for use of deterrents	**Significant & Very Positive** Closure eliminates all interactions with Hawai'i fishers	**Not Significant**	**Significant & Very Positive** Effective prohibitions on shallow sets and requirements for use of deterrents	**Conditionally Significant** Partially offsets positive effects of alternative with which it is combined, but if the research is successful then it could have a significantly positive effect.
	Cumulative		**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Not Significant** Continued high levels of activity in fisheries outside Hawai'i	**Conditionally Positive** If the research is successful then it could have a significantly positive effect on global swordfish fishery interactions.

Table 2-21: Summary of Impacts (continued). Note: The impacts of each management alternative are described in comparison to the baseline No Action alternative, Alternative 1.

Social Impacts

EFFECTS: Social Impacts		**Alternative 1: Existing FMP (No Action)** **Baseline for Comparison**	**Alternative 2: Pending Council Actions**	**Alternative 3: Court Ordered Action (Status Quo)**	**Alternative 4: Seasonal Area Longline Fishery Closures**	**Alternative 5: Increase Fishing Gear Deployment Depth**	**Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas**	**Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas**	**Alternative 8: Regional Longline Closure**	**Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries**	**Alternative 10 (*Preferred*): Increase Fishing Gear Deployment Depth, April-May Closure of Southern Fishing Areas**	**Option A: Swordfish Research Fishery (If implemented will be used in combination with other Alternatives)**
Sustained Participation of Fishing Communities	Direct/Indirect		American Samoa: Potential beneficial impact Other areas: No significant impact	American Samoa: Potential negative impact Other areas: No significant impact	American Samoa: Potential beneficial impact Other areas: No significant impact	American Samoa: Potential beneficial impact Other areas: No significant impact	American Samoa: Potential beneficial impact Other areas: No significant impact	American Samoa: Potential beneficial impact Other areas: No significant impact	American Samoa: Potential beneficial impact Other areas: No significant impact	No significant impact	American Samoa: Potential beneficial impact Other areas: No significant impact	No significant impact
	Cumulative		No significant impact	No significant impact	No significant impact	No significant impact	No significant impact	No significant impact	No significant impact	No significant impact	No significant impact	No significant impact
Effects on Specific Groups and Cultures	Direct/Indirect		General: Public concerns regarding seabird interactions and shark finning are addressed but concerns about sea turtle interactions are not addressed American Samoa: Potential beneficial impact on small-boat fishers and ancillary firms	General: Public concerns regarding sea turtle interactions are addressed but concerns about sea bird interactions and shark finning are not addressed Hawai‘i: Significant negative impact on swordfish vessels and ancillary firms American Samoa: Potential negative impact on small-boat fishers and ancillary firms	General: Public concerns regarding sea turtle and seabird interactions and shark finning are addressed Hawai‘i: Negative impact on swordfish vessels and ancillary firms but may not be significant American Samoa: Potential beneficial impact on small-boat fishers and ancillary firms	General: Public concerns regarding sea turtle and seabird interactions and shark finning are addressed Hawai‘i: Significant negative impact on swordfish vessels and ancillary firms American Samoa: Potential beneficial impact on small-boat fishers and ancillary firms	General: Public concerns regarding sea turtle and seabird interactions and shark finning are addressed Hawai‘i: Significant negative impact on swordfish vessels and ancillary firms American Samoa: Potential beneficial impact on small-boat fishers and ancillary firms	General: Public concerns regarding sea turtle and seabird interactions and shark finning are addressed Hawai‘i: Significant negative impact on swordfish vessels and ancillary firms American Samoa: Potential beneficial impact on small-boat fishers and ancillary firms	Public concerns regarding sea turtle and seabird interactions are addressed; significant negative impact on longline vessels and ancillary firms; significant negative impact on seafood consumers; potential beneficial impact on troll and handline fishers	No significant impact	General: Public concerns regarding sea turtle and seabird interactions and shark finning are addressed Hawai‘i: Significant negative impact on swordfish vessels and ancillary firms American Samoa: Potential beneficial impact on small-boat fishers and ancillary firms	Economic and social impacts on the swordfish fleet would be significantly reduced when coupled with an alternative that substantially restricts swordfish effort
	Cumulative		No significant impact	Hawai‘i: Increasingly restrictive regulatory environment would have a significant negative impact on participants in the longline fishery	No significant impact	Hawai‘i: Increasingly restrictive regulatory environment would have a significant negative impact on participants in the longline fishery	Hawai‘i: Increasingly restrictive regulatory environment would have a significant negative impact on participants in the longline fishery	Hawai‘i: Increasingly restrictive regulatory environment would have a significant negative impact on participants in the longline fishery	Increasingly restrictive regulatory environment would have a significant negative impact on participants in the longline fishery	No significant impact	Hawai‘i: Increasingly restrictive regulatory environment would have a significant negative impact on participants in the longline fishery	No significant impact

Table 2-21: Summary of Impacts (continued). Note: The impacts of each management alternative are described in comparison to the baseline No Action alternative, Alternative 1.

EFFECTS: Social Impacts		**Alternative 1: Existing FMP (No Action)** **Baseline for Comparison**	**Alternative 2: Pending Council Actions**	**Alternative 3: Court Ordered Action (Status Quo)**	**Alternative 4: Seasonal Area Longline Fishery Closures**	**Alternative 5: Increase Fishing Gear Deployment Depth**	**Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas**	**Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas**	**Alternative 8: Regional Longline Closure**	**Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries**	**Alternative 10 (*Preferred*): Increase Fishing Gear Deployment Depth, April-May Closure of Southern Fishing Areas**	**Option A: Swordfish Research Fishery (If implemented will be used in combination with other Alternatives)**
Environmental Justice Issues	Direct/Indirect		American Samoa: Potential beneficial impact on ethnic Samoan population and low-income population Other areas: No significant impact	Hawai'i: Significant negative impact on Vietnamese Americans American Samoa: Potential negative impact on ethnic Samoan population and low-income population Other areas: No significant impact	Hawai'i: Negative impact on Vietnamese Americans but may not be significant American Samoa: Potential beneficial impact on ethnic Samoan population and low-income population Other areas: No significant impact	Hawai'i: Significant negative impact on Vietnamese Americans American Samoa: Potential beneficial impact on ethnic Samoan population and low-income population Other areas: No significant impact	Hawai'i: Significant negative impact on Vietnamese Americans American Samoa: Potential beneficial impact on ethnic Samoan population and low-income population Other areas: No significant impact	Hawai'i: Significant negative impact on Vietnamese Americans American Samoa: Potential beneficial impact on ethnic Samoan population and low-income population Other areas: No significant impact	Hawai'i: Significant negative impact on various minority and possibly low-income populations American Samoa: Significant negative impact on ethnic Samoan population and low-income population Other areas: No significant impact	No significant impact	Hawai'i: Significant negative impact on Vietnamese Americans American Samoa: Potential beneficial impact on ethnic Samoan population and low-income population Other areas: No significant impact	Negative impacts on Vietnamese Americans would be significantly mitigated
	Cumulative		No significant change in cumulative impact	No significant change in cumulative impact	No significant change in cumulative impact	No significant change in cumulative impact	No significant change in cumulative impact	No significant change in cumulative impact	No significant change in cumulative impact	No significant change in cumulative impact	No significant change in cumulative impact	No significant change in cumulative impact